

Exploring the Widely Used Subjects by Marketing Professionals among WISE College Students

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Abstract

The marketing management major at Co-operative University, Thanlyin plays a vital role in promoting the skills of marketing professionals. This research is to understand the needs, wants and interest of marketers. The objective of the study is to explore the useful subject of marketing professionals among WISE College Students. The primary data are taken with survey method that is collected by using semi-open questions and multiple choice questions. The 80% respondents are collected by using descriptive statistics with simple random sampling, and questionnaires are distributed to marketing professional among WISE College students. In this research, the subjects delivered by marketing management major at Co-operative University are comprehensive for marketing professionals according to the data. All of the respondents want to study Digital Marketing, and moreover, they want this subject to add as Bachelor Degree of Marketing Management Major. Because of the difficulties in studying pricing strategy in private universities, it is needed to add this subject as a human resource development program, if there can be sufficient resources in the department. In analyzing the data, marketing management major students have got great opportunities for work and they are in touch with marketing workplace areas as these subjects offered by marketing management major are complete.

Key words: Principles of Marketing, Pricing Strategies, Consumer Behavior, Marketing Research, Marketing Communications, Retail Management, Brand Management, Service Marketing, Sale and Distribution Management, Customer Relationship Management

I. Rationale of the Study

In market-oriented economy, marketing professionals provides the engine that drives sales. Moreover, marketing professionals understand the market trends, market analysis, strategies, Consumer Behavior, Marketing Research, Marketing Communications, Retail Management, Brand Management, Service Marketing, Sale and Distribution Management, Customer Relationship Management. In addition, marketers need to maintain older customer and catch the attention of new customers. In order to be a successful business, marketers have to determine marketing tools and strategies to attract customers. Besides, the data analyzed by marketing researchers provide not only invention but innovation in producing the new product. In Myanmar, marketing professionals play a vital role to expand market areas and to have the insight of potential market share in order to support the business. Therefore, they have to know the important marketing tools and strategy which are applied in business.

II. Objective of the Study

- To explore the widely used subject by marketing professionals among WISE College Student

III. Research Methodology

This research explores the marketing professionals' useful subjects among WISE College students. This study is conducted by using primary data that are taken with survey method which is collected by using semi-open questions and multiple choice questions. The respondents are collected by using descriptive statistics with simple random sampling, and questionnaires are distributed to marketing professionals among WISE College students.

IV. Scope and Limitations of the Study

This study only analyzes exploring the widely used subjects by marketing professionals among WISE College students. There are total numbers of 11 batches in BMHD. The selected batches are BMHD Batch 8 to Batch 11. Due to limited time and cost, 80% of Marketing Professionals among WISE College students are collected.

V. Literature Review

The basic principles of marketing consist of product, price, place and promotion. Together, these four principles are known as the '4P' (for its initials in English) marketing, and include the integration of marketing. For a marketing strategy to be effective, the four components must be used correctly. The challenge for business owners and industry professionals is to determine the appropriate method for each area, and integrate successfully.

Price is the value that is put to a product or service and the result at a complex set of calculations, research and understanding and risk taking ability. A pricing strategy takes into account segments, ability to pay, market conditions, competitor actions, trade margins and input costs, amongst others. It is targeted at the defined customers and against competitors. There are several pricing strategies such as premium pricing, penetration pricing, economy pricing and skimming strategy. These are the four basic strategies, variations at which are used in the industry.

Consumer Behavior is the study of how individual customers, groups or organizations select, buy, use, and dispose ideas, goods, and services to satisfy their needs and wants. It refers to the actions at the consumers in the marketplace and the understanding motives for those actions. Marketers expect that by understanding what causes the consumers to buy particular goods and services, they will be able to determine – which products are needed in the marketplace, which are obsolete, and how best to present the goods to the consumers.

Marketing Research is the process at gathering, analyzing and interpreting information about a market, about a product or service to be offered for sale in that market, and about the past, present and potential customers for the product or service, research into the characteristics, spending habits, location and needs at the business's target market, the industry as a whole, and the particular competitors.

Marketing planning is the preface to any business enterprise. Planning is deciding at present as to what we are going to do in the future. It involves not only anticipating the consequences of decisions but also predict the events that are likely to affect the business. Marketing planning is to direct the company marketing efforts and resources towards present marketing objectives like growth, survival, minimizing risks, maintain status-quo, profit maximized, service to customers, diversification and image builds,...

Marketing communication refers to the means adopted by the companies to convey messages about the products and the brands they sell, either directly or indirectly to the customers with the intention to persuade them to purchase. In other words, the different medium that company adopts to exchange the information about their goods and services to the customers is termed as Marketing Communication. The marketer uses the tools of marketing communication to create the brand awareness among the potential customers, which means some image of brand gets created in their minds that help them to make the purchase decision.

Brand management is a function of marketing that uses techniques to increase the perceived value of a product line or brand over time, Effective brand management enables the price of products to go up and builds loyal customers through positive brand associations and images or a strong awareness of the brand.

Sales refer to the exchange of goods against money or service. It is the only revenue generating function in an organization. Distribution is the process of making a product or

service available for use or consumption to the end customers or business. Distribution could be of the following two types such as direct distribution and indirect distribution.

Customer relationship management is a term that refers to practices, strategies and technologies that companies use to manage and analyze customer interactions and data throughout the customer lifecycle, with the goal of improving customer service relationships and assisting in customer retention and driving sales growth. CRM systems compile customer data across different channels, or points at contact between the customer and the company, which could include the company's website, telephone, line chat, direct mail, marketing materials and social media. CRM systems can also give customer facing staff detailed information on customers' personal information, purchase history, buying preferences and concerns.

VI. Analysis of the Widely Used Subject by Marketing Professionals

In this research, the analysis explores the useful subjects of Marketing Professionals among Wise College students. The data is analyzed by using Statistical Package for Social Science.

A. Profile of the Respondents

In this section, profile of the students is presented with marketing professionals based on gender, age, educational level, position, experience and types of job.

Table1: Profile of the Respondents

Particular	Frequency	Percentage
Gender		
Male	32	40%
Female	48	60%
Total	80	100%
Age level		
20-25	37	46%
25-30	28	35%
>31	15	19%
Total	80	100%
Educational Level		
Bachelor	80	100%

Total	80	100%
Job Position		
Marketing Staff	59	74%
Marketing Supervisor	4	5%
Marketing Manager	15	18%
Founder	2	3%
Total	80	100%
Types of Job		
CMHL	56	70%
CB Bank	9	11%
Toyota Car Showroom	10	13%
Medical Service	5	6%
Total	80	100%
Working Experiences in Marketing Field		
1-3 years	35	44%
4-6 years	25	31%
6-10 years	16	20%
>11 years	4	5%
Total	80	100%
Introduction with Subjects		
Newspaper	7	8%
Magazine	5	6%
Book	68	86%
Total	80	100%
Studying Campus		
Private College or University	45	56%
Public University	35	44%
Total	80	100%

Usage for years with subjects		
>3 months	-	-
3-6 months	14	17%
6months -1 year	10	13%
2 years-3 years	17	21%
4 years -6 years	23	29%
>7 years	16	20%
Total	80	100%
Comprehensive with these subjects		
Yes	60	75%
No	20	25%
Total	80	100%
Engagement with these subjects in workplace		
Yes	75	94%
No	5	6%
Total	80	100%
Benefitting with these subjects in workplace		
Yes	80	100
No	-	-
Total	80	100%

Source: Survey Data (Nov, 2019)

As shown in Table 1, there are 80 respondents in this study from Wise College students. According to gender, the percentage of female respondents is higher than male respondents. It means that female population is larger than male population appearing in birth rate, Myanmar. Moreover, 37% of young people are more dominated in marketing field and all of the respondents have got Bachelor Degree in educational level. The table shows that 59 of the marketing staff are participating in this survey and types of job are from 56 respondents of City Mart Holding Limited,

11% of the respondent of CB Bank, 10 respondents of Toyota Car Showroom and 6% of Medical Service person. Most respondents have 1 year and 3 years working experience in marketing field. The most 86% of the respondents knew concerning with the marketing subjects in book and the 56 percentage of respondents studied the marketing subjects in private universities. This is because Bachelor degree specializing marketing management is conferred for the first time by Co-operative University last few years. However, other Economics Universities teach their marketing subjects only as a portion. Most of the respondents use the marketing subject in their respective workplace. 75% of respondents answer that the subjects concerned with marketing are comprehensive for marketing professionals. Corresponding with the table, the subjects delivered by Marketing Management major at Co-operative University are engaged and benefited in marketing workplace areas.

Table 2: The Useful Subjects of Marketing Professionals

Particular	POM	PS	CB	MR	MP	MC	RM	BM	SM	SDM	CRM
	Frequency										
Knowledge with these subjects	18	15	32	13	23	22	30	21	18	21	21
Studied these subjects	29	10	21	27	29	18	15	18	10	37	14
Utility in workplace	30	18	21	25	29	18	10	29	11	46	16
Mostly usage in workplace	31	16	13	20	26	19	6	25	11	36	6
Usage in workplace with one year	12	2	9	14	9	17	11	23	9	41	8
Difficulty in studying at Private	20	50	20	21	17	15	16	13	17	18	11
Need of the subjects for	18	15	32	13	23	22	30	21	18	21	21

Marketing Professionals											
Want of the subjects for Marketing Professionals	16	14	14	17	15	16	26	20	21	30	20
Marketing Professionals Interesting	19	12	31	13	25	21	36	27	19	21	25

Source: Survey Data (Nov, 2019)

According to this analysis, all of the respondents understand these subjects and use in actual workplace with marketing areas. In private study, pricing strategy is difficult to study for marketing professionals.

VII. Findings

In this research, the subjects delivered by marketing management major at Co-operative University are comprehensive for marketing professionals according to the data. All of the respondents want to study Digital Marketing, and moreover, add to support this subject to Bachelor Degree at Marketing Management Major. Owing to the subject of pricing strategy is difficult to study in Private University, Human Resource Development Program need to be considered this subject if there are sufficient resources. In analyzing the data, marketing management major students have got great opportunities for work and they are in touch with marketing workplace areas as these subjects offered by marketing management major are completion.

VIII. Conclusion

The study emphasizes exploring the widely used subject by marketing professionals among WISE College Student. If time and cost are not restricted, further research is encouraged it to study other workplace areas.

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A STUDY ON FIRM'S PERFORMANCE
USING BALANCED SCORECARD
(A CASE STUDY OF FIRST PRIVATE BANK LIMITED)

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Abstract

This study intends to analyze the performance of First Private Bank Limited. To understand how well a bank is doing, this study analyses the financial and non-financial measures such as customer satisfaction, employee satisfaction and innovation. Descriptive methods are used in this study. The results from this study based on 100 customers and 40 employees from Yangon head office branch and used convenient sampling method. Primary data were collected from responsible persons of First Private Bank Limited using interviewed method and from customers using structured questionnaire. Secondary data were collected from text books, reports of First Private Bank Limited from 2008-09 to 2017-18, previous research papers and articles available from internet websites. Based on the financial perspective, most of the financial performances are satisfactory. From the customer perspective, it is found that most of the respondents satisfied on providing the bank services. Regarding on the analysis on internal-business process perspective, it is found that the proficiency of staffs offering of the financial services are excellent. As a result of learning and growth, most of the employees satisfy their jobs because of the higher appraisal results.

Key words: Balance scorecard, financial, internal business perspectives, customers, Learning and growth

INTRODUCTION

Nowadays, chief executive officers' of most organization and profit seeking as well non for profit seeking companies, spend much time, energy and financial sources in order to edit the basic tactics of their units; but most of them talk about non-efficiency of their strategies. Management of the business organizations must be aware of where to compete and how to compete with the competitors under the intense competition. The basic goal of the business organization is to survive and prosper. In order to survive over the long term, it is vital for organization to have good performance of financial and non-financial results. Traditionally, performance measures focus solely on financial accounting measures and on past performance favoring a short-term view and failing to provide long-term strategic perspective. The current trend is its preparation by firm to achieve financial goals through innovations and satisfaction of employees and customers. The bank is also important to have a

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strong performance in terms of both financial and non-financial results. Although there are many banks in Myanmar Banking Industry, this research selected First Private Bank Limited to study performance of First Private Bank Limited in Yangon. First Private Bank Limited is one of the public companies in Myanmar Banking Industry. To realize the current situation and growth, there is a need to analyze the financial and non-financial performance indicators. The bank measures its financial performance only and does not measure non-financial indicators such as customers' satisfaction, employees' satisfaction and innovations.

RESEARCH OBJECTIVES

This research focuses on how well the First Private Bank Limited is doing and competing with the other banks. In order to know these results, two objectives are set. The objectives of the research are as follows:

- (a) To analyze the financial performance of First Private Bank Limited;
- (b) To analyze the non-financial performance of First Private Bank Limited.

RESEARCH METHODOLOGY

This research focuses only on analyzing the financial and non-financial performance indicators of First Private Bank Limited to evaluate its current success and also its potentials for growth in the future. To measure the performance of the bank, this research is conducted using the balanced scorecard approach devised by Kaplan and Norton in 1992. It measures the performance of an organization from four different indicators including financial, customer, internal process, and learning and growth.

Primary data was used in this research. The primary data was collected from sample respondents by survey using a structured questionnaire. First Private Bank Limited has 5 branches in Yangon and among them Yangon head office branch is the largest branch. This research does not cover other functions of the bank such as operations and human resource functions. And then, 100 customers and 40 employees from Yangon head office branch were selected by convenience sampling method during the banking hours within 7 days. This was most specifically targeted at collecting data on identified measures under customer perspective, the internal business process and, learning and growth perspectives. Secondary data were collected from text books, published financial statements from 2008-2009 to 2017-

2018, reports of First Private Bank Limited, previous research papers, journal, articles and papers available from internet websites.

REVIEW OF LITERSTURE

For most of the banking industry, measuring its financial performance only and does not measure non-financial measures such as customers' satisfaction, employees' satisfaction and innovations. Now it needs to measure not only financial performance but also non-financial performance of the banking industry. Most of the researchers focused Balanced Scorecard theory in analyzing on the financial and non-financial performance indicators of companies.

In the study of (Aravind, M., & Nagamani, P., 2013), analyzing financial performance of State Bank of India for the year 2000-2012. The researcher has found that the bank's financial performance has been almost progressive over the operational periods considered for the study. Therefore, the study highlights the points where the banks need to proliferate and sustain that development in the realm of financial performance. In the study of (Zawadi, Ally., 2013), the study on financial performance of commercial banks in Tanzania has found that the overall performance of the banks has increased during the first two years of the study. It is found that the performance of the Public Sector Banks compared to its similar groups is less satisfactory. Moreover, the results show that Capital Adequacy Ratio, Interest Expenses to total loan and Net Interest Margin have a considerable impact on Return on Assets.

(Dr. Ansarul Haque, 2014) examined the comparison of financial performance of commercial banks using some financial ratios such ROA, ROE and NIM. The researcher found that most of the banking groups have witnessed a downtown performance in terms of ROA from 2009 to 2010. For the public sector banks, it is recorded 0.97% in 2010 against 1.02% in 2009. ROA of the SBI group is also a notch lower at 0.90% 2010 than 1.02% during the previous year. The decline in ROE is proved during 2009-2013 for all banks mentioned here. Net Interest Margin of Old Private Sector Banks and New Private Sector Banks is trending high ranging between 14.69% and 10.69% in 2009 to 16.22 % and 16.51% in 2013 for both of the banking groups consequently. It is found that all the banks have slightly growth in Net Interest Margin from 2009 to 2013.

(Kaplan,R.S.,& Norton, D.P., 1992) explored an article titled "BSC" in which the new management functions have been introduced by BSC. BSC has been used by

Norton and Kaplan (1996) as an auxiliary tool for organizations in order to put the strategies into function. By using this card and having all four dimensions given in BSC they were able to have a comprehensive view of strategies in all branches of company. And to make companies improved they decided to take action second article of “BSC”.

(LaPointe, 1999) described that Balanced Scorecard helped marketers and executives. It provided measures for input and outcomes. He suggested that the Balanced Scorecard might be adopted or adapted. Some organizations might be using some other names for the Balanced Scorecard and many companies used it without even knowing it. (Barkley.S., 2000) said that a recent survey showed that 88% of the organizations felt that the Balanced Scorecard had improved the performance of the employees. Balanced Scorecard was considered motivating, measuring and rewarding the people and then innovating the strategies.

The research objective of the current research was to analyze the performance indicators of First Private Bank Limited. According to literature and previous research studies, the balanced scorecard is the most widely applied performance management system. The balanced scorecard was originally developed as a performance measurement system in 1992 by Dr. Robert Kaplan and Dr. David Norton at the Harvard Business School. The conceptual framework for the current research was developed as shown in figure 1.

Figure 1: Conceptual Framework of the study

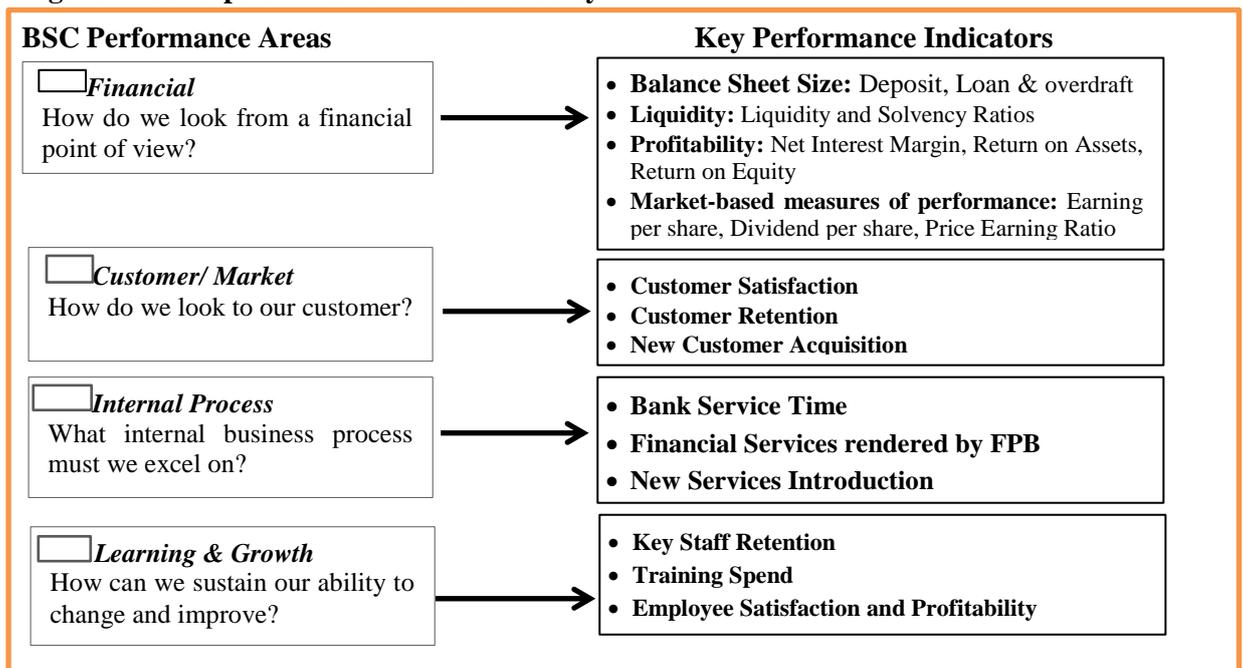


Figure 1: Balanced Scorecard, (Kaplan & Norton)

RESULTS

1. Analysis on the Financial Performance of First Private Bank Limited

In this section, the financial performance was firstly analyzed. The analysis on financial perspective includes liquidity, profitability and market-based performance measures. Two kinds of ratios are included in liquidity ratios: liquidity and solvency ratios. Profitability measures are similar to those applied in other industries with ROA and ROE. In addition, given the importance of the intermediation ratios of the banks, net interest margin is also analyzed. Market-based performance measures take into account the net worth of shareholders. Price earnings ratios and price dividend ratios are analyzed in this research. The main revenue of the bank relies on its deposits amount and loan amount. The bank cannot offer all deposits as loan. The remaining balances of deposits amount are used to invest government bond. Therefore, it should be seen the trend of total deposits, loan and overdraft of First Private Bank Limited firstly.

Total Deposits, Loan and Overdraft

Total deposits, loan and overdraft of bank show public trust on the bank and stability and credibility of bank. Table 1 shows the rising trend of total deposits, loan and overdraft of First Private Bank Limited.

Table 1: Total Deposits, Loan and Overdraft

Kyats in Million

Financial Year	Total deposits	Loan and Overdraft
2008-2009	43,214.63	24,589.60
2009-2010	44,144.95	31,178.00
2010-2011	50,824.67	40,847.66
2011-2012	64,406.65	54,200.35
2012-2013	91369.00	76830.00
2013-2014	107,197.37	100,339.65
2014-2015	136,986.50	121,149.81
2015-2016	151,070.20	143,103.00
2016-2017	165,662.60	157,948.11
2017-2018	185,157.78	175,601.92

Source: First Private Bank Limited, 2018

Myanmar is basically a cash society and only a small percentage of the population has bank accounts. Deposit growth depends on many factors. The existence of number of bank branches is a key determinant of the growth of deposits. FPB was able to open 34 branches up to the current date. Deposits are increasing from

year to year and also the amount of loans and overdraft are increasing yearly. With the raised authorized capital, the bank allows increased saving deposits.

Interest income from loans and overdraft is the main source of revenue for FPB. FPB has to rely mainly on interest income. FPB provided almost all of deposit to loans and overdraft. These are due to the FPB's policy of special efforts and drive to increase lending to small and medium enterprise. FPB extends loans to corporate, small and medium enterprises, retailers, traders and exporters based on real estate collateral, gold and other eligible collateral acceptable to the bank. Borrowers must satisfy the criteria set by the bank such as the integrity, capability and repayment capacity of the borrower.

Liquidity Position

To evaluate the stability and liquidity of the bank, the liquidity ratios and solvency ratio are calculated. Liquidity position of First Private Bank is shown in Table 2.

Table 2: Liquidity Ratios of First Private Bank Limited

Financial Year	Liquidity ratio	Solvency ratio
2008-2009	66.25%	1.26
2009-2010	54.05%	1.30
2010-2011	42.32%	1.28
2011-2012	37.71%	1.28
2012-2013	33.24%	1.27
2013-2014	26.91%	1.29
2014-2015	30.47%	1.25
2015-2016	29.23%	1.33
2016-2017	23.13%	1.33
2017-2018	23.12%	1.31

Source: First Private Bank Limited, 2018

From the above Table 2, it can be seen that the bank's liquidity ratio in 2017 and 2018 is decreasing but it is more than the Central Bank's standard 20%. Also the bank's solvency ratio shows trend. This appears to be no immediate liquidity problem facing First Private Bank Limited in terms of its properties' value.

Profitability

Profitability is the guiding factor for performance of banking sector. It strengthens of the financial position of bank. The researcher in the present study has used different ratios or indicators to measure the profitability position of First Private Bank, namely – ROA, ROE and (NIM). Profitability position of First Private Bank has been analyzed in the Table 3 below:

Table 3: Profitability Ratios of First Private Bank Limited

Financial Year	Net Interest Margin	Return on Assets	Return on Equity
2008-2009	5.13%	11.20%	47.71%
2009-2010	6.19%	9.99%	36.09%
2010-2011	5.69%	8.45%	33.37%
2011-2012	6.14%	7.66%	35.19%
2012-2013	5.60%	3.48%	29.80%
2013-2014	5.18%	3.76%	32.78%
2014-2015	5.23%	3.54%	32.97%
2015-2016	4.36%	3.09%	27.10%
2016-2017	4.04%	2.77%	26.19%
2017-2018	3.89%	2.49%	25.25%

Source: First Private Bank Limited, 2018

The net interest margin shows the bank's ability to measure of assets and liabilities management. According to Table 3, the net interest margin is decreased yearly from 2008-09 to 2017-18 due to the decline in net interest margin could be attributed to the weakening of the bank's earnings. Therefore, the business should consider increasing the percentage of the net interest margin over the coming years.

From 2008-09 to 2017-18, the ROA of bank are down slightly. The principal reason of the decreasing ROA is increasing value of total assets. Although the ROA provides useful information about bank profitability, the shareholders want to know how much earnings they get on their equity investment.

The data on ROE in Table 3 for First Private Bank shows a decreasing trend during the period of 2015-16 to 2017-18 and then ROE is in standard range from 2008-09 to 2014-15. Therefore, ROE should be made even better in the future.

Market –Based Measures of Performance

Price earnings ratio and price dividend ratio are primarily concerned with the performance of ordinary shares in regard to earnings and dividend payments. Price earnings ratio shows the investors' confidence on the banks and the price dividend ratios also show the actual receipts of shareholders relatively with market share price. Table 4 shows earning per share, dividend per share, price earnings ratio and price dividend ratios of First Private Bank Limited.

According to Table 4, the bank's shares are gradually issued year after year based on market demand. Earnings per share is dropped in 2015-16, 2016-17 and 2017-18 because the profit over the years are fluctuated and the number of shares issued are increased and the opening of more banks. Although the decline of EPS, PE

ratios of the bank are slightly increased from 3.03 in 2008-09 to 10.69 in 2017-18 over ten year period.

Table 4: Market-based Measures of Performance of First Private Bank Limited

Financial Year	Earnings per Share (Kyats)	Dividend per Share (Kyats)	Price Earnings Ratio	Price Dividend Ratio
2008-2009	4,937.19	3,160.26	3.03	4.75
2009-2010	3,972.82	2,745.33	3.78	5.46
2010-2011	3,571.34	2,386.00	4.20	6.29
2011-2012	3,822.00	2,499.00	5.68	6.80
2012-2013	3,233.00	2690.00	6.71	NA
2013-2014	3,523.00	2306.00	5.47	7.80
2014-2015	3,363.00	2197.00	5.76	8.65
2015-2016	2,984.00	2005.00	7.38	9.97
2016-2017	2,619.19	2000.00	12.03	6.35
2017-2018	2,524.57	2000.00	10.69	7.41

Source: First Private Bank Limited, 2018

Higher PE ratio is a reflection of market optimism relating to First Private Bank's growth prospects. The price dividend ratio is said to be good from 2008-09 to 2017-18. The price dividend ratio is nearly seven times in 2017-18. It can be shown that the investors are willing to pay dividend that they received.

2. Analysis on the Non-Financial Performance of First Private Bank Limited

In this section mentions the non-financial performance of First Private Bank Limited. Based on the balanced scorecard model, there are three non-financial perspectives including a customer perspective, and internal process perspective, and an innovation and learning perspective. In the customer perspective of the First Private Bank Limited, the core outcome measures include customer retention and customer satisfaction using questionnaire. To measure performance of the bank's internal process, bank service time, and innovation process. Learning and growth identifies the infrastructure that the organization must build to create long-term growth improvement. As in the customer perspective, employee-based measures include employee satisfaction, retention, training and skills.

Profile of Customers

Total number of respondents in this study was 100. The demographic characteristics of respondents are classified into four groups: gender, age, and occupation and education level.

Table 1: Profile of Respondents

Sample Size	100	100%	Sample Size	100	100%
Gender			Education Level		
Male	66	66%	High School	16	16%
Female	34	34%	Bachelor	62	62%
			Master Degree	12	12%
			Ph.D	5	5%
			Others	5	5%
Age			Occupation		
≤20	2	2%	Government Staff	11	11%
21-30	12	12%	Company Staff	38	38%
31-40	19	19%	Self- Employed	22	22%
41-50	45	45%	Pensioners	13	13%
51-60	12	12%	Dependent	11	11%
≥60	10	10%	Others	5	5%

Source: Survey Data, 2019

According to Table 1, out of total 100 respondents, 66 respondents were male and the remaining 34 were female. It is found that among 100 respondents, most of them are between 41 and 50 years old. A second largest group is between 31 and 40 years. The education levels of respondents are classified into 5 groups: high school level, bachelor degree, master degree and Ph.D. The results of the survey state that 62% of respondents are bachelor degree holders. According to Table 1, almost all the respondents are graduated persons, thus their level of education may support to the assessment of the quality of banking services. So it is found that the higher the education levels the higher the level of the knowledge in assessing to the quality of banking services. According Table1, 38% of all respondents are company staff and the second largest group is self-employed. As a result the largest customers who take the financial services from First Private Bank Limited are company staffs and self-employed.

Number of years Dealing with First Private Bank Limited

Respondents were asked the number of years dealing with the bank. They are then grouped into four different ranges of years: less than 2 years, 2 to 5 years, 6 to 10 years and more than 10 years.

Table 2 Number of Years Dealing with First Private Bank Limited

No. of years	Frequency	%
< 2years	18	18%
2-5 years	29	29%
5-10years	15	15%
> 10 years	38	38%
Total	100	100%

Source: Survey Data, 2019

According to Table 2, the results from analysis show that 38% of all respondents dealing with the bank more than 10 years are the largest group. It can be concluded that this group is its loyal customers of the bank throughout the 28 years of business life of First Private Bank Limited.

Categories of Banking Services by Frequency of Customer Usage

The bank offers six categories of services to its customers. These are saving account, internal remittances, current account, demand loan, overdraft loan, and foreign exchange service.

Table 3 Categories of Banking Services by Frequency of Customer Usage

	Frequency	%
Saving account	42	42
Internal remittances	36	36
Current account	10	10
Demand Loan	6	6
Overdraft loan	4	4
Foreign exchange	2	2
Total	100	100

Source: Survey Data, 2019

Table 3 is the analysis of the usefulness of banking services. Based on these results, 42 % of respondents visit the bank for saving service and 36 % of respondents visit the bank for internal remittances services. Based on these results most customers visit the bank for saving and internal remittances services.

Frequency of Visits to the bank

Regarding the frequency of visits to the bank, respondents were asked to choose five different choices: once a week, twice a week, once a month, twice a month and rarely.

Table 4 Frequency of Visits to the Bank

No of visits	Frequency	%
Once a week	37	37%
Twice a week	16	16%
Once a month	20	20%
Twice a month	10	10%
Rarely	17	17%
Total	100	100%

Source: Survey Data, 2019

According to Table 4, 37% of respondents of all respondents visit to the bank once a week. The result shows that more than 50 % respondents visit to the bank for

their business transactions at least once a week. For saving transactions, 20% of respondents visit to the bank once a month.

Dealing with Other Banks

Most customers of the bank use banking services more than one bank. The following Table 5 shows most of the respondents deal with other banks' banking services in addition to First Private Bank Limited.

Table 5 Dealing with Other Banks

Dealing other bank	Frequency	%
Dealing	69	69%
Not dealing	31	31%
Total	100	100%

Source: Survey Data, 2019

From Table 5, 69 % of all respondents deal with other banks due to their large business transactions and 31% of all respondents do not deal with other banks due to the size of their business.

Customers' perception towards Bank Performance

Table 6 shows the perception of customers on First Private Bank Limited's services.

Table 6 Customers Perception towards Bank Performance

Particulars	Excellent		Good		Fair		Poor		No remarks		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Safety Resolving customers' complaints	65	65	25	25	8	8	2	2	-	-	100	100
Safety of customers' deposits	74	74	12	12	10	10	4	4	-	-	100	100
Services Caring and understanding on customers' needs	77	77	11	11	12	12	-	-	-	-	100	100
Willingness to help customers	65	65	19	19	10	10	6	6	-	-	100	100
Promptness of inquiry	55	55	20	20	14	14	11	11	-	-	100	100
Speed in transactions	83	83	10	10	5	5	2	2	-	-	100	100
Services waiting area	66	66	25	25	3	3	6	6	-	-	100	100
Services waiting time	54	54	23	23	18	18	5	5	-	-	100	100
Appearances Staffs	59	59	21	21	17	17	3	3	-	-	100	100
Bank	48	48	28	28	15	15	9	9	-	-	100	100

Source: Survey Data, 2019

Table 6 shows that response of customers' perception on staff's appearances and bank's appearances is said to be good. Thus the bank should not only maintain this position but also more satisfaction adds some new facilities for customers. As a result of respondents' feedback, most of the respondents are satisfied the waiting area and waiting time. But the bank should seek to improve its service speed and need to support customer waiting area in the banking hall concerning relaxation for its customers to a great extent due to customer response percent in Table 6. Especially waiting for services should be cautious because 5% of respondents' comment is poor for waiting time.

According to Table 6, almost of the respondents are satisfied customers' perceptions on providing the banking services and responsiveness of staff. The responsiveness of staff leads to attract and maintain customers for repetition of visit to the bank. The bank should continue to maintain these excellent remarks for its future success.

Table 6 presents customers' perception on safety of customers' deposit, skills on resolving customers' complaints and caring and understanding on customers' needs. It explicitly shows the satisfying results – nearly all respondents recognize excellent response on staff's safety and assurance.

Internal Business Process Perspectives

First Private Bank Limited's internal perceptive measures the bank's ability to identify profitable market segments, develop new products and services, selling existing and new products to customers and to service these customers in an efficient and timely manner without service defects.

Bank Service Time

Table 1 shows that the longest service duration time is over 20 minutes and the shortest is below ten minutes and between them are ten to twenty minutes. Among them, the most frequent service duration is ten to fifteen minutes and the least time duration of ten minutes is second.

Table 1 Bank Service Time

	Frequency	%
Below 10 minutes	28	28
10-15 minutes	49	49
16-20 minutes	15	15
Over 20 minutes	8	8
Total	100	100

Source: Survey Data, 2019

According to Table 1, 77 % of the respondents shows that the service waiting time duration is less than or equal to 15 minutes. So this proves the proficiency of staff in the offering of the financial services. The lesser the service time given by the staff the greater the satisfaction of the customers waiting time.

Financial Services Rendered by First Private Bank

First Private Bank Limited intends to carry out all financial services as a commercial bank and investment bank. The services provided by First Private Bank Limited are similar to other local bank's services. These services are shown in Table 2. Nine major financial services are provided by First Private Bank Limited until 2010 but foreign banking including money changer, authorized dealer license was introduced in 2011. According to the authorized dealer license, the bank accepts opening foreign currency account, providing account transfer, service foreign remittances and preparing letter of credit for export & import enterprises. Hire purchase is also offered the installment credits to customers to support for acquiring automobiles, computer and electronic appliances and telephone. The agreement was signed on 12-1-2013 by the First Private Union Bank and Western Union money transfer service. Western Union and USA, UK, Canada, Australia, UAE, Japan, Singapore, Malaysia, Thailand and Korea provide direct remittance services to over 70 countries, including Myanmar. Myanmar allows foreign remittances services (Outbound Service) from Myanmar on 6 January 2016, providing foreign remittance services to foreign countries.

Form May 5th 2015, Mykyat mobile bank can be downloaded as a mobile application. The bank can open a mobile bank account and run the Mobile Banking Account. Finastra Financial Software, a London-based in London, UK, has developed a core banking solution to transform digital banking services into digital banking. The bank arranges to provide international banking services Society for Worldwide Interbank Financial Telecommunication (SWIFT) wire transfers, trade finance and foreign exchange dealers. First Private Bank 6/2015 Board of Directors approved the purchase of two hundred thousand kyats for a share price kyats 30,000 per share for Myanmar Union Company to improve the payment system from card business to improve the payment system by card company. First Private Bank Limited will slowly issue its shares to existing shareholders at first priority to become strong and healthy bank. The new branches will plan to open over the country.

Learning and Growth Perspective

The ability to meet targets for financial, customer and internal business objectives depends on the organizational capabilities for learning and growth. The enablers for learning and growth come primarily from three sources: employees, systems and organizational alignment. Employee morale and job satisfaction is one of the important factors in most organizations and also for First Private Bank Limited.

Employee Satisfaction on Head Office of First Private Bank Limited

Table 1 can be seen that most of the employees obtained satisfaction level. The results are due to employees' satisfaction expert taking leave.

Table 1 Employee Satisfaction on Head Office of First Private Bank Limited

Sr.No	Employee Satisfaction	Mean Value
1	I satisfied with the current work environment.	3.70
2	I like the location of the bank existing now.	3.70
3	I was recognized and praised for doing a good job.	3.65
4	I satisfied with the accommodation, food, transportation and other support provided by the business.	3.45
5	The court is respect in the community.	3.55
6	My workers work well together.	3.75
7	I am satisfied with the current work rules and regulations.	3.55
8	Communication within my division/ department/ units is good.	3.80
9	I enjoy coming to work.	3.85
10	I appreciate the freedom to speak freely in the workplace.	3.60
11	I am encouraged to try new ways of doing things.	3.70
12	We appreciate that you participate in various aspects of your work.	3.70
13	You are satisfied that you have been treated fairly by your superior.	3.55
14	I am proud that I work in the bank.	3.55
15	I have opportunities to express my opinion about how things are done in my division.	3.25
16	In the last month, someone in the bank has talked to me about my performance.	3.85
	Total Mean Value	3.64

Source: Survey Data, 2019

According to Table 1, almost employees of First Private Bank Limited found that on average they were satisfied. If the bank can support employees in furthering their academic careers, the employees will be more willing to work.

Employee Retention

Employee retention is measured by type of skills development program and benefits. Employees are satisfied these factors and then the bank can retain them.

(i) Skills Development Program

First private bank Limited develops its staff through various training programs such as basic banking training, foreign banking training and diploma of banking provided by Myanmar Institute of Banking. Moreover the bank also trains its new staffs through staff training course twice a year. Managers are allowed to attend local and oversea banking training courses and workshop and seminar intending to develop banking knowledge and advanced technology used in banking industry. Expert from Western Union gives training on foreign remittances to the staffs of First Private Bank Limited in 2011-12.

(ii) Benefits of First Private Bank Limited

Benefits are a major component of reimbursing employees for their work and motivating them to perform to the best of their abilities. To be competitive in its compensation, First Private Bank limited provides basic salary and additional benefits to the staffs. Additional benefits consists of graduate allowance, travelling allowance, field allowance, uniform fees, New Year's present, school grant given at admission time and bonus. The following Table 2 shows employees' benefits of First Private Bank Limited.

Table 2 Employees' Benefits of First Private Bank Limited

Benefits	Remark
Graduate allowance	Certificate and diploma related with banking practices
Travelling allowance	Actual charges
Field allowance	Employee who transfer from native town
Union fees	Offer annually
School grant given at admission time	Kyats 15,000 to 35,000 based on students
Bonus	Based on annual profits and employees performance

Source: First Private Bank Limited, 2019

Promotion is considered employees who work at least three years' service and they can be promoted when they pass promotion exam. Moreover the bank honors model managers and model workers based on their performance. Employees who service are 9 years and above are honored by First Private Bank Limited. Income tax payments for the employees are paid by the bank. As a special program, installment payment by motor cycle, telephone and computers for its staff is offered by the bank in 2015-16. Also the bank provide loan without interest for its staff when needed. The

bank attracts and maintains its talented staff using above development programs' benefits.

Employee Productivity

Table 3 shows the number of staff of First Private Bank Limited from 2013-14 to 2017-18.

Table 3 Number of Staff of First Private Bank Limited

Financial Year	Frequency	Growth rate (%)
2012-13	557	6.30
2013-14	548	-1.62
2014-15	563	2.73
2015-16	606	7.64
2016-17	620	2.31
2017-18	635	2.42

Source: First Private Bank Limited, 2018

It is concluded that the bank attracts new staff in each year due to expansion of branches and image of the bank. According to Table 3, growth rate of staff is gradually increased in each year expect 2013-14. Employee retention is stable 2013 but afterwards large extents of employees were leaving due to existence of new banks up to 2014. The bank can attract new staff promptly because of its image. Therefore the number of staff increase again from 2014-15 to 2017-18.

FINDING AND DISCUSSION

This study has been with the objectives of analyzing financial and non-financial performance of First Private Bank Limited using Balanced Scorecard Model. To achieve these objectives, responsible persons from the bank and 100 bank customers and 40 employees were interviewed.

The study found that bank deposits are increasing year by year and also the amount of loans and overdraft are increasing yearly. It shows the performances of all operations growing due to public trust on the bank and stability and credibility of bank. The financial strengths of bank were concluded based on liquidity situation, profitability and market-based measurements. The bank's liquidity ratio is decreasing in 2016-17 and 2017-18 but it is more than the central bank's standard 20%. Also the bank's solvency ratio shows trend. This appears to be no immediate liquidity problem facing First Private Bank Limited.

According to profitability, this study found that NIM is decreased yearly due to the decline in net interest margin could be attributed to the weakening of the bank's earnings. Therefore, the business should consider increasing the percentage of the net interest margin over coming years. From 2008-09 to 2017-18, ROA of bank are down slightly. The principal reason of the decreasing ROA is increasing value of total assets. ROE is standard range from 2008-09 to 2014-2015 and then it is found that ROE ratios has declined steadily after 2015-16. Therefore, ROE should be made even better in the future.

According to the results, the bank's shares are gradually issued year after year based on market demand. EPS is dropped in 2015-16, 2016-17 and 2017-18 because the profits over the years are fluctuated and the number of shares issued is increased. Although the decline of EPS, PE ratios of the bank are slightly increased from 3.03 in 2008-09 to 10.69 in 2017-18 over ten years period. Higher PE ratio is a reflection of market optimism relating to First Private Bank's growth prospects. The PD ratio is said to be good from 2008-09 to 2017-18. The PD ratio is nearly seven times in 2017-18. It can be shown that the investors are willing to pay dividend that they received.

In studying the customer perspective, the demographic factors of customers, and the degree of relationship between the customer and the bank and the assessment on the quality of banking service are presented. It is found most of them are male and between 41 and 50 years old. Graduates and company staffs are the largest users of banking services and 38 % of all respondents dealing with the bank more than 10 years are the largest group. It can be concluded that this group is its loyal customers of the bank throughout the 28 years of business life of First Private Bank Limited. By analyzing of the usefulness of banking services, it is found that most customers visit the bank for saving service. For saving transactions, 20 % of respondents visit to the bank once a month. The bank should not only retain the loyal customers but also more satisfaction adds some new facilities for customers. As a result of respondents' feedback, most of the respondents are satisfied the waiting area and waiting time. Especially waiting for services should be cautions because 5 % of respondents' comment is poor for waiting time.

Regarding on the analysis on internal business processes perceptive, the respondents judged the improvement in services through in time services and innovation of new technologies and facilities. It is found that the proficiency of staffs in the offering of the financial services are excellent because most frequent service

duration is ten to fifteen minutes and the least time duration of ten minutes is second. It indicates that staffs from FPB are proficient in their daily task because almost of all respondents do not face with error.

As a result of learning and growth perceptive, measuring employee satisfaction, employee retention and employee productivity. It can be concluded that most of the employee satisfy and it is found that FPB encourages and supports its supports its staff to attend the respective training course not only local training but also oversea training. The bank also gives training as needed.

SCOPE AND LIMITATIONS

Although there are many banks in Myanmar Banking Industry, this current study focused on financial and non-financial performance measure on First Private Bank Limited using balanced scorecard model. This study only found that performance indicators and cannot link performance measures and the bank's strategy. Future research should emphasize on the link of the bank's strategies and its performance measures. Moreover it should conduct many researchers related to public trust on bank services, perception of staff on the bank, marketing strategies of bank and forces on the bank.

CONCLUSION

This study examined the analyzing the financial and non-financial performance of First Private Bank Limited in Yangon. Findings indicate that total deposits, loan and overdraft of bank are increasingly yearly. The bank's liquidity position in 2017 and 2018 is decreasing but it is more than the Central Bank's Standard 20%. Also the bank's solvency ratio is stable. And then, ROA is down slightly from 2008-09 to 2017-18 and ROE has declined steadily after 2015-16 and the rest of financial years is said to be good. EPS is dropped in 2015-16, 2016-17 and 2017-18 because the profits over the years are fluctuated. Although the decline of EPS, PE ratios of the bank are slightly increased from 3.03 in 2008-09 to 10.69 in 2017-18 over ten years period. Higher PE ratio is a reflection of market optimism relating to First Private Bank's growth prospects. The PE ratio is nearly seven times in 2017-18. It can be shown that the investors are willing to pay dividend that they received. On the other hand, Balanced Scorecard analyses on non-financial measures also, which led to future performance of the organization, customer perspective tried

to know the level of satisfaction of the customers. Internal process perspective aimed at the desired internal process to meet the expectations of the customers. Innovation and learning perspective innovated and improved the existing products and process to meet constantly changing requirement of the customers.

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STUDY ON DIAGRAMMATIC & GRAPHIC REPRESENTATION FOR STATISTICAL DATA USING COMPUTER APPLICATION

Banyar Min Min Tun¹

Abstract

This paper present rules for drawing diagrams and graphs. There are various design and method for drawing to present statistical data. Computerized simple techniques are illustrated with examples for drawing diagrams and graphs. Then we observed some points of difference between diagrams and graphs.

Keywords: Diagrammatic, Graphic, statistical data

1. INTRODUCTION

The important, appealing and easily understood method of presenting the statistical data is the use of diagrams and graphs. They are nothing but geometrical figures like points, lines, bars, squares, rectangles, circles, cubes etc., pictures, maps or charts. Diagrammatic and graphic representation has a number of advantages. Diagrams are generally more attractive and impressive than the set of numerical data. They are more appealing to the eye and leave a much lasting impression on the mind as compared to the uninteresting statistical figures. Diagrams and graphs are visual aids, which give a bird's eye view of a given set of numerical data. The data is presented in the simple and understandable form. They register a meaning impression on the mind almost before we think. They also save lot of time, as very little effort is required to grasp them and draw meaningful inferences from them. The technique of diagrammatic representation is made use of only for purpose of comparison. While the comparison could not possible or not necessary, this technique is not used. When properly constructed, diagrams and graphs readily show information that might otherwise be lost amid the detail of numerical tabulations. They highlight the salient features of the collected data; facilitate comparisons among two or more sets of data and enable use to study the relationship between them more readily.

1.1. Objectives of the study

The objectives of the study are-

- (i) To know diagrammatic and graphic representation has a number of advantages
- (ii) To construct diagrams and graphic charts using computer applications
- (iii) To know rules with drawing diagram for statistical data.

1.2. Method of Study

This paper mainly uses in literature survey and the data sources are based on secondary data obtaining from libraries, internet, website. We develop the Diagrams and graphs for statistical data and that the Diagrams and graphs are drawing in Microsoft Excel, and IBM SPSS.

1.3. Scope of the study

This study is focused on method of presenting the statistical data is the use of diagrams and graphs with computer application.

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2. RULES FOR DRAWING DIAGRAMS

1. The first and the most important thing is the selection of a proper scale. No definite rules can be laid down as regards the selection of scale. But as a guiding principle the scale should be selected consistent with the size of the paper and the size of the observations to be displayed so that the diagram obtained is neither too small nor too large.

2. The vertical and horizontal scales should be clearly shown on the diagram itself. The former on the left hand side and the latter at the bottom of the diagram.

3. Neatness should be strictly being written on the top in bold letter and should be very explanatory. If necessary the footnotes may be given at the left hand bottom of the diagram to explain certain points of facts.

3. TYPES OF DIAGRAMS

A variety of diagrammatic devices are used commonly to present statistical data.

(a) One Dimensional Diagrams *i.e.*, line diagrams and bar diagrams.

(b) Two Dimensional Diagrams *i.e.*, rectangle, squares, circles and pie diagrams.

(c) Three Dimensional Diagrams *i.e.*, cubes, spheres, prisms, cylinders etc.

(d) Pictograms.

(e) Cartograms

3.1 Line Diagram

This is the simplest of all the diagrams. It consists in drawing vertical lines, each vertical line being equal to the frequency. The variate values are presented on a suitable scale along the X-axis and the corresponding frequencies are presented on a suitable scale along Y-axis.

3.2 Bar Diagram

The term 'bar' is used for a thick wide line. The width of the bar diagram shows merely to make the diagram more explanatory. Bar diagrams are one of the easiest and the commonly used diagram of presenting most of the business and economics data. They consist of a group of equidistant rectangles one for each group or category of the data in which the length or height of the rectangles represents the values or the magnitudes, the width of the rectangles being arbitrary. There are various types of bar diagrams.

(a) Simple Bar Diagram

It is used for comparative study of two or more items or values of a single variable or category of data.

(b) Subdivided Bar Diagram

If a magnitude is capable of being broken into component parts or if there are independent quantities which form the subdivisions of the total, in either of these cases, bars may be subdivided into the ratio of the various components to show the relationship of the parts to the whole.

(c) Percentage Bar Diagrams

(i) Subdivided bar diagrams presented graphically on percentage basis give percentage bar diagrams. They are especially useful for the diagrammatic portrayal of the relative changes in the data.

- (ii) Some other bar diagrams are multiple bar diagram, Deviation bar, broken bars etc. The number of sets of correlated data are represented in a multiple bar diagram. The method of drawing multiple bar diagram is the same as that of simple bar diagram. Deviation bars are popularly used for representing net quantities excess or deficit, i.e., net loss, net profit etc. Such types of bars have both positive and negative values. Obviously positive values are shown above the base line and negative values below the base line.

3.3 One Dimensional Diagram

In one dimensional diagram magnitude of the observations are represented by only one of the dimension. *i.e.*, height (length) of the bars while the widths of the bars is arbitrary and uniform.

3.4 Two Dimensional Diagrams

In two dimensional diagrams, the magnitude of given observations are represented by the area of the diagram. Thus the length as well as width of the bars will have to be considered. It is also known as are diagram or surface diagram. Some two dimensional diagrams are

(a) **Rectangle diagram:** A rectangle is a two dimensional diagram because area of rectangle is given by the product of its length and widths. *i.e.*, length and width of the bars is taken into consideration.

(b) **Square Diagram:** It is specially useful, if it is desired to compare graphically the values or quantities which differ widely from one another. The method is not complicated to draw a square diagram. First of all take the square root of the values of the given observations and then squares are drawn with sides proportional to these square roots, on an appropriate scale, which must be satisfied.

(c) **Circle diagrams:** Circle diagrams are alternative to square diagrams and are used for the same purpose. The area of circle, which represents the given values, is given πr^2 , where $\pi = 22/7$ and r is the radius of circle. That is the area of circle is proportional to the square of its radius and consequently, in the construction of the circle diagram the radius of circle is a value proportional to the square root of the given magnitude.

(d) **Pie diagram:** Pie diagram are also called circular diagrams.

3.5 Three Dimensional Diagrams

Three dimensional diagrams are also known as volume diagrams, consists of cubes, cylinders spheres etc. length, width and height have to be taken into account. When the difference range is very obvious between the largest and smallest value, three dimensional diagrams are used. Of the various three dimensional diagrams, 'cubes' are the smallest and most commonly used devices of diagrammatic presentation of the data.

3.6 Pictograms

Pictogram is the technique of presenting statistical data through appropriate pictures and is one of very important key particularly when the statistical facts are to be presented to a layman without any mathematical background. Pictograms have some limitations also. They are difficult to construct and time consuming. Besides, it is necessary to one symbol to

represent a fixed number of units, which may create difficulties. It gives only an overall picture, not give minute details.

3.7 Cartograms

For expressing the quantitative information on a geographical basis, the statistical maps or Cartograms are used. Cartograms are simple and elementary forms of visual presentation and are easy to understand. Normally it is used when the regional or geographical comparisons are to be required to highlight.

4. GRAPHIC REPRESENTATION OF DATA

Graphs are used to study the relationship between the variables. Graphs are more obvious, precise and accurate than diagrams and can be effectively used for further statistical analysis, viz., to study slopes, forecasting whenever possible. The special type of paper, a graph paper, is used to draw the graph. Graph paper has a finite network of horizontal and vertical lines; the thick lines for each division of a centimeter or an inch measure and thin lines for small parts of the same. Graphs are classified in two parts.

1. Graphs of frequency distribution
2. Graphs of time series

4.1 Graphs of Frequency Distribution

The so-called frequency graphs are designed to reveal clearly the characteristic features of a frequency data. The most commonly graph for charting a frequency distribution of the data are:

(a) Histogram: A frequency density diagram is a histogram. According to Opermann, “a histogram is a bar chart or graph showing the frequency of occurrence of each value of the variable being analyzed”. In another way we say that, a histogram is a set of vertical bars whose areas are proportional to the frequencies represented. When building the histogram, the x-axis takes the variable and the y-axis takes the frequencies of this variable. It applies in general or when class intervals are equal.

In each case the height of the rectangle will be proportional to the frequencies. When class intervals are unequal, a correction for unequal class intervals is required. For making the correction we take that class which has lowest class interval and adjust the frequencies of other classes. The height of rectangle is divided by two when one class interval is twice as wide as the lowest class interval. The height of rectangle is divided by three, if it is three times.

(b) Frequency Polygon: ‘Polygon’ literally means ‘many-angled’ diagram. The graph of frequency distribution is known as frequency polygon. To compare two or more frequency distribution, this type of graph is effective. There are two ways for constructing frequency polygon.

(c) Frequency Curve: A frequency curve is a smooth free hand curve drawn through the vertices of a frequency polygon. The area enclosed by the frequency curve is same as that of the histogram or frequency polygon but its shape is smooth one and not with sharp edges. Smoothing should be done very carefully so that the curve looks as regular as possible and sudden and sharp turns should be avoided. A variety of frequency curves could be risen due to the different types of data.

- (i) **Symmetrical Curve:** In this type of curve, the class frequencies first rise steadily, reach a maximum and then fall in the same identical manner.
 - (ii) **Asymmetrical (skewed) frequency Curves:** A frequency curve is said to be skewed if it is not symmetrical.
 - (iii) **U- Curve:** The frequency distributions in which the maximum frequency occurs at the extremes (i.e., both ends) of the range and frequency keeps on falling symmetrically (about the middle), the minimum frequency being attained at the centre, give rise to a U-shaped curve.
 - (iv) **J-shaped curve:** In a J-shaped curve the distribution starts with low frequencies in the lower classes and then frequencies increase steadily as the variable value increases and finally the maximum frequency is attained in the last class. Such curves are not regular but become unavoidable in certain situations.
- (d) Cumulative frequency curve or Ogive:** Ogive, pronounced Ojive, is a graphic presentation of the cumulative frequency distribution. There are two types of cumulative frequency distributions. One is 'less than' ogive and second is 'more than' ogive. The curve obtained by plotting cumulative frequencies (less than or more than) is called a cumulative frequency curve of an ogive.
- (i) **Less than Method:** In this method we start with the upper limits of the classes and go on adding the frequencies. The rising curve can get by plotting these frequencies.
 - (ii) **More than Method:** In this method we start with the lower limits of the classes and from the frequencies we subtract the frequency of each class. The declining curve can get by plotting these frequencies.

4.2 Graphs of Time-Series

A time series is an arrangement of statistical data in a chronological order i.e., with respect to occurrence of time. The time series data are represented geometrically by means time series graphs which is also known as Histogram. The various types of time series graphs are-

1. Horizontal line graph or histograms
2. Net balance graphs
3. Range or variation graphs
4. Components or band graphs.

5. SOME COMPUTER APPLICATION FOR DRAWING DIAGRAMS AND GRAPHS

There are many application software in computer system for drawing diagrams and graphs. In this paper we state two applications such as;

1. Microsoft Office Excel
2. IBM SPSS.

5.1 Charts from Microsoft Office Excel

To create a chart, enter your data in a worksheet and then click the type of chart you want under the Charts group. The following data to the right is going to be used as an example. Once a chart is selected from the charts group, three new tabs, **Design, Layout, & Format**, will appear on the ribbon, grouped together under Chart Tools. The Chart Tools

Design tab is used to setup a chart. First, you need to set your data source by clicking **Select Data** under the Data group. The chart data range can be added in a Select Data Source window. We can highlight the cells that we want to show in the chart.

Using the data set as shown above, we now have the data range set for our chart. You can now specify how you want your legend and axis labels to appear. In the example to the left, the legend will display the colors and the axis label will display as “People who prefer”. If you click the **Switch Row/Column** button, it will swap the legend and axis labels (for example, “People who prefer” would now be on the legend and the names of the colors would appear on the axis.) Once you have the data source set, click the OK button. The example displays the following graph:

Now that the chart has been created, the design chart tools tab can be used to change the chart to a different type of chart, change the layout of the chart or apply a chart style.

The Chart Tools Layout tab is used to set labels for the title, axes, legends, and data labels on the chart. It can also be used to set axes options, add backgrounds, and add trend lines. The Chart Tools Format tab is used to apply formatting options to the chart, such as selecting a predefined style for the shape or manually setting fill, outline, and effects options for shapes.

Color	People who prefer
Red	51
Orange	36
Yellow	19
Green	47
Blue	78
Purple	23

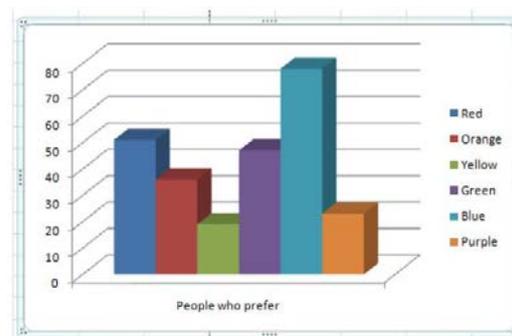


Fig 1

5.2 Charts from IBM SPSS

Although some statistical procedures can create charts, we can also use the Graphs menu to create charts.

- From the menus choose: Graphs > Chart Builder...
- Click the Gallery tab (if it is not selected).
- Click Bar (if it is not selected).
- Drag the Clustered Bar icon onto the canvas, which is the large area above the Gallery.
- Scroll down the Variables list, right-click *Wireless service [wireless]*, and then choose Nominal as its measurement level.
- Drag the *Wireless service [wireless]* variable to the x axis.
- Right-click *Owns PDA [ownpda]* and choose Nominal as its measurement level.
- Drag the *Owns PDA [ownpda]* variable to the cluster drop zone in the upper right corner of the canvas.
- Click OK to create the chart.

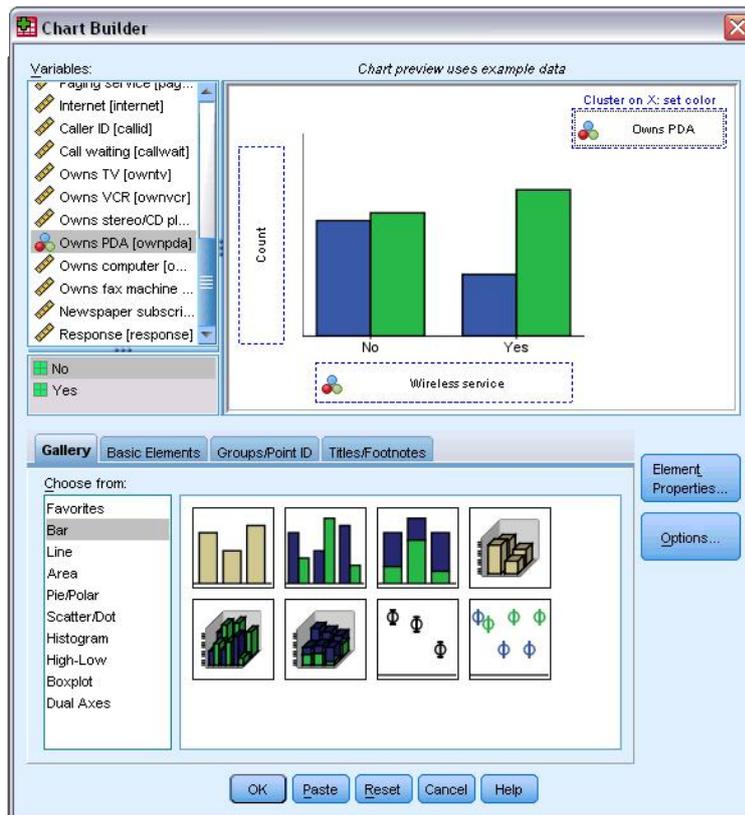


Fig 2

Generally, when we create diagrams and graphs in descriptive statistics, we are occurred suitable diagrams and graphs for measurement level as shown in Table 1.

Measurement Level	Descriptive Statistics	Diagrams	Graphs
Nominal	Frequencies, percentage, mode	Bar, Pie	-
Ordinal	Frequencies, percentage, Median, mode, percentiles	Bar, Pie,	steam & leaf
Interval	Frequencies, percentage, Mean, Median, mode, Variance, percentiles Std deviation, Skewness, Kurtosis	Bar, Pie	Line, steam & leaf Boxplot Histogram

Table 1

5.3 Compare of Excel software and SPSS software

Excel software contain more diagrams than graphs (Fig 3). SPSS software contain same amount of diagrams and graphs (Fig 4). We will use Excel software to draw diagrams and SPSS software for graphs.

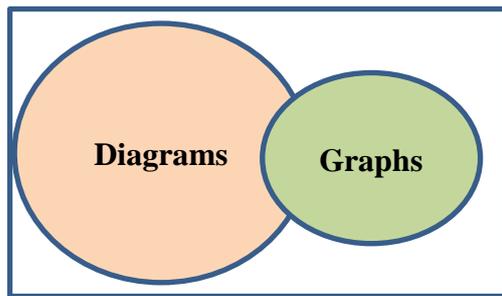


Fig 3

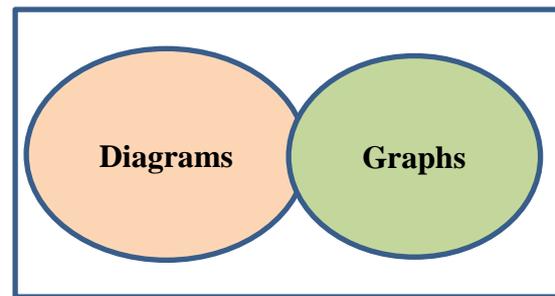


Fig 4

6. CONCLUSION

In this paper we occurred difference between graphs and diagrams. There are no certain method to distinguish between diagrams and graphs but some points of difference are occurred-

1. Generally graph paper is used in the construction of the graph, which helps us to study the mathematical relationship between the two variables, whereas diagrams are generally constructed on a plain paper and used for comparison only not for studying the relationship between two variables.
2. In graphic mode of representation points or lines (dashes, dot, dot-dashes) of different kinds are used to represent the data while in diagrammatic representation data are presented by bars, rectangles, circles, squares, cubes, etc.
3. Diagrams furnish only approximate information. They do not add anything to the meaning of the data and therefore, are not of much use to a statistician or researcher for further statistical analysis. On the other hand graphs are more obvious, precise and accurate than the diagrams and are quite helpful to the mathematician for the study of slopes, rate of change and estimation *i.e.*, interpolation and extrapolation, whenever possible.
4. Construction of graphs is easier as compared to the construction of diagrams. Diagrams are useful in depicting categorical and geographical data but it fails to present data relating to frequency distributions and time series.

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1. Introduction

Increasing amounts of information on traveling are available on the web. As is the case for many other domains, the web is becoming the most important information source for planning a holiday. Specialized web sites, such as Expedia or SkyScanner, exist for finding the best deals, flight tickets or travel packages. Others, such as WikiVoyage or Frommers, are specialized in providing information and travel advice on different destinations. Reviews and evaluations of hotels, restaurants, and attractions can be read on websites such as TripAdvisor. Although these services are all valuable information sources, they typically give no personal advice which holiday destination to choose.

Now-a-days recommendation system is becoming very popular and people are getting attracted to it, as it is assisting them in discovering interesting items over huge amount of information. Recommendation systems are used in digital libraries, electronic stores, travel tours, restaurants, hospitals and in general can be useful in any decision-making process to provide predictions of appropriate items to specific users. During a commercial interaction, recommendation systems have advantages for both customers and merchants.

In a business interaction through the online shopping, recommendation systems can help customers to find their favorite items among an overwhelming number of items in an electronic department store. Therefore, recommendation systems can facilitate and accelerate shopping for users. Merchants proffer their products and hereby they can increase their sales and customers satisfaction by offering the new and preferable items. Similarly, in a digital library, recommendation systems can manage information overload by helping users to choose appropriate information items from a large set of alternatives.

In the tourism field, travel recommendation systems aim to match the characteristics of tourism and leisure resources or attractions with the user needs. The travel companies have to aware of these preferences from different tourists and serve more attractive packages to get more business and profit. Therefore, the demand for intelligent tour services, from both travellers and tour companies, is expected to increase dramatically. Since recommendation systems have been successfully applied to enhance the quality of service for customers in a number of fields, it is natural direction to develop recommendation systems for personalized travel package recommendation.

2. Anatomy of Recommendation System

Recommendation systems are made to help users in their search for a fitting product from an overwhelming array of options. Recommendation systems can nowadays be found in a broad range of applications and are very common in e-business solutions. Every recommendation system needs to at least consist of two base elements: the user profile and the information filtering technique.

The user profile is needed for the system to represent the user's information and preferences. Without a user profile, it becomes impossible to generate personalized recommendations. Based on this user profile, the recommendation will need a certain matching (filtering) approach to match users with items. Figure 1 shows the process of recommendation system.

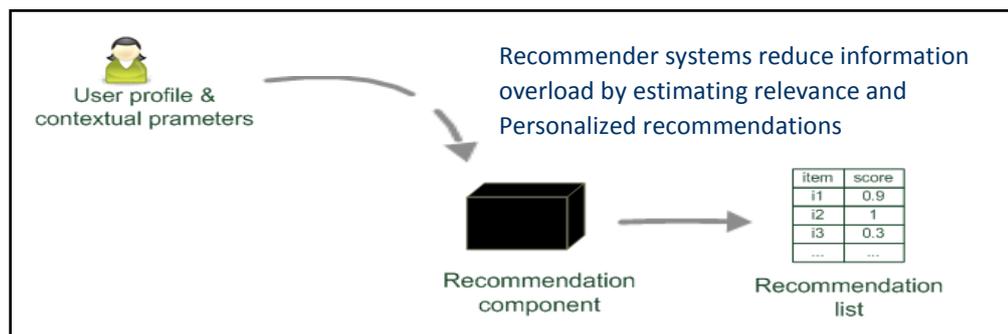


Figure 1: Paradigm of Recommendation System

2.1 User profiles

A user profile includes all personal information needed of a user to help with making recommendations. For constructing and maintaining user profiles, there are many different ways to represent the user's preferences. Two of the most successfully used techniques are to save a user-item matrix with ratings a user made in the past combined with the use of a feature vector, representing the affinity of a user to predefined features. For example, in a travel recommendation, feature can represent hobby. The user profile would then represent what are user hobbies. The user can also be asked for explicit input. In such case the users can state their preferences by answering questions or indicating their interests from a list.

Recommendation systems always try to improve their user's profiles and adapt to changing user's preferences over time. So, user feedback is another important aspect of any system. Explicit feedback can be attained by asking the user to rate items or ask his opinion (like/dislike) on a recommendation. Explicit feedback is the most accurate information but

ask the user for to make an effort for the system. The more user-friendly approach is to collect implicit feedback from a user's behaviour and (natural) interactions with the system. Processing this information can also give insight to the user's preferences.

2.2. Filtering approaches

With the user profile and a database of items available, the final step to make a recommendation is to match users with suitable items. The filtering method determines how these are found. This work categorizes recommendation systems by their filtering approach and distinguishes between four different ones.

- (1) In Content-Based Filtering, where the system makes use of the user's profile to recommend items that exhibit similar characteristics to what he has liked in the past.
- (2) In Collaborative Filtering, the recommendation compares the user's past ratings with those of other users to find users with similar taste. Highly rated items by these neighbors will be recommended.
- (3) Knowledge-Based recommendations make use of domain specific information to match user interests with items.
- (4) Hybrid systems represent any system that combines two or more of the above approaches to a more complex whole.

3. Rating Estimations

An important element in recommendation systems is the user-item ratings. Ratings in recommendation systems represent how pleasing or useful a certain item is to a user. When a user has experienced the product, he can give it an explicit rating. But for most products, such rating is not known. Most recommendation approaches reduce the problem of making a recommendation to estimating ratings for items a user hasn't rated yet. Given these estimations, the system can then recommend the highest scoring items to the user.

3.1 Explicit ratings

Asking for explicit item ratings is probably the most precise one among the existing alternatives for gathering users' opinions. In most cases, five-point or seven-point Likert response scales ranging from "Strongly dislike" to "Strongly like" are used; they are then internally transformed to numeric values so the previously mentioned similarity measures can be applied. Some aspects of the usage of different rating scales, such as how the users' rating

behavior changes when different scales must be used and how the quality of recommendation changes when the granularity is increased.

Explicit ratings require additional efforts from the users of the recommendation system and users might not be willing to provide such ratings as long as the value cannot be easily seen. Thus, the number of available ratings could be too small, which in turn results in poor recommendation quality. Figure 2 shows the five-point interval ratings scale.



Figure 2: Example of 5-point interval ratings

3.2 Implicit ratings

Implicit ratings are typically collected by the web shop or application in which the recommendation system is embedded. When a customer buys an item, for instance, many recommendation systems interpret this behavior as a positive rating. The system could also monitor the user's browsing behavior. If the user retrieves a page with detailed item information and remains at this page for a longer period of time, for example, a recommendation could interpret this behavior as a positive orientation toward the item.

Although implicit ratings can be collected constantly and do not require additional efforts from the side of the user, one cannot be sure whether the user behavior is correctly interpreted. Still, if a sufficient number of ratings is available, these particular cases will be factored out by the high number of cases in which the interpretation of the behavior was right. In some domains (such as personalized online radio stations) collecting the implicit feedback can even result in more accurate user models than can be done with explicit ratings.

4. Collaborative Filtering

The major purpose of collaborative filtering approaches is to exploit information about the past behavior or the opinions of an existing user community for predicting which items the current user of the system will most probably like or be interested in. These types of systems are in widespread industrial use today, in particular as a tool in online retail sites to

customize the content to the needs of a particular customer and to thereby promote additional items and increase sales.

From a research viewpoint, these types of systems have been explored for many years, and their advantages, their performance, and their limitations are nowadays well understood. Years ago, many types of algorithms and techniques have been proposed and successfully evaluated on real-world and artificial test data.

A matrix of given user–item ratings is taken as the only input and typically produced the following types of output in pure collaborative approaches. These are (a) a numerical prediction indicating to what degree the current user will like or dislike a certain item and (b) a list of n recommended items. Such a *top-N* list should, of course, not include items that the current user has already bought.

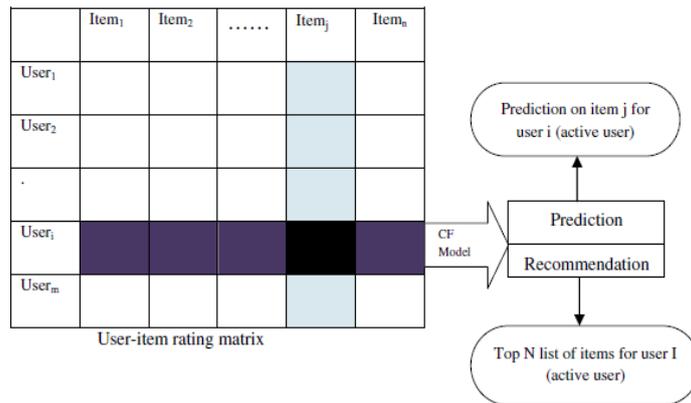


Figure 3: Collaborative Filtering Process

4.1 User-based collaborative filtering

User-based collaborative filtering is a straightforward algorithmic interpretation of the core premise of collaborative filtering: find other users whose past rating behavior is similar to that of the current user and use their ratings on other items to predict what the current user will like. In a travel recommendation system, to predict Mary's preference for an item she has not rated, user-based collaborative filtering looks for other users who have high agreement with Mary on the items they have both rated. These users' ratings for the item in question are then weighted by their level of agreement with Mary's ratings to predict Mary's preference.

Besides the rating matrix R , a user-based collaborative filtering system requires a similarity functions: $U \times U \rightarrow R$ computing the similarity between two users and a method for using similarities and ratings to generate predictions. The main idea of user-based

collaborative filtering is that given a ratings database and the ID of the current (active) user as an input, identify other users referred to as peer users or nearest neighbors that had similar preferences to those of the active user in the past. Then, in travel recommendation, for every tour package p that the active user has not yet seen, a prediction is computed based on the ratings for p made by the peer users. The underlying assumptions of such methods are that (a) if users had similar tastes in the past, they will have similar tastes in the future and (b) user preferences remain stable and consistent over time.

With respect to the determination of the set of similar users, one common measure used in recommendation systems is Pearson's correlation coefficient. The similarity $sim(a, b)$ of users a and b , given the rating matrix R , is defined in the following formula. The symbol \bar{r}_a corresponds to the average rating of user a .

$$sim(a, b) = \frac{\sum_{p \in P} (r_{a,p} - \bar{r}_a)(r_{b,p} - \bar{r}_b)}{\sqrt{\sum_{p \in P} (r_{a,p} - \bar{r}_a)^2} \sqrt{\sum_{p \in P} (r_{b,p} - \bar{r}_b)^2}}$$

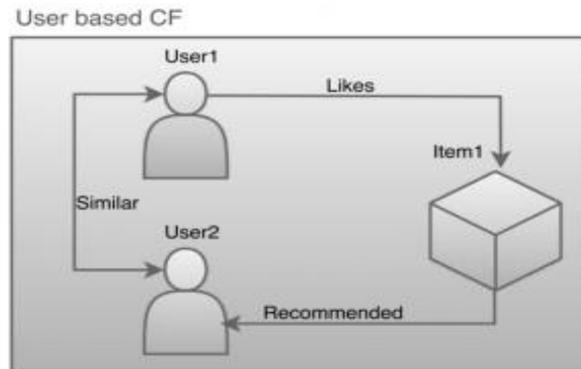


Figure 4: User-based Collaborative Filtering Process

5. Results and Discussion

User-based collaborative filtering recommendation based on nearest-neighbors enjoy a huge amount of popularity, due to its simplicity, efficiency, and ability to produce accurate and personalized recommendations. Table 1 shows a database of ratings of the current user, Mary, and some other users. Mary has, for instance, rated "Package1" with a "5" on a 1-to-5 scale, which means that she strongly liked this item. The task of a recommendation system in this simple example is to determine whether Mary will like or dislike "Package5", which Mary has not yet rated or seen.

In this sample, $U = \{u_1, \dots, u_n\}$ to denote the set of users, $P = \{p_1, \dots, p_m\}$ for the set of tour packages (items), and R as an $n \times m$ matrix of ratings $r_{i,j}$, with $i \in 1 \dots n, j \in 1 \dots m$. A numerical scale from 1 (strongly dislike) to 5 (strongly like) can be defined as the possible rating values. If an item j has not been rated by a certain user, the corresponding matrix entry $r_{i,j}$ remains empty.

Table 1: Sample Ratings Database for Collaborative Recommendation

	Package1	Package2	Package3	Package4	Package5
Mary	5	3	4	4	?
User1	3	1	2	3	3
User2	4	3	4	3	5
User3	3	3	1	5	4
User4	1	5	5	2	1

By substituting the rating value from Table 1 in Pearson's correlation coefficient formula, the similarity of Mary to User1 is thus as follows: $(\overline{r_{Mary}} = \overline{r_a}=4, (\overline{r_{User1}} = \overline{r_b}=2.4$:

$$\frac{(5 - \overline{r_a}) * (3 - \overline{r_b}) + (3 - \overline{r_a}) * (1 - \overline{r_b}) + \dots + (4 - \overline{r_a}) * (3 - \overline{r_b})}{\sqrt{(5 - \overline{r_a})^2 + (3 - \overline{r_a})^2 + \dots + (3 - \overline{r_b})^2 + (1 - \overline{r_b})^2 + \dots}} = 0.85$$

The Pearson correlation coefficient takes values from +1 (strong positive correlation) to -1 (strong negative correlation). The results 0.70, 0.00, and -0.79 are the similarities to the other users, *User2* to *User4* respectively.

Based on these calculations, *User1* and *User2* were somehow similar to *Mary* in their rating behavior in the past. The Pearson measure regards the fact that users are different with respect to how they interpret the rating scale. Some users tend to give only high ratings, whereas others will never give a 5 to any package. The Pearson coefficient factors these averages out in the calculation to make users comparable – that is, although the absolute values of the ratings of *Mary* and *User1* are completely different, a rather clear linear correlation of the ratings and thus similarity of the users is detected.

This fact can also be seen in the visual representation in Figure 5, which both illustrates the similarity between *Mary* and *User1* and the differences in the ratings of *Mary* and *User4*. To make a prediction for *Package5*, which of the neighbors' ratings shall be taken

into account and how strongly shall be valued their opinions. In this example, an obvious choice would be to take *User1* and *User2* as peer users to predict Mary's rating.

A possible formula for computing a prediction for the rating of user a for package p that also factors the relative *proximity* of the nearest neighbors N and a 's average rating r_a is the following:

$$pred(a, p) = \bar{r}_a + \frac{\sum_{b \in N} sim(a, b) * (r_{b,p} - \bar{r}_b)}{\sum_{b \in N} sim(a, b)}$$

In the sample, the prediction for Mary's rating for *Package5* based on the ratings of near neighbors *User1* and *User2* will be:

$$4 + 1/(0.85 + 0.7) * (0.85 * (3 - 2.4) + 0.70 * (5 - 3.8)) = 4.87$$

Given these calculation schemes, rating predictions for Mary can be computed for all items she has not yet seen and include the ones with the highest prediction values in the recommendation list. It will most probably be a good choice to include *Package5* in such a list.

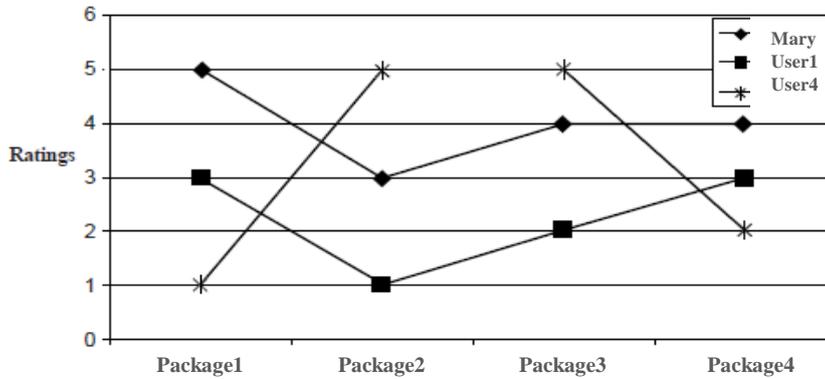


Figure 5: Comparing Mary with two other users

6. Conclusion

Recommendation systems open new opportunities of retrieving personalized information on the Internet. Recommendation techniques have coped with the information overload problem and have proven their usefulness as a tool in many classical domains such as movies, books, and music. A variety of approaches have been used to perform recommendations in these domains, including content-based, collaborative, and knowledge-based.

This paper proposes a recommendation system that offers personalized recommendations for travel destinations to individuals. It can help overcome information

overload problem by exposing users to interesting, novel, surprising and relevant items based on preferences users have expressed either explicitly or implicitly. It can introduce users to new items that have not been known or have not been retrieved. So recommendations can help users in meeting their information needs.

On the whole, it is mainly an intelligent application, created to support users by personalized recommendations in search process and their decision-making while interacting with large information spaces. These recommendations are based on the users' rating profile, personal interests, and specific demands for their travel destination by using user-based collaborative filtering approach. Recommendation system automates some of these strategies with the goal of providing affordable, personal, and high-quality recommendations.

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Firstly, I would like to express my profound gratitude to Dr. Yi Yi Win, Rector, Co-operative University (Thanlyin) for her kind permission to carry out this research. Secondly, I also would like to thank Dr. Soe Mya Mya Aye, Professor and Head of the Department of Computer Studies, Yangon University for encouraging to complete my research. And then, I want to thank Dr. Ohnmar San, Professor and Head of the Department of ICT, Co-operative University (Thanlyin) for her kind guidance. Finally, I would like to thank my supervisor Dr. Wint Pa Pa Kyaw, Associate Professor, Department of Computer Studies, Yangon University, for her close supervision and invaluable suggestions. I wish to thank all who help and give me advice on this research.

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A STUDY ON THE DIFFICULTIES OF LEARNING PHRASAL VERBS BY THE STUDENTS IN CO-OPERATIVE UNIVERSITY, THANLYIN

Wai Wai Hlaing¹

Abstract

This research paper mainly focuses on the students' background knowledge concerning phrasal verbs, their difficulties on phrasal verbs, to what extent their practice of structure word exercises helps them improving their understanding, and to which degree their dictionary skills support them for guessing the meaning of the phrasal verbs. The aims of the research are to realize the learners' difficulties on learning phrasal verbs and to describe some suggestions to develop their learning. For these reasons, needs analysis is used to point out learners' difficulties. In the questionnaires how much exercises and practices relates to the phrasal verbs is measured. Random sampling method is used to collect the data after asking for the volunteering students to answer the questionnaires. Frequency and percentage of descriptive statistics method is used to analyze the data. The research mentions that the more frequent the learners have the contact with structure word exercises, the more confident they will have to face with phrasal verbs, and consequently the more their background knowledge about phrasal verbs, the more favourable they are to get the right answer. Moreover, using dictionary book is more reliable and can make the learners improve more than using applications of this kind, as everyone is the great tendency to find out the meaning of the word simultaneously, without paying much attention to the other points in the dictionary. This makes the learners decrease their dictionary skill, which may affect to develop the language skill. Therefore, the learners should have continuously touched with prepositions or adverbs which are combined with verbs to give the different meaning of the base verbs. In addition, developing dictionary skill actually helps all the learners not only to develop their knowledge about phrasal verbs but also to upgrade their language skills.

1. INTRODUCTION

Throughout our learning life on English Language, starting from our childhood to today, verbs are found crucial to form a sentence rather than any other parts of speech and also, they are complicated and, not easy to understand. Their meanings, tenses, structures, usages and exceptions make the learners feel depressed on one hand, but on the other hand they arouse the learners' interest and increase their curiosity. As for the researcher, it was curiously interesting in the structure of the verbs related to their meanings, especially how the verbs are combined with preposition and or adverb to make a new meaning. The interest unconsciously goes to phrasal verbs. Now the students from Co-operative University,

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Thanlyin, are taught Business English. The course books prescribed for them are series of Business Result. While teaching English to the students, it is found that most students can learn single-word verb and can only absorb its meaning. But, in contrast, for the meaning for phrasal verbs, they rarely guess the meaning and find difficulties to learn. As a consequence, for most students in Co-operative University, Thanlyin, as well as most learners in English Language, the language is really complicated, becoming a great disturbance for progress. The present research indicates that how the students in Co-operative University, Thanlyin found difficulties in learning phrasal verbs, and some suggestions for them to help improving their learning.

1.1 Aims and Objectives of the study

The aims of the research are to realize the actual difficulties of students in learning phrasal verbs while they are learning English Language, and to give the learners certain suggestions to improve their styles of learning phrasal verbs. The objectives of the research are to analyse in which part students are encountering difficulties in learning phrasal verbs, to consider whether their learning styles on structure words really apply for them, and to suggest certain special ways so that students can easily memorize phrasal verbs by themselves.

1.2. Scope of the study

This research only emphasizes on the relationships between the structure word exercises and the difficulties in learning phrasal verbs, and between the students' way of using dictionary and their correct usage of phrasal verbs. Moreover, it chiefly focuses on two-word phrasal verbs.

1.3. Organization of the study

The research paper is composed of eight chapters. In Chapter 1, there are introduction, aims and objectives of the study, scope of the study and organization of the study included. Chapter 2 is about literature review, in which what phrasal verb is, by sub-dividing into differences between phrasal verbs and idioms, and those between phrasal verbs and prepositional verbs, and previous works, are described. Chapter 3 comprises theoretical background, and Chapter 4 consists of research methodology, in which there are hypothesis, research materials and research procedures described. Data analysis is carried out in chapter 5. It is followed by findings and discussions, suggestions of teaching and learning phrasal verbs, and conclusion in chapter 6,7 and 8, respectively.

2. LITERATURE REVIEW

2.1. What is Phrasal Verb?

According to Oxford Advanced Learner's Dictionary, a phrasal verb is a verb combined with an adverb or a preposition, or sometimes both, to give a new meaning, for example go in for, win over, see to, etc. The phrasal verbs can be analysed as four types: transitive phrasal verbs, intransitive phrasal verbs, separable phrasal verbs and inseparable verbs.

1. Transitive phrasal verbs are the verbs that require an object after the verbs.

Eg. She **looks after** the children.

Phv Obj

The flood **brought about** a huge disaster.

Phv Obj

2. Intransitive phrasal verbs are the verbs which do not have an object after the verbs.

Eg. When do you **get up**?

Phv

The kid is **growing up**.

Phv

3. Inseparable phrasal verbs are the verbs in which the words can be separated for using in different places in a sentence. These verbs can be joined form as well as separated form.

Eg. Please **turn on** the light.

Phv

Please **turn** the light **on**.

I will **pick up** you from the bus-stop.

Phv

I will **pick** you **up** from the bus-stop.

The people requested to **cut down** the prices.

Phv

The people requested to **cut** the prices **down**.

4. Inseparable phrasal verbs are the verbs whose words cannot be separated for using it in different places in a sentence.

Eg. She **looks after** her children.

Phv

The patient **passed away**.

Phv

He is trying to **give up** smoking.

Phv

They **carried on** their work.

Phv

In this case, it is needed to notice that transitive verbs can either separable form or inseparable form but in contrast, all the intransitive phrasal verbs are inseparable.

And, phrasal verbs are mostly common in English, especially in less formal English, but they are also found in more less formal contexts, as well. They are used in songs, in films, and also in newspaper headlines. Now, they become more and more common in neutral or formal as well as informal contexts or situations. It is also needed to consider that Phrasal verbs have different meanings. Sometimes the meanings are clearly related, some being literal and some are metaphorical (ie. figurative). Some example sentences of phrasal verbs that means ‘figurative’ are “He spends hours ***glued to*** the TV every evening” and “People are ***flooding into*** the stadium two hours before the concert.”. One more point found here is that the meaning of the phrasal verb is very often greatly influenced by the particle.

E.g Take away → to make a feeling, pain, etc, disappear.

‘away’ means ‘to or at a distance from sb/sth take off in space or time’ (Oxford advanced learner’s dictionary) (of an aircraft, etc)

Take off → to leave the ground and begin to fly.

→ to leave a place especially in a hurry

→ to become successful or popular very quickly or suddenly

Take (sth) off → remove

‘off’ means down or away, remove, leading away from sth.

2.1.1. Differences between Phrasal Verbs and Idioms

There is a slight difference between idiomatic expressions and phrasal verbs. In these, idioms are usually defined as groups of words whose overall meaning is different from the meanings the individual words. So, the word “**over the moon**” has nothing to do with the literal meaning of the moon, it means “**extremely happy or excited**”. An organization that **changes hands** passes from one owner to another; and if you are **in someone’s way**, you are stopping them for moving or doing something. These instances show that the meaning of the

expression is totally different from that of the individual word in that expression. One more point that needs to be considered is that some idioms are difficult to guess while others are not. It depends on the context, as well. On the other hand, phrasal verbs consist of two and occasionally three words: a base verb and at least one particle (preposition or adverb). And the meaning of the verb and particle is different from the base verb on its own. For example, the meaning of **give up** (stop) and **give in (admit)** are quite different from the meaning of **give**. Some phrasal verbs are more transparent, eg. **stand up** and the most common sense of **stand** are very similar in meaning, as are **sit down** and **sit**. (Idioms and Phrasal Verbs: Intermediate by Ruth Gairn and Stuart Redman).

2.1.2. Differences between Phrasal Verbs and Prepositional Verbs

As phrasal verb is rather complicated, one point to be considered is that there are some differences between phrasal verbs and prepositional verbs. Actually, not all the verbs combined with particles (an adverb and/or a preposition) are phrasal verbs or idioms. Some are prepositional verbs. In fact, a prepositional verb is a combination of a verb and only one preposition, eg. **agree to**, **agree with**, etc. Therefore, it can be deduced that phrasal verbs require either a preposition or an adverb, or both, but prepositional verbs are composed of verbs combined with a preposition, eg. **look after**, **give up**, etc. Another major difference is that the meaning of a phrasal verb is totally different from that of a base verb, whereas the meaning of a prepositional verb is quite related or similar to that of the base verb,

<u>Phrasal Verb</u>	<u>Prepositional Verb</u>
Give up (quit)	look at
Look after (take care of)	listen to
Look forward to (anticipate)	laugh at

Next, the form of phrasal verbs can be separable or inseparable, but that of prepositional verbs can only be inseparable.

<u>Phrasal Verb</u>	<u>Prepositional Verb</u>
The people requested to <u>cut down</u> the prices.	Someone is <u>knocking at</u> the door.
The people requested to <u>cut</u> the prices <u>down</u> .	-

Moreover, although phrasal verbs can be transitive or intransitive forms, prepositional verbs are transitive.

<u>Phrasal Verb</u>	<u>Prepositional Verb</u>
The people requested to <u>cut down</u> the prices. (Transitive)	Someone is <u>knocking at</u> the door. (Transitive)

When did you get up? (Intransitive) -

These facts help the learners know how to distinguish phrasal verbs from prepositional verbs.

2.2. Previous Works

Many researches were done concerning phrasal verbs for ESL as well as ELT learnings. Rafidah Kama Rudin did a research on the use of phrasal verbs by Malaysian learners of English. Mi - Lim Ryo emphasized on a Corpus based Study of the Use of Phrasal Verbs in Korean EFL Students' Writing. The Indonesian scholars, YudiJuriardi and his associates did an analysis of student's phrasal verbs translation at English Department of Sultan AgengTirtayasa University. A view of research on Polysemous phrasal verbs was done by Lu Zhi for the Journal of Literature and Art Studies 2015.

3. THEORETICAL BACKGROUND

According to Jack C. Richard, what is identified as a need is dependent on judgments and reflects the interests and values of those making such a judgment. Needs-analysis is not only a distinctive but also a necessary factor in planning educational programs as it includes the procedures used to collect information about learner's needs. The procedures for needs analysis are as follow;

- a) Questionnaires
- b) Self – ratings
- c) Interviews
- d) Meetings
- e) Observation
- f) Collecting learner Language samples
- g) Task analysis
- h) Case studies
- i) Analysis of available information.

Many analysts defined needs and needs analysis in their own ways. Needs analysis in language feeding started in 1960s, as an essential part to measure the language proficiency and also for the curriculum development. (Stafflebeam, McCormicle, Brinluerheff, and Nelsum 1985).

4. RESEARCH METHODOLOGY

In the research methodology; there consists of three parts: hypothesis, research procedures and research materials.

4.1. Hypothesis

Needs analysis measures the needs of the learners in learning language, and in this case, it points out students' needs on learning phrasal verbs. It is believed that learning the structure words can help them to improve their understanding of phrasal verbs and thus structure word exercises can arouse and raise their confidence in learning phrasal verbs. In Co-operative University, Thanlyin, students from first year to third year and Post Graduate Diploma Students have to learn Business English and among them, undergraduate students have to learn the structure words as a must in their respective academic year. So, the more exposure students have in structure words, the more correct answer they will get and also the more confidence they will have.

4.2. Research Materials

Among the procedures of needs analysis, questionnaires together with self-rating are used in the research. In a questionnaire, there are two parts of question: Part A and Part B. Part A consists of four questions, in each of which have five items. These questions analyze how much they understand about the phrasal verbs and in which part they have found difficulty in learning phrasal verbs.

In Part B, four questions are written and for the first question, 5-point Likert-scale is used to measure the student's situation and understanding on the questions of Part A. The second question is about the student's experience in dictionary use, and there 4-point Likert-scale pattern is used. The third question is that whether the students have the own ways to learn Phrasal verbs or not and the last question is the duration of students to answer the questions.

4.3. Research Procedures

For the research to find out the learner's difficulty in learning phrasal verbs, the following steps or procedures are used:

- (1) Students in all the classes in Co-operative University are asked to conduct the questionnaires, and the volunteering students are collected.

(2) The questionnaires are distributed to all those participants without doing any pilot-test.

(3) Data analysis is carried out to find out the results. In conducting data analysis, frequency and percentage of descriptive statistics method is used to be able to mention the data clearly.

In this case, in order to make sure that the research has validity, the statistical method, 'n' method is used to cover the sample size of population. The 'n' method developed by Taro Yamane (1976) is shown below.

$$n = \frac{N}{1 + Ne^2}, e = 0.05$$

As there are altogether 1896 students in Co-operative University, Thanlyin, the number of volunteering participants who joined to conduct the research is (612), and still some more students asked to answer the question next but finally the answer sheets which were back to the researcher is only 560. The validity of the research can be measured as follows;

$$n = \frac{1896}{1 + (1896 \times (0.05)^2)} = 330.313 \dots$$

According to this statistical data, the participant size covers the sample population size. Randomly sampling Method is used for the research, and from nearly 30% (**29.54%**) of the whole mass, the data was collected.

5. DATA ANALYSIS

In the research questionnaire, there are two parts, Part A and Part B. Data analysis is carried out according to the questionnaires divided into part A and Part B.

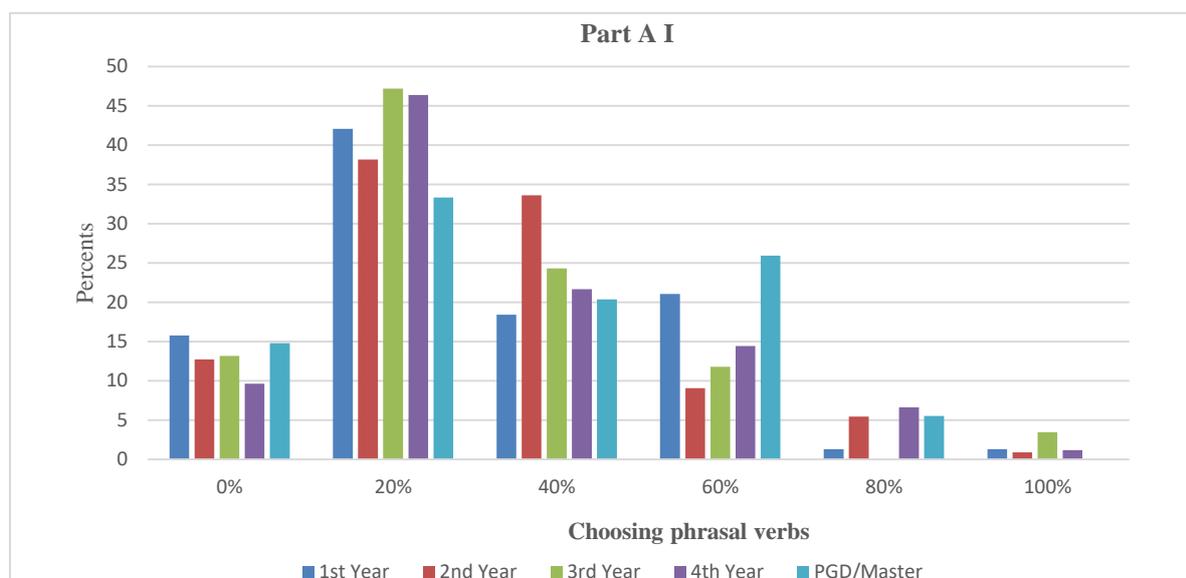
5.1. Data Analysis of Part A

In Part A, there are 4 questions and total mark range for part A to analyse how much knowledge the learners have, how the structure words exercises they have been learning support them and what their difficulties of learning phrasal verbs are.

In question 1, there are five items and the learners are checked to what extent they are familiar with the phrasal verbs. The students are asked to choose single-word verb or phrasal verbs which are the same meaning. In this case, the research points out the most population of choosing phrasal verb level. The data is shown below.

Table 5.1.1. Choosing phrasal verbs

No.	Year	0%		20%		40%		60%		80%		100%	
		No	Percent	No	Percent	No	Percent	No	Percent	No	Percent	No	Percent
1	1 st Year	12	15.79	32	42.10	14	18.42	16	21.05	1	1.32	1	1.32
2	2 nd Year	14	12.73	42	38.18	37	33.64	10	9.09	6	5.45	1	0.91
3	3 rd Year	19	13.19	68	47.22	35	24.31	17	11.81	0	0	5	3.47
4	4 th year	16	9.64	77	46.38	36	21.69	24	14.46	11	6.63	2	1.2
5	PGD / Master	8	14.81	18	33.33	11	20.37	14	25.93	3	5.56	-	0

Figure. 5.1.1. Choosing phrasal verbs

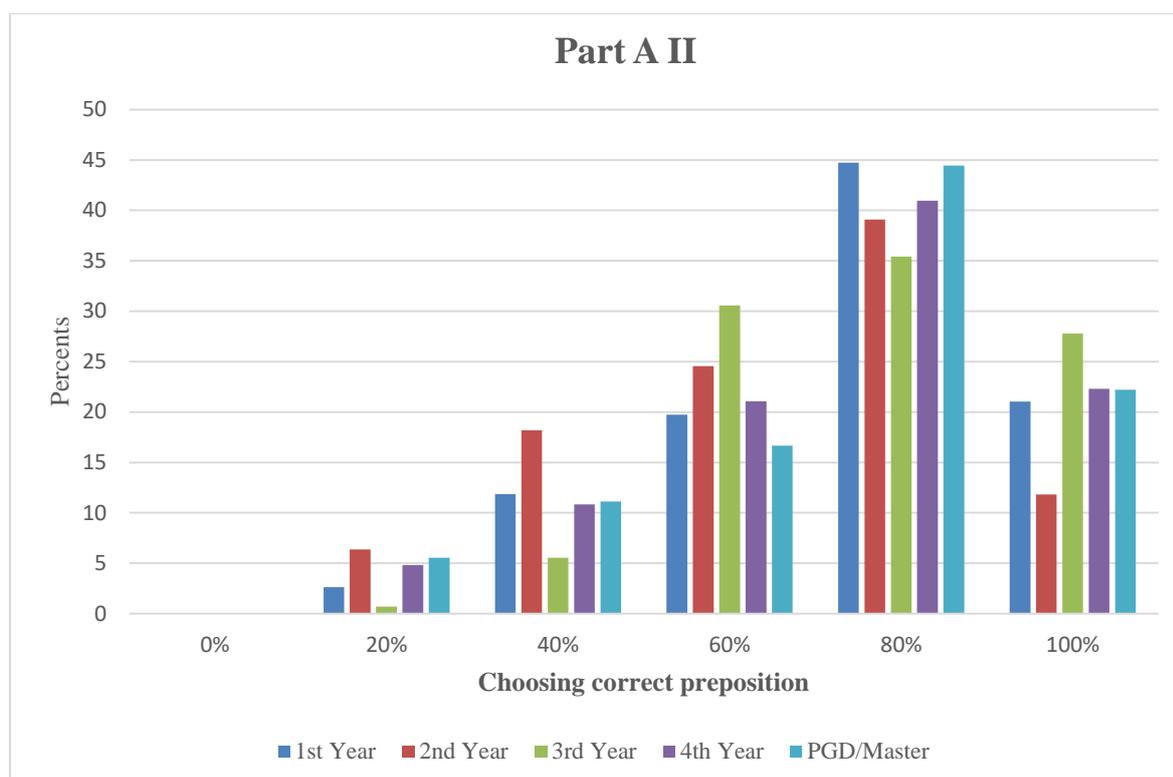
Source : Data

According to the data mentioned above, third year students choose the phrasal verbs most up to all phrasal verbs. In contrast, Master and PGD students' choosing level of phrasal verbs is the least.

In question 2, the students are asked to choose the correct preposition from the lists and there are five items in question 2. The aim of this question is to analyse the students' interest to construct and understand the meaning of the phrasal verbs. The data is shown below.

Table 5.1.2. Choosing correct preposition

No.	Year	0%		20%		40%		60%		80%		100%	
		No	Percent	No	Percent	No	Percent	No	Percent	No	Percent	No	Percent
1	1 st Year	-	0	2	2.63	9	11.84	15	19.74	34	44.74	16	21.05
2	2 nd Year	-	0	7	6.36	20	18.18	27	24.55	43	39.09	13	11.82
3	3 rd Year	-	0	1	0.69	8	5.56	44	30.56	51	35.41	40	27.78
4	4 th year	-	0	8	4.82	18	10.84	35	21.08	68	40.97	37	22.29
5	PGD/Master	-	0	3	5.56	6	11.11	9	16.67	24	44.44	12	22.22

Figure. 5.1.2. Choosing correct preposition

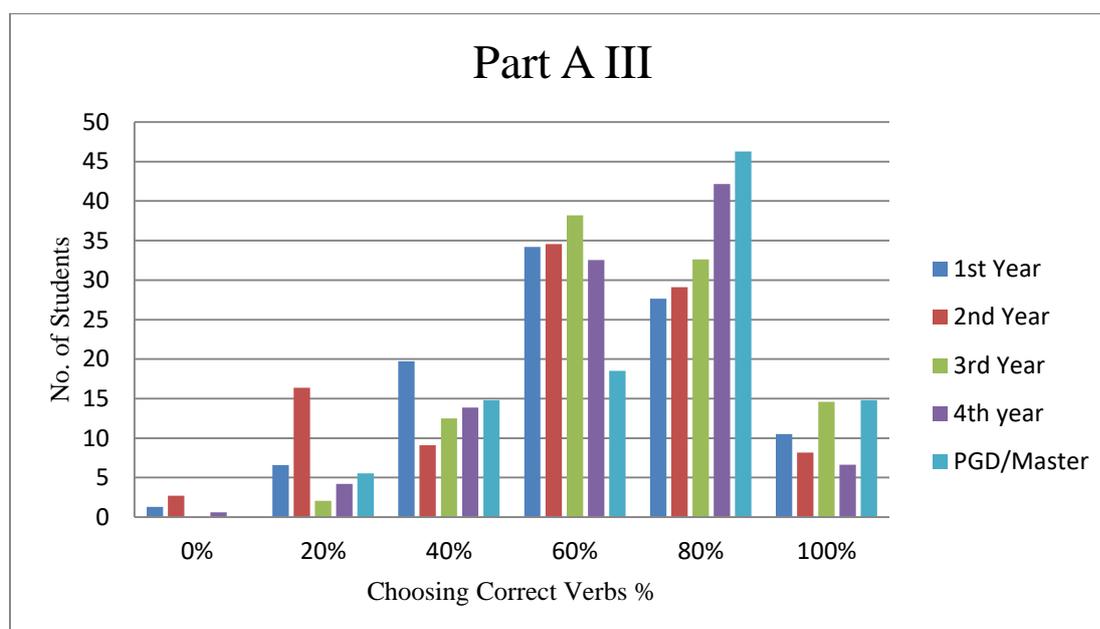
Source : Data

The data shows that the third-year students would do up to the highest level most, and the least number is the second year students. Although the data is not quite different to each other, this shows that the students' interest as well as the experience and practice lead their understanding to choose the correct answer.

In question 3, there are also five items and the aim is to realize how their prior knowledge helps them to know about phrasal verbs. The question is to choose the correct verb to make phrasal verbs. The data is shown below.

Table 5.1.3. Choosing correct verb

No.	Year	0%		20%		40%		60%		80%		100%	
		No	Percent	No	Percent	No	Percent	No	Percent	No	Percent	No	Percent
1	1 st Year	1	1.31	5	6.58	15	19.74	26	34.21	21	27.63	8	10.53
2	2 nd Year	3	2.73	18	16.36	10	9.09	38	34.55	32	29.09	9	8.18
3	3 rd Year	-	0	3	2.08	18	12.5	55	38.19	47	32.64	21	14.59
4	4 th year	1	0.60	7	4.22	23	13.86	54	32.53	70	42.17	11	6.62
5	PGD/Master	0	0	3	5.56	8	14.81	10	18.52	25	46.30	8	14.81

Figure. 5.1.3. Choosing correct verb

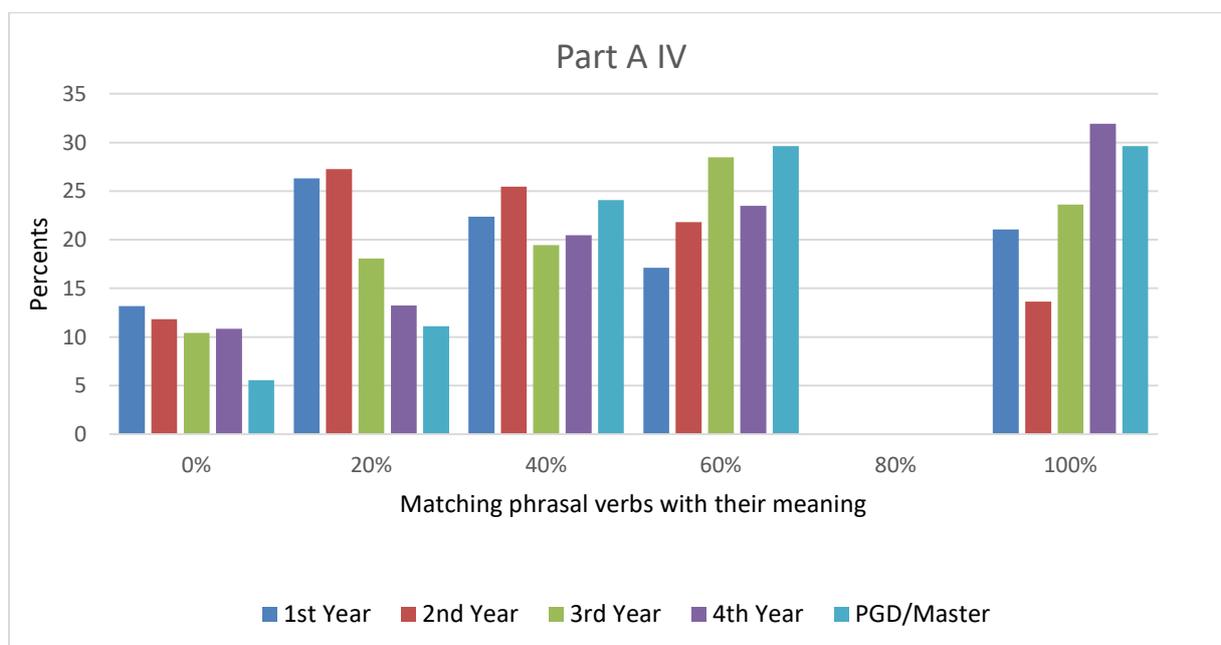
Source : Data

The data shows that Master and PGD students, and third year students could choose the most and second year students could do least.

In question 4, the five items are matching constructed for matching type. The aim of the question is to analyze to what extent students can guess the meaning of the phrasal verbs and how much their learning in their previous academic years and their learning style supports them.

Table 5.1.4. Matching phrasal verbs with their meaning

No.	Year	0%		20%		40%		60%		80%		100%	
		No	Percent	No	Percent	No	Percent	No	Percent	No	Percent	No	Percent
1	1 st Year	10	13.16	20	26.32	17	22.37	3	17.10	-	-	16	21.05
2	2 nd Year	13	11.82	30	27.27	28	25.45	24	21.82	-	-	15	13.64
3	3 rd Year	15	10.42	26	18.06	28	19.44	41	28.47	-	-	34	23.61
4	4 th year	18	10.84	22	13.25	34	20.48	39	23.50	-	-	53	31.93
5	PGD/Master	3	5.56	6	11.11	13	24.07	16	29.63	-	-	16	29.63

Figure 5.1.4. Matching phrasal verbs with their meaning

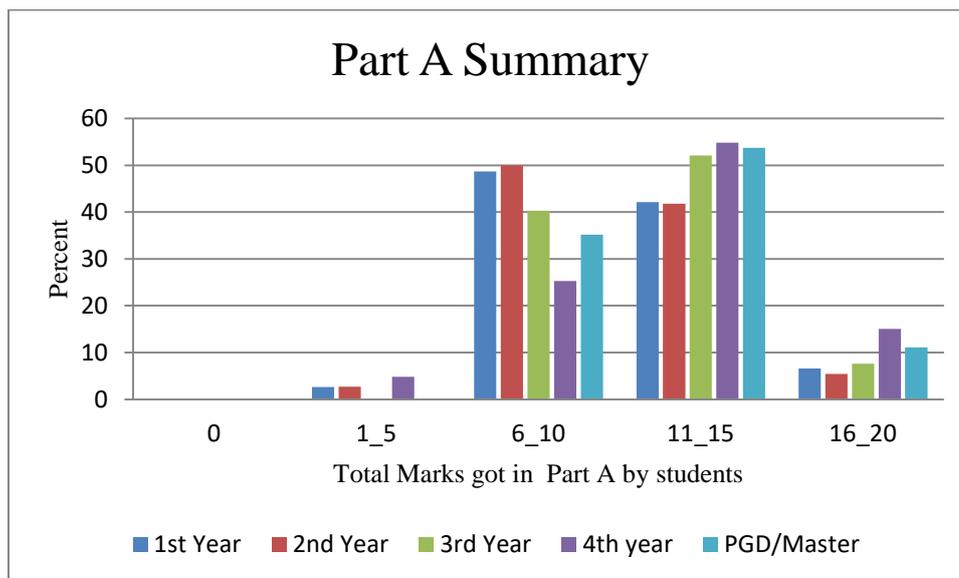
Source : Data

According to the data, the final year undergraduate students are the most who can guess the meaning correctly and the second year students are the least.

After that, the total results for part A is calculated to analyse the actual conditions of the students of to what extent students can deal with the phrasal verbs. The range of the marks is shown below.

Table 5.1.5. Total marks got by the students in Part A

Year	0		1_5		6_10		11_15		16-20	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
1 st Year	-	-	2	2.63	37	48.68	32	42.11	5	6.58
2 nd Year	-	-	3	2.73	55	50.00	46	41.82	6	5.45
3 rd Year	-	-	-	0	58	40.28	75	52.08	11	7.64
4 th year	-	-	8	4.82	42	25.30	91	54.82	25	15.06
PGD/Master	-	-	-	0	19	35.19	29	53.70	6	11.11

Figure 5.1.5. Total mark range got by the students in Part A

Source : Data

Regarding this data, most of the students get the average level (6-10) and even half of the second-year students get this level. The level increases in third year students, final year students and PGD/ Master students, as well. The highest mark level (16-20) mostly occurs in final year students (15.06%) and the least in the second year students (5.45%).

5.2. Data Analysis of Part B

Part B is about the students' experience in learning phrasal verbs, to what extent their prior learning in the previous academic year arouses their interest in phrasal verbs, and what kind of their learning style supports them to be able to answer the questions in Part A. Although there are 17 questions altogether in part B in which 10 are used 5- point Likert scale, 5 are used 4- point Likert scale (Harvard Scale), 1 is an optional question, and the last one is an open ended question. In these, the paper focuses on how learners learn phrasal

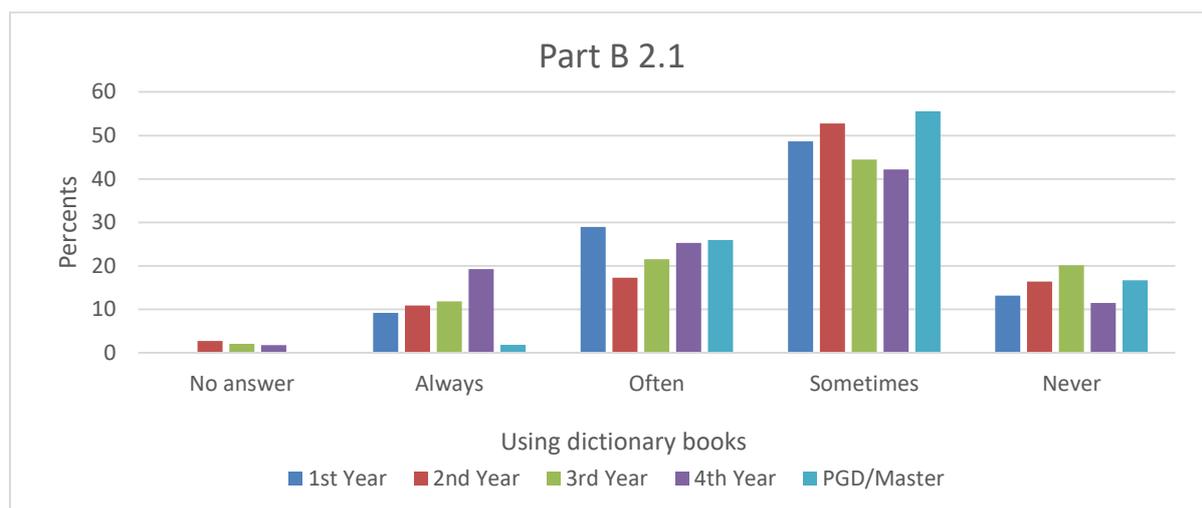
verbs, which ways they used for learning phrasal verbs, and how these ways are benefitted their learning. According to the limitations, the research highlights the most essential parts of analysis, and other parts are described in appendices.

One of the major questions in Part B is whether the students use the dictionary book or not when they check the meaning of the word and how often they use it. The 4-point Likertscale is used for this question and there are very few ‘no answer’ students in some academic year . The data is shown below.

Table 5.2.1. Using dictionary books by students

No	Year	No Answer		Always		Often		Sometimes		Never	
		No	Percent	No	Percent	No	Percent	No	Percent	No	Percent
1	1 st Year	-	-	7	9.21	22	28.95	37	48.68	10	13.16
2	2 nd Year	3	2.73	12	10.91	19	17.27	58	52.73	18	16.36
3	3 rd Year	3	2.08	17	11.81	31	21.53	64	44.44	29	20.14
4	4 th year	3	1.81	32	19.28	42	25.30	70	42.17	19	11.44
5	PGD/Master	0	0	1	1.85	14	25.93	30	55.55	9	16.67

Figure 5.2.1. Using dictionary books by students



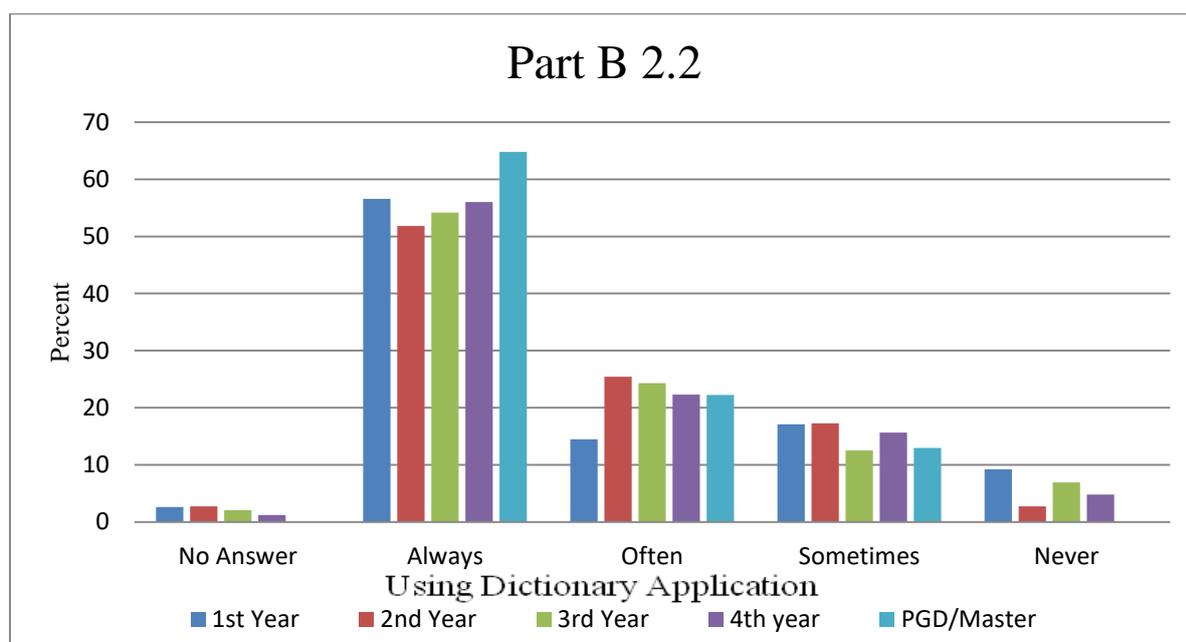
Source : Data

The data shows that the final year undergraduate students use the book most and Master and PGD students use the book least. As the use of the dictionary book supports the learners to be able to check the meaning, the question relates the question IV of Part A.

Another major question is the contrastive one of the question mentioned above, and it is about how many students use the dictionary applications to check the meaning. The question also uses the 4 –pointLikert scale, and also there are still very few ‘no answer’ participants, as well. The data is shown below.

Table 5.2.2. Using dictionary applications by students

No.	Year	No Answer		Always		Often		Sometimes		Never	
		No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
1	1 st Year	2	2.63	43	56.58	11	14.47	13	17.11	7	9.21
2	2 nd Year	3	2.73	57	51.82	28	25.45	19	17.27	3	2.73
3	3 rd Year	3	2.08	78	54.17	35	24.31	18	12.50	10	6.94
4	4 th year	2	1.20	93	56.03	37	22.29	26	15.66	8	4.82
5	PGD/Master	0	0	35	64.82	12	22.22	7	12.96	0	0

Figure 5.2.2. Using dictionary applications by students

Source : Data

The table shows that Master and PGD students use the application most, but the frequency and the number of students is similar to each other in the table. And there are still some students who never use dictionary application to check the meaning.

The next question is the time taken to take the test by the students. According to the data, most of the students took less than 30 minutes to answer the test and very few students took more than 30 minutes.

The last question is whether there is a special way to learn phrasal verbs by the students. For this question, most of the students (60% -80% of students) do not have their own special way to learn phrasal verbs. There are still some 'no answer' participants in every academic year (the percent is up to 7%). Although some students say 'Yes' for this question

(up to 33%), they are actually weak and nearly unmentioned about their own way. It shows the difficulties of learning phrasal verbs.

6. FINDINGS AND DISCUSSIONS

According to the analyses, the following assumptions are found as follows:

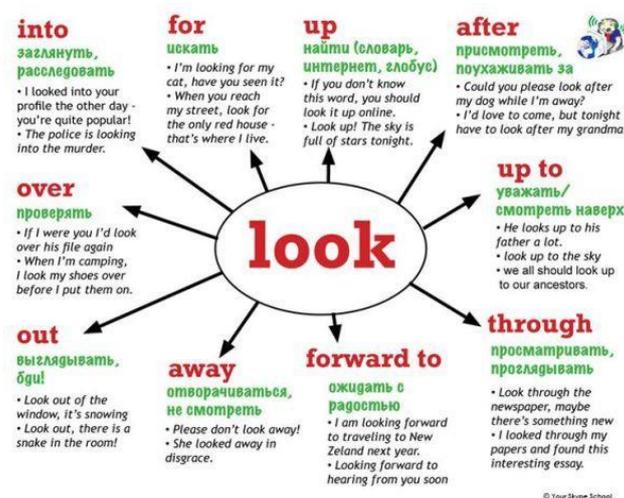
(i) Structure words exercises help the learners improving their language skills. Although the numbers of second year students are the fewest who can choose the correct preposition and get the highest total mark range, it does not mean that they are always weak in phrasal verbs. In this case, it is needed to consider the situations of the students. In our university students started to take specializations in their second year. And as the research was done during their first semester, their emphasis on their specializations may rise rather than that of learning English. So, the research points out that the second year students should be given more practice in their first semester to improve their language skills. This finding meets the hypothesis of the research to and some extent.

(ii) Developing dictionary skill is really applicable for the improvement of English. Unconsciously, first year students use the book dictionary for their language improvement. Third year students' level of English has been risen up again. Final Year students get the highest level most, and this relates to the use of dictionary book. In contrast, PGD/Matser students prefer the applications to the books to search the meaning of the word. This shows that not only the structure word exercise makes the students improve their language skill but also dictionary learning helps the learners to improve their language in their self-learning. For this reason, teaching the learners how to use dictionary skillfully and thoroughly really assists their learning to improve their language skills.

7. SUGGESTIONS OF TEACHING AND LEARNING PHRASAL VERBS

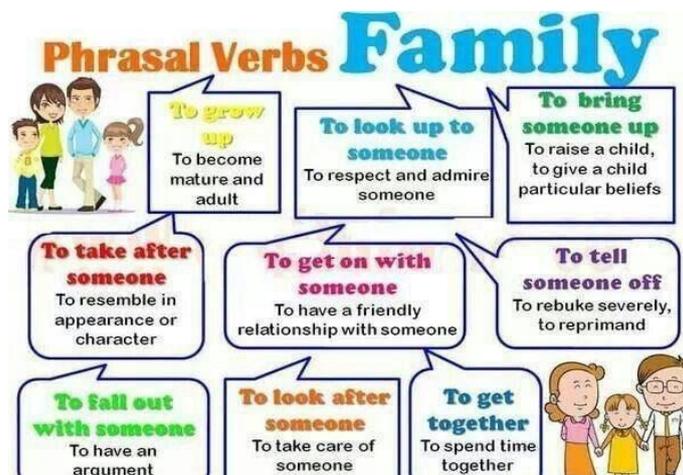
Michael McCarthy, Emeritus Professor of Applied Linguistics in the school of English, University of Nottingham, who wrote *English Phrasal Verbs in Use*, points out that although there are some syllabi or books prescribed for learning and teaching phrasal verbs, teachers should have their own way of engaging students to be familiar with phrasal verbs. Giving some exercises for phrasal verbs can increase the learners' level of understanding phrasal verb. Also, teachers should use phrasal expressions while giving instructions to the class e.g. “**cross out**”, “**Take out**” etc. For learning phrasal verbs, noticing while reading the English texts and noting them down can help the learners memorize the verbs. Reading the

updated newsletter will also make the learner catch the most commonly used and updated verbs. To be able to memorize well, some ways like circling the main verb in the centre and diverging the rays which point out different particles (adverb and/or preposition) mentioning their respective meaning, and collecting as many phrasal verbs concerning with one main verb as the learners can really work. Also, learning phrasal verbs can be made attractive with pictures of the same verb group or some kind of situation, eg. Phrasal verbs used in clothing, phrasal verb used for family. It can be affective for learners to be more interested in and feel free to learn it. Another way is recommended that as particles (preposition, adverb) takes a vital role in phrasal verb, listing the verbs in accordance with the same particles, eg. **take in**, **give in**, **set in**, etc, are also helpful to memorize the phrasal verbs. These are handful suggestions and there can have some other ways for each individual learner to overcome the probable problems concerning this difficulty. Some suggested pictures and diagrams are extracted from the educational websites.



PHRASAL VERBS WITH WORK	
Work on	Shape, form or improve something E.g. John's in the studio <u>working on</u> the plans for the new house.
Work on	Exercise influence on someone E.g. Leave it to me. I'll try to <u>work on</u> the boss to give us the day off.
Work out	Calculate E.g. Can you <u>work out</u> how to get to the university by car?
Work out	Smooth E.g. This is a beta version; we're still <u>working out</u> the kinks.
Work out	Habitually exercise rigorously, especially by lifting weights, in order to increase strength or muscle mass or maintain fitness E.g. Wow, you're looking good! Do you <u>work out</u> ?
Work out	Used other than as an idiom: see work, out E.g. He <u>works out</u> of a small office shared with three others.
Work over	Improve a prototype, or first draft E.g. The estimated figures are not bad, but somebody will have to <u>work them over</u> .
Work over	Physically attack in order to cause injury E.g. He'll talk, once we <u>work him over</u> .
Work up	Raise; to excite; to stir up E.g. He <u>worked up</u> the public's passions to rage.
Work up	Develop E.g. I shall have <u>worked up</u> an appetite with all this heavy work.

Phrasal Verbs - GET



Sources :Internet

8. CONCLUSION

Almost all the students have the desire to improve their English, but they encounter difficulties in their path of learning English. In a teaching process, students are found that they have difficulty to know the meaning of phrasal verbs and as a consequence, they have disturbance to translate the meaning. To check the meaning, their dictionary skills are not enough for them to know what the word means. Some students still don't know about the phrasal verbs. So, phrasal verb is a difficult part for the English learners to improve their language skill. According to Michael Mc Cathy, Phrasal verb is an informal version of more formal expression. And, as long as everyone is in touch with English language, phrasal verb is an unavoidable process. So, as a learner, it is possible to avoid using phrasal verb by himself, but in contrast, it is impossible to deal with phrasal verbs. That is why the learners should be aware of phrasal verb while learning English language. Being able to distinguish the types of verbs whether they are transitive or intransitive is also crucial in learning phrasal

verbs. For that reason, learners should be trained to be able to distinguish these types of verbs. If they are really weak in classifying these types, they can find difficulty not only in learning phrasal verbs but also in developing their language skills, especially their output skills of speaking and writing. Therefore, further research is encouraged to analyze the student's knowledge and distinguishing these types of verbs. Moreover, as this research is analysed on overall students of Co-operative University, Thanlyin, further research is insisted to be done on students of individual academic year to have a more precise data and to analyse some other conditions of the students about their learning on phrasal verbs.

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ANALYSIS OF FOOD SAFETY KNOWLEDGE, ATTITUDE AND PRACTICES IN HLEDAN AND KYIMYINDINE NIGHT BIZAAR

Mu Mu Swe¹

Abstract

Food Safety is a practice that preserves the quality of food to prevent contamination & food borne illnesses. It is essential to ensure the nourishment we eat is not defiled with likely hurtful microscopic organism, poisons, and synthetic substances. Food can get contaminated at any period of time during production, preparation and distribution. Everyone plays a role to ensure that the food we eat does not cause any diseases. This study examined the food safety knowledge of street vendors and food safety practices followed by street vendors from selected two markets in Yangon. A total of 100 street vendors from two markets responded the questionnaires. The questionnaire includes a total of 54 questions in six subgroup such as cooking utensils, food safety knowledge, food preparation, food storage, personal hygiene, food handling and serving, demographic characteristic of vendors. Descriptive analysis based on primary data is conducted on the street food vendors' awareness, attitude and practices of food safety and independent sample t test is also used for comparing the two markets food safety practices and knowledge. It was found that street food vendors from Hledan Market have the better knowledge while vendor's from Kyimyindine night bazaar have lower level of understanding food safety. Personal hygiene and food handling practices of street food vendors' from both markets are very low even though they have better understanding on food safety. And majority of respondent food sellers were found weak to comply the particularly personal hygiene and food handling practices due to lack of food safety training provided by the authority concerned and lack of knowledge. Due to lack of providing educational food safety training and periodic monitoring by the almost no necessary actions have been authority concerned, apparently street food vendors' awareness is likely to be weak and taken regarding unsafe food.

Key words: Food Safety, Food Safety Knowledge, Food Preparation, Storage, Personal hygiene, food awareness, descriptive analysis, independent sample t test

1. INTRODUCTION

Road nourishment is prepared to eat nourishment or drink sold by a seller, or merchant, in a road or other open spot. It is regularly sold from a convenient nourishment stall, nourishment truck, and implied for quick utilization.

Road nourishment distributing offers financial advantages to sellers and nutritious nourishment for urban shoppers, particularly in creating nations. Yangon is the biggest city of Myanmar like the other cities in the world, street food is in vital role for the people who have rare time to cook have to opt street food. There are varieties of street food which offer including mohinga, fries, glutinous rice, stick pork, grilled fish, pickled tea leaf salad, traditional Myanmar snacks, fried chicken, cold drinks, ice cream, varieties of salad and many other appetizers.

In Myanmar, the Yangon City Development Council (YCDC) is principally liable for controlling nourishment slow down. However, food control system is significantly weak and can rarely be seen. Right now, circumstance forestalled the chance to teach sellers. Absence of accessibility of clean water sources and self-revealed sanitation information shortcoming

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are two primary requirements in rehearsing appropriate dealing with rehearse among other arrangement.

As most of the street foods are home-made and cheaper, low investment compares to restaurants or supermarkets but it makes financial benefits to the vendors and on the other hand many people are able to effort. People consume daily basis due to low cost and easiness of access. Unless the street food vendors have the basic knowledge of what the safe food are, how to prepare the safe food, consumers will suffer the health problem even for long term. Consequently, eating unsafe food may head to the hazard to the health of consumers such as food poisoning, diarrheas, hepatitis. There is no lack of clients getting a charge out of the determination, yet customer advocates state upwards of 80 percent of road nourishment slows down in Yangon don't fulfill fundamental cleanliness guidelines.

Nourishment cleanliness in Yangon is low, despite the fact that new government is endeavoring to improve existing models. One of the high-chance nourishments in Yangon is road nourishment. Techniques for cleaning, stockpiling, arrangement and serving, are altogether a long way behind universally wellbeing measures contrast with the neighbor ASEAN nations.

Therefore, this study includes finding the awareness of safe food of street food vendors. And it also seeks the compliance of safe food preparing and personal hygiene, utilization of sanitary facilities, selling by the vendors.

1.1 Objectives of the study

The objectives of this study are as follows;

- (i) to examine the vendors' knowledge and attitude to food that effects food safety and health problem
- (ii) to search how the street food vendors' practices on the food preparation, food handling and serving in two studies market.

1.2 Method of study

This study is based on the primary data conducted by survey from two selected markets which are Hledan Market in Kamayut Township and Kyimyindine Night Bazaar in Kyimyindine Township. As a sampling method, simple random sampling method was used to select the sampled respondents. A total of 100 food vendors were interviewed. And 50 street vendors from each market responded the questionnaires. This study focused on knowledge, awareness and practices of street food safety from supply side. Customer's point of view was not approached in this study. The study utilized the following statistical tools:

1. Descriptive Analysis
2. Kolmogorov-Smirnov test to check if the data is distributed normal
3. Levene's test to use homogeneity (the variances in the two groups must be similar)
4. Independent Samples t Test procedure to test if there is a difference in a measured characteristic between two population (assumption of homogeneity is met)
5. Welch's test procedure to test if there is a difference in a measured characteristic between two population (assumption of homogeneity is not met, and skewness values are both same sign)

The vendor respondents were requested to participate in surveys with the structured questionnaires. The secondary data were collected from Food and Drug Administration and World Health Organization (WHO).

2. LITERATURE REVIEW

2.1 Food Safety and Foodborne Diseases

Sanitation is a logical control depicting taking care of, arrangement, and capacity of nourishment in manners that nourishment borne sickness. This incorporates various schedules that ought to be followed to keep away from conceivably cut off wellbeing risks. Right now wellbeing frequently covers with nourishment safeguard to forestall damage to buyers. The tracks inside this line of thought are security among industry and the market and afterward between the market and the shopper. In thinking about industry to advertise rehearses, sanitation contemplations incorporate the birthplaces of nourishment including the works on identifying with nourishment naming, nourishment cleanliness, nourishment added substances and pesticide buildups, just as arrangements on biotechnology and nourishment and rules for the administration of legislative import and fare assessment and accreditation frameworks for food sources. In considering business sector to shopper rehearses, the typical however is that nourishment should be protected in the market and the worry sheltered conveyance and planning of the nourishment for the purchaser.

Good food hygiene is all about controlling harmful bacteria, which can cause serious illness. The four main things to consider for food hygiene's are cross contamination, cleaning, chilling and cooking. (Food Standard Agency 2014).

2.2 The Burden of Foodborne Disease

The encumbrance of food-borne malady to general wellbeing and welfare and to economy has regularly been belittled due to under revealing and trouble to build up causal connections between nourishment sully and coming about disease or demise.

The general wellbeing and welfare and to economy has frequently been little on the gauge of the worldwide weight of food borne infection introduced the first-historically speaking evaluations of sickness trouble brought about by 31 food borne operators (microbes, infections, parasites, toxins and synthetic compounds) at worldwide and territorial level.

Foodborne diseases (FBD) are highly visible such as outbreaks, contamination, events but true burden invisible. FBD causes extensive bleakness and mortality. FBD are perplexing: various risks, various wellbeing results, impacts on various time scales. Food is not the only transmission pathway of many food-related hazards Norvirus, but *Campylobacter* spp causes most frequent globally foodborne illnesses.

A Global finding, annually, 1 out of 10 people in the world suffer from food borne disease. Diarrheal diseases are the most common cause of illness (550 million cases) and death (230000 deaths). WHO has launched the most comprehensive estimates of the global burden of food borne disease to date. These address the lack of data to support food safety policy making. Priority hazards differ between regions Control methods do exist for many hazards, and are linked to economic development and effective food safety system (WHO,

2017). The following Table is global burden of food borne disease in 2015 estimated by WHO.

Table (2.1) Global Burden of Foodborne Disease 2015

Hazard Group	Foodborne illnesses (millions)	Foodborne deaths (thousands)	Foodborne DALYs (millions)
All	600	420	33
Diarrheal	549	230	18
Invasive	36	117	8
Helminths	13	45	6
Chemicals	0.2	19	0.9

Source: WHO 2015

2.3 Consequences of Unsafe Foods

The right to food is not a new concept and was first recognized in the UN Declaration of Human Rights in 1948. In 1996, the conventional appropriation of the privilege to Adequate Food denoted an achievement accomplishment by World Food Summit Delegates. It pointed the route towards the probability of a privilege based way to deal with nourishment security. In 2004, more than 40 countries practice different nourishment revered in their constitution of FAO gauge that the privilege to nourishment could be legal in somewhere in the range of 54 nations. Nowadays, different countries practice various food safety measures in line with WHO and FAO scheme and corresponding to the condition of respective countries.

The effects of unsafe food are numerous such as food poisonings, fever, headache, nausea, vomiting, abdominal pain and diarrhea, Listeria infection, Vibrio cholera, Antimicrobial, Parasites. Beside, five deadliest types of foodborne bacteria are Listeria, E. Coli, Salmonella, Staph Bacteria and Hepatitis A. (Archana Mishra, March 2017).

2.4 Important Factor of Food Safety

There are numerous components which nourishment preparing organizations need to consider while guaranteeing sanitation for sellers. Holding fast to the fundamental sanitation gauges and guidelines can help forestall episodes of nourishment borne sickness. (Rentokil 2016). The following are 10 important factors to focus to food safety. There are facilities, location and design, machinery and production line design, Pest Control, waste management, cleaning, maintenance, personal hygiene, environmental hygiene, correct handling, storage and transport, and staff training.

2.5 Review of Previous Studies

Chit Ko (2015) studied the current condition of food safety awareness and measure taken by selected in Yangon city in 2015. The main aim of the study is to identify the current condition of food safety practices, knowledge and awareness in two selected high school from urban area and two high school in suburban area were compared their efforts on food safety awareness. Descriptive analysis based on primary data is made on awareness of sellers and students. This study showed that schools from urban area have better awareness and efforts towards food safety in school canteens while school from suburban areas have low level of practices even though they have better understanding on food safety.

Tran Ngoc Cam (2015) conducted survey to investigate the food safety situation in certain districts in Ho Chi Minh city, Vietnam in 2014. The study has the major objective of analyzing the safety street foods vended in Ho Chi Minh city and factor contribution to the safety. The study conducted surveys to investigate the food safety knowledge and attitudes of vendors and consumers of street foods in Ho Chi Minh City of Vietnam. The food handling and hygiene practices of the vendors were also evaluated in this study. In addition, an assessment of the microbiological quality of certain street food was also performance.

The study showed the surveyed consumers had adequate knowledge and attitudes on food safety, the street food vendors had a poor understanding of food safety which was reflected in their unhygienic practices during preparation and vending of the food. The results also showed the most of street vendors had a low educational level and did not have any formal food safety training which contributed to the unsafe condition under which the foods are vended. In addition, the study highlighted the present some pathogenic bacteria in the samples collected in those areas. Regarding the nutritional aspects, the average energy value of the selected streets foods was evaluated and it was determined that those street foods considered as major's dishes contribute a significant amount of the average energy requirement of Vietnamese men and women.

Nurudeen, Lawal, and Ajayidid (2014) a survey examining general hygiene and sanitary practices of street food vendors in Nigeria. 110 random sample of street food vendors were selected to represent 18% of street food vendors in the study area 2014. Data was collected using pre-test structured questionnaire and observation checklists. The relationships in the factors studied were determined. Food vendors lacked basic training on hygiene. The study indicated absence of evidence of relationship between vendor's education and vending location as well as between gender and personal hygiene. The non-regulation of street food vending business in Africa especially Nigeria portends danger of outbreak of food poisoning.

3. DEMOGRAPHIC CHARACTERISTICS OF VENDOR

This section covers the demographic and background characterized of vendors from two selected markets. In this section, data on demographic characteristic and background characteristics such as gender, Age, Education, Shop type and food type are presented based on survey data 2017.

3.1 Hledan Market

Hledan market is a most famous and most ancient among any other markets in Yangon. Due to its easily accessible location, this area is the one of the busiest places in Yangon and so shops particularly several cuisine food businesses is booming with road side food shops around Hledan market. Hundreds of food stalls set up each day in the surrounding streets (6–11am & 3–11pm). And closed at 6:30 pm. However, street food shops continue selling till 10pm. The demographic and background characteristic of Haldane market are shown in Table (3.1).

According to the Table (3.1), out of 50 street vendors, female vendors share 42% while male vendors share 58%. Therefore, most of the street vendors in Hledan Market are male vendors. Majority of the age group of vendors are in the age group 31-40 with 38% of the total sampled of Hledan Market while lowest number of vendors under age between 18-20 with only 2% in Hledan Market.

Regarding the education, the majority of vendors in Hledan Market have high school or middle school education with 84% of the total sampled vendor in Hledan market. Additionally, it is found the only two graduated and there is no illiterate person also street vendor in Hledan market. It is learnt that graduates rarely become street vendors and they might opt the salary earner based on their profession as well as their higher education instead.

Most of the vendors also use the wooden shop with roof for selling street food and a few numbers of vendors use the aluminium due to save the cost of shop in this market while only one vendor has other type of shop for selling fried chickpea in Hledan market. Among the variety of food type, food prepared on the street is majority of vendors and foods prepared on the streets are also high numbers due to the market demand.

Table (3.1) Demographic Characteristics of Vendors in Hledan Market

Sr.No	Characteristics of Respondents	No. of Respondents	Percentage (%)
1	<u>Gender</u>		
	Male	29	58
	Female	21	42
Total		50	100
2	<u>Age</u>		
	18 – 20 years	1	2
	21 – 30 years	9	18
	31 – 40 years	19	38
	41 – 50 years	13	26
	51 – 60 years	8	16
Total		50	100
3	<u>Education Level</u>		
	Graduate	2	4
	Undergraduate	1	2
	High School	18	36
	Middle School	24	48
	Primary School	5	10
	Illiterate	0	0
	Total		50
4	<u>Food Type</u>		
	Packaged food/ cooked food	6	12
	Cooked food	11	22
	Food prepared on the street	16	32
	Beverage	5	10
	Grilled	12	24
Total		50	100
5	<u>Shop Type</u>		
	Aluminum	1	2
	Wheel cart (roof)	15	30
	Wheel cart (no roof)	1	2
	Wooden (roof)	22	44
	Wooden (no roof)	7	14
	Other	4	8
Total		50	100

Source: Survey Data 2019

3.2 Kyimyindine Night Bazaar

It is located in Kyimyindine Township between Lower Kyimyindine road and strand road. It is famous among Yangon's local as night market (n ya Zay). many locals come to this market for kitchen needs, other electronic products, fabric material, cosmetics products and medicine needs. And there are also food shops with several tastes are available outside of the market the whole day. Even though it is called night market, it starts at 10 am till 10 pm. The demographic and background characteristic of Kyimyindine Night bazaar are shown in Table (3.2).

According to the Table (3.2), out of 50 street vendors, female vendors share 52% while male vendors share 48%. Therefore, most of the street vendors in Kyimyindine Night Bazaar are female vendors. Majority of the age group of vendors are in the age group 41-50 with 38% of the total sampled of Kyimyindine Night Bazaar while lowest number of vendors underage between 21-30 with only 2% in Kyimyindine Night Bazaar. Additionally, it was found that there is no one in the age group of 18-20 in Kyimyindine Night Bazaar. Regarding the education, equal number of vendors has high school or middle school education and it is found the only one graduate and an illiterate person also street vendor. It is learnt that graduates rarely become street vendors and they might opt the salary earner based on their profession as well as their higher education instead.

Most of the vendors also use the wooden shop with roof for selling street food and a few numbers of vendors use the aluminium due to save the cost of shop in this market while only one vendor has other type of shop for selling fried chickpea. Among the variety of food type, food prepared on the street is majority of vendors and grilled shops are also high numbers due to the market demand.

Table (3.2) Demographic Characteristics of Vendors in Kyimyindine Night Bazaar

Sr.	Characteristics of Respondents	No. of Respondents	Percentage (%)
1	<u>Gender</u>		
	Male	24	48
	Female	26	52
Total		50	100
2	<u>Age</u>		
	18 – 20 years	0	0
	21 – 30 years	1	2
	31 – 40 years	17	34
	41 – 50 years	19	38
	51 – 60 years	13	26
Total		50	100
3	<u>Education</u>		
	Graduate	1	2
	Under Graduate	1	2
	High School	19	38
	Middle School	19	38
	Primary School	9	18
	Illiterate	1	2
Total		50	100

4	Food Type		
	Packaged food/ cooked food	15	30
	Readymade food/ cooked food	22	44
	Food prepared on the street	7	14
	Packaged food	4	8
	Grilled	2	4
Total		50	100
5	Shop Type		
	Aluminum	1	2
	Wheel cart (roof)	1	2
	Wheel cart (no roof)	19	38
	Wooden (roof)	19	38
	Wooden (no roof)	9	18
	Other	1	2
Total		50	100

Source: Survey Data 2019

4. DATA RELIABILITY

In this study, most variables are measured by Likert scale. Therefore, qualitative variables is used, it should be checked their reliability of each dimension. Cronbach's alpha is a measure used to assess the reliability, or internal consistency, of a set of scale or test items. In other words, the reliability of any given measurement refers to the extent to which it is a consistent measure of a concept, and Cronbach's alpha is one way of measuring the strength of that consistency. Cronbach's alpha is computed by correlating the score for each scale item with the total score for each observation (usually individual survey respondents or test takers), and then comparing that to the variance for all individual item scores:

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum_{i=1}^k \sigma_{y_i}^2}{\sigma_x^2} \right)$$

Where : k refers to the number of scale items

$\sigma_{y_i}^2$ refers to the variance associated with item i

σ_x^2 refers to the variance associated with the observed total scores

The resulting α coefficient of reliability ranges from 0 to 1 in providing this overall assessment of a measure's reliability. If all of the scale items are entirely independent from one another, then $\alpha = 0$; and, if all of the items have high covariance, then α will approach 1 as the number of items in the scale approaches infinity. In other words, the higher the α coefficient, the more the items have shared covariance and probably measure the same underlying concept. Although the standards for what makes a "good" α coefficient are entirely arbitrary and depend on your theoretical knowledge of the scale in question, many methodologists recommend a minimum α coefficient between 0.65 and 0.8 (or higher in many cases); α coefficients that are less than 0.5 are usually unacceptable, especially for scales purporting to be unidimensional. (Chelsea Goforth, 2015)

Table (4.1) Results of Cronbach's Alpha Value

Scale	Type of Scale	No. of Items	Cronbach's Alpha
Cooking Utensils	5-point Likert	7	.756
Food Safety Knowledge	5-point Likert	20	.887
Food Preparation Knowledge	5-point Likert	5	.774
Food Storage Knowledge	5-point Likert	4	.791
Personal Hygiene Knowledge	5-point Likert	5	.807
Food Handling and Serving	5-point Likert	13	.995

Source: Survey Results, 2019

† he results of the Cronbach's alpha value above 0.6, suggesting very good internal consistency and reliability for the scale with this sample. †n the above † able, Cronbach's alpha for all scale dimension are range between 0.756 to 0.995, which indicates a high level of internal consistency for studies scale with this specific sample.

4.1 Descriptive Statistics for Each Dimension

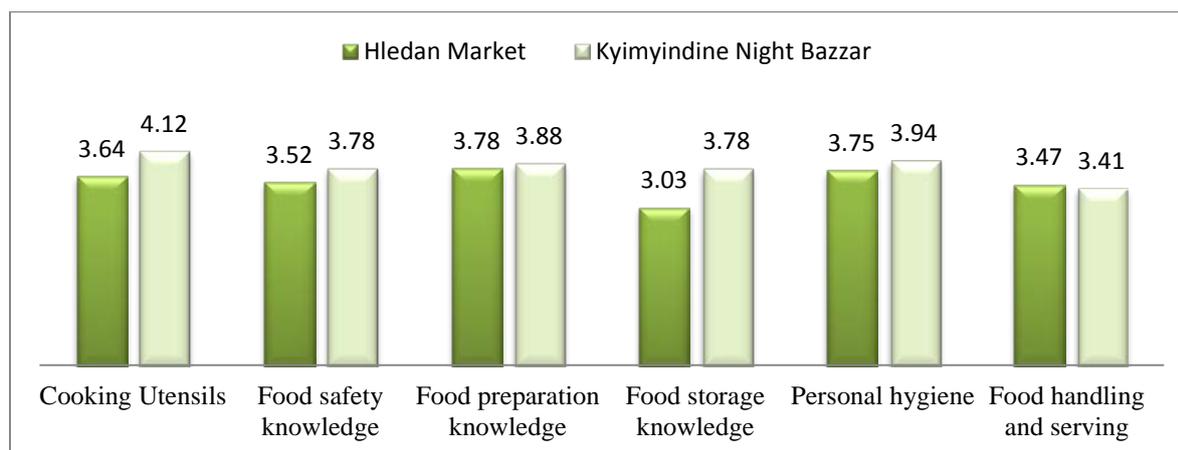
Measurement is referring to the assignment of numbers to objects or event systematically. The four levels of measurement scales are nominal, ordinal, interval and ratio. In this section, interval scale measurement is employed to measure each dimension to determine the vendor's food safety knowledge. ā ll the variables are measured via five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The students were asked to rate on the statements that describe their saving behavior. A higher scale demonstrates that the vendor practices are effective on their food safety knowledge and vice versa.

Table (4.2) Results of Overall Mean and Standard Deviation for Each Dimension

Variable	Hledan Market		Kyimyindine Night Bazaar	
	Mean	Std. Dev	Mean	Std. Dev
Cooking Utensils	3.64	.835	4.12	.434
Food safety knowledge	3.52	.701	3.78	.567
Food preparation knowledge	3.78	.783	3.88	.856
Food storage knowledge	3.03	.831	3.78	.968
Personal hygiene	3.75	.976	3.94	.843
Food handling and serving	3.47	1.08	3.41	1.14

Source: Survey Result, 2019

The average score of *Food Preparation Knowledge* is 3.78 which the highest scores as compare to other factors in Hledan Market. The average score of *Cooking Utensils* is 4.12 which the highest scores as compare to other factors in Kyimyindine Night Bazaar. The comparative analysis for each dimension knowledge of food safety in Hledan market and Kyimyindine Night Bazaar are shown in following Diagram.

Figure (4.1) Comparison of Each Type of Food Safety Knowledge

Source: Survey Result, 2019

4.2 Independent Sample t -Test

Firstly, independent sample t-test required the data to be distributed normal. Two test procedures are available to test if the data is distributed normal: Shapiro-Wilk test and Kolmogorov-Smirnov test. Usually, the Shapiro-Wilk test is used when the sample size is small, generally less than 50. Table (4.2) shows the test for normality by using Kolmogorov-Smirnov test.

Table (4.3) Normality Test of Food Safety Knowledge

Types of Food Safety Knowledge	Kolmogorov-Smirnov Test		
	Statistic	df	Sig.
Cooking Utensils	.156	650	.200*
Food Safety	.143	620	.200*
Food Preparation	.077	650	.200*
Food Storage	.069	620	.200*
Personal Hygiene	.107	650	.200*
Food Handling and Serving	.101	620	.200*

Source: Survey Result, 2019 (* Significant at 5% level)

In Table (4.2), p values of the all tests are 0.200 which are greater than 0.05. Therefore, it can be concluded that normality can be assumed for those data set and provided t test assumption are satisfied; a parametric t test can be used.

Table (4.3) presented the “t” value for comparison of each dimension of knowledge between Hledan and Kyimyindine Night Bazaar. The p value of the Levene’s test for equality of variance more than 0.05 for all studied. Hence, the assumption of equality of variances is met. Therefore, for the test of equality of means, the statistics in the equal variance assumed will be used. The two tailed p value of the test for cooking utensils, food safety knowledge, food storage knowledge is less than 0.05 that is 5% level of significance. Thus, it was found that there was significant difference between Hledan and Kyimyindine Night Bazaar at the

5% level of significance. According to the Table (4.3), knowledge for food preparation, personal hygiene, and food handling and serving are not significant difference between Hledan and Kyimyindine Night Bazaar since the p value of the test is greater than 0.05 level of significant.

Table (4.4) Independent Sample t Test for Comparison of Each Food Safely Knowledge

Variable	Levene's Test for Equality of Variance		Independent Samples Test	
	F	Sig.	t	Sig(2-tailed)
Cooking Utensils	20.7	.452	-3.58	.001**
Food safety knowledge	5.55	.221	-2.07	.041*
Food preparation knowledge	.530	.469	-.585	.561
Food storage knowledge	2.65	.107	-4.12	.000**
Personal hygiene	5.22	.124	-1.07	.285
Food handling and serving	.707	.403	.324	.746

Source: Survey Result, 2019

**Significant at 1% level

*Significant at 5% level

5. CONCLUSION

This study achieved the main objectives of assessment of food safety knowledge and attitudes as well as food handling practices of food vendors in the selected tow markets in Yangon city. The survey results show that the knowledge and attitude on food safety the street food vendors had a poor understanding of food safety which was reflected in their unhygienic practices during the preparation and vending of the foods and weak in compliance of disciplines issued by YCDC. The results show that most of street vendors have a low education level and do not have any formal food safety training. It is learnt that lack of food safety knowledge by street food vendors from both selected markets particularly regarding health knowledge resulting less compliance of food safety practices. It is also inadequate knowledge of proper food storages in both selected markets. Access to portable water is not easy enough for vendors in both market places.

Although it is important the personal hygiene of food sellers and food handlers, according to the respondents, it shows that the knowledge of personal hygiene extremely low. Additionally, government should pay more attention on build standardized infrastructures for street food sectors such as portable water, toilets and waste disposal facilities at the vending sites so that the risks of cross contamination can be minimized. As a result, most of the vendors surveyed possessed a good knowledge of health and personal hygiene, although there is a need to put their knowledge into practice. To support this, authority-supported awareness raising training programs and periodic monitoring should be introduced to street food vendors in Yangon.

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A GEOGRAPHICAL ASSESSMENT OF ECONOMIC ACTIVITIES IN THANLYIN TOWNSHIP

Yupar Nyunt¹

Abstract

This research paper is entitled “A Geographical Assessment of Economic Activities in Thanlyin Township”, Thanlyin Township is one of the townships included in the Southern District parts of the Yangon region. Although, the study area is including in Yangon region, it composes rural area and urban area. According to Urbanization, rural population is 189820 (70%) persons, urban population is 83223 (30%) persons and total population is 273043 persons of the study area. The area of township is 92149 acres (372.9 sq. kilometers) and it is made up of 28 village tracts and 17 wards. The shape of township is compact, a titled ‘J’ shape. The local economic development is concerned directly on affluence and advance of economic activities of this region. So, this paper is mainly focused on economic activities of Thanlyin Township from a geographical point of view. The study are of economic activities including many kinds of section is based on physical situation and condition of population distribution. Investigation of field data, the kind of economic activities identified four types of activities by each detail. Finally, using field survey and application of GIS, this paper focus and assessment on the various economic activities in Thanlyin Township.

Keywords: Economic Activities, Physical Situation

1. INTRODUCTION

This thesis studied “A Geographical Assessment of Economic Activites in Thanlyin Township”. Thanlyin Township possesses better economic and social situation, health facilities, transportation and communication than other townships in Southern District in Yangon. The economic activities of Thanlyin Township are grouped by four main types. Most of the people in Thanlyin Township are engaged in agriculture. Primary raw materials are directly obtained from within the area, while so some of the secondary economic activities can easily be expanded. Tertiary sector provided to the urban dwellers as well as commercial and local market development. Quaternary sector considers three parts; education, services and public transportation. Economic activities might provide some insights on the understanding of distribution for many dwellers of study area. Traditionally, agriculture has become the dominant economic activity of Thanlyin Township. After the State Government has practiced open market oriented economic system, rapid changes occurred in various economic activities. As the regional development plans were

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implemented as a state policy, infrastructure development was effectively carried out in Thanlyin Township. The local population can hold new job opportunities and the income of the rural population increased. The booming economic condition of the people reflected in every area of the township and urban-rural development can be clearly seen in Thanlyin Township.

1.1 Research Questions

- What the local products provide the local market in Thanlyin Township?
- Where are the commercial and tertiary activities concentrated in Thanlyin Township?
- How can economic activities provide local area to promote socio-economic, with the study of economic activities in Thanlyin Township?

1.2 Aim and Objectives

The main of this paper is to study geographical point of view of the condition of economic activities in Thanlyin Townhsip. The objectives of this paper are –

- (1) to express the relationship between physical phenomena and demographic factor.
- (2) to examine the condition of economic activities of the study area.
- (3) to assessment the development of economic activities in current situation of study area.

1.3 Literature Review

There are relatively few articles included in this paper, concerned with the concept of the economic activities. The term economic activities is sometimes used to refer to the internal structure of cities but more correctly refers to number (or kinds) of cities in a defined territory (Ronald Hill, 2002).

The articles from the early 1990s analyzed to the problems of the socialist urban structure and presented for visions of post-socialist era. It focused on the relatively complex intra-urban geography, such as physical, functional, housing or social spatial structure of cities and their near hinterland, including process, development, planning and management aspects.

The arrangement of functional areas in cities was mostly rigorous and that particularly mono-functional areas were planned. Industrial areas had a greater range. Smaller areas were designated for services for residents. Since the mid-1990s the functional-spatial arrangement of cities (economic sectors) was relatively quickly transformed. This is due to the processes of commercialization, deindustrialization, auto mobilization and construction of super and

hypermarkets, followed by revitalization of industrial, railway within cities. (Kubes, p-23, 2013)

1.4 Data Collection and Methodology

Primary data is based on commercial, tertiary activities and governmental offices, those are derived from the field observation between the year 2014 and 2019. Based on these statistics (location of shops/ government department and offices) are conducted to get information and analysis for those activities and arrangement of public buildings (public and institutions). It is concerned with the degree of spatial concentration of economic activities how they are concentrated near a local business area of township or on the main road.

Secondary data is obtained from the Township Administrative Office, Thanlyin Town, it consists of ward areas, population data, town characteristics as well as from the concerned department and libraries. Available data and facts are calculated, tabulated and employed for the application of GIS. To show spatial distribution and concentration of particular economic activities, mean center of are calculated by Arc GIS 10.1. Finally, mapping and analytical study are illustrated for this study.

2. GEOGRAPHICAL BACKGROUND

2.1 Location, Size, Shape and Boundary

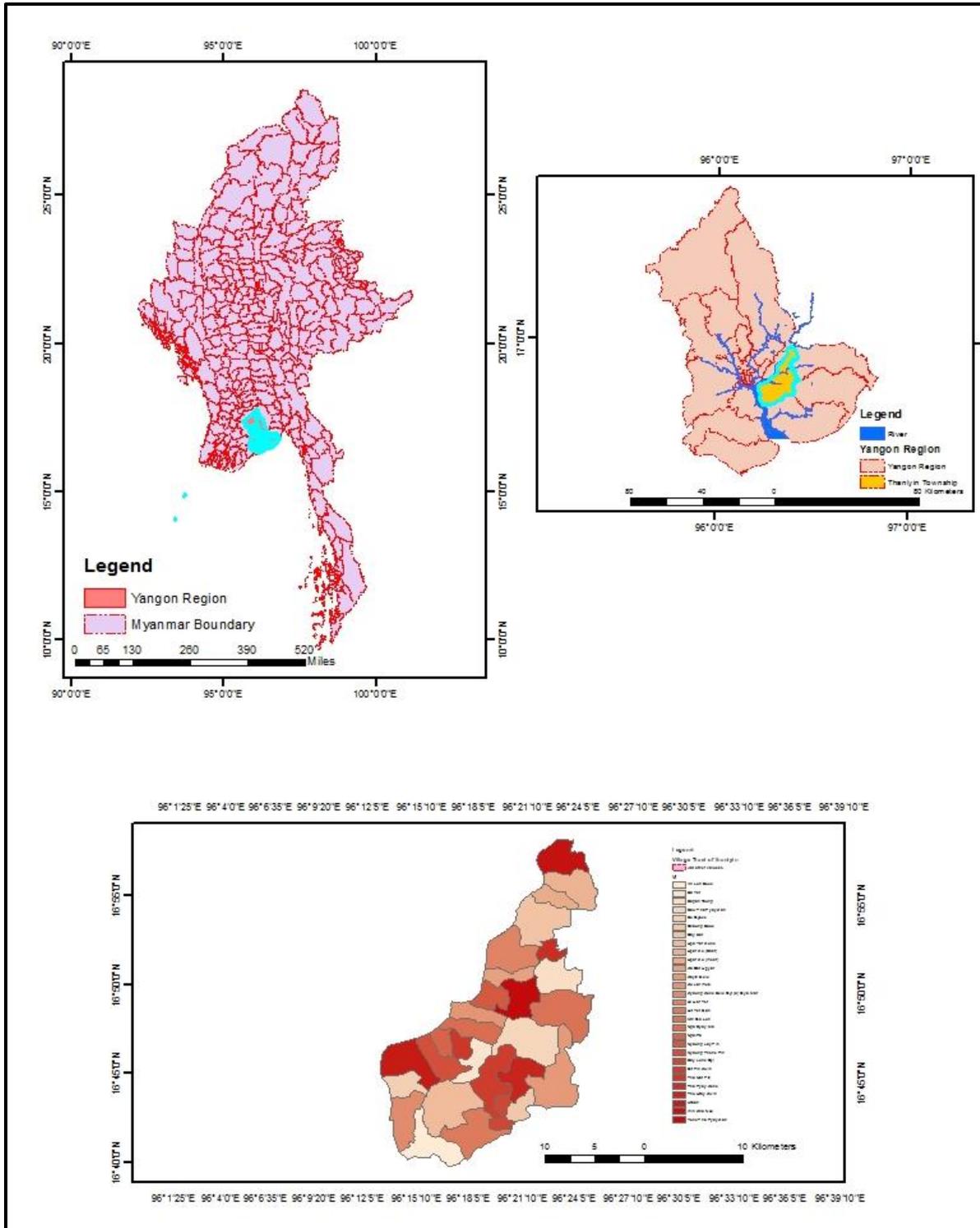
Thanlyin Township is included in the Southern District in Yangon Region. It lies between north latitudes 16° 40' and 16° 59' and east longitudes 96° 13' and 96° 25'.

Thanlyin Township has a total area of 372.9 square kilometer or 143.56 square miles (92,147 acres), and it comprises about 3.8 percent of Yangon Region. This township is 38.6 kilometers (24 miles) long north to south, and 20.92 kilometers (13 miles) wide from east to west. The total length of land boundaries is 65.13 kilometers (40.5 miles). The southwestern part, the boundaries were also marked from the function of Bago and Yangon River to the frontier of Kyauktan Township. The total length of water boundary is 50.66 kilometers (31.5 miles). It is surrounded on the north by Bago River, on the east by Thonegwa Township and Khayan Township, on the south by Kyauktan Township and on the west by Yangon River. It is located on the left bank of Bago River and closer to the Yangon City.

The shape of Thanlyin Township is elongated shape with a longer axis from north east to southeast and a shorter axis from southeast to northwest. This region has a titled of “J”

shape. Thanlyin Township is comprised into two parts, i.e, urban area and rural area. Urban area is formed by (17) wards and rural area is made up of (28) village tracts and 57 villages.

Figure(1.1) Location of Study Area



Source: Based from MIMU (Shape File)

2.2 Total Population and Population Growth

In this study area, population data based on three-years period in Thanlyin Township. The first year is started on 2014 census population data. According to 2014 census data, the total population of Thanlyin Township was 268,063 persons composing 130,537 males and 137,526 females. The population included to 269,489 persons, comprising 131,842 males and 137,656 females in 2016 population record. In 2019, the total population had 273,043 persons is dividing 131,571 males and 141,472 females. These data are shown in table (1.1)

Therefore, the annual growth rate is one percent normal increased in yearly. The population was an increased partly due to natural increase and small immigration. The higher population growth is owing to be more favourable transportation routes and Project of Myanmar International Terminal Thilawa (MITT).

Table (2.1) Total population and Growth Rate of Thanlyin Township (2014-2019)

Sr. No.	Year	Population (person)			Increase of Population	Growth Rate (%)
		Male	Female	Total		
1	2014	130,537	137,526	268,063	-	-
2	2016	131,842	137,656	269,498	+1435	1
3	2019	131,571	141,472	273,043	+3545	1

Source: General Administration Department, Thanlyin Township

2.3 Population Density and Distribution

Based on 2019 population data, the general patterns of population distribution and density of the study area are analyzed. Thanlyin Township is divided into two demographic portions such as urban, rural area and the spatial distribution patterns of population are firstly analyzed. And then population density is compared for the general assumption is made for potential economic development of the study area. This study area, it has totally 17 wards and 28 village tracts. This township had with a total population of 273,043 persons in which urban population is included 83,229 persons and rural population is comprised 189,820 persons. About one third of the township's total population lives in urban center. It is mostly land used for public and government department and industrial landuse. Rural population is unevenly distributed.

Urban population density is highest in Myohaung (east) with total population at 16,328 residents live on the 0.10 sq. mile of land area. The second and third highest population density are Daraga and Myoma (South) in urban area. Lowest population density is found in Yenana with 3,442 persons and population density with 1,721 persons per sq. mile due to its location. It is located at the southwestern part of the township. Densely populated villages are Phayargon, Bogyoke and Letyatsan, because these villages have favourable for agricultural opportunity. Most of them are located on the southwestern end of the township. The sparsely populated area is found in Winkani village tract because it has poor soil, and it has availability to flood and poor accessibility.

Table (2.2) Population Density of Thanlyin Township

Sr. No.	Types	Area (sq. mile)	Total Population (persons)	Population Density (person/ per sq. ml)
1	Rural	137.62	189,820	1,379
2	Urban	5.94	83,223	14,011
	Total	143.56	273,043	15,390

Source: General Administration Department, Thanlyin Township

3. CLASSIFICATION OF ECONOMIC ACTIVITIES IN THANLYIN TOWNSHIP

3.1 Classification of Primary Economic Activities

Primary economic activities are concerned with the extraction of raw material from nature. These activities are the beginnings in further development of other economic activities. (R. Boice, 1978)

Primary economic activities include agriculture, livestock, fishery, forestry and mineral resources. If the primary economic activities of Thanlyin Township are found out, the essential fields to study are agriculture, livestock and fishery, because there is no application in forestry and mining.

3.1.1 Types of Land and Its Uses

According to the data in 2018-2019, the total land use is 92,176 acres. Among the total land use in Thanlyin, the urban land use is (6,275) acres, town land use (709) acres, industrial land use (5,566) acres. The rural land use is totally (66,375) acres. In rural land use (60,506), acres are used for farm land, (1,397) acres are used for pasture, (1,232) acres are used for village land, (2,824) acres are used for garden land, (416) acres are used for nipa palm trees. As the other usages, (8,986) acres for rivers, streams and underground water, (2,708) acres for dams, (2,736) acres for lakes and ponds, (362) acres for railway, (1,624) acres for motorway, (4,642) acres for religious building and graveyard.

Table (3.1) Urban Landuse in Thanlyin Township

Sr. No.	Types	Acres	Percentage
1	Urban Landuse (City Land)	7,09	11%
2	Industry Landuse	5,566	89%
	Total	6,275	100%

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (3.2) Rural Landuse in Thanlyin Township

Sr. No.	Types	Acres	Percentage
1	Village Landuse	1,232	2%
2	Farm Land	60,506	91%
3	Garden Land	2,824	4%
4	Land for Nipa Palm Trees	416	1%
5	Land for Pasture	1,397	2%
	Total	66,375	100%

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (3.3) Other Landuse in Thanlyin Township

Sr.No.	Types	Acres	Percentage
1	Fallow Land	475	2%
2	Unuse Land	686	4%
3	Land for Dams and Irrigations	2,708	14%
4	Streams, Rivers and Underground Water	8,957	46%
5	Ponds and Lakes	2736	0%
6	Railway Land	362	2%
7	Motor Land	1,624	8%
8	Religious Land and Graveyard	4,642	24%
	Total	19,497	100%

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (3.4) Total Landuse in Thanlyin Township

Sr.No.	Land Types	Acres	Percentage
1	Urban Landuse	6,275	7%
2	Rural Landuse	66,375	72%
3	Other Landuse	19,497	21%
	Total	92,147	100%

Source: Administration of Farmland and Statistics Department in Thanlyin Township

The main business in Thanlyin Township is agriculture. The rural area is 95.8% of local area, because rural area has more farmland and paddy cultivation is the traditional business of this area.

The main agricultural land is involved farmland, garden land and land for Nipa Palm Trees. The farmland is (91%) of the agricultural land and it is mostly found. The second mostly used type of land is garden land and the land for Nipa Palm Trees is only a little.

3.1.2 Cultivated Crops

Thanlyin Township has heavy rainfall and moderate weather. The agricultural land is two-third of the whole township area. The type of land is prosperous and it is conducive to plant different types of vegetation. Cultivating paddy is the main food of the nation and the country favours in cultivating. Cultivated crops have been much more efforted to be fruitful every year.

(i) Paddy

Paddy is much more important crops than others. It is cultivated for a short period in “Le” Land. Paddy is more easily cultivated in warm and moist weather. It is planted not only monsoon paddy but also summer paddy with the special farmland projects by irrigated cultivation in summer seasons.

The total paddy field area is 60,506 acreas and fallow land is 475 acres. Formers cultivated the paddy seasonally. There are 28 village tracts and 57 villages. Out of 28 village tracts, the total paddy field area is 60,506 acres, and the net sown area for paddy in the rainy season is 59,760 acres. Yield per acres (baskets) of the paddy in the rainy season is 73 and production of paddy is 4,365,400 baskets. The short period (Thetngè) monsoon paddy in the rainy season can be cultivated at the last week of May and first week of June. They are reaped at the middle of September. Short period (Thetngè) monsoon paddy involves Manawthukha, Elmahta, Nga Sein and Sticky Rice. Long-period (Thetgyi) monsoon paddy includes Pawsannhmway and Ngakywel. Those types are started to be cultivated in the last week of May and first week of June. They are all reaped at the end of October.

The net sown area is 2000 acres for summer paddy in Thanlyin Township, the yield per acre (baskets) is 65 and production of paddy is 132,470 baskets. The monsoon paddy is planted in almost 28 village tracts, and the summer paddy is planted only in 13 villages. The 13 villages under the dry season area irrigated in the summer, water is also obtained by pumping water from the closed Buch Creek and Khayan Creek. The village tracts where summer paddy is cultivated include Yonethabyegan, Bauhthabyegan, Thahtay-kwin, Sitpin Kwin, Bayet, Ngapyayma, Na/Pa, Thanutpin, Nyaungthonepin, Phayargon, Nyaunglaypin, Kalawe, Saylongeyi. The cultivated monsoon and summer paddy, the different type of acres and their production are presented in the following tables.

Table (3.5) Monsoon Rice Cultivated area in the village tracts of Thanlyin Township

Sr. No.	Village Tract	Sowned Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	3,245	3,245	66	214,170
2	Phakuu (East)	3,123	3,123	67	209,241
3	Phakuu (West)	908	911	69	62,859
4	Dazat	3,502	3,502	69	241,638
5	Yonethabyegan	2,611	2,615	68	177,820
6	Mingalon	5,060	5,060	69	349,140
7	Bauhthabyegan	4,595	4,595	68	312,460
8	Kayinseik	5,655	5,655	68	384,540
9	Thabyegon	1,017	1,017	67	68,139
10	Pagantaung	2,506	2,506	70	175,420
11	Alwunsoke	977	977	66	64,482
12	Kyaunggone-seikgyi	564	568	55	31,240
13	Latyetsan	1,756	1,760	69	121,440
14	Thatay-kwin	1,907	1,907	69	131,583
15	Sitpin-kwin	3,484	3,484	67	233,428
16	Bayet	1,783	1,783	67	119,461
17	Ngapyayma	2,300	2,300	67	154,100
18	Ngapa	871	876	65	56,940
19	Thanutpin	958	958	68	65,144
20	Bogyoke	805	805	53	42,665
21	Nyaungthonepin	1,577	1,577	66	104,082
22	Phayagon	1,255	1,265	62	78,430
23	Laharyet	1,434	1,434	65	93,210
24	Kadatphyar	2,517	2,517	67	168,639
25	Nyaunglaypin	1,191	1,201	60	72,060
26	Kalawe	1,338	1,338	63	84,294
27	Saylonegyi	1,088	1,088	58	63,104
28	Chaungsauk	1,733	1,733	66	114,378
	Total	59,760	59,800	73	4,365,400

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (3.6) Summer Rice Cultivated area in the village tracts of Thanlyin Township

Sr. No.	Village Tract	Sown Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	-	-	-	-
2	Phakuu (East)	-	-	-	-
3	Phakuu (West)	-	-	-	-
4	Dazat	-	-	-	-
5	Yonethabyegan	29	29	19	551
6	Mingalon	-	-	-	-
7	Bauhthabyegan	162	164	49	8,036
8	Kayinseik	-	-	-	-
9	Thabyegon	-	-	-	-
10	Pagantaung	-	-	-	-
11	Alwunsoke	-	-	-	-
12	Kyaunggone-seikgyi	-	-	-	-
13	Latyetsan	-	-	-	-
14	Thatay-kwin	58	66	33	2,178
15	Sitpin-kwin	302	308	69	21,252
16	Bayet	439	439	74	32,486
17	Ngapyayma	281	285	63	17,955
18	Ngapa	96	96	39	3,744
19	Thanutpin	247	247	56	13,832
20	Bogyoke	-	-	-	-
21	Nyaungthonepin	121	121	40	4,840
22	Phayagon	150	152	42	6,384
23	Laharyet	-	-	-	-
24	Kadatphyar	-	-	-	-
25	Nyaunglaypin	74	80	35	2,800
26	Kalawe	26	30	19	570
27	Saylonegyi	15	21	17	357
28	Chaungsauk	-	-	-	-
	Total	2,000	2,038	65	132,470

Source: Administration of Farmland and Statistics Department in Thanlyin Township

(ii) Pulses and Other Vegetation

Later 2000, different types of beans are the nation's major export. Due to the differentiation of land and weather, the pulses cannot be widely cultivated and they are produced just for local consumption. The net area for planting them is 50 acres. The planted pulses are ground nuts, chickpeas and grams. The net cultivating area of ground nut is 18 acres, yield per acre is 45 and production of crop is 810 baskets. The net cultivating area of gram is 14 acres, yield per acre is 43 and production of crop is

602 baskets. The net sown cultivating area of green gram is 18 acres, yield per acre is 45 and production of crops is 810 baskets.

In Thanlyin Township, monsoon paddy, summer paddy pulses and other vegetation are also planted. The other cultivated vegetation are betel, peppers, bananas, coconuts, palm fruits, other fruits and vegetables. (Shown in table (3.7))

Table (3.7) Major Crop Cultivated area in the village tracts of Thanlyin Township

Sr. No.	Crops	Sowned Area (acres)	Matured Area (acres)	Yield per Acre (Baskets/Vass)	Production in Baskets/Vass
1	Monsoon Paddy	59,760	59,771	73	4,363,283
2	Summer Paddy	2,000	2,038	65	132,470
3	Groundnut	18	18	45	810
4	Gram	14	14	43	602
5	Green Gram	43,182	43,182	65	2,806,830
6	Plam	39	39	-	-
7	Betel	24	20	4,200	84,000
8	Betel nut	16	16	-	-
9	Pepper	30	30	-	-
10	Banana	202	195	692	134,940
11	Coconut	430	319	3,405	1,086,195
12	Other Vegetables	396	396	1,722	681,912
13	Fruit from lands	1,052	559	-	-
14	Dani	420	420	-	-

Source: Administration of Farmland and Statistics Department in Thanlyin Township

3.1.3 Livestock Breeding

Livestock breeding is a branch of agricultural sector. Livestock is one of the business in study area but it is only a small business. There is no livestock breeding in 28 village tracts. They can be found only in 10 villages. In urban area, the households keep their own. The animals kept in rural areas are for the support of agriculture and local consumption.

The number of animals is not quiet much compared to the number of the animals in the whole township. Due to the less number of animals, the animal keepers feed them by products of the farm. Sometimes, they feed them ready made animal food. The different types of animals kept in Thanlyin Township mainly include buffaloes, cows, goats, pigs, chicken, and ducks. Milk, meat and eggs produced from them can be consumed locally.

10 villages where animals are kept include Nyaungthonepin, Sitpingwing, Bagantaung, Bauthapyaykan, Thanatpin, Kyaungoneseikkyi, Latyatsan, Pharkuu (west), Kyiekinn and Ohtphoosu. The number of owners of livestock, the number of animals and the meat production area are shown in the following tables.

Table (3.8) Animal Products in Thanlyin Township (2019)

Sr. No.	Types of Animals	Production of meat (Vass)	Production of milk (Vass)	Production of eggs (egg)
1	Local Cows	114,000	-	-
	Cows kept for milk	-	7,662,760	-
2	Local Buffalo	4,042	-	-
	Buffalo kept for milk	-	914,000	-
3	Chicken kept for eggs	-	-	1,001,873
	Local Chicken	6,308,560	-	-
4	Ducks kept for eggs	-	-	163,236
	Local Ducks	106,904	-	-
5	Goats	12,222	3,250	-
6	Pigs	491,536	-	-
	Total	7,037,264	8,580,010	1,165,109

Source: Livestock and Veterinary Department

3.1.4 Fishery

Two different types of fishing in Thanlyin are natural fishing and seasonal fishing. There is no enterprises doing with systematic tank or lake. Seasonal fishing prohibits people from fishing during the designated period: May, June, July. As these months are duration for breeding fishes. If people fish during these months, fishes can be extinct or almost extinct. To prevent this situation, the above rule is enacted. The natural fishing refers to fishing in the lakes, streams, creeks, and rivers. There are altogether 7 villages which earn their living by natural fishing. They are Kalawal, Nyaunglaypin, Daysatt, Pharkuu, East Myohaung, Winnkhani and Ngwethanwinn.

Fishing areas in Thanlyin Township are around Yangon River, Bago River, Khayan Creek, Buch Creek and all the other streams, lakes and creeks. The different types of fishes are Ngazinyaing, K-Katic, Ngarbat, Ngartan, Ngarbyat and various of fishes. There are 7 villages which do the fishing and 816 fishermen. (see Table 3.10)

3.2 Classification of Secondary Economic Activities

Secondary Economic Sector involves the transformation of raw materials into goods. Secondary activity is mainly associated with manufacturing and industry. Examples of secondary sectors are textile, leather industry, ceramic industry, cash crop industry etc. In developing countries, very few people (5% average) work in secondary sectors. In developed countries, moderate number of people (25% average) work in secondary sectors. Secondary activity ultimately leads to industrialization. (Wikipedia)

In Thanlyin Township, the industrial sector is based on agricultural production and other small industrial enterprises. Depending on these industrial enterprises, the main products are produced according to local market. In 1990s, Thanlyin has public industrial business and other small enterprises like paddy mill, oil mill, saw mill, grinding enterprise and gold smiths. However, these businesses are not properly developed. The qualities of the products are also not promoted. Therefore, they cannot enter the local market.

Thanlyin is one of the 45 townships in southern district in Yangon. During 1990s, among 45 townships under the management of Yangon City Development Council, 11 townships are selected for constructing industrial and economic zone (or) industrial area. Thanlyin is also listed as one of 11 townships. By doing this the selected areas are specially chosen for the continuous development of outside and inside of the municipal area.

Table (3.10) Number of Common Fisher Tools, Fishermen and Yield per Fish Types (Vass) in Thanlyin Township (2018-2019)

Sr. No.	Particular	Total
1	Villages	7
2	Authroized Fishing tools number	(102)
	(a) Net Crab	90
	(b) Crab (overall)	12
3	Total Fishermen	816
	(a) Part Time	102
	(b) Full Time	102
	(c) Family	612
4	Yield per Fish Types (Vass)	(122,400)
	(a) Ngarzinyaing	42,840
	(b) K-Katic	18,360
	(c) Ngarbat	12,240
	(d) Ngartan	12,240
	(e) Ngarbyat	12,240
	(f) Various of fishes	24,480

Source: Department of Fisheries, Thanlyin township

As the good result, regional government has encouraged the industrial and economic development as the change of economic policy after 1993. Based on the survey data in 2019, Thanlyin Township is much more developed than other townships. Most of the secondary economic activities involve producing products from the raw materials or semi-finished products. The higher the value of the products from secondary economic activities, the more developed the local economic sector and the national socio-economic status.

3.2.1 Various Types of Industry

In the present study area, Thanlyin, Three governmental industries and many private industrial enterprises had been established and in 1990s, around Thanlyin local industrial zone and Thanlyin Special Economic Zone are going to be set up with specific projects. Among these two zones, Thilawa Special Economic Zone (SEZ) link with not only local business people but also international businessmen. As a result, the local enterprises in Thanlyin and the job opportunity of residents will be abundant and the national income is obviously increased. The products produced from township area can be observed in the list.

Generally, the industries and workshops in Thanlyin are observed and the production is classified based on the different types and nature of activities.

3.2.1.1 State Owned or Government Owned Industry

There are three state owned factories in Thanlyin Township. No.(1) Oil Refinery Factory was established in the Yenon Ward, No(10) Saw Factory as set up in the Myohaung (West) at 1975 and White Lead Refinery Factory was built up 1993 in Aungchanthar Ward respectively. The information of these factories is not available

under certain circumstances. Before 1993, the industrial enterprises did not develop widely and the major focus was an agricultural sector. At that time the value and the quality of the products are not as high as the present situation.

3.2.1.2 Private Industry

The number of private industry is more than that of public industry. They produce more products. Observing the production, the need of raw materials and uses is directly proportional to the raw materials. The production and types of product in private industries differ according to the market.

- Food and Beverage Industry
- Chemical Industry
- Saw Mill (or) Saw Factory
- Metal Industry and
- Other Industry

Food and beverage industry is the most commonly found type of industry out of the secondary economic activities because there are 82 factories and 36% of the total. The second most type is other industry as there are 74 factories and 32.5%. The third most is saw mill industry and the number of the factory is 33 with 14%. There are 26 metal industries with 11.4%. The least type of industry is chemical industry with 13 factories and 5.7%. (see Table 3.11)

3.2.1.3 Thanlyin Local Industrial Zone and Thanlyin-Thilawa Special Economic Zone

(a) Thanlyin Local Industrial Zone

By observing industrial sector, by the year 2000, the Government established Thanlyin Local Industrial Zone with the 1,000 Acres at the south western part of Thanlyin is established for the purpose of promoting the economic market. There are altogether 32 factories and in these factories the enterprises are run with the local investment. Two-third of the total land area is not possessed by any factory. There are five different types of factories. According to secondary sector, concerning with the factories where raw materials are produced into finished products, the number of factories are 10 with 32.3% which is the largest number. The second and the third are metal and other industry with the number of 9 (27.5%) and 7 (21.4%) respectively. The number of chemical industry is 4 (12.3%). The least type is saw mill with the number of 2 and 6.3%.

There is a controlling department to supply the requirements of industrial business and to manage the processes in the industry.

(b) Thanlyin Special Economic Zone (SEZ)

Thilawa Special Economic Zone (SEZ) covers approximately 2,400 hectare (ha) or 5,930.5 acres with Yangon South District, Yangon Region, Myanmar. It is connected with 25 kilometer (16 miles) by road from downtown Yangon. The two townships most directly linked to the Thilawa SEZ development are Thanlyin and Kyauktan Township.

A special Economic Zone (SEZ) is an area within or across national boundaries that is administered under special rules. They come in different forms, which in Myanmar include free zones and promotion zones, as well as the potential for the creation of other types of zones as need be.

Table (3.11) Types of Secondary Activities of Local Industries in Thanlyin Township (2019)

Sr. No.	Main Type of Industry	Subtype of Industry	Numbers	%
1	Food and Beverage Industry	ice cream and chocolate	2	
		snacks and cashew nut	15	
		ice production	3	
		grinding services	6	
		purified water	36	
		rice mill	10	
		oil mill	5	
		bean mill	3	
		soft drinks production	2	
		Total	82	36%
2	Chemical Industry	plastic	6	
		make up and cosmetics	2	
		traditional medicine	3	
		mosquito repellent coil	1	
		hair cleaning	1	
		Total	13	6%
3	Saw Mill Industry	wood mill	13	
		furniture	17	
		rattan table and chair	2	
		cushion	1	
		Total	33	14%
4	Metal Industry	steel production	7	
		gold smith	5	
		lathe	7	
		steel box and steel cupboard	2	
		steelcoil and zinc	3	
		stone shaping	1	
		glass blowing	1	
		Total	26	11%
5	Other Industry	woolen and garment	54	
		printing paper	9	
		sewing flowers on cloth	1	
		shoes	2	
		candles and fragrant stick	8	
		Total	74	32%
	Total		228	100%

Source: Myanmar Japan Thilawa Development (MJTD)

Announced in January 2011, the Thilawa SEZ has been continuously developed since November 2014. The Thilawa SEZ incorporates the Myanmar International Terminals Thilawa (MITT), a deep-sea port facility built in the mid-1990s. Development of the Thilawa SEZ aligns with the Government of Myanmar (GOM) focus on sustainable economic development and re-structuring of the Myanmar economy, from primary dependence on agriculture, forestry and fisheries to include labour-intensive industries such as manufacturing and services.

In March 2014, a preparatory study on Thilawa SEZ infrastructure development was undertaken to identify the required infrastructure and to develop the first phase of Zone (A).

Zone A comprises around 405 ha and is divided into phase 1 and phase 1 expansion (Phase A). Phase 1 construction activities commenced in September 2013 and concluded in August 2015. At the time, Zone A of the SEZ commenced operations. The Grand opening ceremony was held on 23rd September 2015.

Zone B comprises 700 ha and is planned for development from early 2017. It includes about 262 ha of industrial area, 267 ha of logistics area and 169 ha of residential and commercial areas. Other areas of the SEZ is 200 ha Development area (not including Zone A), is divided into Zone B (Area 1-4) and Area 5 and 6. Remaining area of the SEZ (outside Zones A and B) are earmarked for potential future development. However, this will depend on a number of factors including the success of the development and operation of these initial zones.

The industrial enterprises have been carrying out since 2015 in Thilawa Special Economic Zone. The investment of Myanmar Government is 10%, that of Myanmar Investors is 41%, that of Japan Government is 10%, that of Japan investors is 39% respectively. There are 302 factories, 109 factories for reservation agreement, 107 factories for investment permit sublease agreement and 96 factories for other types of industries according to the data of 2019 in MJTD.

The product types in Thilawa Special Economic Zone are different therefore, these different types are observed and categorized based on secondary economic activities.

There are 21 factories with (19.6%) of food and beverage industry, 15 factories with (14.1%) of chemical industry, 47 factories 43.9% of metal industry and 24 factories with 22.4% of other industry.

There is no industry concerning with saw mill industry. Metal industry is the highest type found in Special Economic Zone. 65% of products produced in Thilawa Special Economic Zone is sold in local market, 43% for Export and 1% for others (local and export).

There are 109 factories for reservation agreement and the ownership according to the nation is that – 55 factories are owned by Japan; 55 by Thailand, 8 by Korea; 6 by Taiwan; 4 by Malaysia; 3 by Myanmar; 3 by Hong Kong; 3 by Switzerland; 2 by USA; each by Germany, Netherland, France, Australia, Vietnam, India and Indonesia.

Table (3.12) Types of Secondary Activities of Thilawa Special Economic Zone (SEZ) in Thanlyin Township (2019)

Sr. No.	Main Type of Industry	Sub-type of Industry	Number	Percent (%)
1	Food and Beverage Industry	Various of Snack Industry	11	19.6%
		Agricultural Product Industry	8	
		Noodles and Ready-to-eat Product Industry	2	
		Total	21	
2	Chemical Industry	Paints Industry	4	14%
		Lubricant Industry	2	
		Plastic Molding	3	
		Medical Products	6	
		Total	15	
3	Saw Mill Industry	-	-	-
4	Metal Industry	Construction Material and Parts Industry	17	40%
		Wire Industry	3	
		Ironworks Industry	1	
		Automobile & Parts Industry	7	
		Homecare Product Industry	1	
		Electronic Parts Industry	8	
		Conveyance Machinery Industry	1	
		Galvanized Metal Industry	5	
		Total	43	
5	Other Industry	Garment Industry	15	26%
		Variety of Paper and Tissue Industry	9	
		Shoes and Parts Industry	3	
		Animal Feed Industry	1	
		Total	28	
	Total		107	100%

Source: Myanmar Japan Thilawa Development (MJTD)

3.3 Classification of Tertiary Economic Activities

According to R. Boice, the tertiary economic activities are third stage in economic activities and they are transition or exchange between the produces and the consumption sectors.

Tertiary sector is service sector of the economy. Services of various kinds like education, health, banking, insurance, trade are included in this area.

The study area is divided into urban and rural area. People in rural area mainly do the agricultural business and they contribute to the economy of the township. People in urban area have the main enterprises by dealing and trading tertiary economic activities, and they support the urban economic development.

The tertiary economic activities which promote the local economic can be categorized into two types. They are commercial (exchange commodity and service activities).

3.3.1 Commercial Activities

Commercial activities consist of markets, wholesale and retail shops, restaurants and food shops, hardware shops and shops catering for other goods.

There are two types of markets observing in Thanlyin like permanent market and temporary market. Permanent market such as Myohaung Bazaar (or) Kannar Bazaar in northern of Town, Myoma Market and Aungchanthar Bazaar in the central of town and Htarmlone Bazaar in the southern of town or outer urban area scatters in the respective area of the town. Four permanent markets are under the control of township YCDC.

Temporary markets are Myohaung (middle) market, Thaukyetwin Market, Oatphosu Market, Dhamma Yaungchi Bazaar (lower), Nyaung Thone Bin Bazaar (Sand Street), Nantthargone Bazaar, Payagone Bazaar and Aungchanthar Bazaar (Upper). These bazaars are all located on the roads of wards and the streets of wards and they are not controlled by YCDC.

Table (3.13) Commercial (exchange commodity) Activities of Thanlyin Township (2019)

Sr. No.	Wards	Market		Wholesales & Retail Shops	Restaurants & Food Shops	Hardware Shops	Other shops	Total Shops
		Permanent	Temporary					
1	Amuhtan	-	1	25	10	7	23	66
2	Aungchanthar	1	2	28	25	12	17	85
3	Aungmingalar	-	-	6	9	4	5	24
4	Bagosu	-	-	5	4	4	6	19
5	Daraga	-	-	6	2	3	2	13
6	Htanpingone	-	-	4	7	3	3	17
7	Myohaung (East)	-	-	3	6	3	1	13
8	Myohaung (Middle)	-	1	16	14	13	11	55
9	Myohaung (West)	1	-	5	9	3	2	20
10	Myoma (North)	1	-	32	37	14	21	105
11	Myoma (South)	-	-	14	12	8	10	44
12	Myothit (East)	-	-	5	7	5	2	19
13	Myothit (Middle)	-	-	5	15	5	3	28
14	Myothit (West)	-	-	3	12	8	11	34
15	Yenan	-	-	-	-	-	-	-
16	Okkphosu	-	2	4	15	5	8	34
17	Thauktawtwin	-	1	3	17	7	7	35
	Total	10		164	201	104	132	611

Source: Administration of Farmland and Statistics Department in Thanlyin Township

3.3.2 Tertiary Activities

There are various types of services (tertiary activities) observed in Thanlyin Township. These services activities include financial institution, professional services, skilled services, repair services, lending services, recreational services and ICT services. Majority of services can be mostly found along roads such as Bogyoke Nay Min Road, Lanmadaw Road, Theinkyaung Road and Kyaikkhauk Pagoda Road and their surroundings.

The total number of shops providing tertiary service is 401 and they play the vital role in the economic development of the town.

Financial institution is composed of insurance businesses and pawning services. The banks are opened in local business area of Thanlyin. There are two types of banks: stated owned and private owned banks. State owned banks like Myanmar Economic Bank can be found on Kyeikhauk Pagoda Road, Ahmuhtan Ward, near clock tower. Myanmar Agricultural Development Bank is opened also in Ahmuhtan Ward. Private Banks are altogether 6 private banks in the township and they also run insurance businesses. Ayeyarwaddy bank is on the Kyeikhauk Pagoda Road, Thauktawtwin Quarter; CB Bank is on Kyeikhauk Pagoda Road, Aungmingalar Quarter; Myawaddy Bank is on Lanmadaw Road, Myoma (North) Ward, Myanmar Apex Bank and Kanbawza Bank are on Bogyoke Nay Win Road, Myoma (South) Ward, Global Treasure Bank is on Theinkyaung Road, Myothit (middle) Quarter.

Insurance business and transfer counter is opened in Aungmingalar Ward as well as money changer counters are in the crowded area such as highway road, main motorway, near market area, around Kyeikhauk Pagoda.

Provisional services are comprised of Myanmar Traditional Medicine and Western Medicine, training schools, tuitions and computer technologies services, English and other languages center. Provisional services can be found in the downtown area, the crowded area, and the area which has good transportation. The number of clinics (curing eyes, teeth and general practitioners) is (63). (51) clinics can be observed in the inner area and 12 clinics can be seen in the outer area. Clinics can be mostly found in 4 Ward: Myoma (North), Myoma (West), Aungmingalar Ward, and Aungchanthar Ward. Training school (also included in provisional services) provide 22 services.

Beauty salons, photo studio and barber are described as skilled services. In the whole area of Thanlyin, there are altogether 100 percent services. The beauty salons and barber services are about 75 services, and among them 55 services can be found in the inner area and the rest 20 services can be observed in the outer area. Photo studio services are in the crowded area. They are on Bogyoke Nay Win Road, Kyeikhauk Pagoda Road and Thanlyin-Kyauktan Motorway.

Repair services have workshops, motorcycle, bicycle, battery and other electronic devices. The total number of repair services is 125. Among them, motorcycle services can be widely used in different areas in the township.

Lending services provide lending books, videos (DVD shops) and others. These shops are in such quarters as Myoma (North), (South) and (West), Thauktawtwin, Oatphosu, Bagosu and Aungchanthar. The number of shops is about 20. According to the data from Administrative Statistics in 2009, the number of shops providing lending

services is between 30 and 50 in 2009. The different small number of shops within one decade period is due to the development in socio-economics and social media.

The different number of services in recreation services is 22. They are hotel, lodging, township gym (Thihadipa), tennis court, golf club, cinema, karaoke hall. There is one cinema, one golf club and one tennis court in the downtown area. The most common type is lodging. They are mainly found on Kyeikhauk Pagoda Road, and Bogyoke Nay Win Road.

ICT services include mobile shop and services. There are 53 services. All of them, 19 shops are on Bogyoke Nay Win Road and Lanmadaw Road, 20 shops are on Kyeikhauk Pagoda Road and 14 shops are on Theinkyaung Road, other streets and other crowded area. In this township, there are no services for computers and accessories.

When the tertiary services in the township are observed, there are different services. The number of skill services and repair services is the highest. The economic activities in the urban area, are depending on the tertiary activities and the urbanization is also developed according to the prosperous condition of urban economy.

Table (3.14) Tertiary Activities of Thanlyin Township (2019)

Sr. No.	Wards	Financial Institution	Provisional Services	Skilled Services	Repair Services	Lending Services	Recreational services	ICT services	Total Shops
1	Amuhtan	2	4	5	9	1	2	5	28
2	Aungchanthar	3	11	8	12	2	2	6	44
3	Aungmingalar	2	10	6	10	-	3	5	36
4	Bagosu	3	8	6	7	1	3	2	30
5	Daraga	-	2	2	5	-	-	-	9
6	Htanpingone	-	2	3	7	-	-	2	14
7	Myohaung (East)	-	2	2	4	-	1	2	11
8	Myohaung (Middle)	-	2	5	9	1	2	4	23
9	Myohaung (West)	-	3	4	7	3	1	3	21
10	Myoma (North)	3	12	10	14	5	1	6	51
11	Myoma (South)	1	11	6	10	4	-	6	38
12	Myothit (East)	-	3	2	8	-	-	1	14
13	Myothit (Middle)	3	2	2	6	-	1	2	16
14	Myothit (West)	-	5	4	7	-	1	4	21
15	Yenan	-	-	-	-	-	-	-	-
16	Okkphosu	3	5	7	8	2	2	3	30
17	Thauktawtwin	1	3	3	2	1	3	2	15
	Total	21	85	75	125	20	22	53	401

Source: Administration of Farmland and Statistics Department in Thanlyin Township

3.4 Classification of Quaternary Economic Activities

In this analysis, the real situation of the study area has four major criteria (i.e.) Education, Health, Transportation, Communication and are suitable to use as the basic types of this sector.

3.4.1 Education

Education is very fundamental base for all around development of a region and thus it is necessary to observe as a basic one for any form of research work. The current trends of education and the success of local education plays the vital role of the future development of the region. They are quite different from the widespread education and regular common type of education in the past. It is necessary to study the schools, teacher-student ratio which can provide educational support to the area.

There are two strata of education. They are (a) basic education and (b) higher education. According to the data by the year 2019, the basic education structure is described.

By observing the teacher-student ratio in the above 3 levels, the ratios are uneven proportion and they are even more than the normal amount (that is 1:20±)

Higher education: the number of students and their specialization over higher education structure are closely related to potential demand of labour forces that can take a promise to the development of economic structure. Therefore, facts about higher education structure in that area are collected and interpreted here. (See the table 3.15)

Table (3.15) Basic Education Structure of Thanlyin Township (2019)

Sr. No.	School	Number	Teacher	Student	Ratio of Teacher & Student
1	High School	9	462	16,784	1:36
2	High School (Branch)	5	154	5,530	1:36
3	Middle School	4	70	2,530	1:36
4	Middle School (Branch)	5	81	3,068	1:38
5	Post Primary School	23	383	8,835	1:23
6	Primary School	34	188	3,690	1:20
7	Monastic School	14	204	6,828	1:33
	Total	94	1542	47,265	1:31

Source: General Administrative Department, Thanlyin Township

Table (3.16) Higher Education Structure of Thanlyin Township (2019)

Sr. No.	University	Teacher	Student	Ratio of Teacher & Student	Remark
1	Co-operative University	140	1,881	1:13	
2	East Yangon University	527	10,295	1:20	Art & Science
	U.D.E (East Yangon Branch)	-	6,830	1:13	
3	Thanlyin Technological University	366	4,765	1:13	
4	Myanmar Maritime University	115	1,920	1:17	
	Total	1148	25,691	1:22	

Source: General Administrative Department, Thanlyin Township

According to the table, there are 4 universities in the higher education in Thanlyin. They are Co-operative University, East Yangon University, and University of Distant Education, Thanlyin Technological University and Myanmar Maritime University. The ratio of teacher student in Co-operative University and in Thanlyin Technological University is (1:13). The ratio of teacher- student in Myanmar Maritime University is (1:17) and the ratio in East Yangon University is 1:20, and it is observed that it is more than other higher education structure. In accord with the human resources of higher education structure in the study area, the qualification of human resources, production and reproduction are all depending on the level.

3.4.2 Health Care Centre

In accord with the data by the year 2009, (104) health care centre in the township are listed and they provided the best health care services for the residents. The data concerning with these centres are described in the table (2.17). These centres provide the different abilities and varied number of patients are also attending the centres.

Table (3.17) Different Types of Health Care Centre in Thanlyin Township

Sr. No.	Health Care Center	Numbers	Doctors	Nurses	Patient		Remark
					In	Out	
1	General Hosiptal	1	55	74	7,288	25,869	(State) Average per year
2	Chanmyae Myittar	1	65	96	-	-	(Private)
3	Circle Hospital	1	3	7	(100-150)	-	(State) Average per year
4	Rural Health Care Centre	22	16	45	(250-400)	-	(State) Average per year
5	Clinic	71	-	-	-	-	(Private)
6	Clinic (NGO)	8	11	15	-	-	
	Total	104	150	237	7,288	25,869	

Source: General Administrative Department, Thanlyin Township

3.4.3 Transportation

Transportation sector plays a pivotal role for the development of the region. There are three types of transportation in Thanlyin Township. They are road transportation, railway transportation and water way transportation. There is no airline in Thanlyin Township. So, the other types are observed by excluding the airline.

3.4.4 Communication

Within 2000s year period, the three different types of communication are post office, telegraph and auto telecommunication office. By the year 2019, it has modern communication system like fax, email, mobile phone and online. Thanks to the widespread communication network, the economic status, information processing can be done in a quick momentum, they can have the contemporary development. According to 2019 data, there are one post office and one telegraph office, 2,374 auto phones users (one percent of total population), 239,935 mobile phone users (88% of total population) and 218,254 internet users (80% of total population). It is observed that Thanlyin keeps abreast with the modern development.

4. GENERAL ASSESSMENT OF ECONOMIC ACTIVITIES

Thanlyin Township is one of the 45 townships in Yangon Region and is a seaport located in southern Yangon District. As soon as it is passed through, Thanlyin Bridge from downtown Yangon, the climate of the study area is fine and the land is covered with soils which are rich in fertility. The rate of population there annually increases in one percent and different ethnic groups and several of business live there. So, the research is emphasized by economic activities to assess the economic development of the region from geographical point of view.

While studying activities of the whole area by dividing into four sectors, although agriculture, livestock and fisheries are described in primary sector, mineral and forestry industries cannot be described as these industries do not exist there. In agricultural sector, the farmland is 91% of all the land area of the whole township. So, there is a high yield of monsoon paddy in that study area and it not only gives enough provisions to local people but also can export to other regions. However, only 3% of farmland for summer paddy is grown and as this is a small area, the area should be enlarged. As for green grams and grams are mainly cultivated but groundnut is slightly planted. Monsoon paddy is grown in the east and middle of the study area and summer paddy only in the middle of the area as these are vast lowlands and soils are the most suitable for agriculture. In the aspect of other crops, only seasonal vegetables are grown and they should be promoted for lucrative purpose. As agriculture is the chief economy of the township, there should be an increase in annual growing rate of the crops such as summer paddy, monsoon paddy and biennials as well as a higher yield of those crops to be able to expand the market to local region as well as to other township.

To study the economic development of Thanlyin Township, it is needed to consider both urban area and rural area. The economic benefit of rural area depends only on agricultural businesses but that of urban area mainly focuses on industries and services. In the matter of secondary sector, various industries in the region can be classified into 5 types. Despite not having a great deal of the importance of industry and its development in this region in 2000s, the industries are collaborating with local industries as well as those from foreign countries nowadays in 2019. In 2019, compared with the economic sectors of other townships, local industry and Thilawa Special Economic Zone (SEZ) develop more and more, as the secondary sector, and they regularly fulfill the daily necessities of native people

in the region and the market demands as well as they stand an important role for exportation. However, the local business persons should make a competitive market system as it is crucial to export the goods to the foreign countries. It can be some inflexibility, rigidities and complexities in searching competitive markets because of such situations, however, market and importing system develop more and more. As for the foreign business persons, they become increasing in investments and get more market opportunities. As a consequence, market competition is now being faced by the entrepreneurs who have fewer amounts in investment and those who spend great amount in investment because of their long-term competition. Because of the data, local and international entrepreneurs gradually expand the regional market. Therefore, the local traders mainly need to maintain the balanced market and trade development.

Among the economics activities, tertiary sector obviously and successfully exists as the central business area in the internal areas of the township. Those places are chiefly transforming into the trade centres for retail and wholesale. The services, standing as a tertiary sector, are mainly found not only in central business area but also in crowded places and on main roads and this is one of the main reasons which rapidly changes in accordance with the (civil development projects/ development projects of the city). Moreover, tertiary sector plays a vital role in economic activities of local people and the economic development of the township.

In the education sector, among the quaternary activities, the present number of teacher and students and the qualities of the school are taken as an important factor. But, in basic education level, it is need to solve the inequality of the ratios of teachers to students. As for the health care sector, the health care services in rural areas and the number of hospital and doctor in urban areas are numerous but not enough. Though there are some health care centres and dispensaries in the rural region, people mainly rely on the clinics and hospitals in urban area for their health.

In the matter of transportation sector, although waterway plays between the destinations once a day and railway plays between the destinations twice a day, delays are occurred in carrying out the works timely. As there are 7 bus-routes that play on Thanlyin–Kyanktan–Khayan road, transportation is easy and convenient.

Nowadays, information, technology and communication developments are crucial. According to the data in 2019, among the total population of 273,043 in Thanlyin Township, 88% use mobile phones and 80% are the internet users. Local people of the township use email, fax and online system in keeping with the time.

Therefore, advancing all the factors of these four sectors and completing their qualities make the economic developments of a township catch up with the times.

5. CONCLUSION

The economic activities are studied dividing into 4 sectors to be able to assess the socio-economic development of Thanlyin Township.

Primary economic activities mainly consist of agriculture, livestock and fishery of Thanlyin Township. The net sown area of plot of land is 60,506 acres, and although it is 91% of the whole study area, the net sown plotting area for monsoon paddy is 59,760 acres and that of summer paddy is only 2,000 acres, annually. Besides, in agricultural sector, not only the monsoon paddy and summer paddy but also various kinds of pulses and other crops are grown. In the sector of livestock, animal husbandry businesses are done only in 10 of 28 village tracts. There are a few businesses concerning livestock in the rest of the village tract, they are just to support the agricultural processes and to consume in the local region. There

are altogether nine types of animals raised in those 10 villages and the total number is 835,467. In the fishery of the study area, the businesses are done by naturally catching from the rivers without any systematic way for fisheries like fishponds. There are seven villages in which people make their living with fisheries, in the rivulets of Khayan Creek, Bouh Creek, etc., Yangon River, Bago River and other lakes and ponds.

In the secondary sector, compared with the whole area of the township, there are 228 industries and they can be classified into five categories. Moreover, Thilawa Special Economic Zone (SEZ) has been established since mid-1990s and now 107 industries have been running since 2014. In tertiary sector, there are two types: commercial activities and tertiary activities. As in the first type, totally 611 shops exist mostly in Myoma (North) ward, Aungchanthar ward and Ahmuhtan ward. In the second type, which is termed as tertiary activities, 401 services are found mainly in Myoma (North) ward, Myoma (South) ward and Aungchanthar wards. Distinctively, those services are not done in Yen-an ward. This is because an Oil Refinery plant was launched in that place in 1897 and the workers and their families of this industry live in the compound and so it is sparse in that ward. The crowded places are Myoma (North), Myoma (South), Aungchanthar, Kyaikkhauk Pagoda Road, Bogyoke Nay Win Road and their surroundings, and people live collectively in these places and these are the areas of supporting incomes for the whole township.

The Quaternary sector is analyzed in education, health, transportation and communication. In education field, it is found that the number of students is much more according to the ratio of students to teachers. Then, healthcare system and transportation system are also studied. Therefore, by completely describing all those 4 activities, the research paper points out the economic development of Thanlyin Township as well as the socio-economic development of the region.

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GEOGRAPHICAL ANALYSIS ON RICE CULTIVATION OF THANLYIN TOWNSHIP

Nyein Chan¹

Abstract

Thanlyin township lies in the Southern part of Yangon Region. Thanin Township has a total land area of 143.98 square miles. It is made up of 17 wards and 28 village tracts. The rice is staple food of Myanmar. This paper is divided into three parts. The first part is the physical factors, second part is the human factors, third part include the conditions of Rice cultivation in Thanlyin Township. This paper analyzed on the geographical analysis on rice cultivation of Thanlyin Township.

Keywords: Rice Cultivation

1. INTRODUCTION

Myanmar economy depends mainly on Agriculture. Paddy is the mainly crop and the staple food of Myanmar. Rice is mainly cultivated in Thanlyin Township because of its low land area and there are many suitable plots for farming.

Thanlyin Township is located south part of the Yangon Region. Rice cultivation is a traditional livelihood of the region, the area of cultivated land cannot be extended as much as it should be because the town is surrounded by rivers and other towns. This paper is composed of three chapters. In chapter I deals with to physical bases of Thanlyin Township and social bases of Thanlyin Township is presented in chapter II. In chapter III, deals with the conditions of rice cultivation in Thanlyin Township.

1.1 Aim

The aim of this study is express the geographical analysis on rice cultivation within the study area.

1.2 Objectives

In this paper, the main objectives are-

- (1) To study the condition of rice cultivation in Thanlyin Township.
- (2) To encourage paddy cultivation in Thanlyin Township.

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1.3 Historical Background

Thanlyin (Syriam) is derived from the Mon word “Trawn” which mean Hasun Ban (aqmifyef;). Europeans pronounced Mon word. “Trawn” as “Syriam” when the English man. Ralpfitch came to Myanmar during the King Nanda Bayin (1581-1599), he called “Syriam”.

European adventures and seafarers (Portuguese, Dutch, English and French) came to Thanlyin as early at the end of thirteenth century. They came to trade and settled down at the port of Thanlyin. And they believed the harbor of Thanlyin protected to the ships from the storms and strong winds. The confluence of Bago, Hmawun and Dawpon Rivers was known as “Than Hlet Soon”. Mons who first built the present town “Thanlyin” where settled down.

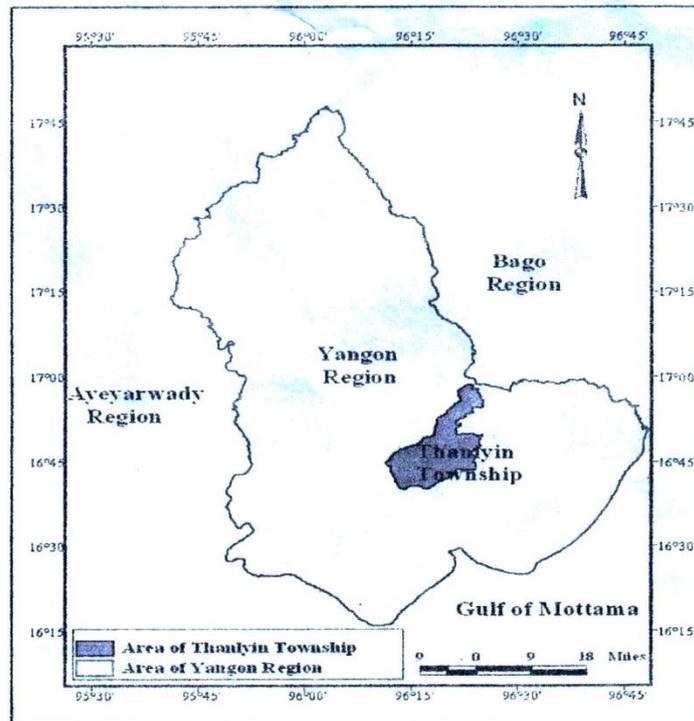
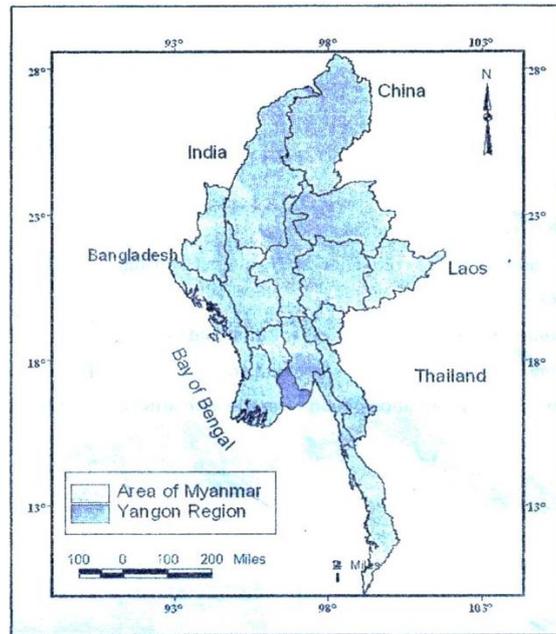
2. GEOGRAPHICAL BACKGROUND OF THANLYIN TOWNSHIP

2.1 Location, Size, Shape and Boundaries

Thanlyin Township is located on the south of Yangon Region. It lies between north latitudes 16° 40' and 16° 59' and between east longitudes 96° 13' and 96° 25'.

Thanlyin Township has a total area of 143.98 square miles (92147 acres). It comprises 17 wards and 28 village tracts. Thanlyin Township is surrounded on the east by Khayan and Thonegwa Township and on the south by Kyauktan Township, on the north by Bago River, and on the west by Yangon River. It total land boundary is 40.5 miles and with 31.5 miles of sea boundary.

Figure(2.1) Location of Study Area



Source: Based from MIMU (Shape File)

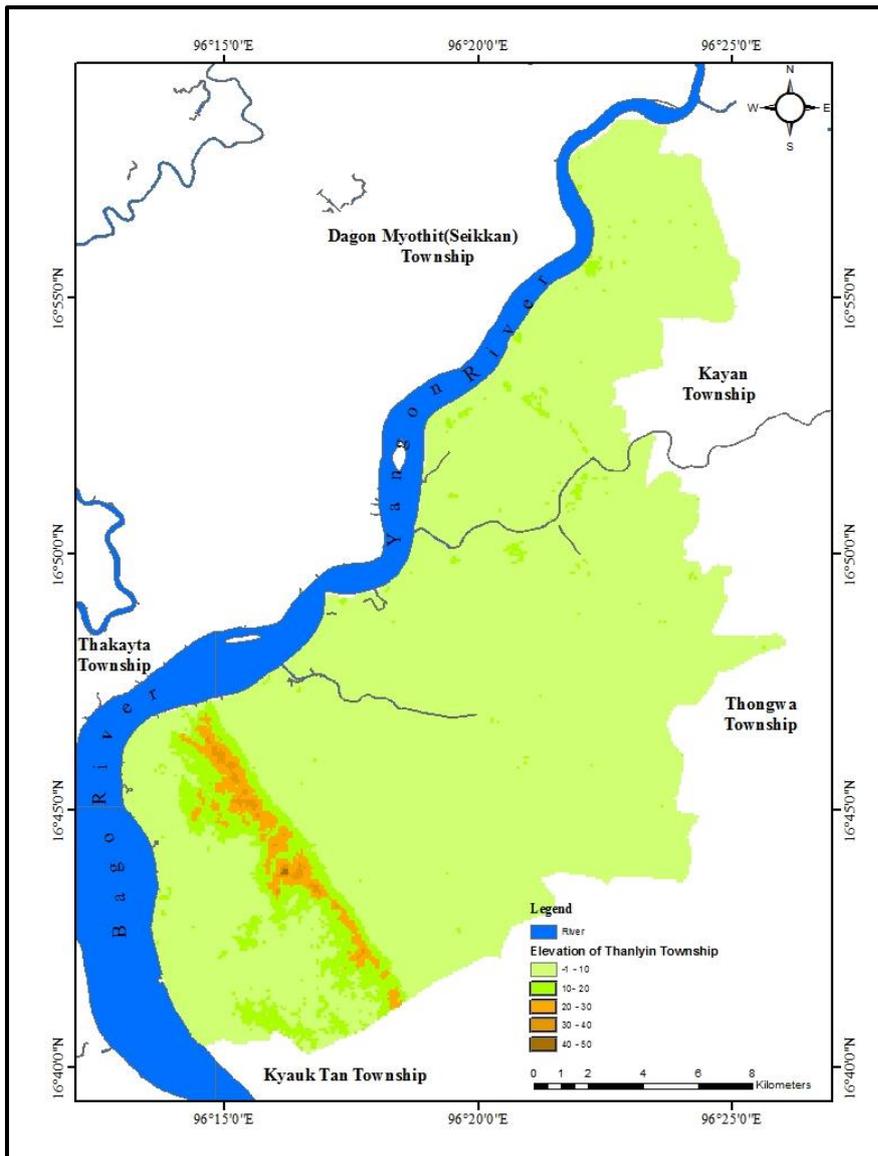
2.2 Relies and Drainage

The southern part and the south eastern parts are parts of lateritic ridge located 50 to 100 feet above sea level. The highest part of the township is southern portion.

The most part of Thanlyin Township area is an almost level plain below 50 feet.

The main rivers of the township are Yangon River, Bago River and Khayan Creek. The small creeks are Kadatphyar, Alunsoke, Bauh Chaung, Myoyoe Chaung. In Thanlyin Township, Khayan Creek flows into Bago River near Kalawe village tract.

Figure (2.2) Elevation of Thanlyin Township



Source: Based from DEM

2.3 Geology

Geological, Thanlyin Township can be classified as Pliocene type and Rock layers are included in Irrawaddy Group. These layers are most of the sediments, and the rocks are made of grey or grayish blue in colour.

In Thanlyin Township, a small lateritic ridge elongated from the west and northwest to the east and southeast.

Many rivers rivulets and gutters including Bago River and Yangon River flowing through this area have high tide and low tide.

2.4 Climate

Climate is directly related to the availability of temperature and precipitation. Thanlyin Township is located in the Southern District of Yangon Region. This climate of Thanlyin Township is the tropical monsoon type.

March and May have maximum monthly average temperature of 27.2°C, 38.4°C and 37.1°C respectively. The minimum monthly temperature of March is 18.5°C

The Rainy Season stands the end of May to end of October. According to this data, the average total rainfall is 2294.5mm. August receives the highest total rainfall of 535.45 mm.

The cool season starts from November to end of February. According to this data, the maximum temperature ranges from 34.7°C to 37.2°C. The minimum temperature ranges from 13.8° C to 15.7°C.

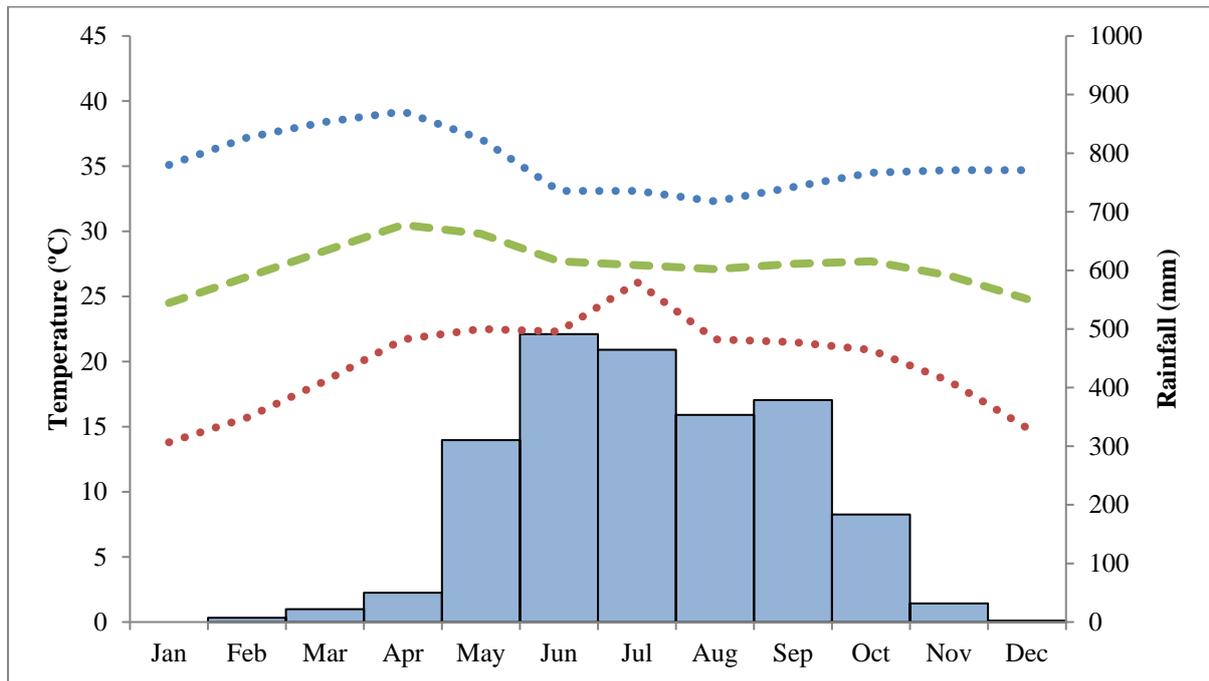
Climate play an important role in economic activities. Temperature, rainfall and humidity are influencing the climate condition of paddy cultivation in study area.

Table (2.1) Monthly Mean Temperature and Rainfall of Thanlyin Township (2009-2019)

Month	Maximum Temperature (°C)	Minimum Temperature (°C)	Mean Temperature (°C)	Rainfall (mm)
Jan	35.1	13.8	24.5	0
Feb	37.2	15.7	26.5	7.3
Mar	38.4	18.5	28.5	22
Apr	39.2	21.7	30.5	49.9
May	37.1	22.5	29.8	310.5
Jun	33.1	22.3	27.7	491.4
Jul	33.1	26.1	27.4	464.5
Aug	32.3	21.7	27.1	353.4
Sep	33.4	21.5	27.5	378.8
Oct	34.5	20.9	27.7	183.4
Nov	34.7	18.5	26.6	31.8
Dec	34.7	14.9	24.8	2.4

Source: Meteorology and Hydrology Department (Kaba-aye)

Figure (2.3) Monthly Mean Temperature and Rainfall of Thanlyin Township (2009-2019)



Source: Table (2.1)

2.5 Soils and Natural Vegetation

Soil is the most important factor for the development of agriculture in any region. Six types of soils are found in Thanlyin Township. There are-

- (1) Strongly eroded soil
- (2) Lateritic soil
- (3) Meadow laterite soil
- (4) Meadow soil
- (5) Meadow gley soil and
- (6) Meadow swampy soil and meadow swampy saline soil.

- (1) The strongly eroded soil can be found in the highest part of the hills. This type of soil is not useful for cultivation.
- (2) Lateritic soil - this type of soil is found in the ridge located in the southwest of the township, which stretches towards northwest and southeast of the township.
- (3) Meadow lateritic soil - Meadow lateritic soil is found in the smooth slope. This soil is useful for gardening.
- (4) Meadow soil - The total area of meadow soil is as wide as 16883.48 acres of the land area of the township. This type of soil is suitable for rice cultivation.

(5) Meadow Gley soil - Water needed for the cultivation of paddy is conserved in the soil. Meadow soil of the region is very fertile, paddy is the main cultivated crop of the region. It is found in the middle part and the whole eastern part of township, the area is 35327.04 acres.

(6) Meadow swampy soil and meadow swampy saline soil are found in the hollow with deep curves where rainwater collects for a long time. Meadow swampy soil can be used for rice cultivation despite its has yield. (Figure) In Thanlyin Township, deciduous and evergreen forests thrive well. The species of these forests are Kanyin, Pinyin and Pyingadow. In this area average annual rainfall is between 80 inches and 120 inches.

3. HUMAN FACTORS

3.1 Total Population and Population Growth

The total population of Thanlyin Township is 268063 persons in 2014 and 269498 persons in 2016. Thanlyin Township is made up of 17 wards and 28 village tracts. The total population and Growth rate of Thanlyin Township is 273043 persons currently living in the township in 2019. The annual growth rate is one percent normal increased in yearly.

In 2014, the total population of Thanlyin Township is 268063 persons composing 130537 males and 137526 females. In 2016, the total population of this township include to 269498 persons, composing 131842 males and 137656 females. The total population of Thanlyin Township in 2019 was 273043 persons, of which males are 131571 and females are 141472. Table (3.1).

Table (3.1) Total population and Growth Rate of Thanlyin Township (2014-2019)

Sr. No.	Year	Population (person)			Increase of Population	Growth Rate (%)
		Male	Female	Total		
1	2014	130537	137526	268063	-	-
2	2016	131842	137656	269498	+1435	1
3	2019	131571	141472	273043	+3545	1

Source: General Administration Department, Thanlyin Township

3.2 Population Distribution and Density

The distribution of population varies from place to place depending on the relief, economic activities and transportation routes. The population of Thanlyin Township is distributed in 17 wards and 28 village tracts. Densely populated village are Myoma (south) and Daraga in urban area. The sparsely populated area is found in Yenana with 3442 persons and population density with 1712 persons per sq. mile. Rural population is unevenly

distributed. In 2019, the highest density of villages are Bogyoke, Phayargon, Kyaungkoneseikgyi and Letyatsan, because these villages have favourable and availability of water and agricultural opportunity. The sparsely populated area is found in Winkani village tract because it has poor cultivated land, and it has availability to flood.

3.3 Urban and Rural Population

In 2019, the number of population living in urban area was 83223 persons (30%) and 189820 persons (70%) in rural area. The wide area and large population is rural area are favourable for the growing cultivation.

Table (3.2) Population Density of Thanlyin Township

No.	Types	Area (sq. mile)	Total Population (persons)	Population Density (person/ per sq. ml)
1	Rural	137.62	189,820	1379
2	Urban	5.94	83,223	14011

Source: General Administration Department, Thanlyin Township

Table (3.3) Urban Population Density of Thanlyin Township

No.	Name of Wards/ Village Tract	Area (sq. mile)	Total Population (persons)	Population Density (person/ per sq. ml)
1	Amuhtan	2.00	10,740	5,370
2	Aungchanthar	0.40	9,454	23,635
3	Aungmingalar	0.14	2,294	16,386
4	Bagosu	0.30	4,572	15,240
5	Daraga	0.10	6,705	67,050
6	Htanpingone	0.10	4,000	40,000
7	Myohaung (East)	0.10	16,328	163,280
8	Myohaung (Middle)	0.10	3,654	36,540
9	Myohaung (West)	0.10	3,271	32,710
10	Myoma (North)	0.04	1,729	43,225
11	Myoma (South)	0.10	5,207	52,070
12	Myothit (East)	0.10	1,100	11,000
13	Myothit (Middle)	0.02	840	42,000
14	Myothit (West)	0.03	426	14,200
15	Yenan	2.00	3,442	1,721
16	Okkphosu	0.20	5,445	27,225
17	Thauktawtwin	0.11	4,016	36,509
		5.94	83,223	14,011

Source: General Administration Department, Thanlyin Township

Table (3.4) Rural Population Density of Thanlyin Township

Sr. No.	Village Tract	Area (sq.mile)	Total Population (persons)	Population Density (person/per sq. mile)
1	Winkani	7.38	328	44
2	Phagu (East)	5.78	4986	863
3	Phagu (West)	1.8	4191	2328
4	Dazat	6.8	4329	637
5	Yonethabyegan	5.9	5136	871
6	Mingalon	9.34	4883	523
7	Bauhthabyegan	8.4	4515	538
8	Kayinseik	9.73	4030	414
9	Thabyegon	1.91	3599	1884
10	Pagantaung	5.27	3512	666
11	Alwunsoke	5.3	6695	1263
12	Kyaunggone-seikgyi	5.63	3716	660
13	Latyetsan	6.65	22480	3380
14	Thatay-kwin	3.43	3994	1164
15	Sitpin-kwin	6.4	3905	610
16	Bayet	3.08	2945	956
17	Ngapyayma	4.3	2879	670
18	Na/pa	2.26	3546	1569
19	Thanutpin	1.78	978	549
20	Bogyoke	4.58	21562	4708
21	Nyaunghthonepin	3.4	7790	2291
22	Phayagon	8.83	46445	5260
23	Laharyet	4.31	4803	1114
24	Kadatphyar	4.65	4516	971
25	Nyaunglaypin	3.43	3603	1050
26	Kalawe	3.04	4791	1576
27	Saylonegyi	2.2	1783	810
28	Chaungsauk	3.04	3880	1276
	Total	138.62	189,820	1369

Source: General Administration Department, Thanlyin Township

3.4 Age and Gender Structure

Total population of Thanlyin Township is divided into two age groups as mature population which is composed of over 18 years persons and unmatured population which is composed of under 18 years persons.

In 2019, Thanlyin Township has 166870 matured population and 106173 unmatured population forming about 61 percent and 39 percent of total population.

According to 2019 data obtained total population of Thanlyin Township is 131571 male and 141471 female form about 48.19 percent and 51.81 percent of total population.

Table (3.5) Age Structure of Thanlyin Township

Sr. No.	Urbanization	Aged Under (18) year (person)			Aged Above (18) year (person)			Total Population (person)		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
1	Rural	38,430	37,824	76,254	54,651	58,915	113,566	93,081	96,739	189,820
2	Urban	13,841	16,078	29,919	24,649	28,655	53,304	38,490	44,733	83,223
	Total	52,271	53,902		79,300	87,570		131,571	141,472	273,043

Source: General Administration Department, Thanlyin Township

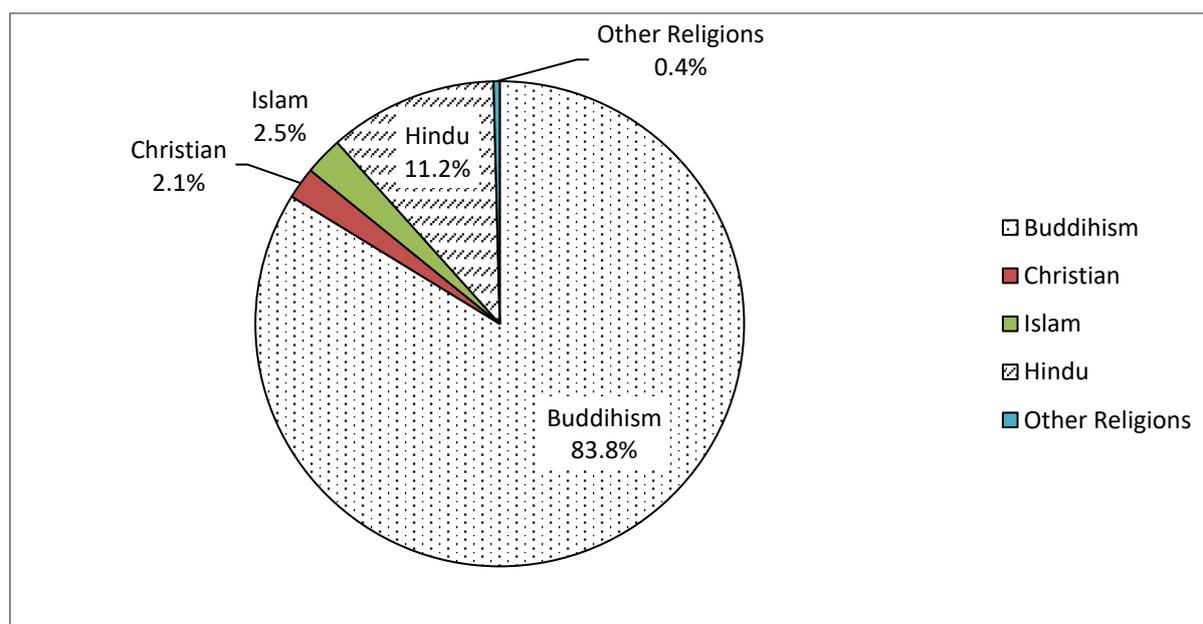
3.5 Ethnicity and Religion

The specific data concerning races and religions are not available. According to field survey and office data, most of people are Bamar and Indian. Majority of population are Buddhist and Hindus. Buddhism ranks first with 83.8 percent. Hindu ranks second with 11.2 percent in 2019.

Table (3.6) Religions of Thanlyin Township

Sr. No.	Urbanization	Buddhism	Christian	Islam	Hindu	Other Religions	Total population
1	Rural	149,920	5,456	5,341	28,059	1,044	189,820
2	Urban	78,863	302	1,552	2,448	58	83,223
	Total	228,783	5,758	6,893	30,507	1,102	273,043

Source: General Administration Department, Thanlyin Township

Figure (3.1) Religions of Thanlyin Township

Source: Table (2.6)

4. Conditions Of Rice Cultivation In Thanlyin Township

Physical bases which influence over paddy cultivation are mature of topography, climate, soil type. Paddy favors a hot, humid climate. Thanlyin Township's major crop is rice, it is found grow it. According to the 2018-2019, the total cultivated land in Thanlyin Township was 59760 acres, which accounted for 100 percent of the study area. The proportion of agricultural area is fully hundred percent in 2016-2017, the total agricultural area is 4600 acres. The people are staying at their own field, they do not transfer to another place.

4.1 Production of Monsoon Paddy

Production of Monsoon Paddy is 83% of the total production of paddy. There are mainly two types of monsoon paddy. They are dry dispersing and wet dispersing. Dry dispersing is usually carried out at the beginning of the rainy season. They are dispersed in the region surrounding with wide and deep water. Wet dispersing gets started in Myanmar month called Nayon. Preparing land, appropriate cultivating system, applying fertilizer, utilizing bio-fertilizer, using standardized seeds are basically considered and cultivated.

The commonly cultivated types of paddy are Sin Thukha, Sinn Thwel Latt, Pathein Yar Kyaw, Pale' Thwe, Manaw Thukha. Paddy likes hot and wet weather. They are more productive in the land without salt. They are also more productive in the sour soil. The monsoon paddy has to be watered until they sprout. Only if enough water is stored, the seeds are dispersed. After three nights, water in the field is drained out. After draining out for five nights, the natural fertilizer, and other bio-fertilizer are used. When duration of the plantation is 15 days old, the fertilizer needs to be dispersed. When they are 25 days or 30 days old, they need to be transplanted. They need to be carefully and systematically planted. When they are 3 months old, the shoots appear. After 4 months, in Thidingyut, the paddy are reaped and after four and a half month, the cultivating process is finished.

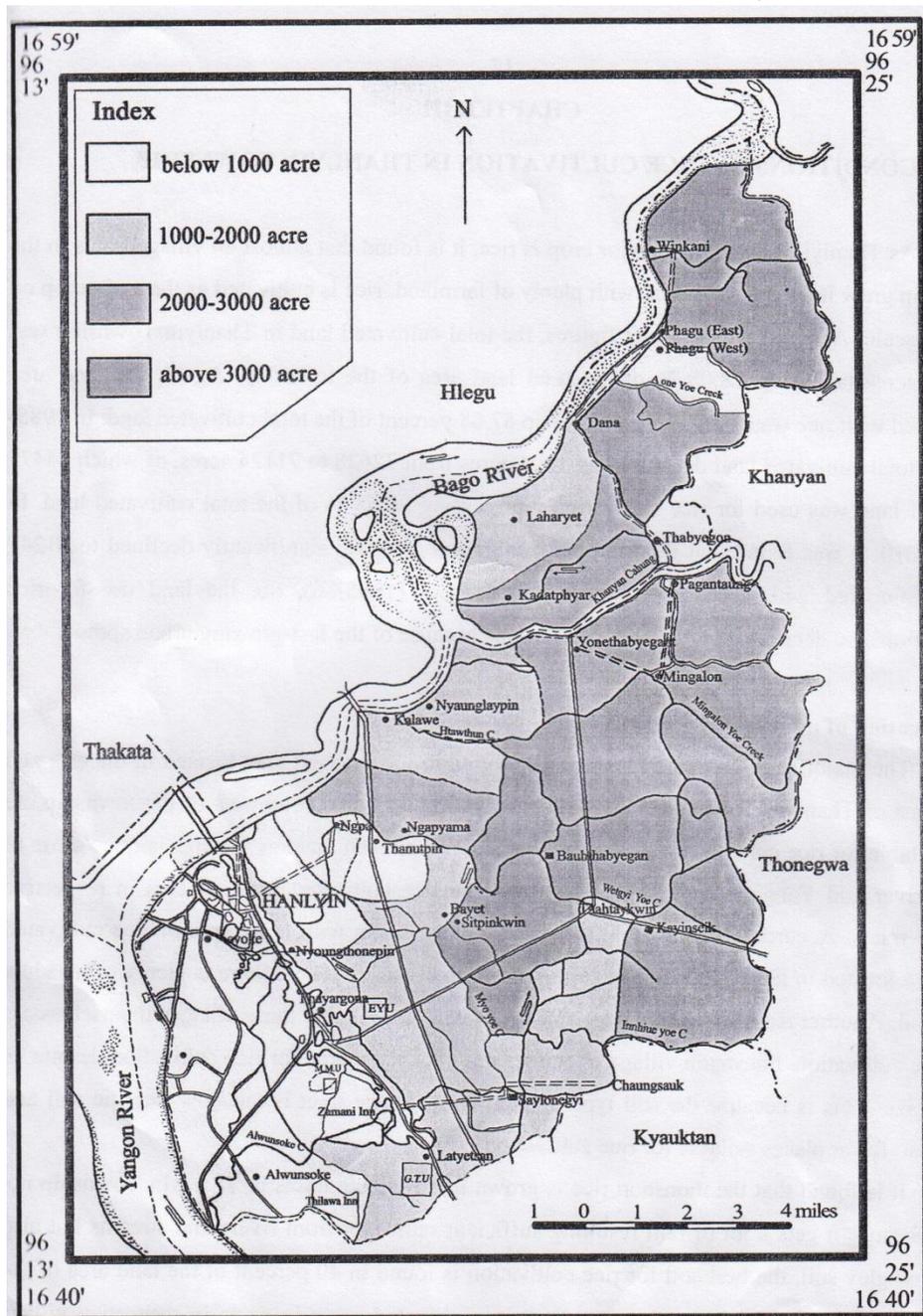
4.2 Location of Monsoon Rice Cultivation

The agriculture or rice favours best, himid climate. It requires temperatures above 16°C-27°C and it needs 100mm-200mm during the growing period. Paddy tertiaryes best on alluvial soil above clay subsoil. The majority of cultivated land can be found in the lowland area located in the east and northeast of Thanlyin Township. Tables show the rice cultivated area in acres in respective village tracts.

Figure (3.1) shows the monsoon rice cultivated areas in respective village tracts in four groups. The first comprises these each of which with an area under 100 acres, while the

second and third groups list the monsoon rice cultivated areas which ranges between 1000 and 2000 acres, and between 2000 and 3000 acres respectively. The fourth groups is made up of those with an area over 3000 acres. The village tracts in the third and fourth groups are mostly found in the eastern and middle part of the township as they have meadow gley soil, the best type for rice cultivated area with the fewest area are mostly found in the west of the township.

Figure (4.1) Distribution of Monsoon Rice Cultivation in Thanlyin Township (2019)



Source: Land Survey Department (Thanlyin)

4.3 Production of Summer Paddy

In Myanmar, a total of (18) million acres consisting (14)million acres of monsoon paddy and (4)million acres of summer paddy are aimed to cultivate since 1992-1993. The paddy cultivated from 1st October to the end of April is regarded as the summer paddy.

The summer paddy is cultivated by applying different ways of achieving water. The area of paddy depends on the access of water, diesel. The paddy likes to grow in the clay type of soil. They are differentiated into two types according to the life span of the paddy and the seasons of the cultivation.

Some types of paddy begin sprouting in Tazaungmone whenever they are cultivated. Some sprout only if they are due. The production of good paddy type is between (60-100) Tinn. In planting paddy, direct seeding and transplanting is common. Direct seeding should be implemented when there is not enough labour, the field is near the dam or the type is the summer paddy. There are two types of seeding, wet and dry type. If the paddy is transplanted, the cultivating field must be separated.

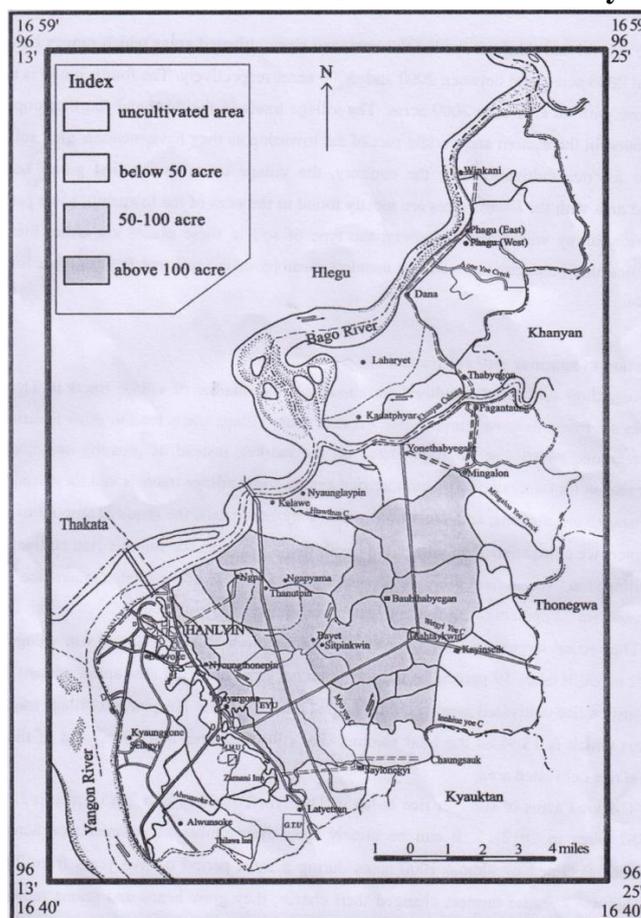
4.4 Location of Summer Rice Cultivation

Summer rice cultivation, about half the number of village tracts in Thanlyin Township are found to grow summer rice. Paddy favours hot and wet areas since it likes high relative humidity. In areas of low rainfall, rice may be cultivated with the help of irrigation. The village tract with largest area for summer rice cultivation is Bayet village tract which has 439 acres, accounting to 26 percent of the total summer rice fields.

The second largest area of summer rice cultivation is found in Sitpinkwin village tract with 308 acres. The third largest area is found in Ngapyayma village tract with 285 acres. In Thanlyin Township, the total acre of summer rice fields was 2038 acres in 2018-2019.

Figure (3.2) shows summer rice cultivated can be put under four group depending on the size of the area. In the first group are the largest size with an area over 100 acres. In the second largest size, with a range of 50-100 acres, the third below 50 acers and the fourth with no cultivated area.

The second largest summer rice cultivated area namely Bayet, Sitpinkwin and Ngapyayama village tracts are found to be situated in the middle of the township. For the paddy plants to for the paddy plants to grow well, the soil has to be fairly fertile. Soil with capacity to retain mature is the best soil for rice cultivation. Therefore, it is found that the success of rice cultivation mainly depends on soil, water source and weather conditions.

Figure (4.2) Distribution of Summer Rice Cultivation in Thanlyin Township (2019)

Source: Land Survey Department (Thanlyin)

4.5 Production of Rice

In 2018-2019, the total acreage of the monsoon rice fields was 59,800 acres with a yield of 4365400 baskets of rice. Total basket of rice produced from 2038 acres of summer rice cultivation, 132470 baskets.

On the studying of sown acreage of the crop cultivated in Thanlyin Township, paddy is found to be the largest sown crop. To study the production pattern of rice cultivation, analysis is made on rice cultivation over 5 years from 2014-2015 to 2018-2019.

Pagantaung village tract produces 70 baskets of rice per acre, the maximum yield per acre for the monsoon rice cultivation. Latyetsan village tract produces 69 baskets of rice per acre, the seasonal maximum yield per acre for the monsoon rice cultivation. Winkani village tract produces the minimum yield of 66 baskets per acre.

Harvested acreage raise and fall are depending on the conditions of weather and pests. Yield per acre of paddy varies depending upon the climatic conditions, types of paddy, the

use of fertilizers and the method of farming. During the five years from 2014-2015 to 2018-2019, the yield per acre was the highest with 175420 baskets in 2018-2019.

Table (4.1) Monsoon Rice Cultivated area in the village tracts of Thanlyin Township (2014-2015)

Sr. No.	Village Tract	Sowned Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	3,400	3,405	67	228,135
2	Phagu (East)	3,280	3,280	69	226,320
3	Phagu (West)	920	925	68	62,900
4	Dazat	3,602	3,602	69	248,538
5	Yonethabyegan	2,680	2,685	67	179,895
6	Mingalon	5,100	5,100	73	372,300
7	Bauhthabyegan	4,600	4,600	70	322,000
8	Kayinseik	5,700	5,700	72	410,400
9	Thabyegon	1,040	1,040	72	74,880
10	Pagantaung	2,526	2,520	72	181,440
11	Alwunsoke	1000	1000	70	70,000
12	Kyaunggone-seikgyi	598	598	71	42,458
13	Latyetsan	1,780	1,780	70	124,600
14	Thatay-kwin	1,927	1,927	71	136,817
15	Sitpin-kwin	3,500	3,500	74	259,000
16	Bayet	1,790	1,790	71	127,090
17	Ngapyayma	2,320	2,320	70	162,400
18	Na/pa	890	890	70	62,300
19	Thanutpin	970	970	71	68,870
20	Bogyoke	825	825	68	56,100
21	Nyaungthonepin	1,577	1,577	69	108,813
22	Phayagon	1,275	1,280	68	87,040
23	Laharyet	1,434	1,434	69	98,946
24	Kadatphyar	2,517	2,517	70	176,190
25	Nyaunglaypin	1,200	1,215	70	85,050
26	Kalawe	1,338	1,338	69	92,322
27	Saylonegyi	1,088	1,088	68	73,984
28	Chaungsauk	1,735	1,735	70	121,450
		60,612	60,641	69	4,184,229

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (4.2) Summer Rice Cultivated area in the village tracts of Thanlyin Township (2014-2015)

Sr. No.	Village Tract	Sown Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	-	-	-	-
2	Phagu (East)	-	-	-	-
3	Phagu (West)	-	-	-	-
4	Dazat	-	-	-	-
5	Yonethabyegan	29	29	20	580
6	Mingalon	-	-	-	-
7	Bauhthabyegan	162	164	50	8,200
8	Kayinseik	-	-	-	-
9	Thabyegon	-	-	-	-
10	Pagantaung	-	-	-	-
11	Alwunsoke	-	-	-	-
12	Kyaunggone-seikgyi	-	-	-	-
13	Latyetsan	-	-	-	-
14	Thatay-kwin	58	66	35	2,310
15	Sitpin-kwin	302	308	63	19,404
16	Bayet	439	439	69	30,291
17	Ngapyayma	281	285	60	17,100
18	Na/pa	96	96	35	3,360
19	Thanutpin	247	247	52	12,844
20	Bogyoke	-	-	-	-
21	Nyaungthonepin	121	121	37	4,477
22	Phayagon	150	152	40	6,080
23	Laharyet	-	-	-	-
24	Kadatphyar	-	-	-	-
25	Nyaunglaypin	74	80	30	2,400
26	Kalawe	26	30	20	600
27	Saylonegyi	15	21	18	378
28	Chaungsauk	-	-	-	-
		2,000	2,038	62	126,356

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (4.3) Monsoon Rice Cultivated area in the village tracts of Thanlyin Township (2015-2016)

Sr. No.	Village Tract	Sowned Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	3,400	3,405	66	224,730
2	Phagu (East)	3,280	3,280	67	219,760
3	Phagu (West)	920	925	65	60,125
4	Dazat	3,602	3,602	66	237,732
5	Yonethabyegan	2,680	2,685	65	174,525
6	Mingalon	5,100	5,100	70	357,000
7	Bauhthabyegan	4,600	4,600	65	299,000
8	Kayinseik	5,700	5,700	70	399,000
9	Thabyegon	1,040	1,040	68	70,720
10	Pagantaung	2,526	2,520	70	176,400
11	Alwunsoke	1000	1000	69	69,000
12	Kyaunggone-seikgyi	598	598	65	38,870
13	Latyetsan	1,780	1,780	68	121,040
14	Thatay-kwin	1,927	1,927	67	129,109
15	Sitpin-kwin	3,500	3,500	70	245,000
16	Bayet	1,790	1,790	69	123,510
17	Ngapyayma	2,320	2,320	67	155,440
18	Na/pa	890	890	68	60,520
19	Thanutpin	970	970	67	64,990
20	Bogyoke	825	825	62	51,150
21	Nyaungthonepin	1,577	1,577	66	104,082
22	Phayagon	1,275	1,280	65	83,200
23	Laharyet	1,434	1,434	65	93,210
24	Kadatphyar	2,517	2,517	66	166,122
25	Nyaunglaypin	1,200	1,215	65	78,975
26	Kalawe	1,338	1,338	66	88,308
27	Saylonegyi	1,088	1,088	64	69,632
28	Chaungsauk	1,735	1,735	65	112,775
		60,612	60,641	65	3,941,665

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (4.4) Summer Rice Cultivated area in the village tracts of Thanlyin Township (2015-2016)

Sr. No.	Village Tract	Sowned Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	-	-	-	-
2	Phagu (East)	-	-	-	-
3	Phagu (West)	-	-	-	-
4	Dazat	-	-	-	-
5	Yonethabyegan	29	29	15	435
6	Mingalon	-	-	-	-
7	Bauhthabyegan	162	164	40	6,560
8	Kayinseik	-	-	-	-
9	Thabyegon	-	-	-	-
10	Pagantaung	-	-	-	-
11	Alwunsoke	-	-	-	-
12	Kyaunggone-seikgyi	-	-	-	-
13	Latyetsan	-	-	-	-
14	Thatay-kwin	58	66	28	1,848
15	Sitpin-kwin	302	308	60	18,480
16	Bayet	439	439	65	28,535
17	Ngapyayma	281	285	56	15,960
18	Na/pa	96	96	30	2,880
19	Thanutpin	247	247	48	11,856
20	Bogyoke	-	-	-	-
21	Nyaungthonepin	121	121	32	3,872
22	Phayagon	150	152	35	5,320
23	Laharyet	-	-	-	-
24	Kadatphyar	-	-	-	-
25	Nyaunglaypin	74	80	25	2,000
26	Kalawe	26	30	14	420
27	Saylonegyi	15	21	12	252
28	Chaungsauk	-	-	-	-
		2,000	2,038	56	114,128

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (4.5) Monsoon Rice Cultivated area in the village tracts of Thanlyin Township (2016-2017)

Sr. No.	Village Tract	Sown Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	3,400	3,405	67	228,135
2	Phagu (East)	3,280	3,280	69	226,320
3	Phagu (West)	920	925	71	65,675
4	Dazat	3,602	3,602	72	259,344
5	Yonethabyegan	2,680	2,685	69	185,265
6	Mingalon	5,100	5,100	72	367,200
7	Bauhthabyegan	4,600	4,600	73	335,800
8	Kayinseik	5,700	5,700	73	416,100
9	Thabyegon	1,040	1,040	70	72,800
10	Pagantaung	2,526	2,520	72	181,440
11	Alwunsoke	1000	1000	70	70,000
12	Kyaunggone-seikgyi	598	598	67	40,066
13	Latyetsan	1,780	1,780	71	126,380
14	Thatay-kwin	1,927	1,927	72	138,744
15	Sitpin-kwin	3,500	3,500	72	252,000
16	Bayet	1,790	1,790	72	128,880
17	Ngapyayma	2,320	2,320	70	162,400
18	Na/pa	890	890	70	62,300
19	Thanutpin	970	970	70	67,900
20	Bogyoke	825	825	65	53,625
21	Nyaungthonepin	1,577	1,577	71	111,967
22	Phayagon	1,275	1,280	70	89,600
23	Laharyet	1,434	1,434	73	104,682
24	Kadatphyar	2,517	2,517	70	176,190
25	Nyaunglaypin	1,200	1,215	72	87,480
26	Kalawe	1,338	1,338	73	97,674
27	Saylonegyi	1,088	1,088	69	75,072
28	Chaungsauk	1,735	1,735	71	123,185
		60,612	60,641	79	4,790,639

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (4.6) Summer Rice Cultivated area in the village tracts of Thanlyin Township (2016-2017)

Sr. No.	Village Tract	Sowned Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	-	-	-	-
2	Phagu (East)	-	-	-	-
3	Phagu (West)	-	-	-	-
4	Dazat	-	-	-	-
5	Yonethabyegan	29	29	17	493
6	Mingalon	-	-	-	-
7	Bauhthabyegan	162	164	44	7,216
8	Kayinseik	-	-	-	-
9	Thabyegon	-	-	-	-
10	Pagantaung	-	-	-	-
11	Alwunsoke	-	-	-	-
12	Kyaunggone-seikgyi	-	-	-	-
13	Latyetsan	-	-	-	-
14	Thatay-kwin	58	66	30	1,980
15	Sitpin-kwin	302	308	64	19,712
16	Bayet	439	439	70	30,730
17	Ngapyayma	281	285	60	17,100
18	Na/pa	96	96	32	3,072
19	Thanutpin	247	247	50	12,350
20	Bogyoke	-	-	-	-
21	Nyaungthonepin	121	121	35	4,235
22	Phayagon	150	152	38	5,776
23	Laharyet	-	-	-	-
24	Kadatphyar	-	-	-	-
25	Nyaunglaypin	74	80	30	2,400
26	Kalawe	26	30	15	450
27	Saylonegyi	15	21	13	273
28	Chaungsauk	-	-	-	-
		2,000	2,038	60	122,280

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (4.7) Monsoon Rice Cultivated area in the village tracts of Thanlyin Township (2017-2018)

Sr. No.	Village Tract	Sowned Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	3,400	3,400	66	224,400
2	Phagu (East)	3,280	3,280	67	219,760
3	Phagu (West)	920	927	70	64,890
4	Dazat	3,602	3,602	70	252,140
5	Yonethabyegan	2,680	2,682	67	179,694
6	Mingalon	5,100	5,100	70	357,000
7	Bauhthabyegan	4,600	4,600	70	322,000
8	Kayinseik	5,700	5,700	71	404,700
9	Thabyegon	1,040	1,040	68	70,720
10	Pagantaung	2,526	2,520	72	181,440
11	Alwunsoke	1000	1000	68	68,000
12	Kyaunggone-seikgyi	598	598	65	38,870
13	Latyetsan	1,780	1,780	70	124,600
14	Thatay-kwin	1,927	1,927	71	136,817
15	Sitpin-kwin	3,500	3,500	70	245,000
16	Bayet	1,790	1,790	71	127,090
17	Ngapyayma	2,320	2,320	69	160,080
18	Na/pa	890	885	69	61,065
19	Thanutpin	970	970	70	67,900
20	Bogyoke	825	825	60	49,500
21	Nyaungthonepin	1,577	1,577	70	110,390
22	Phayagon	1,275	1,280	69	88,320
23	Laharyet	1,434	1,434	72	103,248
24	Kadatphyar	2,517	2,517	68	171,156
25	Nyaunglaypin	1,200	1,210	70	84,700
26	Kalawe	1,338	1,338	71	94,998
27	Saylonegyi	1,088	1,088	67	72,896
28	Chaungsauk	1,735	1,735	69	119,715
		60,612	60,625	78	4,728,750

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (4.8) Summer Rice Cultivated area in the village tracts of Thanlyin Township (2017-2018)

Sr. No.	Village Tract	Sowned Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	-	-	-	-
2	Phagu (East)	-	-	-	-
3	Phagu (West)	-	-	-	-
4	Dazat	-	-	-	-
5	Yonethabyegan	29	29	21	609
6	Mingalon	-	-	-	-
7	Bauhthabyegan	162	164	51	8,364
8	Kayinseik	-	-	-	-
9	Thabyegon	-	-	-	-
10	Pagantaung	-	-	-	-
11	Alwunsoke	-	-	-	-
12	Kyaunggone-seikgyi	-	-	-	-
13	Latyetsan	-	-	-	-
14	Thatay-kwin	58	66	38	2,508
15	Sitpin-kwin	302	308	72	22,176
16	Bayet	439	439	77	33,803
17	Ngapyayma	281	285	69	19,665
18	Na/pa	96	96	42	4,032
19	Thanutpin	247	247	60	14,820
20	Bogyoke	-	-	-	-
21	Nyaungthonepin	121	121	45	5,445
22	Phayagon	150	152	47	7,144
23	Laharyet	-	-	-	-
24	Kadatphyar	-	-	-	-
25	Nyaunglaypin	74	80	40	3,200
26	Kalawe	26	30	25	750
27	Saylonegyi	15	21	22	462
28	Chaungsauk	-	-	-	-
		2,000	2,038	70	142,660

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (4.9) Monsoon Rice Cultivated area in the village tracts of Thanlyin Township (2018-2019)

Sr. No.	Village Tract	Sowned Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	3,245	3,245	66	214,170
2	Phagu (East)	3,123	3,123	67	209,241
3	Phagu (West)	908	911	69	62,859
4	Dazat	3,502	3,502	69	241,638
5	Yonethabyegan	2,611	2,615	68	177,820
6	Mingalon	5,060	5,060	69	349,140
7	Bauhthabyegan	4,595	4,595	68	312,460
8	Kayinseik	5,655	5,655	68	384,540
9	Thabyegon	1,017	1,017	67	68,139
10	Pagantaung	2,506	2,506	70	175,420
11	Alwunsoke	977	977	66	64,482
12	Kyaunggone-seikgyi	564	568	55	31,240
13	Latyetsan	1,756	1,760	69	121,440
14	Thatay-kwin	1,907	1,907	69	131,583
15	Sitpin-kwin	3,484	3,484	67	233,428
16	Bayet	1,783	1,783	67	119,461
17	Ngapyayma	2,300	2,300	67	154,100
18	Na/pa	871	876	65	56,940
19	Thanutpin	958	958	68	65,144
20	Bogyoke	805	805	53	42,665
21	Nyaungthonepin	1,577	1,577	66	104,082
22	Phayagon	1,255	1,265	62	78,430
23	Laharyet	1,434	1,434	65	93,210
24	Kadatphyar	2,517	2,517	67	168,639
25	Nyaunglaypin	1,191	1,201	60	72,060
26	Kalawe	1,338	1,338	63	84,294
27	Saylonegyi	1,088	1,088	58	63,104
28	Chaungsauk	1,733	1,733	66	114,378
		59,760	59,800	73	4,365,400

Source: Administration of Farmland and Statistics Department in Thanlyin Township

Table (4.10) Summer Rice Cultivated area in the village tracts of Thanlyin Township (2018-2019)

Sr. No.	Village Tract	Sowned Area (acres)	Matured Area (acres)	Yield per Acre (Baskets)	Production in Baskets
1	Winkani	-	-	-	-
2	Phagu (East)	-	-	-	-
3	Phagu (West)	-	-	-	-
4	Dazat	-	-	-	-
5	Yonethabyegan	29	29	19	551
6	Mingalon	-	-	-	-
7	Bauhthabyegan	162	164	49	8,036
8	Kayinseik	-	-	-	-
9	Thabyegon	-	-	-	-
10	Pagantaung	-	-	-	-
11	Alwunsoke	-	-	-	-
12	Kyaunggone-seikgyi	-	-	-	-
13	Latyetsan	-	-	-	-
14	Thatay-kwin	58	66	33	2,178
15	Sitpin-kwin	302	308	69	21,252
16	Bayet	439	439	74	32,486
17	Ngapyayma	281	285	63	17,955
18	Na/pa	96	96	39	3,744
19	Thanutpin	247	247	56	13,832
20	Bogyoke	-	-	-	-
21	Nyaungthonepin	121	121	40	4,840
22	Phayagon	150	152	42	6,384
23	Laharyet	-	-	-	-
24	Kadatphyar	-	-	-	-
25	Nyaunglaypin	74	80	35	2,800
26	Kalawe	26	30	19	570
27	Saylonegyi	15	21	17	357
28	Chaungsauk	-	-	-	-
		2,000	2,038	65	132,470

Source: Administration of Farmland and Statistics Department in Thanlyin Township

5. CONCLUSION

Thanlyin Town is located on the south of Yangon Region. It lies between north latitudes 16° 40' and 16° 59' and between east longitudes 96° 13' and 96° 25'. Thanlyin Township has an area of 143.98 square miles. Thanlyin Township is elongated shape.

The population worldwide is rapidly increasing day by day. According, it is important to provide the increasing number of people with sufficient food.

In 2014-2015, yield per acre and production of rice was high 73.49 baskets, acre and 4184436 baskets. In 2018-2019, yield per acre and production of rice was high 73 baskets and 3865410 baskets.

Thanlyin Township can cultivate and produce both monsoon and summer rice successfully due to its topography, soil type and suitable weather conditions.

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- (2019): *oefvsifNrdKU\ a'oqdkif&mtcsuftvufsrsm;? taxGaxG tkyfcsKyfa&;OD;pD;Xme? NrdKUe,fv,f,majrpDrHcefYcJGa&;ESihf pm&if;tif;OD;pD;Xme? oefvsifNrdKU?*

INFORMATION TECHNOLOGY BY BOOLEAN CONSTANTS

Moh Moh Kyi ¹

Abstract

This paper expresses the applications of Boolean algebra by Boolean constants with the technical applications. First we have to express with rooted tree, binary tree, ordered tree and expression tree as the case of the graph in discrete version. Then we have to express the prefix code tree by encoding and decoding. According to the transformation of encoding to decoding and decoding to encoding, we can connect with discrete version and Boolean version over communications line. In addition probability version too.

Key Words: prefix code tree, encoding and decoding.

INTRODUCTION

This paper has three parts to be expressed that the connection of the discrete mathematics and *Boolean* algebra. For this paper, we have to start with rooted tree, binary tree, ordered tree and expression tree from the version of discrete mathematics, and then the prefix code tree in the second. In addition the prefix code tree is not only the foundation of rooted tree, binary tree, ordered tree and expression tree but also applications to *Boolean* algebra by using encoding and decoding. Over the communications line the technical applications are going to be informed by transformation of encoding to decoding and decoding to encoding. Here encoding is the length of bit string with *Boolean* constants 0,1 and decoding is the message of the alphabets according to the indicated path of the encoding. Finally, we have to express the relation of the prefix code tree and the tree diagrams of some probability trees.

OBJECTIVES

This paper is intended to be express as the technical information by the connection of the versions of Boolean algebra and discrete mathematics with encoding and decoding in the prefix code tree. Then probability version is too. The information appears over the communications line.

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INFORMATION TECHNOLOGY BY BOOLEAN CONSTANTS

Materials & Methods

1. Boolean Algebra

A Boolean algebra $(B, \wedge, \vee, ')$ is a non empty set B together with two binary operations \wedge and \vee on B and a unary operation $'$ on B satisfying the following axioms for all x, y, z in B .

- | | | |
|--|---|------------------|
| 1. $x \wedge y = y \wedge x$ | } | Commutative law |
| 2. $x \vee y = y \vee x$ | | |
| 3. $x \wedge (y \wedge z) = (x \wedge y) \wedge z$ | } | Associative law |
| 4. $x \vee (y \vee z) = (x \vee y) \vee z$ | | |
| 5. $x \wedge (y \vee z) = (x \wedge y) \vee (x \wedge z)$ | } | Distributive law |
| 6. $x \vee (y \wedge z) = (x \vee y) \wedge (x \vee z)$ | | |
| 7. There is a zero element 0 in B such that $x \vee 0 = x$ | | |
| 8. There is a unit element 1 in B such that $x \wedge 1 = x$ | | |
| 9. $x \wedge x' = 0$ | | |
| 10. $x \vee x' = 1$ | | |

where zero element $0 \in B$ is a least element of B and unit element $1 \in B$ is a greatest element of B for all elements in B (i.e., $0 \leq x \leq 1, \forall x \in B$).

Example

Let $A = \{1, 2\}$ be a non empty set and $P(A)$ be the set of all subsets of A . Then

$P(A) = \{\Phi, \{1\}, \{2\}, \{1, 2\}\}$ has $2^2 = 4$ elements.

Then $\{1\} \cap \{2\} = \Phi$,

$$\{1\} \cup \{2\} = \{1, 2\} = A$$

The above shows that the set $P(A)$ has a least element Φ and a greatest element

A. The complement of set $\{1\}$ is $\{2\}$ and the complement of $\{2\}$ is $\{1\}$.

Therefore $\langle P(A), \cap, \cup, ' \rangle$ is a Boolean algebra because all axioms of Boolean algebra are also satisfied.

Terminology

- (i) $x \wedge y$ (meet of x and y)
- (ii) $x \vee y$ (join of x and y)
- (iii) x' (complement of x)
- (iv) 0 (zero element (or) least element)
- (v) 1 (unit element (or) greatest element)

Theorem

The complement of a Boolean algebra is unique.

(If $a \wedge b = 0$, $a \vee b = 1$, then $b = a'$, $\forall a, b \in B$.)

Proof

For any $a, b \in B$. Then

$$\begin{aligned}
 b &= b \vee 0 \\
 &= b \vee (a \wedge a') \\
 &= (b \vee a) \wedge (b \vee a') \\
 &= 1 \wedge (b \vee a') \\
 &= b \vee a' \\
 a' &= a' \vee 0 \\
 &= a' \vee (a \wedge b) \\
 &= (a' \vee a) \wedge (a' \vee b) \\
 &= 1 \wedge b \\
 &= b
 \end{aligned}$$

Example

Let A be the set of all positive integers which are integral divisions of 20. Then $\langle A, \wedge, \vee, ' \rangle$ is a Boolean algebra.

$\langle A, \wedge, \vee, ' \rangle$ is a Boolean algebra.

Proof: $A = \{1, 2, 4, 5, 10, 20\}$

For any $x, y \in A$. Let $x \wedge y$ be g.c.d (greatest common divisor), $x \vee y$ be l.c.m (least common multiple) and $x' = \frac{20}{x}$

Then

$$4 \wedge 5 = 1, 4 \vee 5 = 20 \text{ and } 5' = 4$$

$$2 \wedge 4 = 2, 2 \vee 4 = 4 \text{ and } 2' = 10$$

Thus $\langle A, \wedge, \vee, ' \rangle$ is a Boolean algebra.

2. Tree

Trees are connected graph with no closed trails. Here a trail is a walk with distinct edges.

3. Rooted tree

A tree with the additional structure of having one vertex designated as the root is called a rooted tree.

Example of Rooted Tree

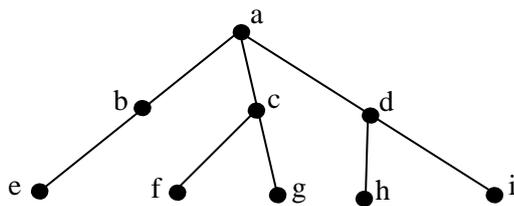


Figure 1: A rooted tree

4. Subtree of a Tree

Subtree of a Tree is a subgraph of the tree.

Example of Subtree

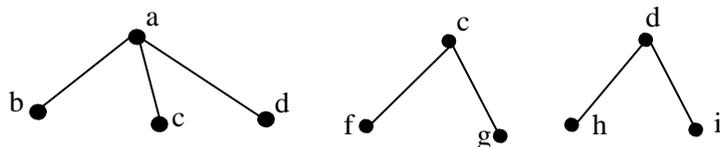


Figure 2: Three subtrees of figure 1.

The above figure shows three subtrees come from a rooted tree of figure 1.

5. Level of the vertex v in a Rooted Tree

Level of the vertex v in a rooted tree is the length of the unique path from the root to v, thus the root is at level 0, the vertices adjacent to the root are at level 1 and so on.

Example of a Rooted Tree with level

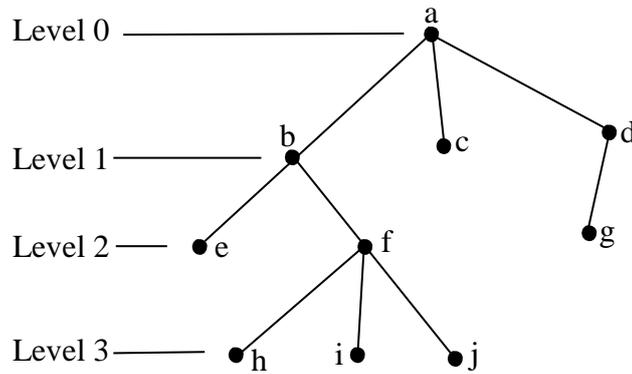


Figure 3: A rooted tree with level 3.

The above figure shows that there are 3 levels, here, ‘a’ is a root at level ‘0’. The vertices b,c,d are at level ‘1’ they are adjacent from ‘a’. The vertices e,f,g are at level ‘2’ here the vertex e and f are adjacent from b and the vertex g is adjacent from d. level 3 vertices are h,i and j they are adjacent from f.

6. Binary Tree

A binary tree is a rooted tree with each vertex has either two branches (both left and right) or only one branch (left or right) for every vertices at level i, $i \geq 1$.

Example of a Binary Tree

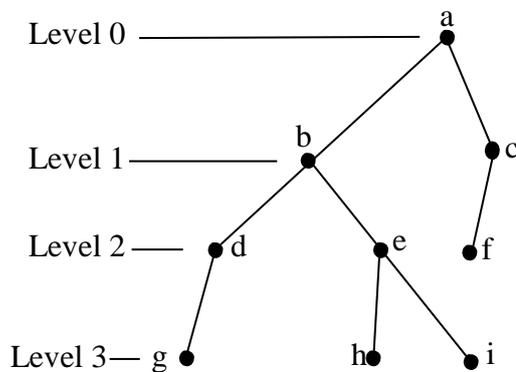


Figure 4: A binary tree

The above figure shows a vertex 'a' is at level 0, ab and ac are left branch and right branch of a. the vertices b and c are at level 1, bd and be are left and right branches of b, cf is only left branch of c. Similarly, the vertices d,e,f are at level 2 and the vertices g,h,i are at level 3 here dg and eh are two left branches of d and e respectively. But ei is a right branch of e.

7. Order tree

An ordered tree is a rooted tree in which the branches of each vertex are shown in order from left to right.

8. Expression Tree

Expression tree is an ordered tree in which leaves represent variables or constants and internal vertices represent operations being applied to the values of their branches.

Example of Expression Tree

The expression tree for $(3+2) \cdot 5$ as the following figure. Consider the expression tree for the calculation $(3 + 2) \cdot 5$. First we consider the addition operation $(3 + 2)$ and then the multiplication operation for the remaining 5 as shown in the following figure from bottom to up position.

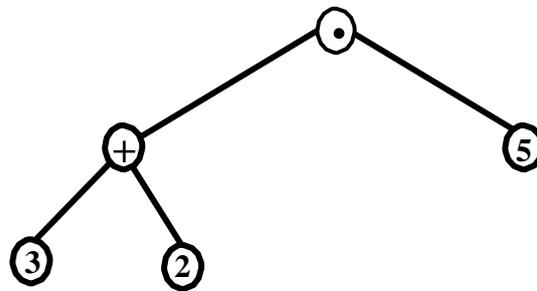


Figure 5 : Expression tree for $(3+2) \cdot 5$

Example of Expression Tree

Consider the expression tree for Boolean expression $(a \wedge b) \vee (b' \wedge c)$. It can be expressed as follows:

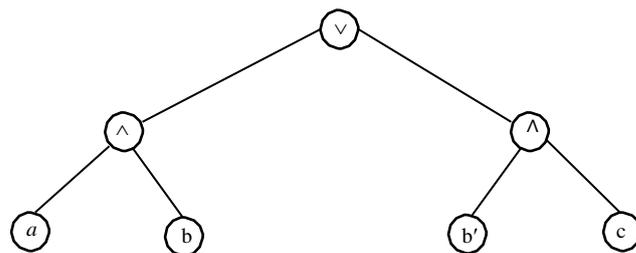


Figure 6 : Expression tree for $(a \wedge b) \vee (b' \wedge c)$

In figure 6, first we have to consider the two brackets $(a \wedge b)$ and $(b' \wedge c)$ and then ‘ \vee ’ join operation for the given expression.

9. Calculation of Boolean Values (or) Boolean Constants

Let us denote Boolean constant 1 for leaf x and 0 for leaf x' .

Example

Consider the expression tree for the expression $(a \wedge b) \vee (a' \wedge c)$. It can be shown as the following figure.

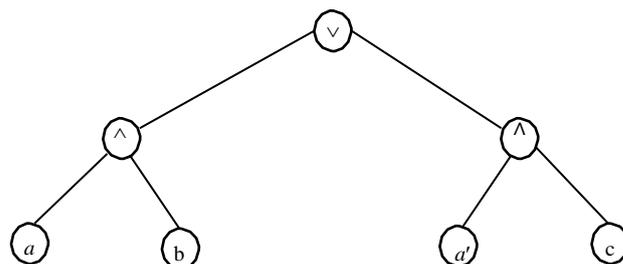


Figure 7(a) : Expression tree for $(a \wedge b) \vee (a' \wedge c)$

There are four leaves in the above figure. Let us denote for the leaf $a = b = c = 1$. Then $a' = b' = c' = 0$. Thus we obtain the following expression tree by substituting the corresponding Boolean constants in place of the given expression in figure 7.

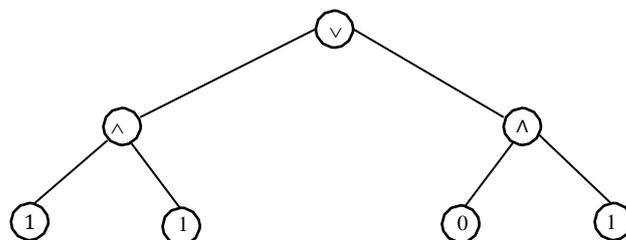


Figure 7(b) : Expression tree by Boolean constants

Figure 7 shows that the new expression tree of figure 7 by substituting Boolean constants 0, 1. Here $1 \wedge 1 = 1$ and $0 \wedge 1 = 0$. Thus $(1 \wedge 1) \vee (0 \wedge 1)$ gives $1 \vee 0 = 1$. Thus the value of the given expression tree by Boolean constant is 1.

Example

Consider the expression tree for the expression $(a \vee b) \wedge (c \wedge b')$. It can be represented by the following expression tree.

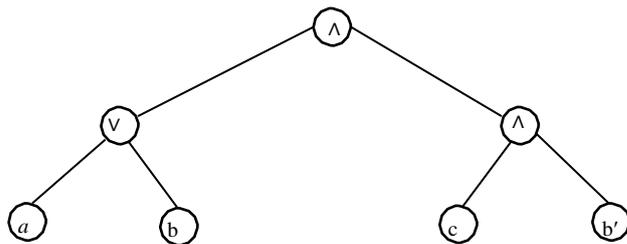


Figure 8 : Expression tree for $(a \vee b) \wedge (c \wedge b')$

The above expression tree as shown in figure 8 can be represented by the following expression tree as shown in figure 9. Here we have to replace the Boolean constant 1 in place of the leaves a and b . Similarly Boolean constant 0 takes place in leaf b' .

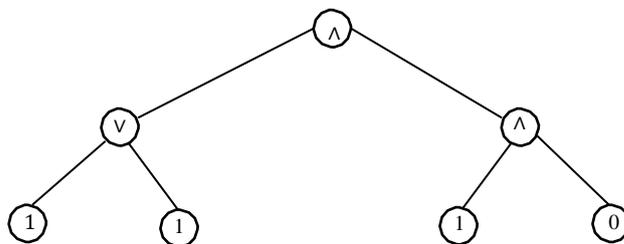


Figure 9 : Expression tree by Boolean constants

We have to calculate Boolean values for the above expression $(1 \vee 1) \wedge (1 \wedge 0) = 1 \wedge 0$ gives the value 0.

Example

Consider the expression tree for the expression $(a \wedge b) \vee (a \wedge c) \vee (a' \wedge b')$. It can be represented by the following expression tree.

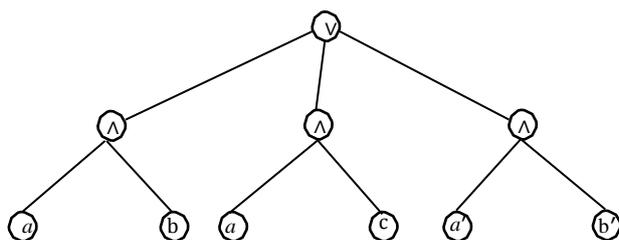


Figure 10: Expression tree for $(a \wedge b) \vee (a \wedge c) \vee (a' \wedge b')$

Here the leaves a, b the leaves a, c and the leaves a', b' are level 2 vertices. They are separated from each level 1 vertices with 3 meet operation leaves. Then these three meet operations are separated from a level 0 vertex with the leaf join operation. Thus we obtain the given expression.

On the other hand, we have to substitute the value ‘1’ in place of the leaves a, b, a, c and the value 0 in place of the leaves a', b' . Therefore we get the following expression tree again.

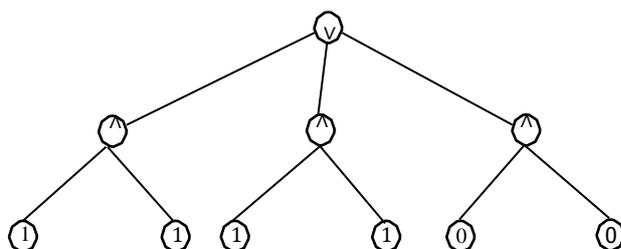


Figure 11: Expression tree by Boolean constants

From figure 11, we can calculate the value of the given expression $(1 \wedge 1) \vee (1 \wedge 1) \vee (0 \wedge 0) = 1 \vee 1 \vee 0 = 1$. So the figure 11 gives the value 1.

Example

Expression tree for the Boolean expression $(a' \vee b) \wedge (b' \vee c') \wedge (a \vee c')$ can be represented by the following figure.

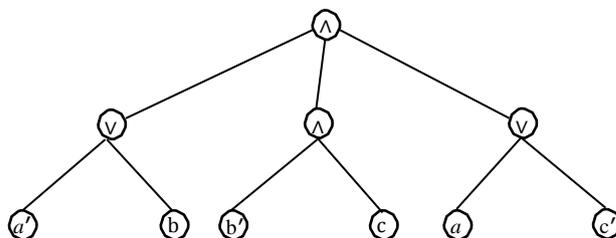


Figure 12: Expression tree for Boolean expression $(a' \vee b) \wedge (b' \vee c') \wedge (a \vee c')$

In figure 12, we need to express the given expression from bottom to up positions. If we put the value '1' to the leaves a , b and the value '0' to the leaves a' , b' , c' at each level 2 vertex. Therefore we obtain the following expression tree

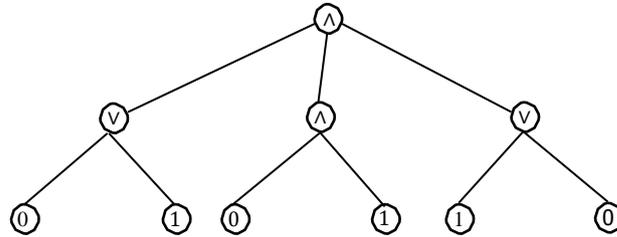


Figure 13: Expression tree by Boolean constants

We can calculate $(0 \vee 1) \wedge (0 \wedge 1) \wedge (1 \vee 0) = 1 \wedge 0 \wedge 1 = 0$. The above figure 13 gives the value 0.

Example

Expression tree for the set $(A \cap B) \cup (C \cap D)$.

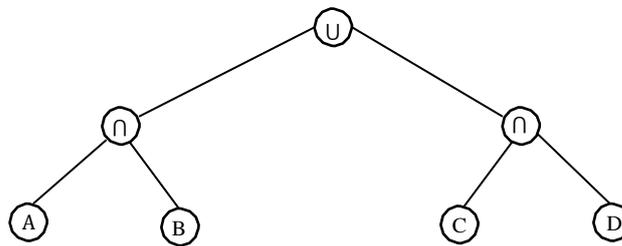


Figure 14: Expression tree for the set $(A \cap B) \cup (C \cap D)$.

The above figure shows that the expression tree for the given expression, firstly, we use the intersection operation '∩' for each bracket and then the union operation '∪' for the whole set.

Here we notice that we can replace the set operations '∩' intersection and '∪' union on behalf of the Boolean operations '∧' meet operation and '∨' join operation respectively.

Remark

Every expression tree of Boolean expression gives the Boolean values.

Results & Discussion

1. Prefix Code Tree

A prefix code tree for an alphabet set V is a binary tree whose leaves are in one-to-one correspondence with the elements of V . If v is a symbol in V , then the encoding of v is the bit string that represents the path from the root of the tree to the leaf corresponding to v , where a ‘0’ represents descent to a left branch and a ‘1’ represents descent to a right branch.

2. Encoding

When information is stored in a computer or when information is sent over communications lines, it is usually as bit strings. On the other hand, an encoding method is a function from V^* to $\{0, 1\}^*$ where V^* is the set of bit strings over the alphabet V .

For instance, encodes 011 and 100 represents a bit string of length 3 for some alphabets A and B in V .

Example of a Prefix Code Tree

Let $V=\{A, B, C, D, E, F, G, H, I\}$ be the set of alphabets. We can show as the following prefix code tree.

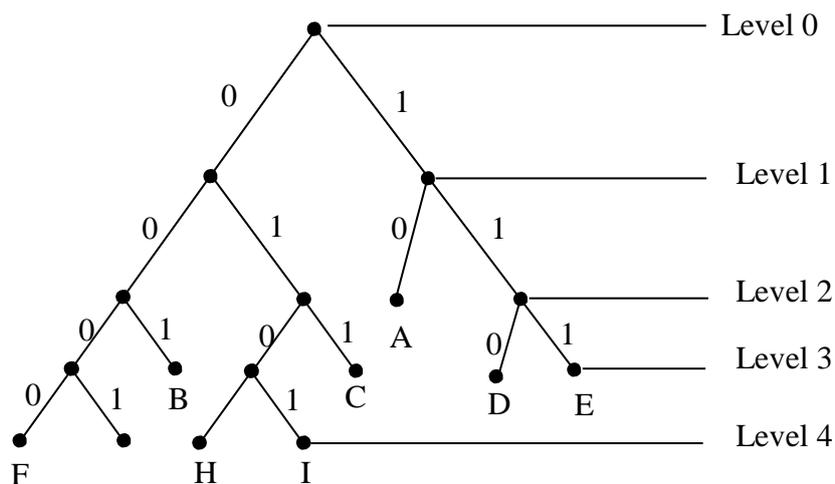


Figure 15: A prefix code tree with level 4.

The above prefix code has 4 levels with level 0 to level 4. Each vertex separates 2 branches with left branch ‘0’ and right branch ‘1’. A set V has 9 alphabets, each alphabet takes place from level 2 to level 4 and each alphabet has no new separating branches to the next level. Moreover each alphabet can be represented by the codes such as the codes 10 for A, 001 for B, 011 for C, 110 for D, 111 for E, 0000 for F, 0001 for G, 0100 for H, 0101 for I respectively. Clearly, we see that F, G, H, I have bit strings of length 4, alphabets B, C, D, E have bit string of length 3 and A has bit strings of length 2. The encoding for AGE can be represented by 10 0001 111. Similar way for any message of alphabets in V .

3. Decoding

Decoding is the message of the alphabets in V. It may be obtained by the indicated path from a prefix code tree of the encoding.

Example of Decoding

In figure 7, let's consider decoding from the bit string of encoding 110 01 10.

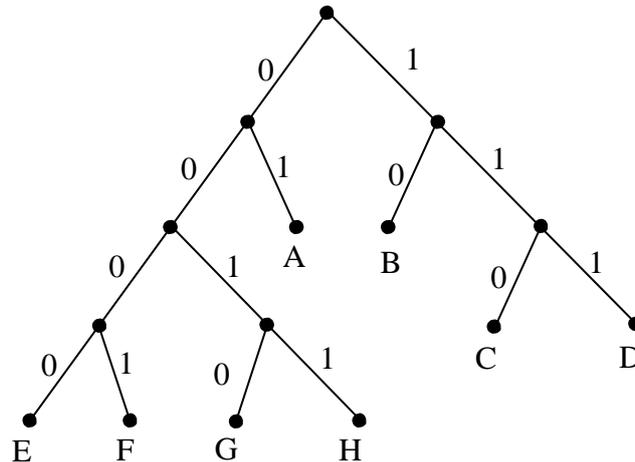


Figure 16: A prefix code tree in a set V

The given encode 110 01 10 begins with 1. In the above figure shows there are three possible alphabets begin with 1 namely B, C and D. By decoding, 10 refers to B, 110 refers to C and 111 refers to D. Similarly there are 5 possible letters begin with 0 namely A, E, F, G and H. By decoding A refers to 01, E refers to 0000, F refers to 0001, G refers to 0010 and H refers to 0011 respectively. Thus we get the decoding CAB for the given encoding 110 01 10. Therefore we can find message decoding from any given encoding.

Remark

- (1) In any prefix code tree has the length of bit string and the number of level of the vertices are the same.
- (2) In any prefix code tree, we can send the information from bit string of encoding to message of decoding and vice versa.

4. Connection of Probability Version

In study of probability, we have to know the basis of the probability such that experiment, outcomes, random experiment, sample space and event. An **experiment** is any process of observation. The result of an observation is called **outcomes**. **Random experiment** is an experiment if its outcome cannot be predicted. The set of all possible outcomes of an experiment is called **sample space**. Then a subset of a sample space is called an **event**.

Examples of Experiment (Random experiment)

Examples of random experiments are the roll of a die, the toss of a coin, drawing a card from a desk and selecting a message signal for transmission from several messages.

For instance, tossing a coin is an experiment with heads or tails as possible outcomes. Each time the coin is tossed is a **trial**.

Example of Sample Space and Events

In the experiment of drawing a number from the numbers 1 through 10. Then the sample space is $S=\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. The event of drawing an odd number is $\{1, 3, 5, 7, 9\}$, the event of drawing an even number is $\{2, 4, 6, 8, 10\}$, and the event of drawing a prime number is $\{2, 3, 5, 7\}$.

5. Some Tree Diagrams in Probability

In study of some tree diagrams in probability, we have to study the experiment of tossing in a coin. If a coin is tossed once in a time, we have two possible outcomes head and tail. Thus the sample space $S=\{H, T\}$ with the following tree diagram.

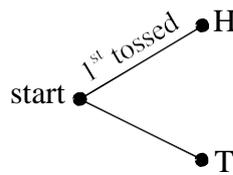


Figure 17: A tree diagram of a coin is tossed once in a time

If a coin is tossed twice, we have four possible outcomes HH, HT, TH, TT. So we get the sample $S=\{HH, HT, TH, TT\}$ as the following tree diagram.

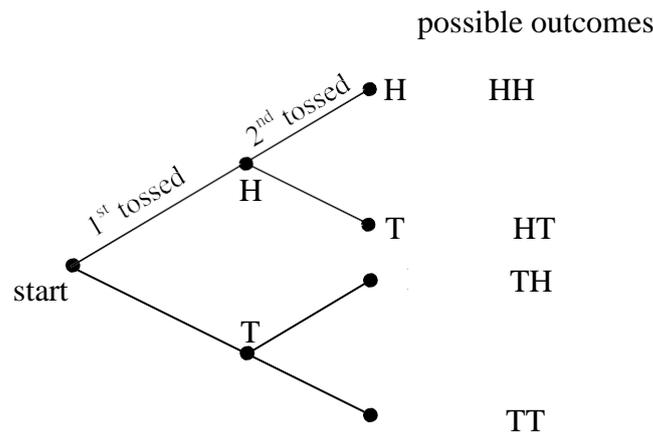


Figure 18: A tree diagram of a coin is tossed twice

Next if a coin is tossed three times, we have eight possible outcomes namely HHH, HHT, HTH, HTT, THH, THT, TTH, TTT. Therefore the sample space $S=\{ HHH, HHT, HTH, HTT, THH, THT, TTH, TTT \}$ as follows.

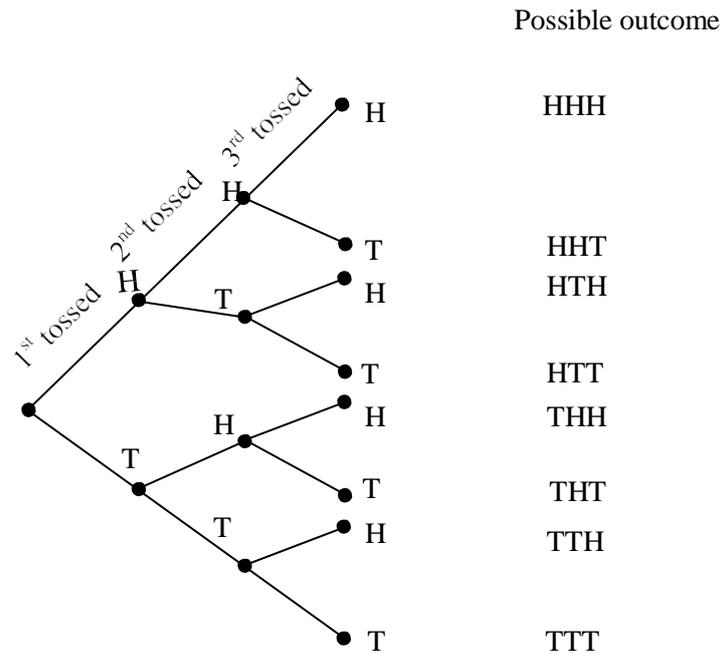


Figure 19: A tree diagram of a coin is tossed three times

Rooted Tree of Figure 17

Look at a tree diagram of figure 17, we can see the vertex at a root from left to right position to top to bottom as follows.

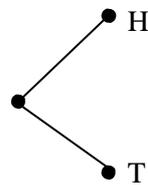


Figure 20(a)

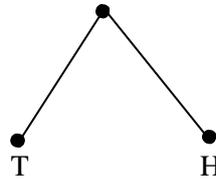


Figure 20(b)

Figure 20(a) and Figure 20(b) show that they are the same. Moreover they are rooted trees as well as binary trees with left and right branches.

Both Binary Tree and Prefix Code Tree of Figure 18

Clearly we can see that figure 18 from left to right position to from up to down position are as follows:

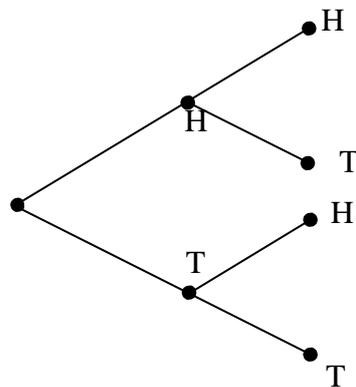


Figure 21(a)

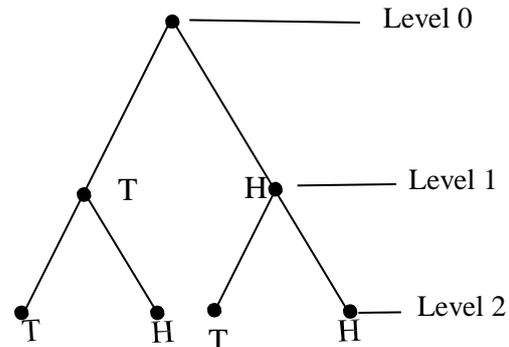


Figure 21(b)

We can transform figure 21(a) to figure 21(b) the root is at the top from left to right position. Therefore they are the same. Each vertex of them shows both left and right branches. Thus they are binary trees. Each binary tree shows 3 level of vertices. So they are also the prefix code tree as follows.

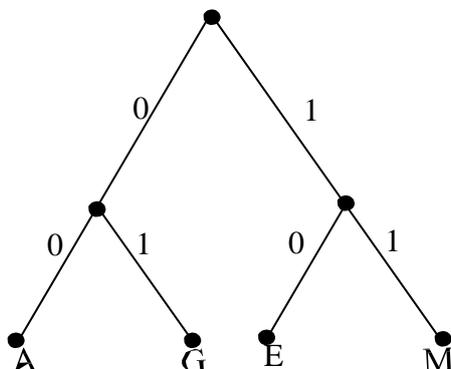


Figure 21(c):A Prefix Code

Relation Between Tree Diagram in some probability trees (Tossing a Coin) and a Prefix Code Tree

In the experiment of some probability trees (tossing in a coin), if we tossed a coin, there are two possible outcomes head (H) and tail (T).

In study of prefix code tree, clearly we see that from upward to downward (top to bottom) position, each level of vertices (or) vertex will be separated left and right branches with Boolean constants 0 and 1 respectively.

Obviously we see that Boolean constant '0' takes place in left branch along the possible outcome tail (T). Boolean constant '1' takes place in right branch along the possible outcome Head (H).

Moreover in study of tossing in a coin. All the possible outcomes are represented by a sample space S . In study of prefix code tree. The vertices which are not separated to the next level of vertices are represented by the alphabets in the set of alphabets V .

Then we have to be continued the information by sending from bit string of encodes to message of decodes according to the encodes and the information by sending from message of decodes to bit string of encodes.

For instance in Figure 21, there are four alphabets A, G, E, M in a given prefix code tree. They are represented by encodes such that the code A is 00, the code G is 01, the code E is 10 and the code M is 11. Again if the given encode is 01 10 11 then we can find the message GEM, it is decode. If the given message is AGE, then we can show that the encode with bit strings 00 01 10.

Transformation of a prefix code tree from figure 19-

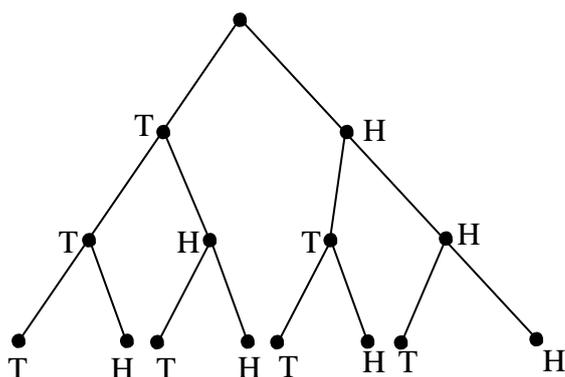


Figure 22: Binary Tree

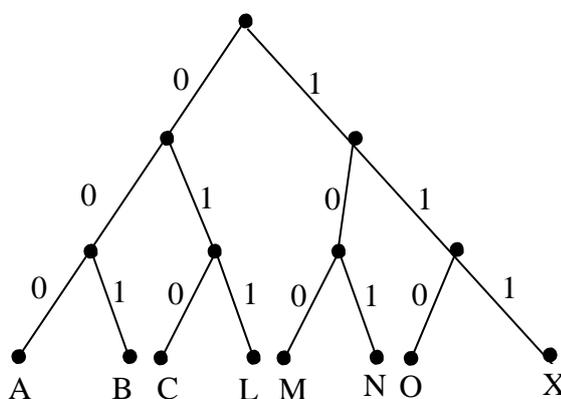


Figure 23: A Prefix Code Tree

Figure 22 shows that binary tree by transformation of figure 19 the root tip is from left to right position to top to bottom position. Figure 23 shows a prefix code tree of Figure 22 by substituting the Boolean constants 1, 0 in place of along the vertices H and T of Figure 22 respectively. For instance, the codes for A is 000, B is 011, C is 010, L is 011, the code M is 100, N is 101, O is 110 and X is 111. We can send the information from encode of bit string 100 000 101 to message of decode namely MAN. Next we can also send message of decode MOON to bit string of encode 100 110 110 101.

Observation

- (i) The root tips of from left to right position and from top to bottom position are the same.
- (ii) Replace the Boolean constant ‘1’ in place of along the vertex H (success) and the Boolean constant ‘0’ takes place in place of along the vertex T (fail) by transformation of binary tree to prefix code tree.
- (iii) Any prefix code tree has at least level 2 vertices.
- (iv) Both sender and receiver need to define the secret meaning of each alphabets when the information sends by encodes to decodes and vice versa.

Usefulness

This observation is useful when we would like to send some top secret information or some breaking news from one place to another place over the communications line.

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