YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF STATISTICS

EFFECTS OF INCOME ON HOUSEHOLD ENERGY CONSUMPTION IN MYANMAR

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M.Econ (Statistics)
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This thesis is submitted as a partial fulfillment towards
the Degree of Master of Economics (Statistics).

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ABSTRACT

In this study, an attempt has been made to carry out household energy consumption in Myanmar. The objectives of this study are to study the household energy consumption and to investigate the effect of income level on energy consumption of the selected regions in Myanmar. The original household energy survey was conducted to 967 households in 11 regions across Myanmar but that the selected six regions were investigated the available data sets. Therefore, this study is evaluated 640 household's energy consumption of six regions (Yangon, Mandalay, Shan, Rakhine, Kayar and Mon). The descriptive analysis is applied to demonstrate the household energy consumption by income level. According to the result, 62.66% of households are earned under 150000 kyats, 21.09% of households are earned from 150000 kyats to 250000 kyats and 16.25% of households are earned above 250000 kyats. This analysis found that 100% households of high income level is consumed the various energy above 60000 kyats in one month. The discriminant analysis is employed to determine how the energy in households is consumed, based on both region and income. According to the result, electricity, candle and other (diesel, fuel wood, liquefied petroleum gas, charcoal, gasoline, paraffin, kerosene, rice husks, coal, charcoal and village generator) are potentially important for both region and income.

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LIST OF ABBREVIATIONS

UNDP	United Nations Development Programme
WEC	World Energy Council
GDP	Gross Domestic Product
MLCS	Myanmar Living Condition Survey
ADB	Asian Development Bank
MOE	Ministry of Energy
PV	Photovoltaic
MW	Megawatt
EIA	Environmental Impact Assessment

CHAPTER I
INTRODUCTION

1.1 Rationale of the Study

Today, energy access is a major building block for economic growth, human development and environmental sustainability. Therefore, energy is crucial for human survival and development. Improvements in standards of living have historically been associated with increases in energy consumption and access to appropriate services has always been seen as a necessary precondition for development. While the developed or post-industrialized nation have seen some decoupling of energy and gross domestic product (GDP) growth in recent years at high levels of per capita energy use, recent trends reveal that energy consumption in Myanmar. The emphasis of much the energy literature, both in developed and developing countries, has conventionally been on energy supply and production. This supply-oriented paradigm has encouraged developing countries to follow policies that focus solely on the growth of energy supply to guarantee further economic growth. However, given the present global concern regarding serious environmental, social and macroeconomic problems associated with the more traditional approaches to energy, a number of recent publications have highlighted the need for a reorientation of thinking towards a new focus on energy services rather than on energy supply (UNDP 2000; UNDP and WEC 2000).

Alternative approaches to studying energy services have changed in the last few decades, one of which assumes that all production in an economy takes place to ultimately satisfy final consumption. Thus, all household consumption of goods and services is expressed in terms of the energy required to domestically produce that specific good or service. One can then examine energy use from the perspective of individual consumers or households as they form the main consumption sector of economy. This approach, however, does not include the energy illustrated in capital formation and exports/imports, though the latter are still relatively small but growing for the case of large developing economies like Myanmar. Myanmar has one of the fastest growing economies in Asia, yet its potential is severely constrained by limited energy infrastructure has resulted in Myanmar having one of the lowest per capita energy consumption rates in the world. This study examines how energy use in Myanmar has evolved in the last recent years, both at the region and income level and energy consumption expenditure. It subsequently looks at the success that the country has achieved and the challenges that lie ahead in improving access to energy.

Studies that follow such a household perspective on energy consumption do exit in Myanmar as many of survey and reports. Example of these include the Myanmar Living Condition Survey (MLCS 2017), the Integrated Household Living Conditions Assessment (IHLCA-1 2005), IHLCA-2 2010 (enumerated in December 2009 and May 2010), ADB conducted a household survey in 2014 and Myanmar Energy Consumption Surveys in 2017. The MLCS 2017 captured energy access through several different questions, a set of which were asked at the village or ward level, allowing for cross-checks to be made. Good lighting can improve productivity, by allowing the day to stretch beyond sunlight hours. Households have shifted from a reliance on candle and kerosene to electricity for lighting in 12 years between 2005 and 2017. The main energy shift took place in rural areas, while the same trend in urban areas occurred at home modest rate. The Myanmar Energy Consumption surveys 2017 were intended to enhance the understanding of energy consumption trends in Myanmar, which in turn would enhance the level of confidence in the quality of the data that is used to inform the energy demand forecasts that underpin the Energy Master Plan (EMP).

As the country continues to develop, ensuring sustainable access to energy will become a priority so that energy consumption in our country needed to be studied.

1.2 Objectives of the Study

The objectives of this study are

(i) to study the household energy consumption

(ii) to investigate the effect of income level on energy consumption of the selected regions in Myanmar

1.3 Scope and Limitation of the Study

In this study household energy consumption expenditure data sets are used, which were obtained from unit record file of the Myanmar household energy consumption surveys. This surveys were conducted under the authority of the Ministry of Energy (MOE) by Asia Development Bank (ADB) in 2017. The Asian Development Bank (ADB) has provided sequenced technical assistance for Myanmar covering energy sector policy, planning and legal and regular frame work development, one result of which was the launch of an energy master plan in 2016. As part of the master planning process, ADB conduct a household survey in 2014 to better understand energy consumption trends, and to enhance the quality of the data used for energy demand forecast that underpin the master plan. In total, 967 households were conducted in 11 regions across Myanmar, Ayeyarwaddy, Magway, Mandalay, Yangon, Shan State (North), Shan State (South), Kayar State, Rakhine State, Chin State, Mon State and Kayin State. This study is evaluated 640 household's energy consumption of six state and regions in Myanmar during 2017.

1.4 Method of Study

In this study, the descriptive statistics and the discriminant analysis are employed to analyze the household energy consumption in Myanmar. The descriptive analysis is conducted to demonstrate the household energy consumption by income in Myanmar. The discriminant analysis is applied to determine how the energy in household is consumed, based on both region (Yangon, Mandalay, Shan, Rakhine, Kayar and Mon) and income.

1.5 Organization of the Study

This study consists of five chapters. Chapter I is the introductory chapter and it describes rationale, objective, scope and limitation, method and organization of the study. Literature review is discussed in Chapter II. Chapter III is explained theoretical background. Results and findings are performed in Chapter IV. In Chapter V, conclusion and suggestions are presented.

CHAPTER II
LITERATURE REVIEW

2.1 Energy Sector in Myanmar

Energy plays an important role in daily lives and society. Energy is needed to provide services such as lighting, cooking, moving machines and vehicles, and powering phones and appliances. Energy is expected to play a central role in the democratization and modernization of Myanmar (Lofus, 2016). However, the nation's electrification rate as well as the consumption of electricity remains very low. The availability of energy is an important driver and facilitator of local economic development.

Myanmar is experiencing a major political, economic and social transition from what was once under a military regime to today's open democracy. In this process, energy consumption of the country is expected to play a fundamental role in its development. While essential for a well-functioning economy and society, energy is a means and not an end in itself. Extraction, production, and consumption of energy can have environmental and social impacts. The more productively energy is used, the better for the economy, and the more we can save on costs, conserve limited energy resources, and reduce deleterious impacts.

Energy has many forms, from firewood to solar, coal, petroleum, and electricity. Primary energy, or natural forms of energy, such as sun, wind, coal, and petroleum, have to harnessed or mined and converted to final energy, like electricity or gasoline, suitable for end users. Some energy is inevitably lost when primary energy is converted to final energy. Efficiency is therefore an important consideration in the conversion and delivery of final energy.

As the economy grows, energy planning is essential to make sure that supply can meet growing demand. Developing energy resources requires careful consideration of options, costs, impacts, and policy objectives, such as equitable access and sustainability. The planning process requires effective public engagement to arrive at solutions that are acceptable to the community and that will be robust over the long term.

Energy intensity, a measure of energy input per unit of Gross Domestic Product (GDP), typically increases during the transition from a developing to middle income status. In fact, Myanmar's energy intensity trend of recent years has shown a decline; however, this appears to reflect the impact of gas sales on GDP because gas production, transport and sales, in itself, is not an energy intensive activity. A target energy efficiency improvement in rural areas, evidenced through an environment of sustainable use of forest resources, maintaining total firewood consumption at around 17 million tons per annum despite a growing population.

With economic growth Myanmar's energy needs will also grow. Myanmar's energy intensity can be expected to increase as economic reform takes place and traditional labor-based activities are impacted by technology. There is strong evidence that energy consumption follows 'GDP' in developing countries. An econometric analysis of 80 countries, using time series data drawn from the World Bank's Development Indicators, found that GDP growth precedes energy growth. In the transitional phase from developing to middle income country status, traditional activities result in the accumulation of wealth that is later channeled into investment in energy infrastructure. In the longer term the nature of economic activity changes to become highly energy dependent; additional energy must be provided before further economic growth can take place. Energy intensity, a measure of energy input per unit of GDP, typically increases during the transition from a developing to middle income status. In fact, Myanmar's energy intensity trend of recent years has shown a decline; however, this appears to reflect the impact of gas sales on GDP because gas production and sales is not an energy intensive activity.

2.2 Types of Common Energy

There has a variety of energy consumption in Myanmar. The most commonly use of energy in Myanmar are electricity, petrol, candles, batteries and other usages. Other usage contained diesel, fuel wood, charcoal, rice husks, paraffin, coal, kerosene, liquefied petroleum gas and village generator. The following types of energy are the most commonly use in Myanmar.

2.2.1 Electricity

In Myanmar, 68% of the population has no access to reliable electricity. Growing up in a home without power and light, a child's chances of receiving a good education and finding a good job are drastically reduced. Renewable energy sources offer the chance to transform the quality of life and improve economic prospects for millions. Typically, wind projects and solar photovoltaic require less time to build than fossil-based, large-scale hydro, or nuclear-power plants. Building a solar PV project of 1MW (Tritec Group, 2014) can take less than a month, compared to three or four years for fossil-fuel plants and even longer (at least six years) for nuclear power plants (EIA, 2015). Solar and wind projects enable the rapid increase in generation capacity; solar PV, wind and pico hydro are also more modular, enabling people who live in very remote areas to benefit from distributed electricity production. Recent technology has made distributed solar PV cheaper and more efficient than diesel generators (Bloomberg New Energy Finance, 2011) together with hydropower and biomass gas fires.

2.2.2 Petrol

Myanmar has become a net importer of petroleum products as a consequence of increased domestic demand for petroleum products in the recent past combined with limited oil refining facilities. The production from three ageing refineries is observed to be significantly below design capacity (at around 50% of rated capacity on average) and has generally been following a downward production trend. Major petroleum products consumed in Myanmar are gas/diesel oil, motor gasoline and jet kerosene. Gas and diesel oil constitutes some 59% of petroleum demand in Myanmar, followed by 24% motor gasoline and 5% jet kerosene. The imported segment of gas and diesel oil is dominant accounting for 87% over the last three years (2011/12 to 2013/14). Similarly, around 58% of the motor gasoline in Myanmar is imported. Petrol and diesel are basic necessities for the people. If prices increase, transportation charges will also rise and it will have an impact on consumers. However, in Myanmar, when global oil prices decrease, domestic petrol and diesel prices do not decrease in tandem.

2.2.3 Candle

The candle can be used during the event of a power outage to provide light. The limited availability of modern energy services and infrastructure has resulted in Myanmar having one of the lowest per capita energy consumption rates in the world. In Myanmar, the household energy consumption includes firewood is mainly used for cooking, candles and torches for lighting, followed by electricity for cooking and battery for lighting while the demand for modern energy sources is rapidly increasing.

2.2.4 Battery Enclosure

Battery is used to supply the necessary current to the starter motor and the ignition system while cranking to start the engine. Battery also supplies additional current when the demand is higher than the alternator can supply and acts as an electrical reservoir. In our country, battery is mainly used as energy in both urban and rural areas for various power usage. Our country has been imported batteries from Asian countries to receive energy. For batteries, the brands our country import are YOKOHAMA, TOYO, GS, NC, VOLTEX, etc.

The metal enclosure in Shan state is required to prevent, of all things, the use of batteries for shocking fish. When 44 companies submitted example systems in the Shan State tendering process, some had all the components in a single metal cabinet box, others had separate components. After seeing the systems in a single box, the tendering committee reflected on their experience that if the system has separate components, many villages will take the battery down to the local fishing whole and use it to shock fish. Out of concern for the battery (and perhaps the fish) the committee felt that it was important to put the battery in a metal box with everything else since they felt this would help deter villagers from this misuse of the battery.

2.2.5 Other

Other consumption types of energy encompassed: diesel, fuel wood, liquefied petroleum gas, charcoal, gasoline, paraffin, kerosene, rice husks, coal, and charcoal and village generator. Diesel is a fuel that can be used to extract diesel fuel from paraffin oil and the rest of the diesel engine. Fuel wood remains a dominant energy source in the developing world in both rural and urban areas. Over two billion people in developing countries are still mainly dependent on fuel wood for cooking and heating. Traditional biofuels have harmful effects, such as human health issues caused by indoor air pollution and impacts on forest areas, so an energy transition from traditional biofuels to modern fuels is needed. Charcoal is an important and very useful for making yarns. They are commonly used in medicine and the manufacture of non-heat-resistant materials.

The Government of Myanmar had declared 1995 the year of fuel substitution. Indeed, in some areas shortages of fuel wood are very severe and basic fuel needs are not met, particularly in the dry zone. Deforestation has in the past decade prevailed in the central and southern provinces. The main cause of deforestation in Myanmar may be cutting and felling for fuel wood. This was encouraged by the Government in order to save on imported fuels. It is now recognized that agricultural residues and other alternative fuel sources are still largely untapped, while, overall the country lacks adequate processing and conversion technologies. Large forests still exist in the north, but they are largely outside the reach of the people for fuel. High-level government representatives say severe punishment awaits villagers who illegally cut trees.

Myanmar is endowed with abundant and varied indigenous sources of energy, including hydropower, natural gas, and crude oil, biomass resources such as rice husks, kerosene, paraffin and coal. Since Myanmar's centrally planned economy has not encouraged private sector and external participation, conventional energy consumption is still low. In 1993-94, 78% of total energy consumption came from fuel woods. Biomass is the major source of energy in both the domestic and industrial sectors.

However, with the exception of pico or micro-hydropower, hydropower can have severe environmental and social impacts. By changing water flow downstream, dams threaten freshwater ecosystems and the livelihoods of millions of people who depend on fisheries, wetlands, and regular deposits of sediment for agriculture. They fragment habitats and cut fish off from their spawning grounds. Creating reservoirs means flooding large areas of land: 40-80 million people worldwide have been displaced as a result of hydroelectric schemes (International Rivers, 2008). In fact, the fact that current hydropower projects are included in the SES does not mean that WWF or its partners condone any specific existing dam. But since they have been built, they are part of the suggested power mix in the SES.

In many developing countries, firewood users are dominant in rural areas, whereas charcoal is commonly employed in urban areas. Unlike firewood use in rural areas, there has been concerned about the environmental impact of charcoal use in urban areas; that is because collected firewood is mostly from deadwood or small branches, though charcoal is mainly produced from living trunks or branches.

2.3 Energy Consumption of Selected Regions

Myanmar has experienced and is expected to continue experiencing accelerating growth and substantive changes in the scope, scale and form in which human and economic activity is arranged and performed within its boundaries. Developing energy sector infrastructure and increasing access to modern forms of energy for Myanmar's people are therefore of paramount importance for the country's economic growth. Under the Asian Development Bank (ADB) technical assistance (TA) for Myanmar on Institutional Strengthening of National Management Committee in Energy Policy Planning, surveys on the use of energy in various sectors were conducted over the year 2014. The energy surveys were focused on end-use energy consumption, which is consistent with the perspective of the Ministry of Electricity and Energy that end-use energy consumption data has the greatest level of uncertainty.

This survey was conducted in eleven selected regions across Myanmar in 2017. Table (2.1) lists the regions and townships where the surveys took place; it also shows the number of surveyed households in each location. The basis for the total number of surveys performed was the maximum number that could be done given the time and budget constraints. Townships were selected to ensure appropriate coverage across each state and region so that geographical diversity in energy consumption trends could be captured across the entire country. The selection of households within each township was done in consultation with the township leaders and were randomly selected in order to avoid bias.

Table (2.1) Summary of Urban and Rural Household Energy Consumption

No.	Region	Township	Number of Households
1	Ayeyarwaddy Region	Ngaputaw	85
2	Magway Region	Magway	61
3	Mandalay Region	Kyaukpadaung/Mandalay	184
4	Yangon Region	Kyauktada/Dala	101
5	Shan State (North)	Thein Ni	69
6	Shan State (South)	Pekon	72
7	Kayah State	Demorso	61
8	Rakhine State	Taunggup	75
9	Chin State	Palatwa	95
10	Mon State	Chaung Sone	78
11	Kayin State	Hlaing Bwae	86
Total			967

Source: ADB Survey Data, 2017

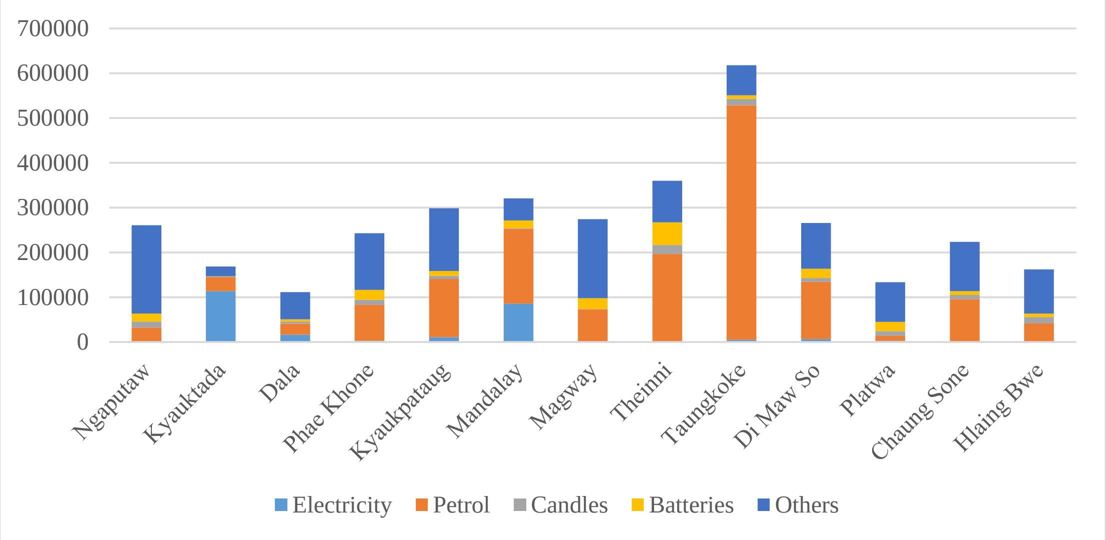

Figure (2.1) Household Energy Consumption by Townships

Source: ADB Survey Data, 2017

Table (2.2) Household Energy Consumption by Townships (kyats per month)

No.	Townships	Electricity	Petrol	Candle	Battery	Other
1	Ngaputaw	0	32455	13199	17904	197379
2	Kyauktada	114011	31243	1751	100	21475
3	Dala	16526	24090	5392	4573	60771
4	Phaekhone	2816	80046	11497	21954	126440
5	Kyaukpataug	10565	130438	7011	11008	139815
6	Mandalay	86089	166956	1581	16875	49272
7	Magway	0	72805	636	24485	176347
8	Theinni	378	196046	20289	50421	92871
9	Taungkoke	5313	523149	14293	7855	66768
10	Di Maw So	6438	127665	8885	20330	102676
11	Platwa	3360	10445	10871	20524	88263
12	Chaung Sone	460	95288	9250	8412	110194
13	Hlaing Bwe	0	41724	14438	7256	98934

Source: ADB Survey Data, 2017

Table (2.2) and Figure (2.1) show the total energy expenditure across all household energy consumptions by townships in selected regions. The data show, the total energy expenditure of Taungkoke township is higher than other townships of the selected regions.

CHAPTER III
THEORETICAL BACKGROUND

Discriminant analysis is popular because this method enables organizations to create knowledge and thereby improve their decision making. Multivariate analysis refers to all statistical techniques that simultaneously analyses multiple measurements on individual or objects under investigation. The information available for decision making exploded in recent years, and will continue to so in the future, probably even faster. Until recently, much of that information just disappeared. It was their not collected or discarded. Today this information is being collected and stored in data warehouse, and it is available to be mined for improved decision making. Some of that information can be analyzed and understood with simple statistics, but much of it requires more complex, multivariate statistical techniques to convert these data into knowledge.

3.1 Discriminant Analysis

Discriminant function analysis is a statistical technique to determine which continuous variables discriminate between two or more variable groups. When the analysis involves two groups, the technique is referred to as discriminant analysis. When there are more than two groups, the technique is referred to as multiple discriminant analysis (MDA). Discrimination and classification are multivariate techniques concerned with separating distinct sets of observations and with allocating new observations to previously defined groups. Discriminant analysis is rather exploratory in nature. Thus, the discriminant function analysis design predicts membership in one or more than two groups. The predictors or the independent variables are continuous variables. The goal of discriminant analysis is to identify discriminant functions. The model in discriminant function analysis is linear, thus the independent and dependent variables have constant relationship to each other. The weights are calculated to derive a discriminant score for each case and the mean discriminant scores for the groups are called the centroid. The sample size needs to be taken into account with discriminant analysis. This statistical technique permits the groups to be of different sample sizes but the sample size of the smallest group should exceed the number of independent variables. Classification ordinarily requires more problem structure than discrimination does.

Discriminant function analysis can be used for two purposes such as:

1. Prediction, referred to as predictive discriminant analysis (PDA) and
2. Explanation, referred to as descriptive discriminant analysis (DDA) (Huberty, 1994)

Lawrence, Glenn and Guarino (2006) illustrated that descriptive discriminant analysis is often used as a follow-up analysis to a significant multivariate analysis of variance (MANOVA) to determine the structure of the linear combination of the dependent variables. This indicated that discriminant analysis is computationally identical to MANOVA. Descriptive discriminant analysis has a focus on revealing major differences among the groups (Stevens, 2002, P. 285). The discriminant function will weight n-independent variables such that two or more dependent variable groups will be differentiated. One way to evaluate the solution that will be explored is based on how accurately the independent variables were classified into groups. The discriminant function score for i^{th} function is as follows:

$D_i = k_{i1}X_1 + k_{i2}X_2 + k_{i3}X_3 + k_{ip}X_p$

Where D_i represents the predicted score in the dependent variables.

k_{ip} (i = 1,2,3,…,n) be the coefficient of associated with the independent variables.

$X_{ip}(i = 1,2,3, \dots,$ n) be the independent variables in the equation.

3.1.1 Test Statistics

There are several tests of significance, but Wilks' lambda is presented here. The test statistic Wilks' lambda is the most common and traditional test in which there are more than two groups formed by the dependent or independent variables. It is a multivariate F-test, similar to the F-test in univariate analysis of variance, such that the smaller the lambda for an independent variable, the more that variable contributes to the discriminant function.

Wilks' lambda varies from 0 to 1, with 0 meaning group means differ and 1 meaning all group means are the same. The t-test, Hoteling's Trace, and F-test are special cases of Wilks's lambda. This test will reject the null hypothesis at α level when the Wilks' lambda is greater than the critical value or p-value less than α. The F-test of Wilks' lambda shows which variables' contribution are significant.

3.1.2 Statistical Assumptions

The assumptions of discriminant analysis are similar to other multivariate techniques. The analysis is quite sensitive to outliers and the size of the smallest group must be larger than the number of predictor variables. The dependent variable of discriminant analysis is a categorical variable. The assumptions for discriminant analysis are as follow:

- Linearity: All relationships among all pairs of predictors within each group are linear.
- Multivariate normality: The independent variables are normally distributed for each level of the grouping variable.
- Independence predictors: observations are considered to be randomly sampled and an observation's score on one variable is assumed to be independent of scores on that variable for all other observations.
- Homoscedasticity: The variances between grouping variables are the equal across levels of predictor variables. When sample sizes are unequal and small, unequal covariance matrices can unfavorable affect the results of statistically significance testing.
- Absence of multicollinearity: As with multiple regression analysis, multicollinearity denotes the situation where the independent/predictor variables are highly correlated. When independent variables are multicollinear, there is "overlap" or sharing of predictive power so that one variable can be highly explained or predicted by the other variable(s). Thus, that predictor variable adds little to the explanatory power of the entire set (Robert Ho, 2014).
- Outliers: The discriminant analysis is highly sensitive to the presence of outliers in that their inclusion can have a substantial impact on the classification accuracy of this analysis results.

The above facts have been advised that the discriminant analysis is relatively robust to slight violations of these assumption.

CHAPTER IV
RESULTS AND FINDINGS

In this chapter, the form of energy consumption with relative of income level in a selected region of Myanmar was studied. Myanmar Energy Consumption Survey conducted by Asian Development Bank (ADB) during 2017. The household energy survey was conducted in 11 regions across Myanmar but that the selected six regions were investigated the available data sets. This survey is intended to collect data on the types and quantities of energy consume in households. Here, income of household is classified three level at a region by the survey data. In this study, the descriptive statistics and the discriminant analysis are used to analyze the household energy consumption. The discriminant analysis included two dependent or categorical variables (region and income level) and five continuous variables (electricity, candle, petrol, battery, and other). The other variable is included diesel, fuel wood, liquefied petroleum gas, charcoal, gasoline, paraffin, kerosene, rice husks, coal, charcoal and village generator.

The first categorical variable is the income level with three group, namely under 150,000 kyats per month (low level), from 150,000 kyats to 250,000 kyats (moderate level), and more than 250,000 kyats (high level). The above-mentioned three levels of income are known to be a household's income per month that is apparent in several measures of the expenses in the households. Household energy consumption is the energy consumed in homes to pick up the needs of the residents themselves. The energy consumption of households is often called the residential energy consumed in household dwellings. Another categorical variable is the selected regions with six areas, namely Yangon, Mandalay, Shan State, Rakhine State, Kayar State and Mon State.

4.1 Descriptive Statistics Analysis of Household Energy Consumption

Descriptive statistics are used to analyze the data collected, to summarize and describe household energy consumption. This section demonstrates the household energy consumption survey by basic characteristics of statistical tools. Moreover, this section introduces energy expenditure of household according to income level of six regions in Myanmar.

4.1.1 Distribution of Households by Income

There are three different income levels of households were taken into consideration as namely under 150,000 kyats per month (low level), from 150,000 to 250,000 kyats (moderate level) and more than 250,000 kyats (high level). The number of households is based on the income level as follows result in Table (4.1).

Table (4.1) Distribution of Households by Income

Income (kyats per month)	Households	
	Number	Percent
Low	401	62.66
Moderate	135	21.09
High	104	16.25
Total	640	100

Source: ADB, 2017

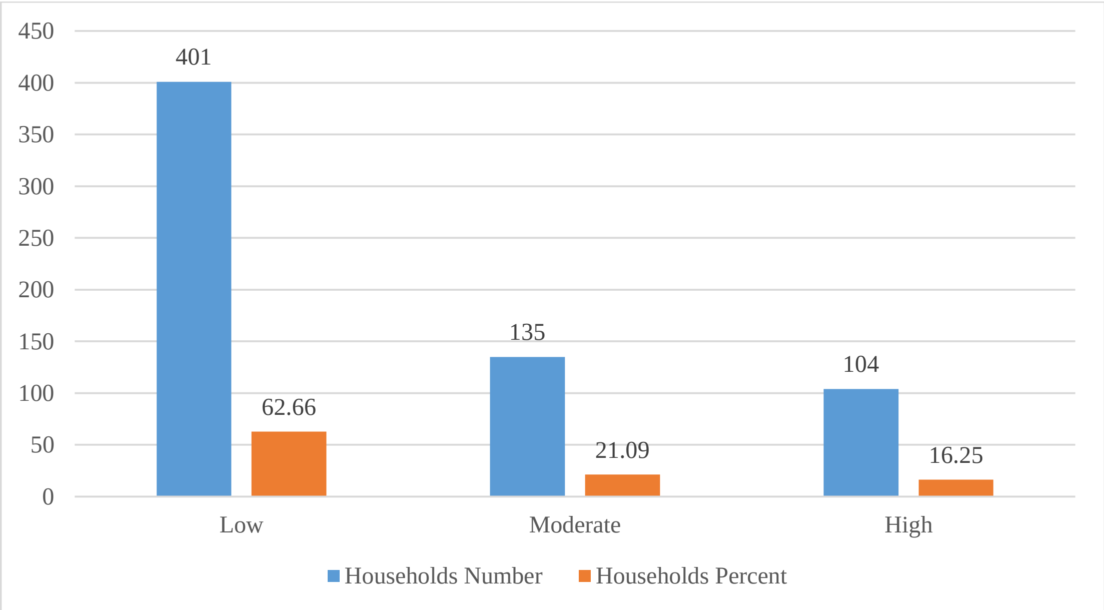

Figure (4.1) Distribution of Households by Income

Source: ADB Survey Data, 2017

Table (4.1) and Figure (4.1) indicate that the most of 401 households are belong to the low income level and 135 households have the moderate income level. The 104 households have high income level.

4.1.2 Distribution of Households by Electricity Consumption

Electricity consumption of households are presented by group of expenditure in below Table. It is classified into three expenditure groups. There are under 20000 kyats, between 20000 kyats 40000 kyats and more 40000 kyats.

Table (4.2) Distribution of Households by Electricity Consumption

Expenditure (kyats per month)	Households	
	Number	Percent
Under 20000	479	74.84
20000-40000	104	16.25
Above 40000	57	8.91
Total	640	100

Source: ADB Survey Data, 2017

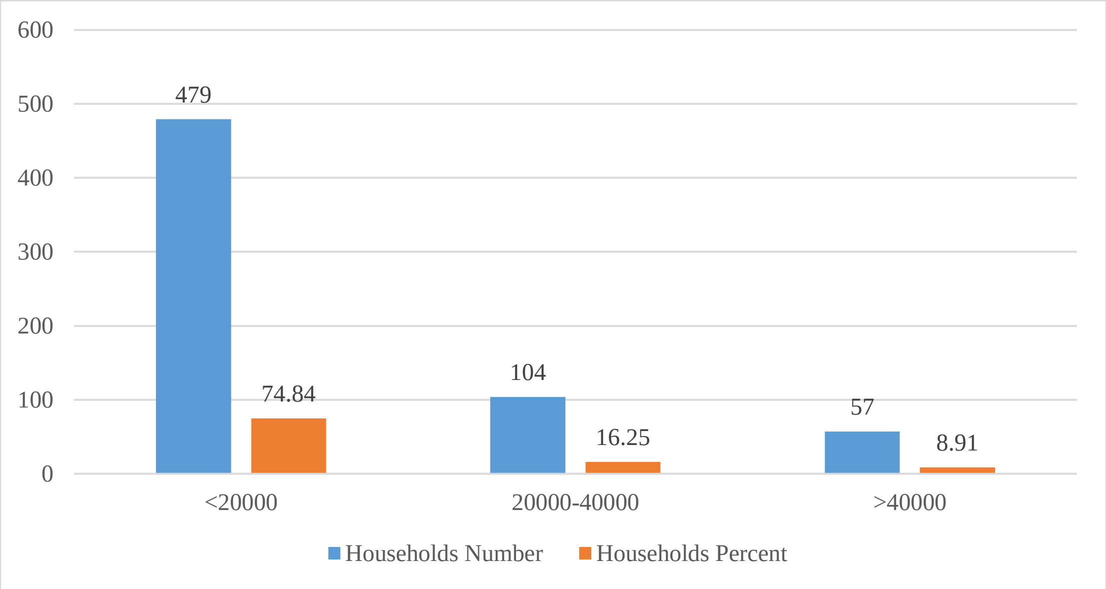

Figure (4.2) Distribution of Households by Electricity Consumption

Source: ADB Survey Data, 2017

From Table (4.2) and Figure (4.2), many households are consumed electricity under 20000 kyats in one month. The second highest rate of 104 households are consumed between 20000 and 40000 kyats. A few households are consumed the electricity above 40000 kyats.

4.1.3 Distribution of Households by Petrol Consumption

The distribution of households by petrol consumption are expressed in Table (4.3). The petrol consumption is classified into three expenditure groups. There are less than 50000 kyats, between 50000 kyats 100000 kyats and above 100000 kyats.

Table (4.3) Distribution of Households by Petrol Consumption

Expenditure (kyats per month)	Households	
	Number	Percent
Under 50000	305	47.66
50000-100000	255	39.84
Above 100000	80	12.5
Total	640	100

Source: ADB Survey Data, 2017

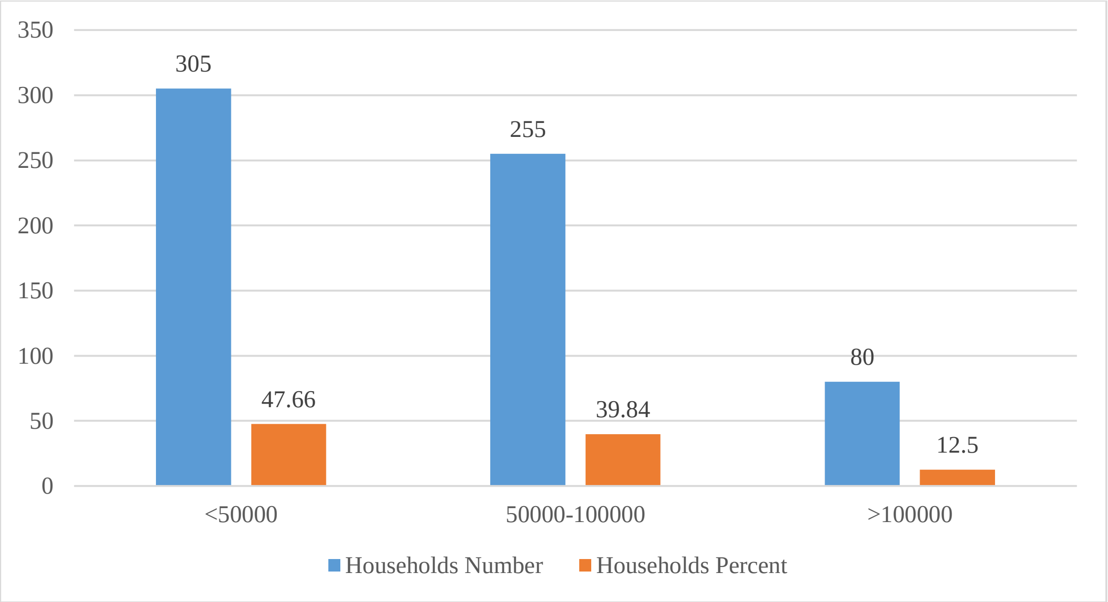

Figure (4.3) Distribution of Households by Petrol Consumption

Source: ADB Survey Data, 2017

According to the above Table (4.3) and Figure (4.3) descriptions, most of the households 47.66% were consumed the petrol energy under 50000 kyats per months. The second largest consumption of households 39.84% were between 50000 and 100000 kyats. The 12.5% households were consumed above 100000 kyats.

4.1.4 Distribution of Households by Candle Consumption

The candle expenditure of households is presented by group of expenditure in below Table. There are three different expenditure groups of households which were less than 4000 kyats, between 4000 kyats 8000 kyats and more 8000 kyats.

Table (4.4) Distribution of Households by Candle Consumption

Expenditure (kyats per month)	Households	
	Number	Percent
Under 4000	276	43.13
4000-8000	206	32.19
Above 8000	158	24.68
Total	640	100

Source: ADB Survey Data, 2017

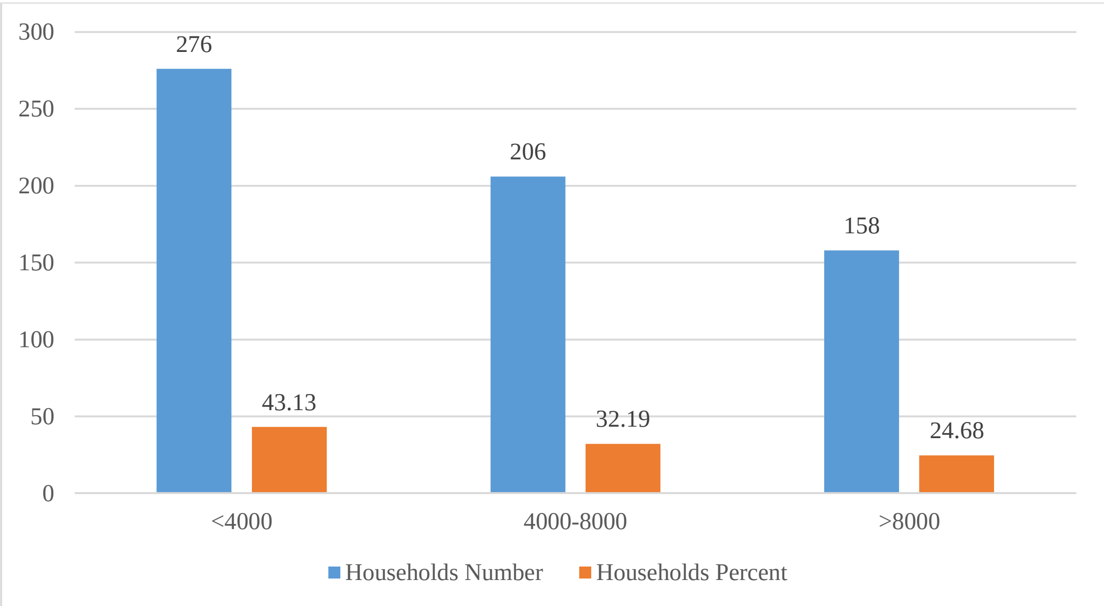

Figure (4.4) Distribution of Households by Candle Consumption

Source: ADB Survey Data, 2017

Table (4.4) and Figure (4.4) demonstrate that many households are consumed candle under 4000 kyats per month. The second highest rate of candle consumption is between 4000 and 8000 kyats. A few households consumed the candle above 8000 kyats.

4.1.5 Distribution of Households by Battery Consumption

The battery expenditure of households is classified into three expenditure groups. There are less than 5000 kyats, from 5000 kyats to 10000 kyats and above 10000 kyats.

Table (4.5) Distribution of Households by Battery Consumption

Expenditure (kyats per month)	Households	
	Number	Percent
Under 5000	269	42.03
5000-10000	202	31.56
Above 10000	169	26.41
Total	640	100

Source: ADB Survey Data, 2017

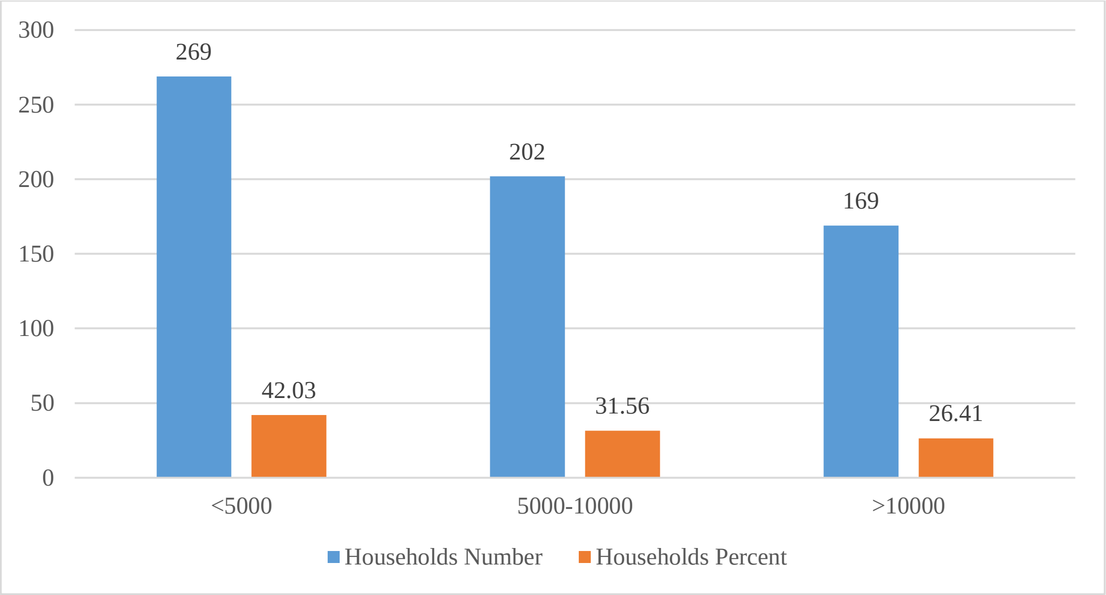

Figure (4.5) Distribution of Households by Battery Consumption

Source: ADB Survey Data, 2017

According to Table (4.5) and Figure (4.5), most of the households 42.03% were consumed the battery under 5000 kyats per months. The second largest households of 31.56% were consumed between 5000 and 10000 kyats. The other households 26.41% were consumed above 10000 kyats.

4.1.6 Distribution of Households by Other Energy Consumption

Finding on households, other energy expenditure is presented by group of expenditure in below Table. There are four different expenditure groups of households which were under 30000 kyats, from 30000 kyats to 60000 kyats and more 60000 kyats.

Table (4.6) Distribution of Households by Other Energy Consumption

Expenditure (kyats per month)	Households	
	Number	Percent
Under 30000	363	56.72
30000-60000	180	28.13
Above 60000	97	15.15
Total	640	100

Source: ADB Survey Data, 2017

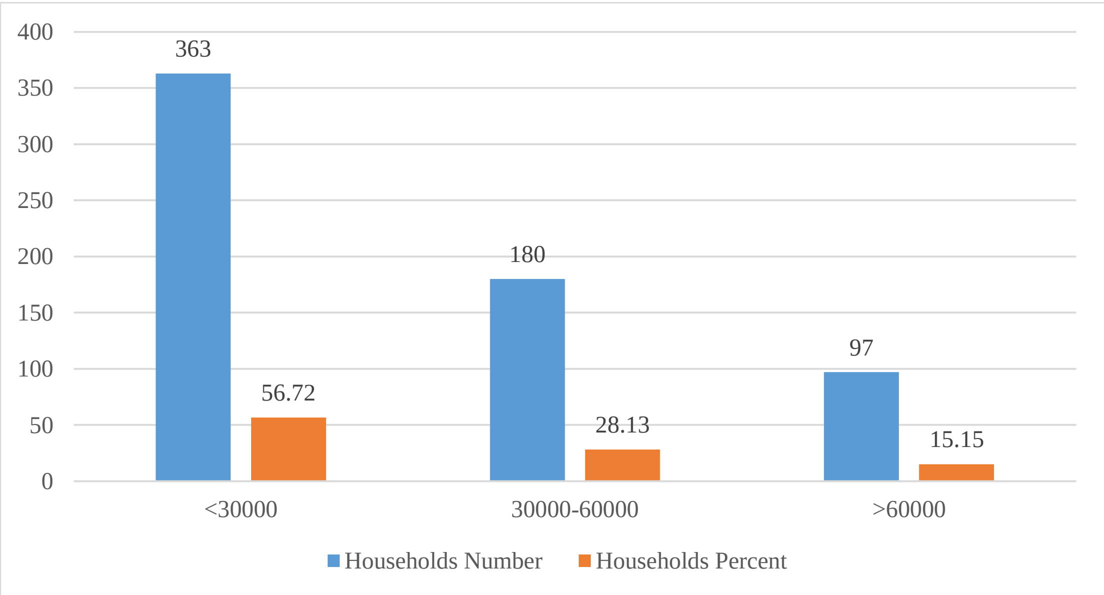

Figure (4.6) Distribution of Households by Other Energy Expenditure

Source: ADB Survey Data, 2017

Table (4.6) and Figure (4.6) shows many households are consumed other energy under 30000 kyats. The second highest rate of other energy consumption is between 30000 and 60000 kyats in one month. The smallest rate of other energy consumption is above 60000 kyats.

4.1.7 Joint Frequency Distribution of Households by Income and Energy Consumption

This section is studied joint frequency distribution between income and energy consumption of households. Income of households is classified into under 150,000 kyats per month (low level), between 150,000 kyats and 250,000 kyats (moderate level) and more than 250,000 kyats (high level). Energy consumption is classified also three group of each power mode expenditure in one month. An average energy consumption of the households in per months is classified by three groups of each power mode in the sample households of selected region. The contingency table of households' income and energy consumption of the households are as follows in each Table.

Table (4.7) Joint Frequency Distribution of Income and Electricity Expenditure

Income (kyats per month)	Electricity Expenditure			Total
	Under 20000	20000-40000	Above 40000	
Low	357	44	0	401
Moderate	75	60	0	135
High	47	0	57	104
Total	479	104	57	640

Source: ADB Survey Data, 2017

To see the above Table, among 640 households in low income level consumes most of 357 households under 20000 kyats, 44 households spend between 20000 and 40000 kyats for electricity. In moderate income level, 75 households spend under 20000 kyats and 60 households consume between 20000 and 40000 kyats. In high income level, 47 households use under 20000 kyats and 57 households spend more than 40000 kyats. It is observed that most of the 479 households are consumed under 20000 kyats for electricity in three income levels. For the above table it can be decided that most of the households, over 74.84% of households being consumed electricity under 20000 kyats in all income level.

Table (4.8) Joint Frequency Distribution of Income and Petrol Expenditure

Income (kyats per month)	Petrol Expenditure			Total
	Under 50000	50000-1000000	Above 100000	
Low	173	228	0	401
Moderate	103	0	32	135
High	29	27	48	104
Total	305	255	80	640

Source: ADB Survey Data, 2017

The above Table shows that petrol consumption of 640 households depend on their income to get energy. In low income level, 173 households consume under 50000 kyats and the highest consumption of 228 households spend between 50000 and 100000 kyats. In moderate income level, 103 households spend under 50000 kyats and 32 households consume more 100000 kyats for petrol energy. In high income level, 29 households use under 50000 kyats, 27 households spend between 50000 kyats and 100000 kyats and 48 households utilize above 100000 kyats. It is observed that most of the 305 households are consumed under 50000 kyats for petrol energy in four income groups. Therefore, over 47.66% of households being consumed petrol energy less than 50000 kyats in all income level.

Table (4.9) Joint Frequency Distribution of Income and Candle Expenditure

Income (kyats per month)	Candle Expenditure			Total
	Under 4000	4000-8000	Above 8000	
Low	74	169	158	401
Moderate	114	21	0	135
High	88	16	0	104
Total	276	206	158	640

Source: ADB Survey Data, 2017

The Table (4.9) presents that income levels of 640 households are how to use candle for light. In low income level, 74 households consume under 4000 kyats, the most of 169 households spend between 4000 and 8000 kyats and 158 households utilize more 8000 kyats. In moderate income level, 114 households spend under 5000 kyats and 21 households consume for candle. In high income level, 88 households use under 5000 kyats and 16 households utilize between 4000 and 8000 kyats. It is observed that most of the 276 households are consumed candle for light under 4000 kyats in four income groups. According to the result, 43.13% of households being consumed candle for light under 4000 kyats in all income level.

Table (4.10) Joint Frequency Distribution of Income and Battery Expenditure

Income (kyats per month)	Battery Expenditure			Total
	Under 5000	5000-10000	Above 10000	
Low	128	169	104	401
Moderate	87	27	21	135
High	54	6	44	104
Total	269	202	169	640

Source: ADB Survey Data, 2017

In the above Table, among 640 households in low income level utilize 128 households under 5000 kyats, most of 169 households use from 5000 to 10000 kyats and 104 households spend more 10000 kyats for battery. In moderate income level, 87 households spend under 5000 kyats, 27 households consume from 5000 and 10000 kyats and 21 households utilize above 10000 kyats. In high income level, 54 households use under 5000 kyats, 6 households spend from 5000 to 10000 kyats and 44 households consume more than 10000 kyats. According to the result, most of the 269 households are consumed under 5000 kyats for battery in three income level. Therefore, it can be decided that most of the households 42.03% being utilized battery less than 5000 kyats in all income level.

Table (4.11) Joint Frequency Distribution of Income and Other Energy Expenditure

Income (kyats per month)	Other Energy Expenditure			Total
	Under 30000	30000-60000	Above 60000	
Low	252	149	0	401
Moderate	72	10	53	135
high	39	21	44	104
Total	363	180	97	640

Source: ADB Survey Data, 2017

The above Table indicates that among 640 households are how to utilize other energy for various power usage (lighting, cooking, heating). In low income level, the most of 252 households consume under 30000 kyats and 149 households spend between 30000 and 60000 kyats. In moderate income level, 72 households spend under 30000 kyats, only 10 households consume from 30000 to 60000 kyats and 53 households use above 60000 kyats. In high income level, 39 households consume under 30000 kyats, 21 households spend from 30000 to 60000 kyats and 44 households utilize above 60000 kyats. It is observed that most of the 363 households are consumed between 30000 and 60000 kyats for other energy in three income groups. According to this result, 56.72% of households being consumed other energy under 30000 kyats in all income level.

4.2 Analysis of Multiple Discrimination

The multiple discriminant analysis considers five metric or continuous independent variables: electricity, petrol, candle, battery and other, together with two categorical or dependent variables: region and income level. The dependent variable (region) is consist of six levels (Yangon, Mandalay, Shan, Rakhine, Kayar and Mon) and income level with four levels (first level, second level, third level and forth level).

The standardized canonical discriminant analysis coefficients are used to determine each independent variable with its contribution to the discriminant function. Therefore, it considers eliminating variables that do not significantly contribute to prediction. The relative importance contribution will be assessed by standardized canonical discriminant function coefficients. All canonical coefficients represent the relative contribution of its associated predictor variable to the discriminant function such that predictor variables with relatively larger coefficients contribute more to the discriminating power of the function than do variables with smaller coefficients.

The structure matrix informs the discriminant loading (correlation) of the predictor variables in the discriminant analysis. These discriminant loadings are ordered in descending magnitude and are like to factor loadings in factor analysis and then the square of the canonical correlation is similar to the coefficient of determination in a multiple regression analysis.

4.2.1 Examining Dependent Variable (Region)

In this section, discriminant analysis is performed dependent variable as region and independent five continuous variables as electricity, petrol, candle, battery and other.

Table (4.12) Tests of Equality of Group Means

Independent variable	Wilks' Lambda	F	df1	df2	Sig.
Electricity	.361	4.254	5	12	.019
Petrol	.721	.930	5	12	.495
Candle	.217	8.658	5	12	.001
Battery	.550	1.962	5	12	.157
Other	.749	.802	5	12	.569

Source: ADB Survey Data, 2017

The Tests of Equality of Group Means Table presents the Wilks' lambda and univariate F-test used to assess differences between the mean scores of the five independent variables for the six groups of selected regions. The F-tests in Table (4.12) are found significant for electricity (p-value $0.019 < 0.05$) and candle variable is significant at 1% level (p-value $0.001 < 0.01$). This result indicating that the energy consumed in the household differ in terms of regions on these independent variables. However, there is no significant difference between the six regions on petrol (p-value $0.495 > 0.05$), battery (p-value $0.157 > 0.05$) and other (p-value $0.569 > 0.05$). Thus, the independent variables (electricity and candle) are potentially important for discriminating between the six groups of region. Here, this result suggests that in a future analysis to consider eliminating the insignificant variables (petrol, battery and other) from the model.

Table (4.13) Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	15.308[a]	87.8	87.8	.969
2	1.312[a]	7.5	95.3	.753
3	.625[a]	3.6	98.9	.620
4	.126[a]	.7	99.6	.335
5	.065[a]	.4	100.0	.247

a. First 5 canonical discriminant functions were used in the analysis.
Source: ADB Survey Data, 2017

Table (4.13) presents the eigenvalues. The larger the eigenvalue, the more of the variance of the six group dependent variables is explained by the discriminant function. There are five discriminant functions in this study, listed in descending order of importance, as shown in function column. The third column displays the percentage of variance explained and the last column shows the canonical correlation. The function 1, 2 and 3 exceeds the criterion of 0.5 for a strong relationship. The squaring of these values provides the coefficients of determination which represents the percentage of variance explained in the dependent variable.

Table (4.14) Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 5	.014	49.415	25	.003
2 through 5	.222	17.312	16	.366
3 through 5	.513	7.674	9	.567
4 through 5	.834	2.090	4	.719
5	.939	.723	1	.395

Source: ADB Survey Data, 2017

The Table (4.14) serves a purpose distinct from the Wilks' lambda in the normal ANOVAs table. In this Table the Wilks' lambda tests the significance of the eigenvalue for each discriminant function. There are five functions in this Table, but it is only one function, "1 through 5" which is statistically significant at alpha 1% level.

Table (4.15) Standardized Canonical Discriminant Function Coefficients

Independent variable	Function				
	1	2	3	4	5
Electricity	-.215	.798	.574	.151	-.251
Petrol	2.785	1.778	-.205	-.020	1.126
Candle	2.093	.517	.258	-.071	-.544
Battery	.150	.140	.569	-.304	1.930
Other	-2.273	-1.862	-.283	1.149	-1.852

Source: ADB Survey Data, 2017

The Table (4.15) express standardized canonical discriminant function coefficients, indicating the relative importance of the independent variable in predicting region. These coefficients can be used to calculate the discriminant score for this case. From this Table (4.15), the best independent variable in predicting the dependent variable is noted. The standardized function coefficients for function 1 are electricity (-0.215), petrol (2.785), candle (2.093), battery (0.15) and other (-2.273). The standardized function coefficients for function 2 are electricity (0.798), petrol (1.778), candle (0.517), battery (0.14) and other (-1.862). The standardized function coefficients for function 3 are electricity (0.574), petrol (-0.205), candle (0.258), battery (0.569) and other (-0.283). The standardized function coefficients for function 4 are electricity (0.151), petrol (-0.02), candle (-0.71), battery (-0.304) and other (1.149). The standardized function coefficients for function 5 are electricity (-0.251), petrol (1.126), candle (-0.544), battery (1.93) and other (-1.852).

Table (4.16) Structure Matrix

Independent variable	Function				
	1	2	3	4	5
Candle	.442	-.465	.730*	-.065	-.226
Battery	.139	-.398	.664*	.460	.412
Electricity	-.259	.590	.664*	.342	-.165
Other	.100	-.207	.126	.957*	.121
Petrol	.081	.247	-.431	.832*	.234

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions

Variables ordered by absolute size of correlation within function.

*. Largest absolute correlation between each variable and any discriminant function

Source: ADB Survey Data, 2017

Table (4.16) shows the simple correlation of each independent variable with the discriminant function(s). According to the structure matrix, function 1 is largest correlated to candle (0.442), function 2 is highest correlated to electricity (0.59), function 3 is highly correlated to candle (0.73), battery (0.664) and electricity (0.664), function 4 is highly correlated to other (0.957) and petrol (0.832) and function 5 is correlated to battery (0.412).

Table (4.17) Classification Results[a]

Region			Predicted Group Membership						Total
			Yangon	Mandalay	Shan	Rakhine	Kayar	Mon	
Original	Count	Yangon	3	0	0	0	0	0	3
		Mandalay	0	3	0	0	0	0	3
		Shan	0	0	2	1	0	0	3
		Rakhine	0	0	0	3	0	0	3
		Kayar	0	0	0	0	2	1	3
		Mon	0	0	0	0	0	3	3
	%	Yangon	100.0	.0	.0	.0	.0	.0	100.0
		Mandalay	.0	100.0	.0	.0	.0	.0	100.0
		Shan	.0	.0	66.7	33.3	.0	.0	100.0
		Rakhine	.0	.0	.0	100.0	.0	.0	100.0
		Kayar	.0	.0	.0	.0	66.7	33.3	100.0
		Mon	.0	.0	.0	.0	.0	100.0	100.0

a. 88.9% of original grouped cases correctly classified.

Source: ADB Survey Data, 2017

In the above Table (4.17), the classification results indicate that how well the discriminant functions were able to classify the cases for each group of the dependent variable. Examination of the classification results table shows that 88.9% of the cases were correctly classified. The prediction of energy consumption in the household for region (Yangon, Mandalay, Shan, Rakhine, Kayar and Mon) was with the overall classification rate of 88.9%. Inspection of the classification results shows that there was (1) a greater success rate for the regions: Yangon, Mandalay, Rakhine and Mon who were 100% correctly classified (2) 66.7% correct classification (33.33% misclassification) for Shan and Kayar. Thus, the six groups of region appear to be quite different with Yangon, Mandalay, Rakhine and Mon are more likely to be correctly classified by the discriminant functions than Shan and Kayar.

4.2.2 Examining Dependent Variable (Income level)

In this section, discriminant analysis is performed that the dependent variable as income and the independent five continuous variables as electricity, petrol, candle, battery and other.

Table (4.18) Tests of Equality of Group Means

Independent variable	Wilks' Lambda	F	df1	df2	Sig.
Electricity	.864	1.184	2	15	.333
Petrol	.834	1.491	2	15	.257
Candle	.951	.384	2	15	.688
Battery	.765	2.308	2	15	.134
Other	.552	6.093	2	15	.012

Source: ADB Survey Data, 2017

The test of equality of the groups' means reflected any significant differences in means of the predictor variables between the three groups of income level. The F-tests in Table (4.18) are found that only other variable is statistically significant at 5% level (p-value 0.012 < 0.05), indicating that the energy consumed in the household differ in terms of income level (low, moderate and high) on these independent variables. However, there is no significant difference between the three groups on electricity (p-value 0.333 > 0.05), petrol (p-value 0.257 > 0.05), candle (p-value 0.688 > 0.05) and battery (p-value 0.134 > 0.05). Thus, only the independent variable (other) is potentially important for discriminating between the three groups of income level. This result suggests that in a future analysis is to consider eliminating the insignificant variables (electricity, petrol, candle and battery) from the model.

Table (4.19) Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.949[a]	74.4	74.4	.813
2	.670[a]	25.6	100.0	.634

a. First 2 canonical discriminant functions were used in the analysis.
Source: ADB Survey Data, 2017

The Table (4.19) shows the Eigenvalues. There are two discriminant functions, listed in descending order of importance as shown into function column, function 1 (1.949) and function 2 (0.67). The third column presents the percentage of variance explained and the last column shows the canonical correlation. These two functions exceed the criterion of 0.5 for a strong relationship. By squaring these values, the coefficients of determination which represent the percentage of variance explained in the dependent variance are provided.

Table (4.20) Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.203	20.730	10	.023
2	.599	6.670	4	.154

Source: ADB Survey Data, 2017

Table (4.20) tests the significance of the eigenvalue for each discriminant function. In this Table there is only one significant function at 5% level.

Table (4.21) Standardized Canonical Discriminant Function Coefficients

Independent variable	Function	
	1	2
Electricity	1.017	-.116
Petrol	-.309	1.850
Candle	.453	-1.175
Battery	-.513	2.715
Other	1.465	-2.119

Source: ADB Survey Data, 2017

The Table (4.21) shows standardized canonical discriminant function coefficients, indicating the relative importance of the independent variable in predicting income level. From this Table (4.21), the best independent variable in predicting the dependent variable is noted. The standardized coefficients for function 1 are electricity (1.017), petrol (-0.309), candle (0.453), battery (-0.513) and other (1.465). Similarly, the standardized coefficient for function 2 are electricity (-0.116), petrol (1.85), candle (-1.715), battery (2.715) and other (-2.119) respectively.

Table (4.22) Structure Matrix

Independent variable	Function	
	1	2
Other	.642*	.115
Battery	.382*	.184
Electricity	.279*	.096
Petrol	.269	.293*
Candle	.122	-.182*

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions

Variables ordered by absolute size of correlation within function.

*. Largest absolute correlation between each variable and any discriminant function

Source: ADB Survey Data, 2017

The structure matrix presents the simple correlations between the independent variables and the dimensions created with the unobserved discriminant function(s). In order to this result, function 1 is highly related to other (0.642) and function 2 is related to petrol (0.293).

Table (4.23) Classification Results[a]

Income level			Predicted Group Membership			Total
			Low	Moderate	High	
Original	Count	Low	6	0	0	6
		Moderate	2	4	0	6
		High	0	1	5	6
	%	Low	100.0	.0	.0	100.0
		Midian	33.3	66.7	.0	100.0
		High	.0	16.7	83.3	100.0

a. 83.3% of original grouped cases correctly classified.

Source: ADB Survey Data, 2017

In Table (4.23), the classification results indicate that 83.3% of the cases were correctly classified. The prediction of energy consumption in the household for income level (low, moderate and high) was with the overall classification rate of 83.3%. Inspection of the classification results shows that there were (1) 100% correct classification for low income level (2) 83.3% correct classification (16.7% misclassification) for high income level and (3) 66.7% correct classification (33.3% misclassification) for moderate income level. Thus, the three groups of income level appear to be quite different with low income level is more likely to be correctly classified by the discriminant functions than moderate and high income level.

CHAPTER V
CONCLUSION

This study has been applied multiple discriminant analysis to evaluate the household energy consumption in Myanmar. Discriminant analysis is multivariate approaches with two categorical variables (region and income level) and five quantitative measure variables (electricity, petrol, candle, battery and other). This is a linear combination of variables indicating whether the independent variables or dependent variables form a linear combination of variables to interpret the household energy consumption survey data. Discriminant analysis looks at the effect of several independent variables that are combined to form one or more linear composites. Discriminant analysis employed to classify how the energy in the households is consumed, based on both region and income level of households. The discriminant functions are not always easy to interpret because they were designed for separate groups, not to make conceptual sense.

A simultaneously discriminant analysis of both region and income level was constructed to determine whether the five independent variables could predict the consumption of energy in the household. The overall Wilks' lambda was significant for region: function 1 with Λ = 0.014, χ^2 = 49.415, p-value is less than 0.01 indicating that the overall independent variables differentiated between the six groups of region (Yangon, Mandalay, Shan, Rakhine, Kayar and Mon). Similarly, the overall Wilks' lambda was significant for income level: function 2 with Λ = 0.023, χ^2 = 20.73, p-value is less than 0.05 indicating that the overall independent variables differentiated between the four groups of income level (low, moderate and high). The findings of the discriminant analysis indicated that the energy consumed in households differ in terms of first, region, the test statistic of electricity was statistically significant at 5% level and candle was significant at 1% level. This result suggests in a future analysis to consider eliminating petrol, battery and other variable from the model. Second, income level, only the test statistic of other variable was statistically significant at 5% level. Here, this result suggests in future analysis to performance omitting electricity, petrol, candle and battery variable from the model. Another found that across all the selected regions the energy expenditure is changing with electricity and candle usages, whereas petrol, battery and other energy usages are relatively stable. Likewise, other energy usages are depending on the various household's income level while electricity, petrol, candle and battery usages are stable. In this analysis, petrol and battery variables are unimportant for discrimination both region and income level.

The result of this study has been presented access to electricity which is depend on various region in our country otherwise household's electricity consumption is influenced on whether connect to the electricity or not by government. If region has not been connected to electricity, public is more used to petrol, battery and other source of energy to get power usage (lighting, cooking, heating and etc.). The amount of petrol, battery and other energy (diesel, fuel wood, liquefied petroleum gas, charcoal, gasoline, paraffin, kerosene, rice husks, coal, charcoal and village generator) consumption will be increased in non-electricity region or local areas. Moreover, various income of households will be effected household's energy expenditure in selected regions of our country. This study indicates that further research are doing in statistical methods with completely primary or secondary large sample such type of data.

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APPENDIX

Summary of Household Energy Consumption Survey Data (kyats per month)

States and region	Income level	Number of Households	Power mode					Total Energy Expenditure
			Electricity	Petrol	Candle	Battery	Other	
Yangon	Low	44	32033	6983	2459	2160	23872	67507
	Moderate	28	36533	19200	2559	975	26981	86248
	High	29	61971	29150	2125	1538	18588	113372
Mandalay	Low	124	12660	55622	5502	5771	26877	106432
	Moderate	32	26797	105216	1284	3570	81866	218733
	High	28	57197	136556	1806	18542	78372	292473
Shan	Low	104	1060	76131	19228	21697	46492	164608
	Moderate	21	1638	49375	7084	16454	69633	144184
	High	16	851	150586	5474	34224	103186	294321
Rakhine	Low	54	2771	36407	10451	1799	23518	74946
	Moderate	17	1792	33611	3517	6056	15625	60601
	High	4	750	453131	325	873	27625	482704
Kayar	Low	45	4238	44821	5824	8182	31521	94586
	Moderate	10	1715	31444	1861	5748	42997	83765
	High	6	1200	51400	1200	6400	28158	88358
Mon	Low	30	158	11758	2982	3875	10539	29312
	Moderate	27	230	25703	3326	1620	24289	55168
	High	21	123	57827	2942	2917	36977	100786

Source. ADB Survey Data, 2017