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**DEVELOPMENT OF POVERTY INDEX WITH AGGREGATED  
WEIGHTS AND BETA REGRESSION ANALYSIS**



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## Abstrak

Kemiskinan adalah satu isu sosio-ekonomi yang serius yang dihadapi di seluruh dunia. Walaupun usaha untuk membasmi kemiskinan telah lama dilaksanakan, namun realitinya Malaysia masih belum bebas daripada permasalahan ini. Kelantan dan Kedah dikenal pasti mempunyai kadar kemiskinan tertinggi di Semenanjung Malaysia. Kebanyakan kajian lepas berfokus kepada pembangunan Indeks Kemiskinan (PI) di peringkat persekutuan dan negeri di mana ia tidak menggambarkan situasi sebenar di peringkat daerah. Oleh itu, kajian ini bertujuan membangunkan PI bagi 12 daerah di Kedah. Oleh kerana nilai PI adalah daripada 0 sehingga 1, maka model regresi beta disesuaikan untuk menyiasat hubungan di antara indikator utama dan sub-indikator PI. Pemberat indikator kemiskinan dikira dengan menggabungkan pemberat subjektif dan objektif menggunakan kaedah Sentroid Turutan Pangkat (ROC) dan Kepentingan Kriteria Melalui Korelasi Antara Kriteria (CRITIC) masing-masing. Maka, PI dibina menggunakan kaedah Pemberat Tambahan Mudah (SAW). Hasil dapatan daripada PI, analisis beta regresi diaplikasi untuk menyiasat hubungan di antara indikator utama dan sub-indikator PI. Hasil dapatan menunjukkan indikator kemiskinan yang paling penting ialah pekerjaan. Ia juga didapati Kuala Muda dan Sik mempunyai nilai PI tertinggi bagi kategori miskin dan miskin tegar. Akhir sekali, terdapat hubungan positif di antara indikator utama dan sub-indikator PI. PI yang dibina boleh digunakan oleh pihak berkuasa yang berkaitan untuk menyediakan inisiatif yang bersesuaian untuk membantu golongan miskin meningkatkan ekonomi mereka ke arah kehidupan yang lebih baik.

**Kata Kunci:** Pemberat teraggregat, Analisis regresi beta, Kepentingan Kriteria Melalui Korelasi Antara Kriteria (CRITIC), Indeks Kemiskinan, Sentroid Turutan Pangkat (ROC)

## Abstract

Poverty is a serious socio-economic issue faced by the world. Despite decades of efforts that have been made to reduce poverty, in reality, Malaysia has yet to break free from the issue of poverty. Kelantan and Kedah have been identified as having the highest poverty incidence in Peninsular Malaysia. Most of the past research has focused on developing Poverty Index (PI) at the federal and state-level which does not really reflect the actual situation in district-level. Therefore, this study aimed to develop a PI for the 12 districts in Kedah. Since the PI value is bounded to 0 and 1, hence the beta regression model was fitted to investigate the relationship between main indicators and sub-indicators of PI. Poverty indicators weight has been computed by aggregating subjective and objective weights using Rank Order Centroid (ROC) and CRiteria Importance Through Intercriteria Correlation (CRITIC) methods respectively. Hence, PI has been developed by using Simple Additive Weighting (SAW) method. From the results of PI, beta regression analysis was applied to investigate the relationship between main indicators and sub-indicators of PI. The result shows the most important indicator of poverty is occupation. It is also found that Kuala Muda and Sik have the highest PI value for poor and hardcore poor categories respectively. Finally, there is a positive relationship between the main indicators and sub-indicators of PI. The developed PI can be used by relevant authorities to provide related initiatives that could help poor people enhance their economic productivity for the betterment of their lives.

**Keywords:** Aggregated weight, Beta regression analysis, CRiteria Importance Through Intercriteria Correlation (CRITIC), Poverty Index, Rank Order Centroid (ROC)

## Acknowledgement

*In the name of Allah, the Most Gracious and the Most Merciful.*

First and foremost, I am thankful to Almighty Allah SWT for giving me the strength to face all the challenges, knowledge, ability, and opportunities to finish writing this thesis.

I would like to express deep and my sincere gratitude to my supervisors, Dr. Nor Hasliza binti Mat Desa and Prof. Dr. Maznah binti Mat Kasim for the continuous support of my master's study and research, for their patience, motivation, enthusiasm and immense knowledge, their guidance helped me in all time of research and writing of this thesis. It was a great privilege and honor to study under their guidance.

I also want to thank the Ministry of Education and Universiti Utara Malaysia for providing all the funds given to complete this research.

I am extremely grateful to my beloved family, especially my parents, Mazwin binti Lokman and Mohamad bin Abdul Hadi for their love, prayers, caring and sacrifices for educating and preparing me for my future. I express my thanks to all my friends who helped me a lot, guiding me and continuing to support me to complete this research work.

Last but not least, I want to thank me for doing all this hard work, for never quitting and I want to thank me for just being me at all times! Thank you!

Love a lot.

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## List of Abbreviations

|         |                                                           |
|---------|-----------------------------------------------------------|
| AHP     | Analysis Hierarchy Process                                |
| CRITIC  | CRiteria Importance Through Inter-criteria Correlation    |
| DOSM    | Department of Statistics Malaysia                         |
| EU      | European Country                                          |
| EW      | Equal Weighting                                           |
| GIS     | Geographical Information System                           |
| HDI     | Human Development Index                                   |
| IHDI    | Inequality-adjusted Human Development Index               |
| ICU JPM | Implementation Coordination Unit, Jabatan Perdana Menteri |
| JKMM    | Social Welfare Department Malaysia                        |
| LCE     | Lower Certificate of Education                            |
| MADM    | Multi-Attribute Decision Making                           |
| MCDM    | Multiple Criteria Decision Making                         |
| MCE     | Malaysian Certificate of Education                        |
| MCO     | Movement Controlled Order                                 |
| MODM    | Multi-Objective Decision Making                           |
| MPI     | Multidimensional Poverty Index                            |
| NDP     | National Development Policy                               |
| NEP     | New Economic Policy                                       |
| NGOs    | Non-Governmental Organizations                            |
| NPT     | National Policy of Transformation                         |
| NVP     | National Vision Policy                                    |
| OLS     | Ordinary Least Square                                     |
| OPHI    | Oxford Poverty and Human Development Initiative           |
| PLI     | Poverty Line Income                                       |
| PMR     | Penilaian Menengah Rendah                                 |
| PNEP    | Pre-New Economic Policy                                   |
| ROC     | Rank Order Centroid                                       |
| RR      | Rank Reciprocal                                           |

|        |                                                                |
|--------|----------------------------------------------------------------|
| RS     | Rank Sum                                                       |
| SAW    | Simple Additive Weighting                                      |
| SD     | Standard Deviation                                             |
| SMART  | Simple Multi-Attribute Rating Technique                        |
| SMU    | Sijil Menengah Ugama                                           |
| SPM    | Sijil Pelajaran Malaysia                                       |
| SPVM   | Sijil Pelajaran Vokasional Malaysia                            |
| SRP    | Sijil Rendah Pelajaran                                         |
| TOPSIS | Technique of Order Preference Similarity to the Ideal Solution |
| UPSR   | Ujian Penilaian Sekolah Rendah                                 |
| VIKOR  | ViseKriterijumska Optimizacija I Kompromisno Resenje           |



# CHAPTER ONE

## INTRODUCTION

### 1.1 Background of Study

Poverty is intertwined with constraints in all aspects of access to available resources, thus the discussion about poverty becomes quite diverse and not merely economic (Ningrum, Hukom, & Adiwijaya, The Potential of Poverty in the City of Palangka Raya: Study SMIs Affected Pandemic Covid 19, 2020). Akinbode (2013) mentioned that poverty is the state of one who lacks a level quantity of money or material. Lately, deaths reported worldwide are around 25,000 people per day due to starvation (Dieterle, 2015). Death from starvation happens because those that are trapped in poverty are prone to the symptoms of deficiencies, resulting in sickness. Consequently, these people become unable to work, making the next generation even poorer. This summarizes the endless vicious cycle of poverty. Poverty does not only occur in under-developed countries, but also in developed countries such as United States of America (USA), Canada, Australia, Japan, and South Korea (Bertolini, 2019). Although most developed countries do have anti-poverty programs in form of provisional funds and advice for the low-income group, these programs are not sufficient to raise people out of poverty, and the government's success is still questionable (Samat, Abdul Rashid, & Elhadary, 2018).

Malaysia was mainly an agricultural country with a rural economy in 1995. However, after two decades, the country began heading towards the characteristics of a developing country through Vision 2020, which highlights the growth of economic prosperity, urbanization, and industrialization nation. Nevertheless, poverty remained as a major

issue in this country (Majid, Jaffar, Che Man, Vaziri, & Sulemana, 2016). Since Malaysia has not yet achieved a precise development target, the Malaysian government has renewed the policies and the vision to become a developed nation by 2030 (Ramely, Ahmad, & Mohamed Harith, 2018) with zero poverty (Elhadary & Samat, 2015). To effectively eradicate poverty, Malaysia applied several practical and integrated methods in determining the multidimensional nature of poverty, resulting in the development of the following policies listed in Table 1.1 throughout six decades.

Table 1.1

*Policies by Malaysia's Government to Eradicate Poverty*

| <b>Policy</b>                           | <b>Years</b> |
|-----------------------------------------|--------------|
| Pre-New Economic Policy (PNEP)          | 1960-1970    |
| New Economic Policy (NEP)               | 1971-1990    |
| National Development Policy (NDP)       | 1991-2000    |
| National Vision Policy (NVP)            | 2001-2010    |
| National Policy of Transformation (NPT) | 2011-2020    |

After Malaysia's Independence, The Pre-New Economic Policy (PNEP) was introduced in 1960 to improve the country's economy immediately. This initiative began with an enormous allocation of money for irrigation projects in education, health, and agriculture (Elhadary & Samat, 2015). With respect to poverty, the plan focused on eradicating absolute poverty regardless of race by increasing the standards of income, increasing the employment opportunities for all Malaysians and reforming society to eradicate the identification of race with economic functions.

According to Hatta and Ali (2013), as outlined in the New Economic Policy (NEP) 1971-1990, poverty was a major concern, and ethnic inequality was widely seen as an important cause. Poverty reduction was a core aim of the NEP. In 1970, the official

poverty rate was 50%, and almost two-thirds of the Bumiputera lived in poverty at that time. Hence, the NEP in 1971 managed to reduce the overall incidence of poverty in Peninsular Malaysia from 49.3% in 1970 to 17.1% in 1990 (Hatta & Ali, 2013)

The 1991-2000 National Development Policy (NDP) is an "ethnicity-oriented policy". Several programs were introduced in this period to eliminate poverty. These include the growth of the local businesses and manufacturing environments, the participation of the private sectors and human resources development ( (Mohd Yusof & Ariffin, 2020).

The 2001-2010 National Vision Policy (NVP) aimed to create a united, progressive, and prosperous Malaysia that engages in complete and equal partnerships. In addition, this policy focused on minority groups such as Sabah and Sarawak, which among all states in Malaysia, still records the highest poverty rates. This phase ended with an overall continued decrease in poverty rate to 3.8% by 2009, which can be attributed to the following components: 2.0% decrease for urban poverty, 7.1% for rural poverty and 5.3% for Bumiputera (Mohd Yusof & Ariffin, 2020)

The National Vision Policy (NVP) was followed by the National Policy of Transformation (NPT). In this phase, Malaysia set an ambitious target to be a zero-poverty developing nation by 2020. According to Raj, Abdul Wahab, Nur Fadia, Awang and Wan Ibrahim (2020), This strategy emphasized concepts such as multicultural, people-centered emphasis, eradication of poverty and fair distribution through ethnic groups and regions. Inclusivity initiatives aim to raise household with low-income from RM 1,440 (USD 480) per month in 2009 to RM 2,300 (USD 770) per month in 2015.

These policies and their associated programs have succeeded in stimulating economic development and thereby sharply eradicating the incidence of poverty. Even though Malaysia was successful in eradicating the poverty rate from 49.3% in 1970 to 12.4% in 1992, then to 1.7% in 2012 and to 0.4% in 2016 as stated by Ali (2019), this could not be a veritable representation of Malaysia's poverty due to some indicators are not included in the approaches to study the poverty. Therefore, countless studies must be conducted in several ways to find the best strategy to overcome it.

Laderchi, Saith and Stewart (2003) stated that there are four approaches to measure the poverty rate. The four approaches are the monetary approach, capability approach, social exclusion approach and participatory approach. The monetary approach is measured with income or expenditure-based metrics while the capability approach focuses on a person's actual ability to achieve their well-being. The social exclusion approach refers to individuals who are not available to participate fully in economic, social, political, and cultural life while a participatory approach is an approach that analyzes and reduces poverty by incorporating the views of the poor.

Most researchers apply the monetary approach to measure the poverty index (PI) for a certain society (Nair & Sagar, 2015; Alkire & Santos, 2014). The monetary approach is measured by expenditure-based metrics such as consumption of goods and services that will meet people's needs and desires over time, or income-based metrics which are not only based on the society's present earnings but also by their long-term income (Stoyanova & Tonkin, 2018).

In contrast, Engstrom et al., (2017) stated that poverty can also be measured by a spatial approach. Spatial approach generally means area-based targeting. This approach has various strategy such as satellite imagery or locating hot and cold spots using the Geographical Information System (GIS) Software as proposed by Samat, Elhadary, and Rainis (2016). Moreover, spatial approach allows poverty to be observed from a geographical perspective. A study by Vista and Murayama (2011) at the Bicol region, Philippines stated that a state poverty was caused by geography and elements of public policy.

In Malaysia, income-based metrics, namely Poverty Line Income (PLI) has been implemented by the government in 2016 (Bhari, et al., 2018) to measure the poverty rate in the country. Malaysia's National PLI has categorized poverty into two categories which are poor and hardcore poor. A poor category denotes households with monthly income lower than the food poverty line. Additionally, these households are also unable to meet other basic needs such as education, clothes, health care, transport, communication, rent, utilities, and leisure that have been recognized as non-food PLI. The food poverty line was determined in accordance with the PLI food calorie guideline based on the daily needs of-person in the family (Bhari et al., 2018). On the other hand, the hardcore poor category represents people who earn less than half of the PLI (Chamhuri, Ahmed, Bashawir, & Mia, 2016). These poor and hardcore poor categories was categorized in research to better understand and address the specific needs and challenges faced by different groups of people living in poverty (Ahmad, et al., 2021).

In 2019, Malaysia increased the PLI value from RM 980 to RM 2,208 (Bhari, et al., 2022). This resulted in over 400,000 households with monthly earnings below this level

in 2019 (Ali, 2019). The reason for this increase because PLI 2005 that determined the national PLI value of RM980 was based on each family member's minimal food requirements as well as 106 non-food items obtained from the spending patterns of the families in the 2005 household expenditure survey. The updated PLI 2019, which resulted in a national PLI value of RM 2,208, was based on optimal food needs and healthy eating, as well as 146 non-food items from the B40 (B40 refers to the bottom 40 percent of income earners) families spending patterns in the 2019 household expenditure survey. The summary of National PLI based on the PLI 2005 and PLI 2019 are presented in the Table 1.2.

Table 1.2

*The National Poverty Line Income based on the PLI 2005 and PLI 2019*

|                                    | PLI 2005      | PLI 2019 |
|------------------------------------|---------------|----------|
| National PLI value                 | RM 980        | RM 2208  |
| Poverty rate                       | 0.4%          | 5.6%     |
| Number of poor households          | 24 673        | 405 441  |
| Number of hardcore poor households | Not available | 27 158   |

Based on PLI 2005, the National PLI value was RM 980, and the poverty rate was 0.4%. The number of poor households was 24 673 households while hardcore poor households are not available since the PLI 2005 are not categorized into two categories yet. Based on PLI 2019, The National PLI value has increased into RM 2208 (Bhari, et al., 2022) and the poverty rate was 5.6%.

Hence, study of poverty is needed to reduce poverty in the field of poverty study. Multi-Criteria Decision Making (MCDM) techniques are used to assign weights to different indicators to reduce poverty. There are two types of weighting methods which are

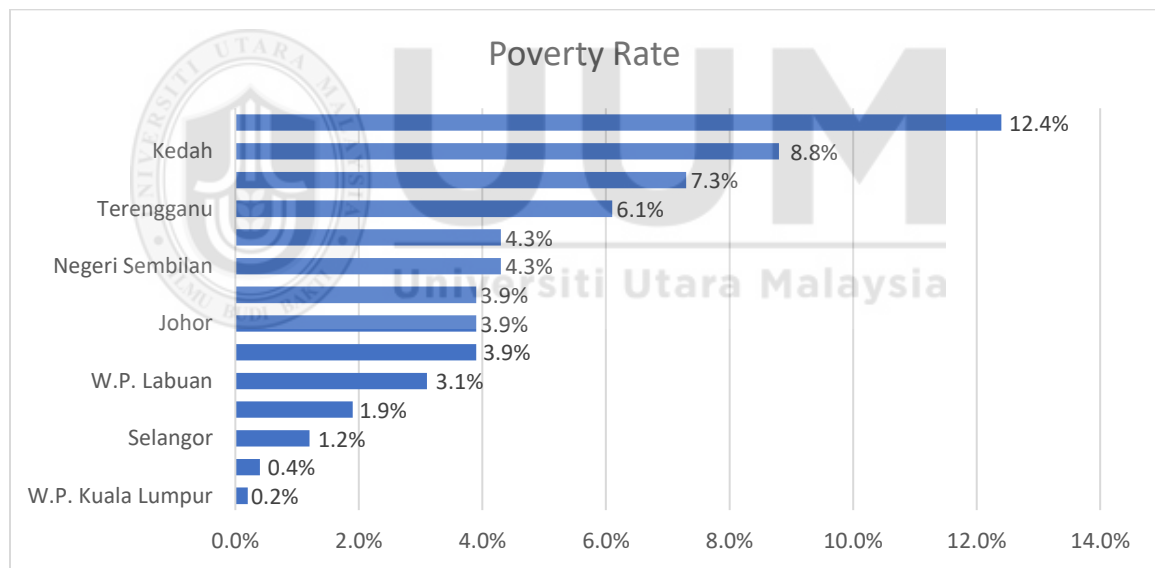


subjective and objective weighting methods. These weights represent the relative importance of each criterion in the decision-making process.

Then, the Poverty Index (PI) will be developed by aggregating the subjective and objective weights. Once the PI was calculated, the study used beta regression analysis to investigate the relationship between the main indicators and sub-indicators of the PI.

## 1.2 Problem Statement

For many years, poverty has become a major problem not only in Malaysia but around the world. In Malaysia, the national poverty rate has increased from 5.6% in 2019 to 8.4% in 2020 (Ab Razak , 2021).



*Figure 1.1. Poverty rate by state in Malaysia in 2020*

Source: Mahiadin (2021)

Figure 1.1 demonstrates that Kelantan and Kedah have higher incidences of poverty than the national average in Peninsular Malaysia which is 8.4%. Hence, several studies in smaller areas have been performed in the Kelantan such as by Chamhuri et al. (2016),

Mohd Ali, (2019), Md Nor, Mohamad and Vellymalay (2019), Mohd Ali, Ibrahim and Ab Aziz (2019), and Zahari, Siwar, Idrus, and Mohd Idris, (2018).

Most of the past research tend to focus on the federal and state-levels rather than smaller areas such as studies by Afroz, Muhibbullah and Rahman (2021) and Haji Othman, Sheh Yusuff, and Cheumar (2020). Until now, it is believed that very few research has been conducted in investigating the poverty at the district level in Kedah such as study by Ibrahim (2021) and Mohamad Zaki, Sulong and Zainal (2021). By studying poverty at the district level, this allows for a more and accurate understanding of poverty issues in a particular area, leading to more effective and targeted poverty reduction strategies. Therefore, this study developed an index to determine the level of poverty by districts in Kedah since Kedah has the second higher incidence of poverty rate.

Since poverty can be equated to an endless vicious cycle, innumerable research has been done using various methods to discover the best way to overcome it. Even though all the states in Malaysia have recorded economic growth, there is still a huge gap in the development of country between regions, states, and rural-urban areas. This might be due to certain indicators in a smaller region not being investigated well. It could have a high impact on poverty in Malaysia. The indicators such as marital status, education level, occupation, living standard, strata, residential and comfortability were related differently to the evaluation of poverty since these indicators have different relative significance on poverty (Crentsil, Asuman, & Fenny, 2019). Therefore, the weight of each indicator should be considered in developing the PI to ensure that the important indicator affecting the poverty rate in Kedah can be properly identified.

The weight of each indicator can be determined by using subjective and objective weighting methods. However, biased results will be obtained if one of the methods is not included as both methods have their disadvantages. Hence, this study attempted to aggregate the Rank Order Centroid (ROC) subjective and Criteria Importance Through Inter-criteria Correlation (CRITIC) objective weighting methods in developing the PI for districts of Kedah to balance both the subjective expert opinions and the objective data driven value perspective. Despite the fact that a number of indices have been developed in the past, Abdul Rahman and Zakaria (2012) indicated that applying existing indices to other nations or regions with different indicators is thought to be less relevant.

As the PI lies between 0 and 1, the ordinary least square (OLS) regression approach will not be sufficient to define regressions with bounded dependent variables. Hence, to avoid biased estimators and hypothesis tests, regression techniques that are more suited for analysis of bounded outcomes are needed. Beta regression analysis is a better method to analyze the relationship between main indicators and sub-indicators of PI.

### **1.3 Research Questions**

The specific questions are formulated as follows:

- i. How can the aggregated weight for poverty be computed for poor and hardcore poor category?
- ii. How to develop a PI by district?
- iii. What is the relationship between main indicators and sub-indicators of PI?

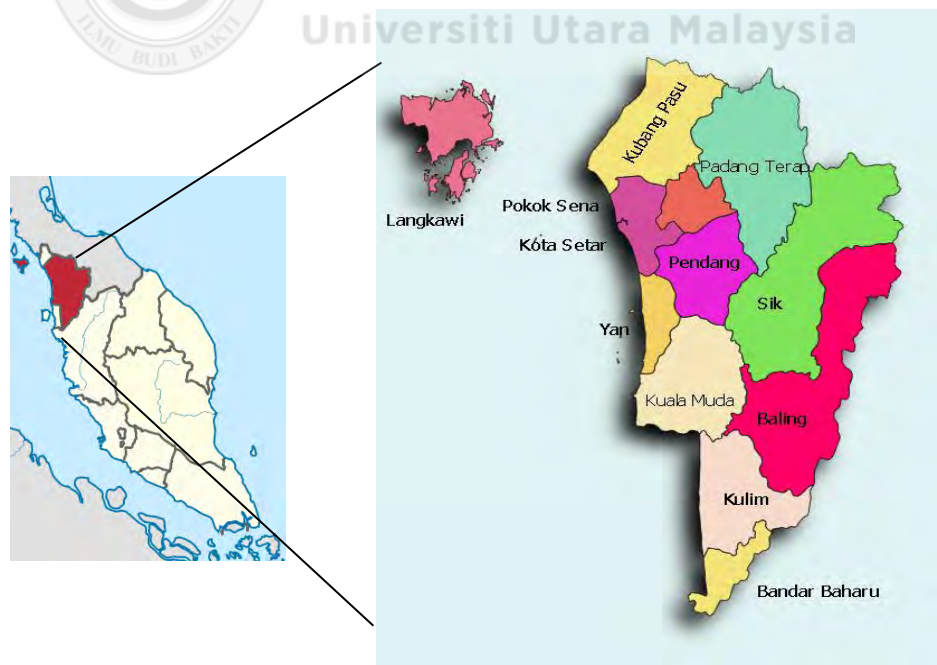
## 1.4 Research Objectives

This study aims to develop Poverty Index (PI) for 12 districts in Kedah and determine the relationship between main PI and Sub PI. Therefore, three research objectives are listed as follows:

- i. To compute the aggregated weight for poverty indicators.
- ii. To develop a PI for ranking the districts according to their PI.
- iii. To model the relationship between main indicators and sub-indicators of PI.

## 1.5 Scope of the Study

Kedah state has been selected for locality mapping of poor and hardcore poor households. Kedah was located on the northwestern corner of Peninsular Malaysia. Its land covers an area close to 3700 square miles with a population of just over two million people in 12 districts.



*Figure 1.2. Map of Kedah in Peninsular Malaysia*

Figure 1.2 shows all the districts in Kedah which are Baling, Bandar Baharu, Kota Setar, Kuala Muda, Kubang Pasu, Kulim, Langkawi, Padang Terap, Pendang, Pokok Sena, Sik and Yan. The secondary data in this study was collected from the Implementation Coordination Unit, Jabatan Perdana Menteri (ICU JPM) which involves data from e-Kasih from 2010 until 2021. Meanwhile, the primary data was collected by interviewing the experts who incharge in poverty fields which are from ICU JPM, Social Welfare Department Malaysia (JKMM), Department of Statistics Malaysia (DOSM) and Kedah Volunteer Club.

### **1.6 Significance of Study**

This study initiates a new approach in studying poverty by computing the aggregated weight of the poverty indicators and investigating the relationship between main indicators and sub-indicators of PI. It is useful to related parties such as government, non-governmental organizations (NGOs), body of knowledge and the society since the results here would provide a better insight on the state of poverty in Kedah. Based on the findings of this study, the government would be able design appropriate policies to reduce the poverty rate in Kedah. This study also offers useful data to assist policy makers in improving the national poverty planning program. Moreover, this study helps NGOs to plan a more effective aid distribution strategy for the hardcore poor and poor people in Kedah. Furthermore, this study provides baseline information about the factors that impact higher poverty rates in Malaysia, which benefits national statistician in predicting future decisions. Finally, the new application of beta regression in poverty field introduced a novel approach to analyzing poverty data for a more understanding of poverty issues.

## **1.7 Organizational of The Thesis**

This thesis contains five chapters. Chapter One summarized the study's context and outlines its emphasis. This chapter discusses the problem regarding poverty issues and the main research gap that this study aims to develop the PI and determine the relationship between main indicators and sub-indicators of PI using the beta regression analysis.

Chapter Two is a review of literature related to the problems highlighted in Chapter One. Firstly, this chapter focuses on previous research on index development using various methods. Next, factors that cause poverty were identified to develop the poverty indicators. The chapter also discusses the best method of subjective and objective methods to determine the weights of indicators. Afterwards, this chapter examines different methodologies to analyze the relationship between the developed PI and Sub PI.

Chapter Three outlines the methodology applied in this study to achieve the goals of developing the PI and investigating the relationship between main indicators and sub-indicators of PI. This chapter highlights the entire process conducted to complete this study which involves data collection, determination of subjective and objective weights, development of PI, poverty mapping by districts in Kedah, and modelling beta regression.

The findings of data analysis using CRITIC and ROC weighting method are described in Chapter Four. The descriptive statistic used in the study is presented at the beginning of the chapter and is then followed by the results of the weighting calculations for the indicators and sub-indicators of poverty in Kedah using subjective, objective, and

aggregated weights. This chapter then explores the outcomes of the development of the Indicators PI. The last section of this chapter elaborates on the beta regression model that was applied for the poor and hardcore poor categories. Lastly, Chapter Five summarized the overall thesis.



## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter reviews six different aspects related to poverty to gain a better understanding of eliminating poverty in Kedah. Firstly, the summary of poverty concept was briefly discussed in Section 2.2. Secondly, the discussion about the indicators that affect the PI in Section 2.3. Section 2.4 summarizes the methods of the subjective and objective weights in Multi-Criteria Decision Making (MCDM) to determine the weights of poverty indicators. Fourthly, the methods of development of PI were explained in Section 2.5. The last section of this chapter elaborates on beta regression modelling.

#### **2.2 The Poverty**

Poverty can be measured in several ways. Alkire and Foster (2010) and Alkire and Santos (2014) measured poverty using three dimensions while Abdullah, Othman, Edo, and Jani (2019) and Che Amat, Naim and Zakaria (2018) suggested that there were four dimensions required to measure poverty which are wealth, education, health and the living standard. On the other hand, Samat et al. (2016) stated that different perspectives of poverty can be visualized by calculating the access to facilities and food retailers by the population.

There are few indices regarding poverty that have been developed such as the Inequality-adjusted Human Development Index (IHDI) which complements the Human Development Index (HDI) and Multidimensional Poverty Index (MPI). These poverty indices were developed by the Oxford Poverty and Human Development Initiative



(OPHI) and the United Nations Development Programs of Human Development Report Office. These indices were established by the OPHI as a measure of acute global poverty (Alkire & Santos, 2014).

HDI classified nations into four stages of human development and statistically measured from three indices which are Life Expectancy, Education and Per-capita Income Indicators Index (Selvarajan & Selvaratnam, 2011). On the other hand, IHDI adjusted the mean value of each measurement according to its weight of deprivation by combining the average achievements in health, education, and income of the country with how the achievements were dispersed among the residents of the nation (Alkire & Foster, 2010).

However, Alkire and Foster (2010) later designed a new methodology called the Multidimensional Poverty Index (MPI) which contained a system of identification that expands the conventional methods of intersection, union, and a class of poverty measures. This index measured three dimensions which were living standard, health, and education. In education, the MPI identified two indicators for this dimension which are years of schooling and child enrolment whereas child mortality and nutrition are categorized as indicators under the health dimension. In the living standard dimension, the indicators are electricity, drinking water, sanitation, flooring, cooking fuels and assets. The indicators for each dimension are explained in Table 2.1.

Table 2.1

*Indicators of Multidimensional Poverty*

| <b>Multidimensional Poverty Index (MPI)</b> |                 |                        |
|---------------------------------------------|-----------------|------------------------|
| <b>Education</b>                            | <b>Health</b>   | <b>Living Standard</b> |
| Years of schooling                          | Child Mortality | Electricity            |
| Child Enrolment                             | Nutrition       | Drinking water         |
|                                             |                 | Sanitation             |
|                                             |                 | Flooring               |
|                                             |                 | Cooking fuel           |
|                                             |                 | Assets                 |

Source: Alkire and Foster (2010)

Zakaria, Ng and Abdul Rahman (2018) have measured the poverty rate of three districts in Terengganu using principal component analysis. Their study only focused on five variables which are income, subsidiary job, academic achievement, water supply and basic household needs. In another study, Che Amat et al. (2018) developed the Peninsular Malaysia PI using the fuzzy logic approach. This approach consists of three phases namely fuzzification, inference rules and defuzzification. In this study, the data used 12 variables depend on 12 different equipment conditions based on socio-economy for each district in Peninsular Malaysia. Hence, to study poverty, different and relevant variables that fit the chosen field of research should be used.

### 2.3 Poverty Indicators

There are several poverty indicators that have been discussed by previous research such as marital status of household head, education level of household head, occupation, living standard, strata, residential and comfortability. Ochieng Ogutu and Qaim (2019) conducted the study of multidimensional poverty that includes four dimension which are education, nutrition, health and living standard.

### **2.3.1 Marital status**

The marital status of household head is an indicator consisting of three sub-indicators which are single, married and divorced. According to Ramezankhani, Azizi and Hadaegh (2019), single status is those who are never married while married is who live with their spouse. Besides, divorced status is a household head that had divorced with their former spouse or no longer living with them and if they have children, they are known as single parents. According to Md Nor et al. (2019) single parent is frequently connected with financial troubles. Divorced are the most challenging ones because they are now technically single parents, meaning that they need to bear all the expenses alone especially if they have young children. Besides that, single parenting is associated with a significant likelihood of poverty (Härkönen, 2018).

### **2.3.2 Education level**

According to Maloma (2016), there are four sub-indicators in education level indicator which are no schooling, primary school, secondary school, and tertiary that affect poverty level. The education level could be an important indicator in the poverty rate where the lack of education of the household head, the probability of poverty incidence increasing due to the challenge to compete for limited resources and income opportunities (Akona, 2014). In addition, Maloma (2016) also mentioned that educated person have more opportunities to get a better job and higher income.

### **2.3.3 Occupation**

Occupation indicator has three sub-indicators that affecting the poverty which are unemployment, self-employment, and paid employment (Fields, 2019). Unemployment is the status of occupation of a household head who lives without a paid job while self-

employment is the status of occupation of a household head who runs their own business and supports their family. On the other hand, paid employment is the status of occupation of a household who has been hired by a company and receiving wages or salaries for their services. Chronically poor households were found where the household head was unemployed in urban and rural areas (Bukari et al., 2022).

#### **2.3.4 Living Standard**

Living standards, on the other hand, refer to the quality of life and material well-being of individuals or households (Chmielewska, 2022). As stated by Mohd Adnan, Wan Yusoff, and Ghazali (2018), poor household or low-income household are affected by living conditions where they are lacked necessities like a steady supply of water, sanitary facilities, and power. Household members are deprived if they reside in a home that has rotted window frames or flooring, moist walls, floors, or foundations (Sokołowski, Lewandowski, Kielcze, & Bouzarovski, 2020).

#### **2.3.5 Strata**

Strata is one of the most crucial factors that should be concerned regarding the poverty rate, and it occurs in both rural and urban areas. The type of poverty based on area are called urban poverty and rural poverty (Chamhuri, Ahmed, Bashawir, & Mia, 2016). According to Aliber (2003), poverty was found to be more serious in rural and township areas. Additionally, Chamhuri et al. (2016) proved that people who are living in rural areas have higher probabilities to experience poverty than those who are living in urban areas.

Factors resulting in urban poverty mostly come from rural migrants who do not have the skills to attain a sustaining income in urban areas. Moreover, these individuals are often

not notified of the information or awareness given by government agencies about the type of assistance offered. Generally, they lack information on social systems and urban economic systems which may help them survive.

High living costs in the city are also a factor that contributes to urban poverty. Although a majority of the people's income in urban regions does not fall under the category of low income, their expenses still exceed their incomes. This is due to the high cost of living in the city, which is contributed by several factors, especially inflation. For example, in 2009, a 3.9 percent inflation rate raised the cost of living in cities which in turn impacted the poverty rate (Munir & Mansur, 2009).

For rural poverty, occupational limitations are one of the factors that affect this form of poverty as most of rural employment lies in the agricultural sector (Choudhari, 2020). In this job sector, modernization is less comprehensive, and it is often exploited or monopolized by the middle-class citizens.

Apart from that, according to Ningrum, Hukom and Adiwijaya (2020) low education and employment status are also the cause of poverty in rural areas. Rural poverty has remained unchanged because of low production capacity. This has contributed to rural people with low incomes being unable to find better employment to increase their quality of living.

### **2.3.6 Residential**

Aristondo and Onaindia (2018) conducted a study that involved type of housing as a characteristic of poor household. The primary objective of the study was to provide a thorough analysis of energy poverty for various household groups and to examine the disparities that currently exist across groups in terms of their energy poverty values. The

primary breadwinner's gender, marital status, country of birth, education, general health, and job condition were taken into consideration, as well as the kind of building, ownership, and number of household members. In addition, when housing costs were considered, only 37% of those who are poor, as many of them have paid off their mortgages and have little to no housing expenses, which mean housing cost depends on types of houses may lead to additional expenses in a family.

### **2.3.7 Comfortability**

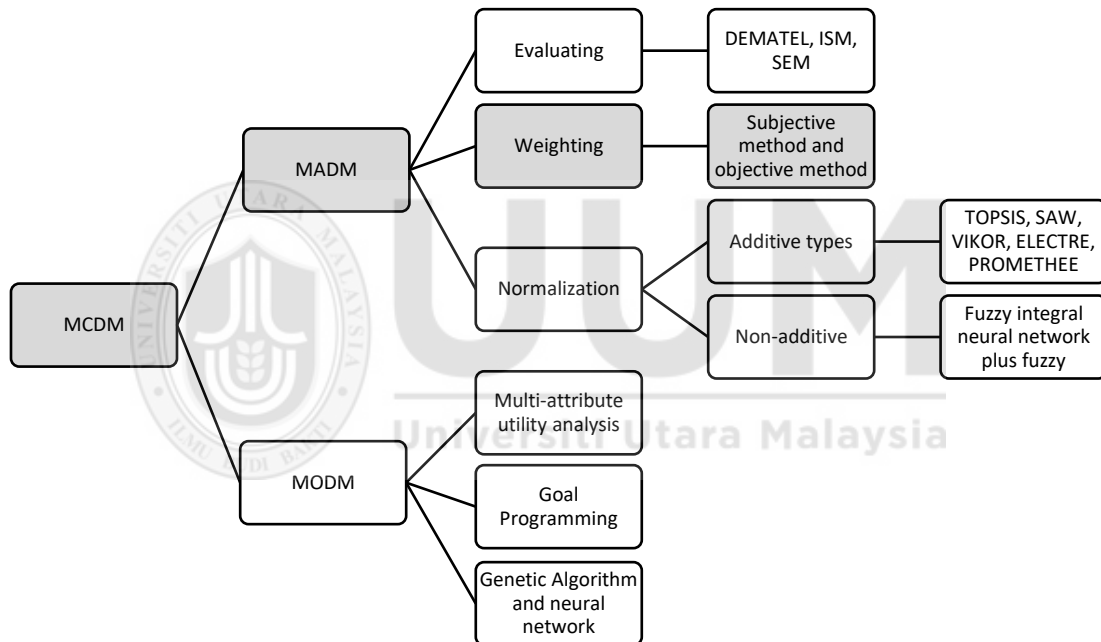
There are two sub-indicators in comfortability indicator which are number of rooms and household size. The bigger the families are in a developing country, the poorer they appear to be (Maloma, 2016). According to Nyariki, Wiggins, and Imungi (2002) poverty can rise to a certain rate if the size of the family increases. Otherwise, an increase in household size is projected to lower the level of poverty.

## **2.4 Multi-Criteria Decision Making (MCDM)**

Multi-Criteria Decision Making (MCDM) is commonly used to identify one or more alternatives to multiple criteria from a collection of available alternatives (Wang & Lee, 2009). The approach includes both quantitative and qualitative characteristics that can be measured by numerical values and subjective judgments (Zhou, Liu, Yang, & Wang, 2019). MCDM can be divided into two categories which are Multi-Attribute Decision Making (MADM) and Multi-Objective Decision Making (MODM) as mentioned by Hwang and Yoon (1981).

MADM's goal is to find the best alternatives when analyzing the entire set of attributes that are difficult to measure. On the other hand, alternatives are not predetermined in

MODM, but a collection of objective functions is optimized instead, subjected to a set of constraints with several infinite alternatives. There are two classifications in MODM. Firstly, by a method that consists of fuzzy methods, stochastic, and deterministic. Otherwise, the type of working data which are qualitative, quantitative, or mixed data. Mardani, Zavadskas, Govindan, Senin, and Jusoh (2016) have divided MADM into three classes and Jahan, Ismail and Noorossana, (2010) have categorized MODM into three classes too as shown in Figure 2.1.



*Figure 2.1. Multi-Criteria Decision Making*

Referring to Figure 2.1, the three classes for MADM are evaluating, weighting and normalization whereas for MODM, the classes are multi-attribute utility analysis, Goal Programming and Genetic Algorithm and neural network.

In MCDM, decision-makers use benefit and cost criteria to compare and evaluate different option based on their overall value or worth. This involves assessing the relative

importance of each criterion and assigning weights to reflect their relative importance. Once the criteria and weights are established, the decision-makers can use various decision-making methods.

Generally, there are two methods to determine the weightage namely the subjective weighting method and objective weighting method. The subjective weighting method is based on experts or specialist opinions regarding the relative significance of the parameters that are to be evaluated while the objective weighting method is based on the driven data value.

#### **2.4.1 Subjective Weighting Methods**

The subjective weights usually require the views of professionals or experts to assess the criterion's relative value. However, the subjective weight is highly dispersed across decision-makers and thereby suffers from systematic biases (Shen, Hu, & Lai, 2018). The simplest way to assess the degree of the criteria is to select it by using rank-based approaches, where based on their assessments, experts may rate the order of importance of the criteria. If  $n$  criteria are to be determined, the expert(s) must rate them on a scale of 1 to  $n$ , where 1 indicates 'the most important' criteria, 2- 'the second most important criteria,' until  $n$ - 'the least important criteria'. Therefore, it is important to consider experts with a wide range of expertise and experience. The choice of experts is vital and should be selected according to the criteria required. Many methods can be used to compile subjective weights.



### 2.4.1.1 Ranking Method

The ranking method for assigning weights to attributes or indicators is the simplest approach. The technique requires the decision-makers to rank the attributes based on their importance and then assign weights in descending order, starting from the most significant one to the least significant attributes. Barron and Barrett (1996) compared the efficiencies of the Rank Order Centroid (ROC), Rank Reciprocal (RR) and Rank Sum (RS) methods using more than 10,000 cases (Alemi-Ardakani, S. Milani, Yannacopoulos, & Shokouhi, 2016). They stated that the ROC method performs better than the other techniques. The equations for each method are as follows:

$$w_j(RS) = \frac{2(n+1-R_j)}{n(n+1)} \quad (2.1)$$

$$w_j(RR) = \frac{\frac{1}{R_j}}{\sum_{j=1}^n \frac{1}{R_j}} \quad (2.2)$$

$$w_j(ROC) = \frac{1}{n} \sum_{k=j}^n \frac{1}{k} \quad (2.3)$$

where;

$n$  represents the number of attributes ( $j=1, 2, \dots, n$ ),

$R_j = 1$ , the most important attribute,

$k$  represents the number of alternatives to be found as optimum (usually  $k=1$ ).

The rank position  $R_j$  in RS method is weighted and then standardized by the sum of all weights. While in RR method, the weights are obtained from the standard reciprocals of the rank of a criterion.

Among others, it is well known that in solving multi-criteria problems, ROC approach is superior and more precise than the other approximation methods as stated by Ahn (2011) and Barron and Barrett (1996). In deciding weight requirements, it can also be considered as a functional approach because it is simpler to use than the Analysis Hierarchy Process (AHP) system (Noh & Lee, 2003). By putting the weights in order of significance, the ROC approach would help minimize the number of pair comparisons. Therefore, the numerical significance of each criterion is determined according to its rating of importance, thus, there is no need to consider the accuracy of the decision on the parameters assessed by the experts.

#### **2.4.1.2 Direct Rating Method**

According to Zardari, Ahmed, Shirazi and Yusop (2015), to reflect the value of each criterion, a ranking from a decision-maker must be obtained by the rating process. The scales are like the Likert scale where the number are 1 to 5, 1 to 7 or 1 to 10. This scale is also used to indicate its importance. The rating approach does not produce the response of the decision-maker as the fixed-point scoring system.

#### **2.4.1.3 Point Allocation**

The point allocation weighting method defines the weights of the criteria by assigning numbers explicitly from the decision-maker. The total number of points should not be divided into several experiments, but the expert(s) are asked to send any figures they prefer to represent the weights of the criteria. The higher the points a criterion receives,

the greater its value. The total score of all weights of the criteria must be 100 to simplify the process. However, if the number of criteria raises to six or more, this approach could be difficult to calculate (Zardari et al., 2015).

#### **2.4.1.4 Pair-wise Comparison Method**

One very old psychometric method is the pairwise comparison method employed by many generations of psychologists (Zardari et al., 2015). If decision-makers consider all elements of a problem, an ideal decision can be obtained. The three main steps to calculate the weights using the pairwise comparison process is to first formulate a matrix that compares the parameters. Then, the strength values are used to fill in the comparison matrix. However, not all values are necessarily required. If the decision-maker finds it difficult to differentiate between meanings, the values for example, 1, 3, 5, 7, 9 or 1, 5, 9 might be used. For continuously asking for the relative value of the measurement criterion without referring to the scales on which metrics are measured, the pairwise comparison approach is frequently criticized.

#### **2.4.1.5 Ratio Weighting Method**

Edwards (1977) proposed a ratio weighting method for rating the related criteria first according to their importance by the decision-makers. A weight of 10 is considered the least significant criterion, and all other criteria are evaluated with multiples of 10. Therefore, the weights can be normalized to one. This method is a direct and decomposed algebraic procedure.

#### **2.4.1.6 Swing Weighting Method**

Winterfeldt and Edwards (1986) initiated the swing weighting method by beginning from an alternative on all criteria with the worst outcomes. The decision-makers were allowed

to modify one criterion from the worst to the best result. The 'swing' result from the largest, second-largest result will be the worst to the best outcome. The most relevant criterion would be the criterion with the most favored swing, which is then assigned 100 points.

#### **2.4.1.7 Graphical Weighting Method**

The Graphical Weighting Method has multiple variations. For example, a decision-maker may put a label on a horizontal line in which the importance of the criterion increases with the marked label towards the right end of the diagram. The decision-makers can measure a quantitative weight by calculating the distance from the mark to the line's left boundary. Then, scores are generally averaged to get an average vector for weights. This method helps decision-makers to communicate their expectations in a strictly visual way. Often, the graphical weighting methodology is criticized because of the simplicity of this method.

#### **2.4.1.8 Delphi Method**

The weights in Delphi Methods are determined in three stages. The first stage is to choose the participants where the initial data was collected, and attendees express their views on the program. Second, the method compiles and distributes a list of potential alternatives to the participants. Lastly, it circulated a revised list of alternatives.

#### **2.4.1.9 Fixed Point Scoring**

According to Zardari et al. (2015), the decision-maker is expected to assign a fixed point of the criteria. A higher point score suggests a greater value for the criterion. Percentages are also used since it is common practice for many decision-makers. The main benefit of fixed-point scoring is that it allows decision-makers to participate in trade-offs in a

question of decision-making. In this method, it is only possible to assign greater importance to one criterion by reducing the importance of another. This presents a challenge for decision-makers to carefully consider the relative value of each criterion.

## **2.4.2 Objective Weight Methods**

The most popular approaches in objective methods are Entropy, Criteria Importance Through Inter-criteria Correlation (CRITIC) and Standard Deviation (SD) methods. In contrast to the subjective approach, the objective weight is based on intrinsic data knowledge and requires many mathematical computations without considering the choice of a decision-maker (Alao, Popoola, & Ayodele, 2022)

### **2.4.2.1 Entropy Weighting Method**

The Entropy method is an uncertainty measure from the knowledge developed using probability theory. This method was endorsed by Zeleny (2011), who found that the Entropy method provides a good measure to be used by the decision-maker. It suggested that more uncertainty than the strongly elevated one reflects a wide distribution (Deng, Yeh, & J. Willis, 2000). Oliveira and Correia (2009) emphasized that Entropy is an objective method of weight designation where it decides weights without any biasness between criteria for the decision-maker problem.

### **2.4.2.2 CRiteria Importance Through Intercriteria Correlation (CRITIC)**

#### **Weighting Method**

CRITIC weighting method was introduced by Diakoulaki, Mavrotas and Papayannakis (1995). It applies correlation analysis to classify differences between criteria. The theory is based on the use of the contrast strength of each variable, regarded as a standard

deviation, and the conflict between criteria, regarded as the coefficient of correlation between the criteria (Marković, et al., 2020).

The CRITIC approach is becoming popular in the field of objective weights as it can combine both contrast intensity and dispute found in the decision-making problem. This approach can be suggested to be more suitable for measuring the weights of both traditional and modern performance indicators and provides all the specifics in the evaluation criteria (Ghorabae, Amiri, Zavadskas, & Antuchevičienė, 2017). Therefore, it was also successfully implemented in obtaining objective weights for time and attendance software selection problem of a private hospital (Tus & Aytac Adali, 2019), supply chain risk evaluation (Rostamzadeh, Ghorabae, Govindan, Esmaili, & Nobar, 2018), Initial Public Offering (IPO) performance analysis (Yalcin & Unlu, 2017) and air conditioner selection (Vujicic, Papic, & Blagojevic, 2017).

The CRITIC method creates sufficiently uniform weight values that are approximate to the average decision-maker (DM) values that the criteria weights are equal to. This is different with the Entropy method, where some of the criteria are removed from the evaluation of several criteria. According to the entropy method, the determination of objective criteria weights is based on the calculation of the uncertain information contained in the decision matrix while the CRITIC method is based on empirical testing of the decision matrix to assess the details found in the criteria under which variants are evaluated.

#### **2.4.2.3 Standard Deviation (SD) Weighting Method**

Zardari et al. (2015) stated that the standard deviation (SD) weighting method is analogous to the Entropy method that allocates an attribute with small weights if the value of the attributes is the same across alternatives.

#### **2.4.2.4 Mean Weight**

The weights are calculated by using the equation  $w_j = \frac{1}{n}$ , where  $n$  is the number of criteria. This method assumes that all parameters are equally relevant. Mean weight is used when there is no decision-maker information or information is not sufficient for a conclusion to be made (Zardari et al., 2015).

#### **2.4.2.5 Direct Ranking Method**

According to Zardari et al. (2015), the Direct Ranking Method is the most straightforward method of assigning values to criteria when the number of criteria is limited and practicable. However, this method is not easy to apply even for such a small number of parameters when the weighting values have more than two decimals. Consequently, weighting using this approach will only be consistent and precise if values have one decimal or two decimal places with the last digit being 5, i.e., 0.15 or 0.25. To overcome this limitation, a planner with an updated evaluation system called 'qualitative ranking' is provided since such specific pre-conditions cannot always be fulfilled.

#### **2.4.2.6 Qualitative Rating Method**

Qualitative Rating Method requires the ordering of criteria to classify the most important to the least important or vice versa. Therefore, based on the rank order, many methods are used to determine the value of the weights. Even though this method is simple, they entail

a major drawback as they cannot rank two or more criteria of equivalent value, a fact which is not acceptable in practice (Zardari et al., 2015).

### **2.4.3 Aggregated Weight**

Aggregated weight attempts to establish an inclusive paradigm that recognizes the individual viewpoints of experts and analytical approaches that resolve multi-criteria decision-making (Markovic et al., 2020). The explanation for this approach lies in the fact that the relationship of the two methods will yield more reliable findings that are relevant in various circumstances and are accessible at all levels to decision-makers.

## **2.5 Development of Index**

There are few methods to develop the index which are Simple Multi-Attribute Rating Technique (SMART), Technique of Order Preference Similarity to the Ideal Solution (TOPSIS), VišeKriterijumska Optimizacija I Kompromisno Resenje (VIKOR), and Simple Additive Weighting (SAW).

### **2.5.1 Simple Multi-Attribute Rating Technique (SMART)**

Winterfeldt and Edwards (1986) defined SMART as the entire method for ranking alternatives and weighting criteria. Decision-makers in this process need to rate the value of the criteria from the worst to the best. Then, 10 points are allocated to the least important criteria, while the other criteria are allocated an increasing point to highlight their importance compared to the least important criteria. Hence, the weights are determined by normalizing the points to a single number.



### **2.5.2 Technique of Order Preference Similarity to the Ideal Solution (TOPSIS)**

TOPSIS is based on finding an optimal and ideal solution and measuring the difference between each of the alternatives and the criteria, as discussed by Hwang and Yoon (1981).

### **2.5.3 ViseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR)**

Serafim Opricovic (1998) designed the VIKOR method in MCDM to solve decision problems with contradictory and different units of criteria, assuming compromise is appropriate for conflict resolution. The decision-maker needs a solution that is the nearest to the ideal and all current criteria compare the alternatives.

### **2.5.4 Simple Additive Weighting (SAW)**

To address the portfolio selection problem, Churchman and Ackoff (1954) introduced Simple Additive Weighting (SAW). Due to the obvious simple concept, exact measurements and the relative performance of alternatives, this approach can also be used to solve decision-making problems with multi-criteria. The most suggested alternative is the one with the highest score of all alternatives (Suhandi, Terttiaavini, & Gustriansyah, 2020).

## **2.6 Regression Analysis**

Regression analysis was applied to model the relationship between one dependent variable and one or more independent variables. The relationship can be linear, linear log, semi-log, form lin-log or reciprocal (Mukherjee & Laha, 2019). There are several features that imply a good regression model which are high R square value, no serial correlation, no heteroscedasticity, and normally distributed residuals.

### **2.6.1 The Ordinary Least Square (OLS) regression**

The ordinary least square (OLS) regression is not appropriate for regression with a bounded dependent variable, such as index variables. The usual practice for a response variable that lies between the intervals of 0 and 1 is to transform  $y$  into,  $\log \frac{y}{1-y}$ , and to apply a standard linear regression analysis. But this approach has several shortcomings, such as that the regression parameters are interpretable in terms of the mean of transformed  $y$  and not in terms of the mean of  $y$ .

### **2.6.2 Beta regression**

Beta regression modelling is commonly used when the response variable is bounded between 0 and 1, such as in the case of proportions, rates, or probabilities. The beta regression model is especially suited for response variables that have the form of fractions or percentages (Algamil & Abonazel, 2021). It is also suitable to use when the assumption of homoskedasticity of residual is violent (Hunger, Baumert, & Holle, 2011). Recently, many studies have applied beta regression analysis in their study. For example, Ferrari and Cribari-Neto (2004) used beta regression for modelling rates and proportions. The prospect of the analysis was on the proportion of crude oil that has been converted to gasoline after distillation and fractionation. The estimated values of the regression coefficients are computed using logit link function when measuring the R square values. The resulting beta regression approach gave the best R square value as compared to classical regression.

Ünlü & Aktaş (2017) used the beta regression model as indicator values for the well-being index of provinces in Turkey. In their study, they used four-link functions, i.e., logit, log-log, probit, and caustic in the beta regression model and compared the values of

AIC and R square among the four-link functions. Results showed that beta regression using the probit link function gave the best value of AIC and R as compared to classical linear regression.

Another study in beta regression was done by Hunger et al. (2011) to analyze the SF-6D index data using beta regression modelling. They explored the applicability of classical and extended beta regression in this analysis to determine the relationship between the SF-6D index score and the subject features. Estimated effects and predictive accuracy of extended beta regression were also compared using linear regression models. The outcome of the study demonstrated that the extended beta regression approach is a more suitable supplement to the classical beta regression models.

## **2.7 Summary of the chapter**

In conclusion, this study used aggregating of CRITIC weighting method for the objective weights because CRITIC weighting method perform better than the other rank-based schemes in terms of choice accuracy (Ahn, 2011) and the ROC weighting method for the subjective weights because the weight values are approximate to the decision-maker values (Vujicic, Papic, & Blagojevic, 2017). From the computed aggregated weights, the PI was developed using the SAW method to rank the level of poverty among the 12 districts in Kedah due to the obvious simple concept and exact measurement (Suhandi, Terttiaavini, & Gustriansyah, 2020). Furthermore, to avoid biased estimators and hypothesis tests, regression techniques that are suitable for the analysis of bounded outcomes are needed. As the PI lies between 0 and 1, beta regression analysis was applied to analyze the relationship between main indicators and sub-indicators of PI.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

Chapter Three discusses the methods to be applied to achieve the goals in this study. The main goals of this study are to develop PI and to analyse the relationships between main indicators and sub-indicators of PI. This chapter enlightens the processes conducted throughout this study, which involves data collection, determination of objective weights, subjective weights and aggregated weights, development of PI, poverty mapping by districts in Kedah and modelling the beta regression to analyze the relationship. It is important to select the correct and effective methods to ensure that the results are accurate and reliable.

The type of this study made here is applied research where it is applicable to address specific questions designed to solve practical problems. In this study, the research conducted attempts to solve the poverty issues in Kedah. Applied research provides the necessary evidence to assist, direct and revisit the theory of creation arising from basic research (Johnsen, Hauge, Magnussen, & Ennals, 2016). Moreover, this study applies a mixed method approach where it combines both quantitative and qualitative methods.

#### **3.2 Methodology Process**

To accomplish the four objectives in this study, the method of analysis is organized into five stages, beginning with data collection, then continuing with determination of subjective weights, objective weights and aggregated weight, development of PI, and modelling the beta regression as illustrated in Figure 3.1.

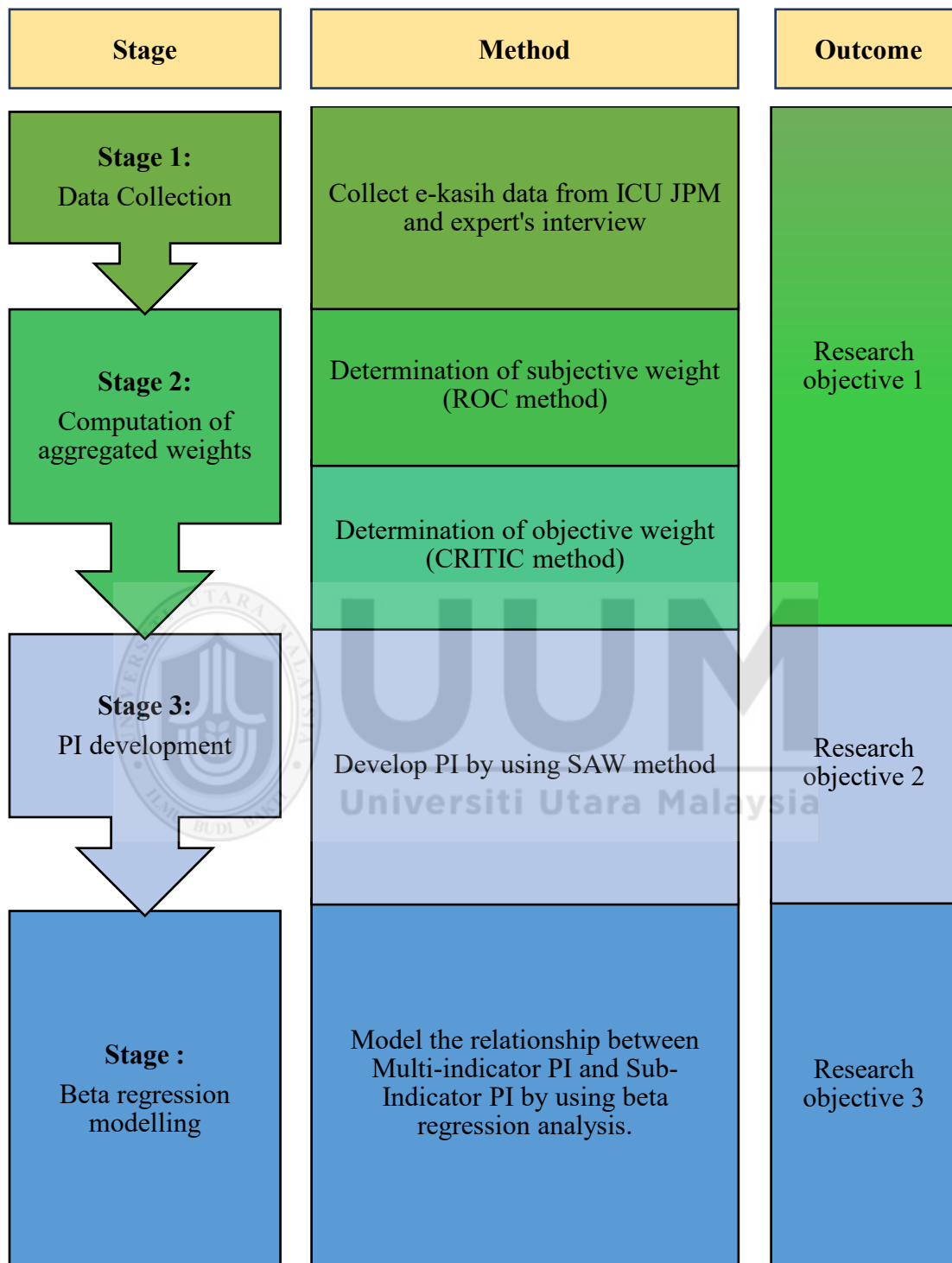


Figure 3.1. Method of analysis

The details of the analysis method are discussed in the next section.

### **3.3 Stage 1: Data collection**

To achieve the first research objective, this stage aimed to define the poverty indicators in Kedah. This stage covers the collection of both the primary and the secondary data.

The primary data refers to the data collected by interviewing experts in the field related to poverty. Interview is an important tool as it involves the expertise, comprehension, opinions, interpretations, inspirations, and communication of experienced individuals. The sample size that was recommended to conduct this study is between five to 25 interviewees with more than five years of experience in the related field (Kvale & Brinkmann, 2015). In this study, 10 experts from various sectors such as the Social Welfare Department, Kedah (JKMM), Implementation Coordination Unit, Jabatan Perdana Menteri (ICU JPM), Department of Statistics Malaysia (DOSM) and Kedah Volunteer Club were selected for the interview stage. The interviews were conducted by distributing an open-ended questionnaire through jotform.com and via phone calls.

This questionnaire consists of two sections. In Section A, respondents were required to fill in the demographic information, including their position in their organization, department, work experience and level of education. In Section B, respondents were required to rank each of the indicators that affects the poverty in Kedah according to its importance.

Traditionally, semi-structured interviews are made up of open-ended questions. This approach offers cost-effectiveness benefits while maintaining a useful parameter representation. A major advantage of semi-structured interviews is the opportunity to come up with previously unknown information. Experience allowed the participants to be

considered experts; therefore, when there is sufficient opportunity to speak freely, new information may emerge (O'Keeffe, Buytaert, Mijic, Brozovic, & Sinha, 2016).

Meanwhile, the secondary data were obtained from ICU JPM which consists of the e-Kasih database. This data has been divided into two categories, namely the poor and the hardcore poor categories that encompasses the 12 districts in Kedah. The data also includes other indicators like marital status, which were used in this study. The indicators used in this study explained in Table 3.1.

Table 3.1

*The description of indicators and sub-indicators*

| Indicator       | Sub-indicator    | Type of indicator | Description                                                                                                                  |
|-----------------|------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------|
| Marital Status  | Single           | Cost indicator    | Household Head who are never married                                                                                         |
|                 | Married          | Cost indicator    | Living with spouses                                                                                                          |
|                 | Divorced         | Benefit indicator | Household Head who are divorced from their former husband or wife and no longer live with them                               |
| Education level | No Schooling     | Benefit indicator | Household Head who are not complete schooling or not receiving any certificate.                                              |
|                 | Primary school   | Benefit indicator | UPSR or below                                                                                                                |
|                 | Secondary school | Cost indicator    | SRP/PMR/LCE/SPM/SPVM/SMU/MCE or equivalent                                                                                   |
|                 | Tertiary         | Cost indicator    | Certificate obtained from college, polytechnic, institutions public or private university, higher institution or equivalent. |

Table 3.1 Continued

|                 |                   |                   |                                                                                                                                      |
|-----------------|-------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Occupation      | Unemployment      | Benefit indicator | Household Head who lives without a paid job but available to work                                                                    |
|                 | Self-employment   | Cost indicator    | Household Head as a freelance or the owner of a business or obtains the profits by themselves                                        |
|                 | Paid employment   | Cost indicator    | Household Head has been hired by a business and is receiving wages or salaries for his or her service.                               |
| Living Standard | Electricity       | Benefit indicator | No access to electricity                                                                                                             |
|                 | Water             | Benefit indicator | No access to safe water resources for drinking, washing, and bathing                                                                 |
|                 | Types of toilets  | Benefit indicator | Do not have Flush Toilet                                                                                                             |
|                 | Cooking Fuel      | Benefit indicator | Household who does not have stove (cooks with wood, carbon)                                                                          |
|                 | Floor             | Benefit indicator | Not using stone and concrete building material                                                                                       |
| Strata          | Urban             | Cost indicator    | Household who lives in town                                                                                                          |
|                 | Rural             | Benefit indicator | Household who does not live in town                                                                                                  |
| Residential     | Semi-D            | Cost indicator    | Household who lives in Semi-D house                                                                                                  |
|                 | Shop Lot          | Cost indicator    | Household who lives in Shop Lot                                                                                                      |
|                 | Bungalow          | Cost indicator    | Household who lives in Bungalow house                                                                                                |
|                 | Terrace           | Cost indicator    | Household who lives in Terrace house                                                                                                 |
|                 | Flat              | Benefit indicator | Household who lives in Flat house                                                                                                    |
| Comfortability  | Number of room(s) | Cost indicator    | Number of rooms in house                                                                                                             |
|                 | Household size    | Benefit indicator | A person or group of related or unrelated persons who live together and make common provisions for food and other living essentials. |



Based on Table 3.1, there are two types of indicators which are benefit and cost indicator that help decision-makers assess the benefits and costs associated with each option (Aytekin, 2021). According to Aytekin (2021), benefit indicators refer to the positive aspects of each option. These included sub-indicators such as divorced status, no schooling, primary school, unemployment, electricity, water, types of toilets, cooking fuel, floor, rural areas, flat house, and household size. The aim of using benefit indicator is to identify the options that offer the greatest positive impact, and to rank them accordingly.

Cost indicator, on the other hand, refer to the negative aspects associated with each option. These included indicators such as single status, married status, secondary school, tertiary, self-employment, paid employment, urban areas, Semi-D house, Shop-Lot, Bungalow, terrace, and number of room(s). The aim of using cost indicator is to identify the options that have the lows negative impact, and to rank them accordingly.

### **3.4 Stage 2: Determination of weights**

The second stage in this study focused on the determination of weights for each poverty indicator. The aggregated weights were computed by integrating the perspectives of both the subjective experts and the objective data-driven values, which would align both assessment perspectives. This study considered the aggregations of ROC subjective weights and CRITIC objective weights to determine the final weights of the poverty indicators. A new contribution to represent both weights is given by the suggested aggregation process, which overcomes the drawbacks of these two individual approaches.

### 3.4.1 Subjective Weight

Since the ROC method was selected to obtain the subjective weights in this study, each indicator was assigned a weight that follows a certain ranking procedure, starting from the most prioritized indicator to the least prioritized one. The rankings are usually formed using statements such as “Indicator 1 is more important than Indicator 2, more important than Indicator 3 and so on until the indicator  $k$ ” (Sari, Gernowo, & Suseno, 2018). The ROC method is an easy way of assigning weights to many objects that are ranked according to their significance. Typically, decision-makers can identify things much more readily than assigning the weight of indicator. This technique takes those ranges as inputs and transforms them into weights for each object. If there are  $n$  indicator based on the ROC method, the subjective weight for the indicator ranked in the  $k$ th position is evaluated as follows:

$$w_k^{sub} = \frac{1}{n} \sum_{j=k}^n \frac{1}{j}, \quad k = 1, 2, \dots, n, \quad 0 \leq w_k^{sub} \leq 1 \quad (3.1)$$

where  $j$  is alternatives,  $k$  is indicator,  $n$  is the number of indicator and  $w_k^{sub}$  is the subjective weightage for the indicator  $k$ .

### 3.4.2 Objective Weight

Objective weights determine the weights based on the values of the estimated indicator from the best indicators of poverty in Kedah. The indicator with the highest weight is considered the most significant indicator in defining the poverty conduct in Kedah. Using the CRITIC process, this study adopted the following steps to obtain the weighting indicator:

**Step 1:** Normalized the decision matrix,  $X_{jk}$

The process of normalization involves converting the scores into standard scales that have a 0 to 1 range. Normalization also deals with cost and benefit indicator to obtain comparable scales (Jahan, Bahraminasab, & Edwards, 2012).

When the indicator is benefit indicator, the formula are shown in Equation (3.2).

$$X_{jk} = \frac{X_{jk} - X_{jk}^{min}}{X_{jk}^{max} - X_{jk}^{min}}, \quad j = 1, 2, \dots, m, \quad k = 1, 2, \dots, n \quad (3.2)$$

While, when the indicator is cost indicator, the formula are shown in Equation (3.3).

$$X_{jk} = \frac{X_{jk}^{max} - X_{jk}}{X_{jk}^{max} - X_{jk}^{min}}, \quad j = 1, 2, \dots, m, \quad k = 1, 2, \dots, n \quad (3.3)$$

where  $j$  is number of alternatives,  $k$  is number of indicator.

**Step 2:** Calculate the standard deviation,  $\sigma_k$  for each indicator

$$\sigma_k = \sqrt{\sum \frac{(X_j - \mu)^2}{N}} \quad (3.4)$$

**Step 3:** Determine the symmetric matrix of  $n \times n$  with element  $r_{jk}$ , which represents the linear correlation coefficient between the vectors  $X_j$  and  $X_k$

$$r_{jk} = \frac{n \sum_{i=1}^n j_i k_i - \sum_{i=1}^n j_i \sum_{i=1}^n k_i}{\sqrt{n \sum_{i=1}^n j_i^2 - (\sum_{i=1}^n j_i)^2} \sqrt{n \sum_{i=1}^n k_i^2 - (\sum_{i=1}^n k_i)^2}} \quad (3.5)$$

where  $r_{jk}$  is scores of all alternatives.

**Step 4:** Determine the quantity of the information related to each indicator

$$c_k = \sigma_k * \sum_{j=1}^n (1 - r_{jk}) \quad (3.6)$$

where  $c_k$  is amount of information for the indicator  $k$ .

**Step 5:** Determine the objective weights

$$w_k^{obj} = \frac{c_k}{\sum_{k=1}^n c_k}, \quad k = 1, 2, \dots, n, \quad 0 \leq w_k^{obj} \leq 1 \quad (3.7)$$

where  $w_k^{obj}$  is objective weightage for the indicator  $k$ .

### 3.4.3 Aggregated Weight

In this study, the aggregated weights were determined by using the following formula.

$$w_k = \frac{w_k^{sub} \cdot w_k^{obj}}{\sum_{k=1}^n w_k^{sub} \cdot w_k^{obj}}, \quad k = 1, 2, \dots, n, \quad 0 \leq w_k \leq 1. \quad (3.8)$$

where  $w_k$  is the aggregated weights for each indicator.

### 3.5 Stage 3: Development of PI by using Simple Additive Weighting (SAW) Method

Since the weights have been computed, then the Poverty Index can be developed. Poverty Index consists of seven sub-index which are Marital Status Index, Education Level index, Occupational Index, Living Standard Index, Strata Index, Residential Index and Comfortability Index as shown in Figure 3.2.

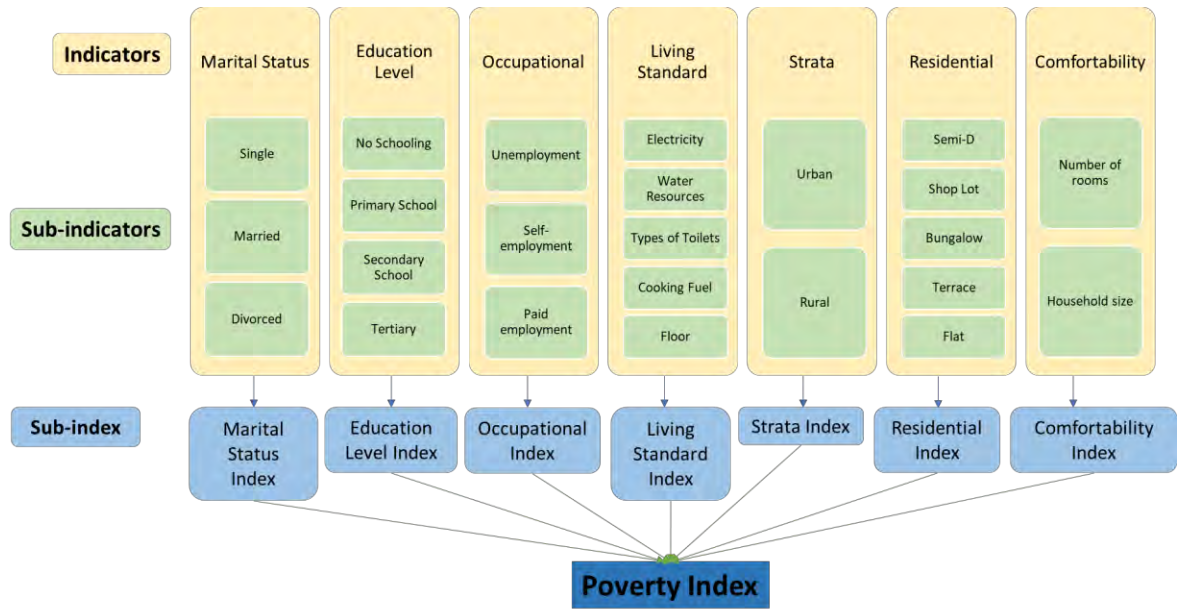


Figure 3.2. Indicators, sub-indicators, PI and sub PI

To develop a PI in Kedah, this study used the SAW method shown by the following equation:

$$PI_j = \sum_{k=1}^n w_k(X_{jk}), \quad 0 \leq PI_j \leq 1 \quad (3.9)$$

where  $w_k$  is the weightage value of  $k$ th poverty indicator and  $X_{jk}$  is the normalized value of  $k$ th poverty indicator for district  $j$ . The greater the value of  $PI_j$  is, the higher its ranking of being poor district in Kedah.

### 3.6 Stage 4: Beta Regression Model

In this stage, the beta regression analysis was applied to determine the relationship between the main indicators and sub-indicators of PI. The beta regression model is a generalization of logit models for situations where the PI score is bounded by the intervals of 0 and 1. Beta regression is defined as when the dependent variable follows a

density-function beta distribution with regression coefficients, giving the response variable a further increase or decrease in log chances.

Since beta distribution density has different shapes, depending on the values of the two parameters that index the distribution, it can become very flexible for modelling proportions. The beta density is given by

$$f(y; p, q) = \frac{\Gamma(p+q)}{\Gamma(p)\Gamma(q)} y^{p-1}(1-y)^{q-1}, 0 < y < 1, \quad (3.10)$$

where  $\Gamma(\cdot)$  denotes the gamma function,  $p > 0, q > 0$ .

The mean ( $\mu$ ) and precision parameter ( $\varphi$ ) are defined as:

$$\mu = \frac{p}{p+q}$$

$$\varphi = p+q$$

The density of  $y$  can be written in the new parameterization:

$$f(y; \mu, \varphi) = \frac{\Gamma(\varphi)}{\Gamma(\mu\varphi)\Gamma((1-\mu)\varphi)} y^{\mu\varphi-1}(1-y)^{(1-\mu)\varphi-1}, \quad 0 < y < 1, \quad (3.11)$$

$$0 < \mu < 1$$

$$\varphi > 0$$

According to Cepeda-cuervo (2015), let  $y_1, y_2, \dots, y_n$  be a sample random from beta density function  $B(\mu_i, \varphi)[(\mu_i, \varphi)]$ . The beta regression is defined as

$$g(\mu_i) = \beta_0 + x_{i1}\beta_1 + \dots + x_{ip}\beta_k = \eta_i, \quad i = 1, \dots, n \quad (3.12)$$

where  $x_{i1}, \dots, x_{ip}$  are the covariates,

$\beta_0, \beta_1, \dots, \beta_k$  are the estimated intercept and coefficient corresponding to each covariate,

$\eta_i$  is the linear predictor for the  $i^{th}$  observation and  $n$  is the sample size,

$g(.)$  is a link function, which connects the linear predictor and the response variable.

The logit link that was used is  $[g(\mu) = \log\left(\frac{\mu}{1-\mu}\right)]$  for the beta regression.

### **3.7 Summary of the chapter**

Overall, this chapter explained the formula of CRITIC weighting method and the ROC weighting method. From the determined aggregated weights of subjective and objective weights, the PI for 12 districts in Kedah were developed by using the SAW method and then, the 12 districts would be ranked accordingly. Furthermore, this chapter elaborates the formula of the beta regression analysis to evaluate the relationship between main indicators and sub-indicators of PI.



## **CHAPTER FOUR**

### **RESULTS AND FINDINGS**

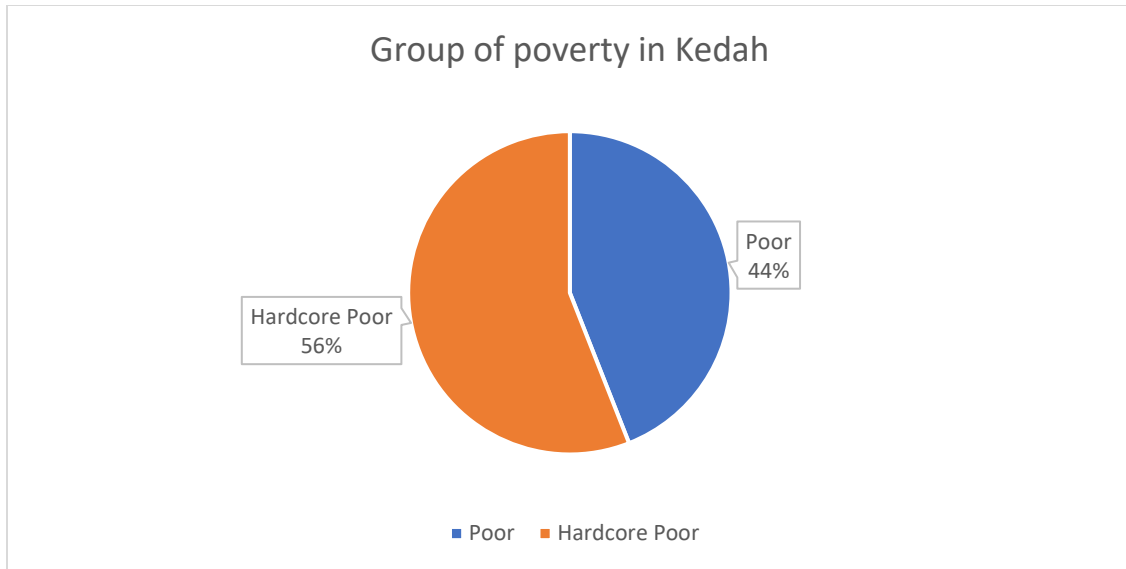
#### **4.1 Introduction**

This chapter elaborates the results and findings of this study. Firstly, the demographic of the data collection is discussed. Next, the result of aggregating of ROC weighting method and CRITIC weighting method are shown. Third, the PI was developed using the SAW method. Lastly, the regression model was established by using beta regression analysis.

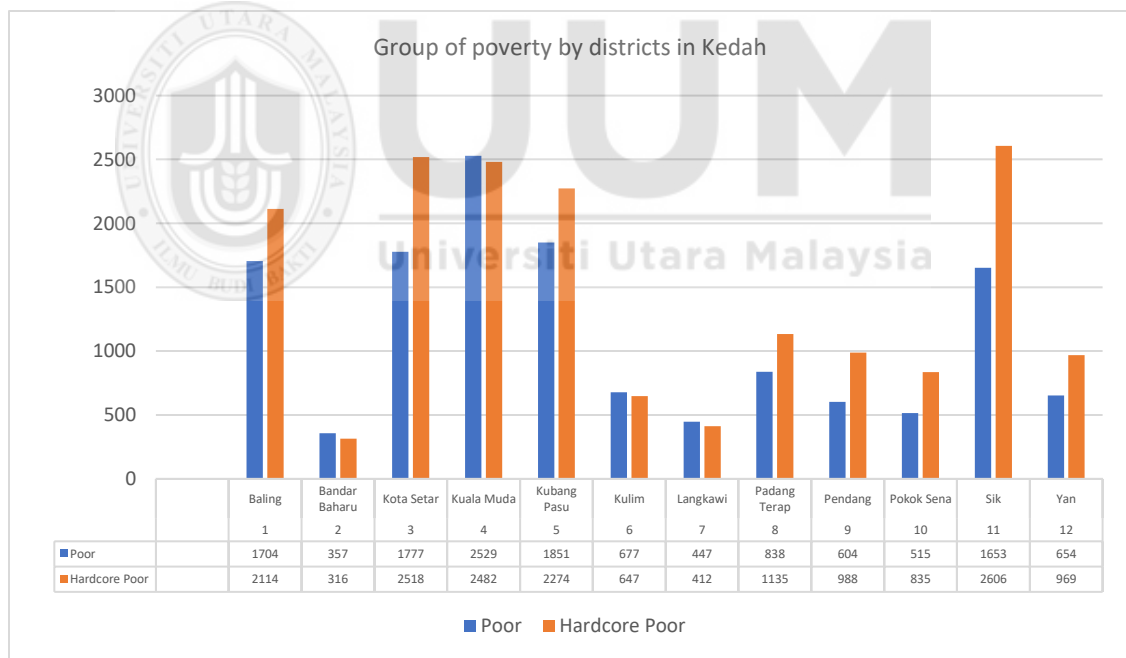
#### **4.2 Data Exploratory Analysis**

The secondary data was obtained from ICU JPM consisted of the poor (with minimum income RM2208) and hardcore poor (with minimum income half of RM2208) categories data from 2008 until 2021 for 12 districts of Kedah. The total number of poor household head in Kedah is 13606, in which 8896 of them are males and the remaining 4710 are females. On the other hand, the total number of hardcore poor household head in Kedah is 17296, with 11929 head being males and 5367 are females with ages ranging from 19 to 107 years old. The total percentage of poor and hardcore poor household heads is shown in Figure 4.1.





*Figure 4.1.* Group of poverty households head in Kedah



*Figure 4.2.* Group of poverty by districts in Kedah

As shown in Figure 4.2, the highest number of poor people is from Kuala Muda with 2529 people while the highest number of hardcore poor people is from Sik with 2606

people. Meanwhile, the least number of both poor people and hardcore poor people come from Bandar Baharu with 357 people and 316 people respectively.

#### 4.2.1 Poor Category

In this study, marital status has been categorized into three sub-indicators which are single, married and divorced.

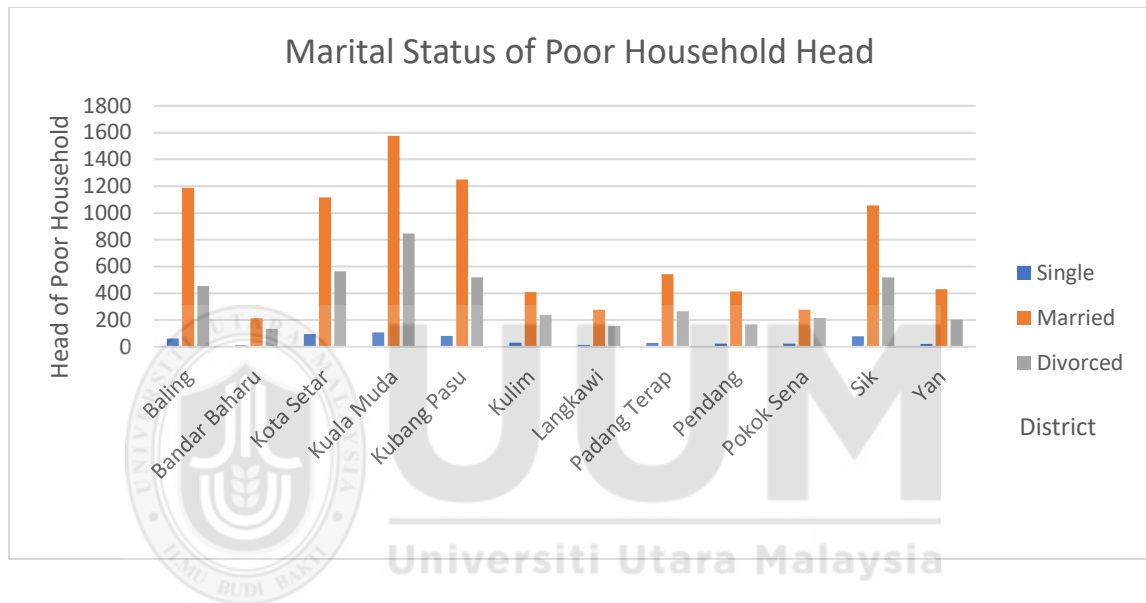


Figure 4.3. Marital status of poor household head by districts in Kedah

Figure 4.3 shows that most of the poor households are married. The highest number of married households is Kuala Muda which is 1576 head of household while the least number of married households is Bandar Baharu which is 213 head of household.

Otherwise, education level has been divided into four sub-indicators which are no schooling, primary school, secondary school, and tertiary. The result of the education

level of the household head is shown in Figure 4.4.

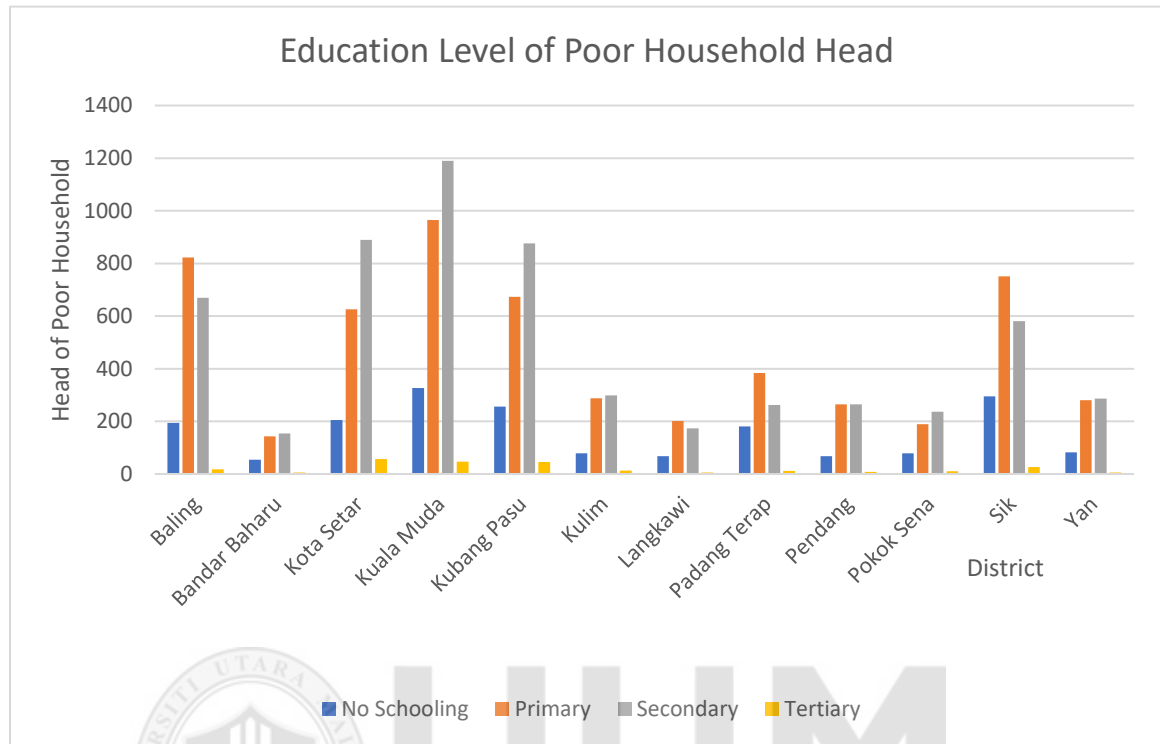


Figure 4.4. Education level of poor household head by districts in Kedah

Figure 4.4 demonstrates that most poor households head only attend formal education until the secondary school level. Alarming, a minority of poor households attempt tertiary education while 1785 head of households do not complete schooling or not receive any certificate.

On the other hand, the occupation consists of three sub-indicators: unemployment, self-employment, and paid employment. Figure 4.5 clearly shows that unemployment is highest in Kuala Muda, with 796 household heads, while the lowest is at Langkawi with 106 household heads. Meanwhile, for self-employment status, Sik has the highest number of self-employed household heads and the lowest is Bandar Baharu. For paid employment status of household head, Kuala Muda has the highest number of paid

employment and Pokok Sena and Bandar Baharu have the lowest number of paid employments.

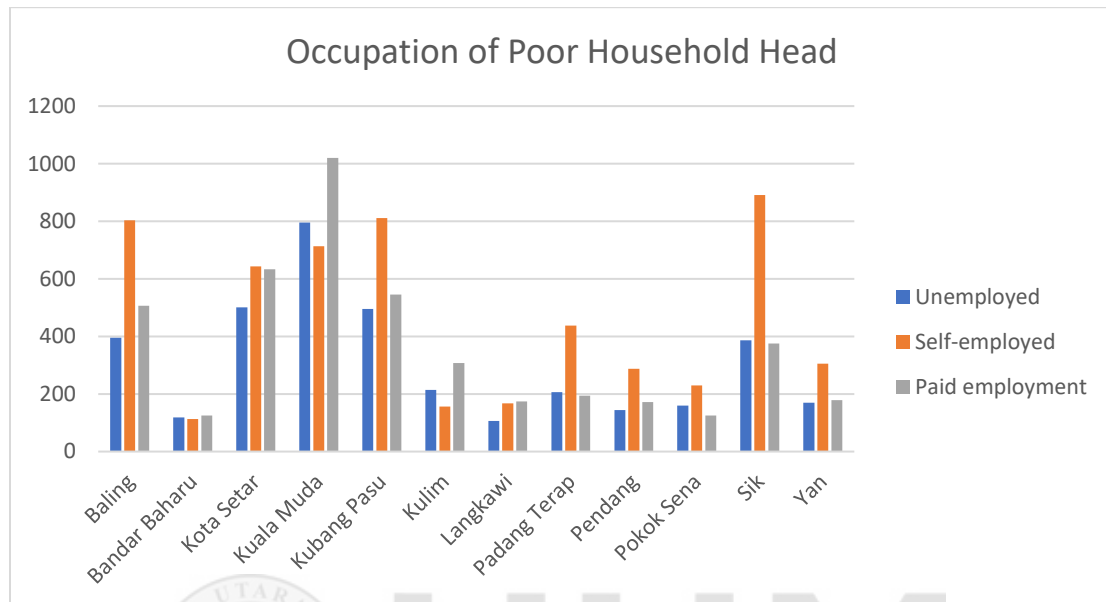


Figure 4.5. Occupation of poor household head by districts in Kedah

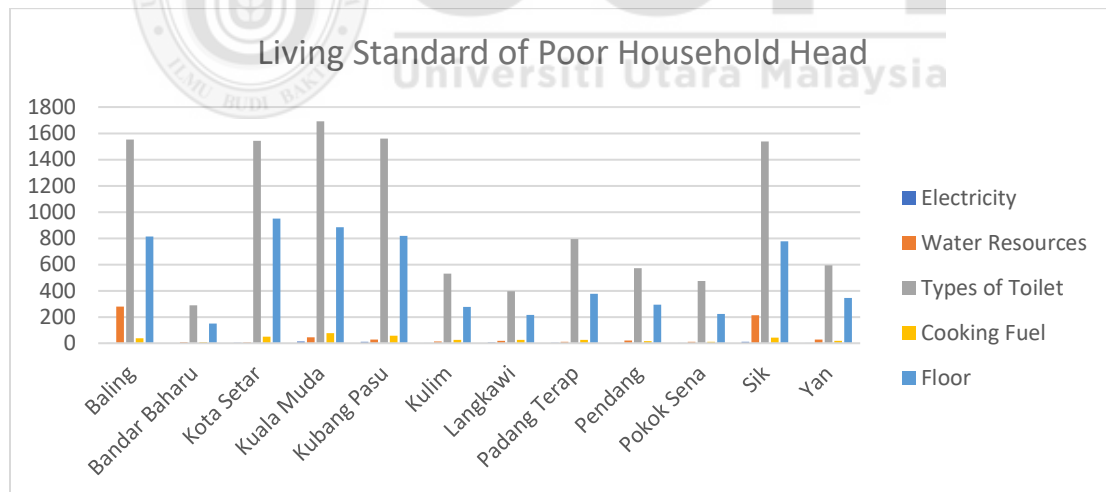


Figure 4.6. Living standard of poor household head by districts in Kedah

Based on Figure 4.6, it is shown that the living standard of poor household head in Kedah. Living standard indicator has five sub-indicators that affect poverty level which are electricity, water resources, types of toilets, cooking fuel and floor. As illustrated in

Figure 4.6, Kuala Muda has the highest number of houses without access to electricity, flush toilets, stoves, and made of non-concrete building materials while Baling has the highest number of houses without having access to safe water resources.

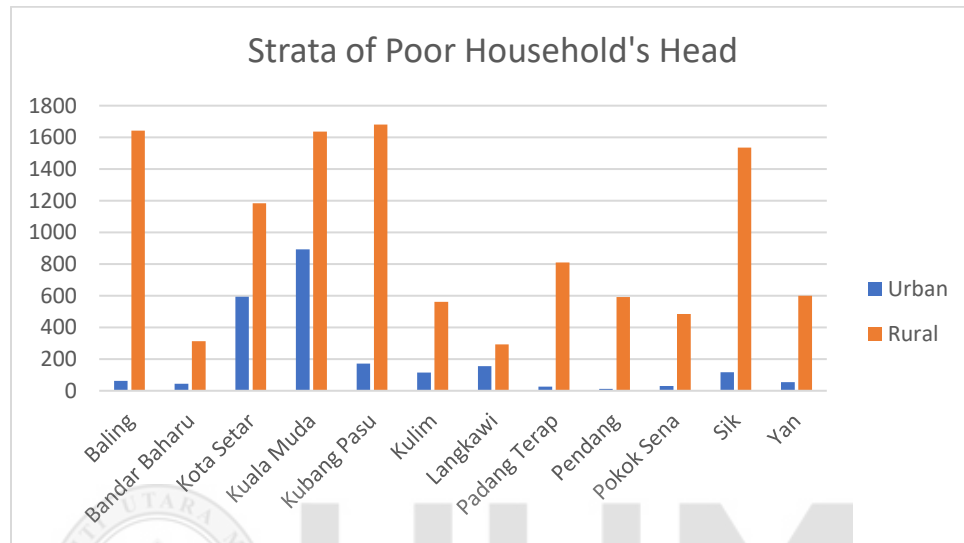


Figure 4.7. Strata of poor household head by districts in Kedah

Figure 4.7 indicates that the majority of poor households in Kedah come from rural areas. Despite that, there are still instances of poverty in urban areas.

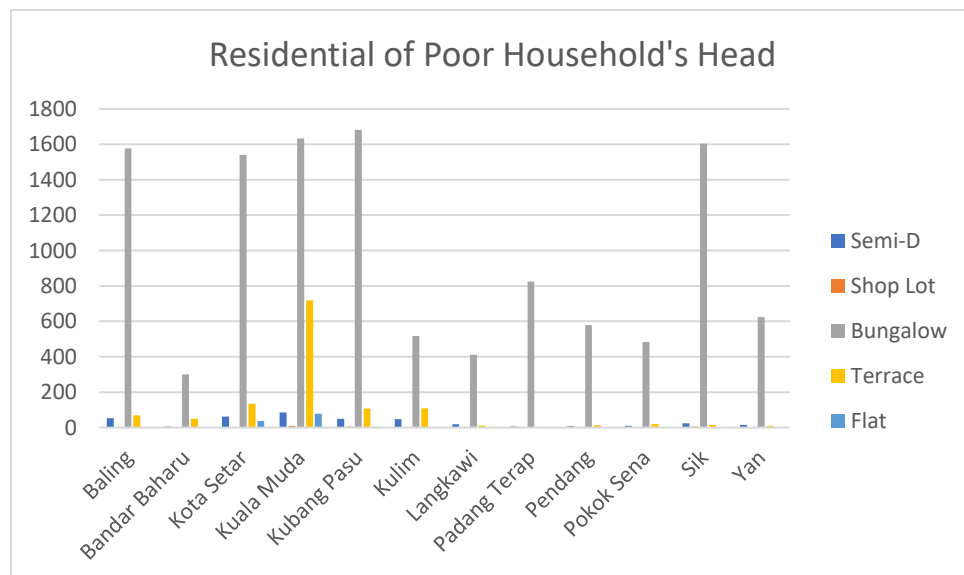


Figure 4.8. Residential type of poor household head by districts in Kedah

As shown in Figure 4.9, most of the poor household head are living in bungalow house especially in Kubang Pasu, Kuala Muda, Sik, Baling and Kota Setar.

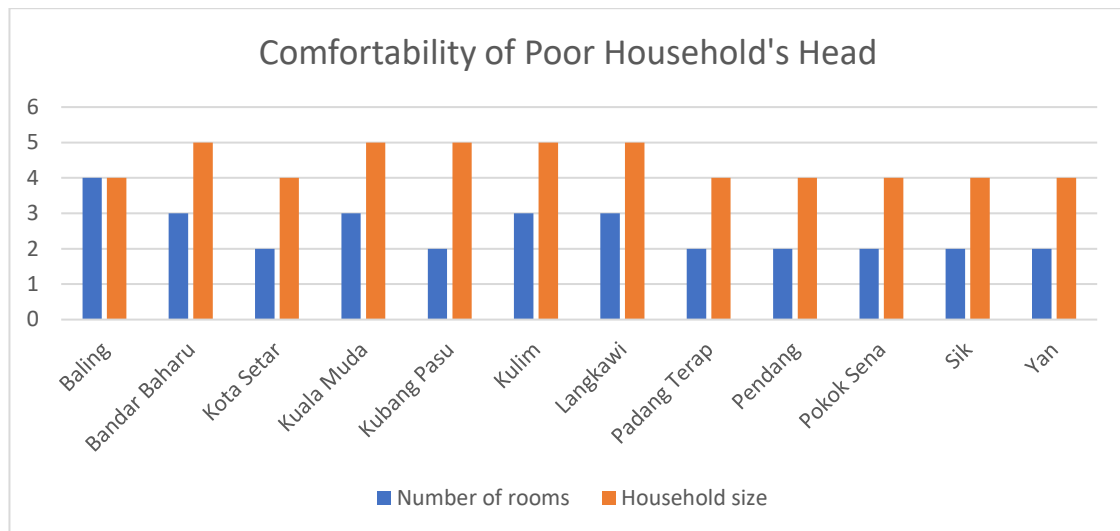


Figure 4.9 Comfortability of poor household head by districts in Kedah

As illustrated in Figure 4.9, majority of poor households have only two rooms while the majority of them are living with four persons in a house.

#### 4.2.2 Hardcore Poor Category

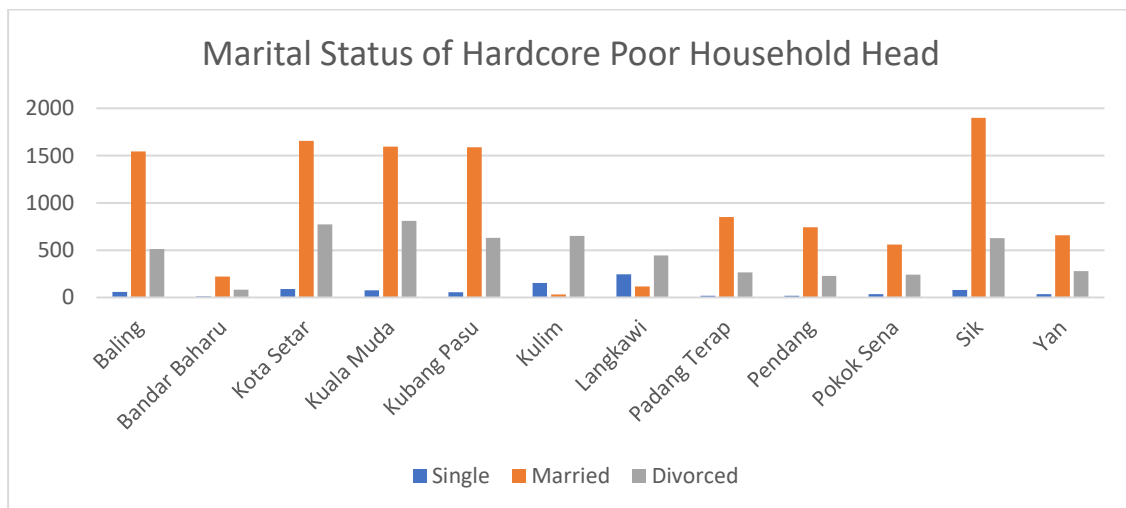


Figure 4.10. Marital status of hardcore poor household head by districts in Kedah

For the hardcore poor category, Figure 4.10 shows that most of the household head in this category are also married, with a total of 11,456 and mostly come from Sik district. A total of 5,546 head of households are divorced and mostly live in Kuala Muda district.

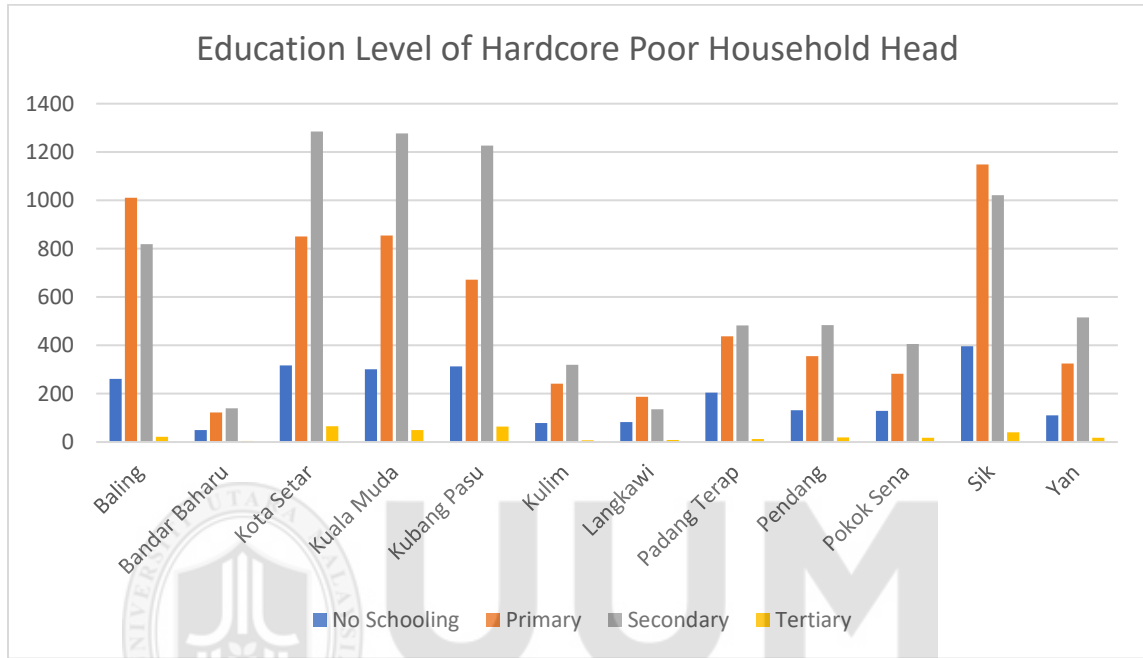
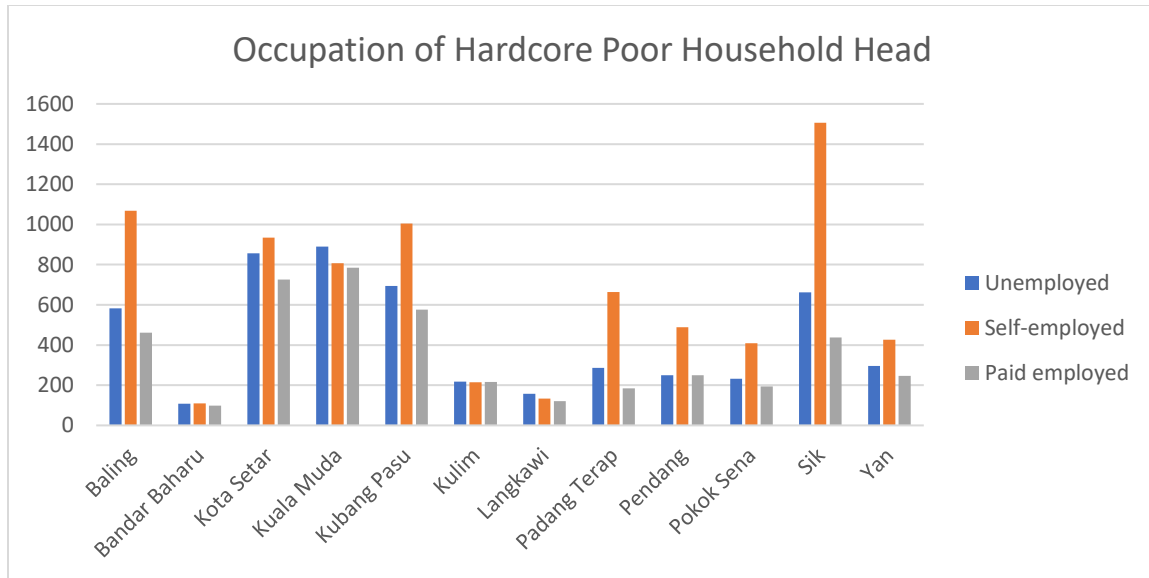


Figure 4.11. Education level of hardcore poor household head by districts in Kedah

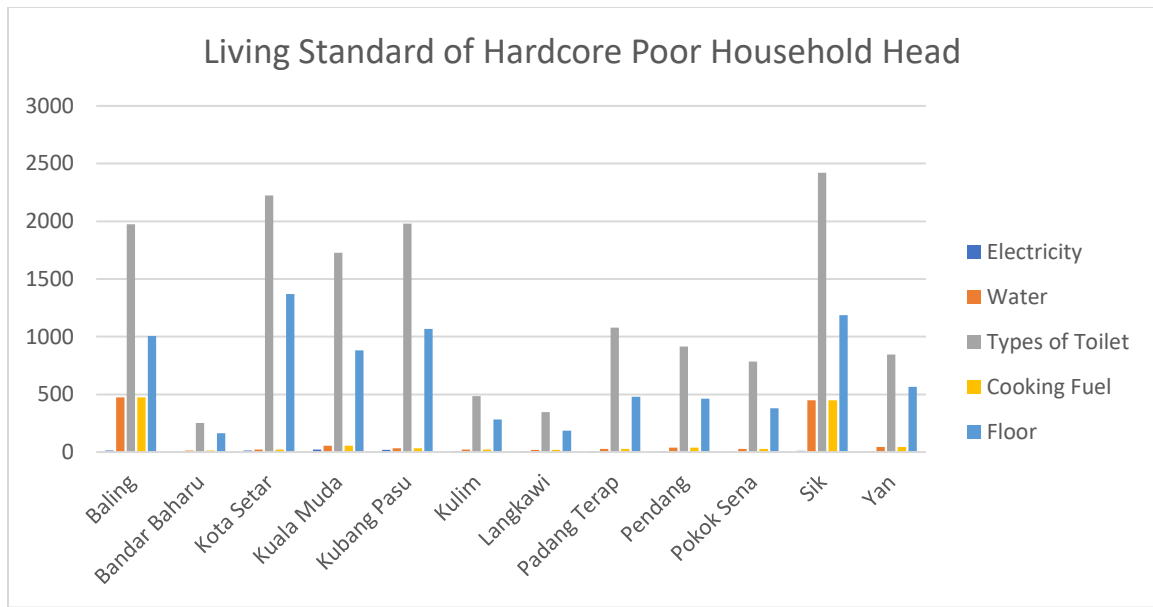
In terms of education, most hardcore poor households head also stopped schooling after the secondary school level as illustrated in Figure 4.11. Additionally, the rate of hardcore poor household heads who did not complete school and those who attempted tertiary education are very similar to that of the poor category.



*Figure 4.12.* Occupation of hardcore poor household head by district in Kedah

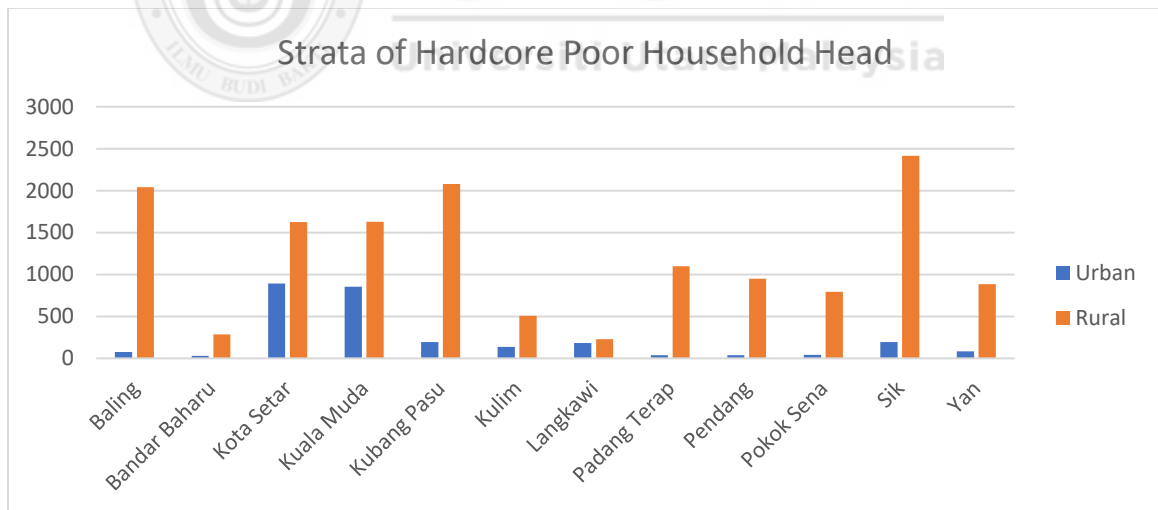
In contrast to the poor category, Figure 4.12 indicates that Sik has the highest number of self-employments with 1506 household heads, while Bandar Baharu has the lowest, with only 110 household heads. For unemployment status, Kuala Muda has the highest number of household heads who are unemployed, while Bandar Baharu has the lowest with 108 household heads. Meanwhile for paid employment status, Kuala Muda has the highest number of household heads who are employed with 785 household heads, while Bandar Baharu has the lowest number with 98 household heads.





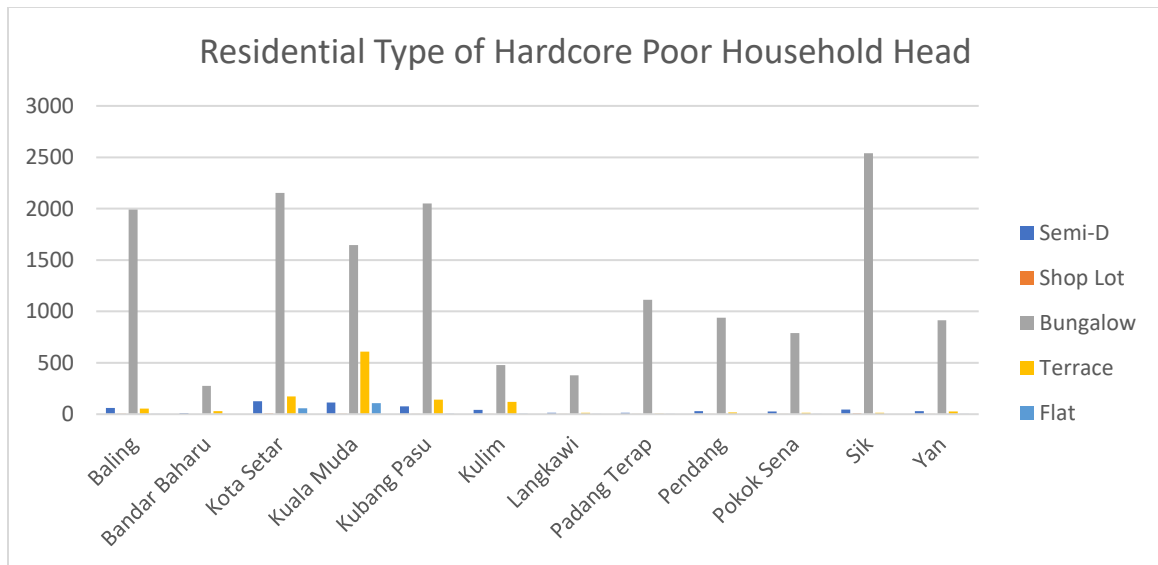
*Figure 4.13.* Living standard of hardcore poor household head by district in Kedah

According to Figure 4.13, majority of hardcore poor households lack access to flush toilets and electricity.



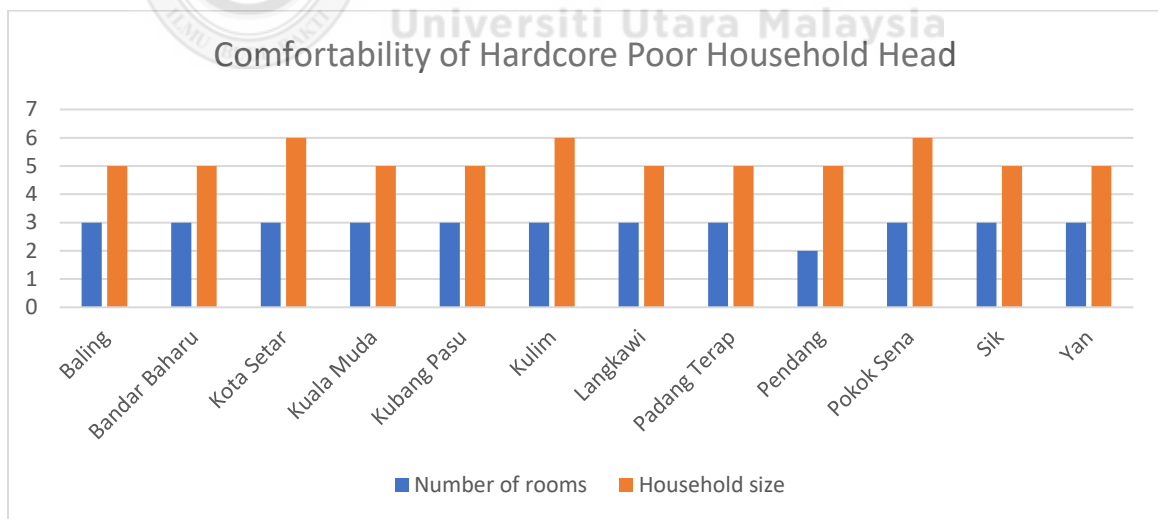
*Figure 4.14.* Strata of hardcore poor household head by district in Kedah

Similar to poor households, hardcore poor households primarily originate from rural areas, although there are still instances of hardcore poor households in urban areas.



*Figure 4.15.* Residential type of hardcore poor household head by district in Kedah

Bungalow houses are also a common type of residential for hardcore poor households, particularly in Sik, Kota Setar, Kubang Pasu, Baling and Kuala Muda as shown in Figure 4.15.



*Figure 4.16.* Comfortability of hardcore poor household head by district in Kedah

As shown in Figure 4.16, the majority of hardcore poor households only have two rooms and typically, five people live in each house.

### 4.3 Subjective Weights

The primary data used in this study was collected by interviewing ten experts from different backgrounds but related to the poverty field. The experts were selected from ICU JPM, JKMM, DOSM and Kedah Volunteer Club. Each selected expert has six to fifteen years of working experience in poverty-related fields. Seven of the experts hold a bachelor's degree, two of them have diplomas and one of the experts does not hold any tertiary degrees.

Since the subjective weight were calculated by using the ROC method, the experts were required to assign weights based on the ranking of each indicator, beginning with priority statements such as "Indicator 1 is more important than Indicator 2", "Indicator 2 is more important than Indicator 3", "Indicator 3 is more important than Indicator 4" and so on until Indicator 7 based on their different knowledge and opinions.

#### 4.3.1 Indicator 1: Marital Status

The marital status indicator consists of three sub-indicators; single, married and divorced. Table 4.1 represents the ranking assigned by the ten experts based on their opinion about the importance of each sub-indicator for the marital status aspect in defining poverty in Kedah.

Table 4.1

*Ranking of each sub-indicator of marital status by experts*

| Expert | Single | Married | Divorced |
|--------|--------|---------|----------|
| 1      | 3      | 2       | 1        |
| 2      | 3      | 1       | 2        |
| 3      | 2      | 1       | 3        |
| 4      | 2      | 1       | 3        |
| 5      | 1      | 3       | 2        |
| 6      | 2      | 1       | 3        |
| 7      | 3      | 2       | 1        |
| 8      | 3      | 1       | 2        |
| 9      | 1      | 3       | 2        |
| 10     | 3      | 2       | 1        |

Based on Table 4.1, a majority of the experts ranked the married sub-indicator as the most important indicator whereas single status was mostly ranked as the least important. The subjective weights for each sub-indicator for the marital status that were calculated using Equation (3.1) are as follows:

$$w_k^{sub} = \frac{1}{n} \sum_{j=k}^n \frac{1}{j}, \quad k = 1, 2, \dots, n, \quad 0 \leq w_k^{sub} \leq 1$$

Since the first expert ranked single status as third in marital status indicator, then the calculation is as follows:

$$w_k^{sub} = \frac{1}{3} \sum_{j=k}^3 \frac{1}{j}, \quad k = 3$$

$$= \left(\frac{1}{3}\right) \times \left(\frac{1}{3}\right)$$

$$=0.1111$$

Then the first expert ranked married status as second in marital status indicator, the calculation is as follows:

$$w_k^{sub} = \frac{1}{3} \sum_{j=k}^3 \frac{1}{j}, \quad k = 2,3$$

$$= \left(\frac{1}{3}\right) \times \left(\frac{1}{3} + \frac{1}{2}\right)$$

$$=0.2778$$

Then the first expert ranked divorced status as first in marital status indicator, therefore the calculation is as follows:

$$w_k^{sub} = \frac{1}{3} \sum_{j=k}^3 \frac{1}{j}, \quad k = 1,2,3$$

$$w_k^{sub} = \left(\frac{1}{3}\right) \left(\frac{1}{3} + \frac{1}{2} + \frac{1}{1}\right)$$

$$w_k^{sub} = 0.6111$$

Hence, for the following experts, by substituting the values, the results are shown in Table 4.2.

Table 4.2

*Subjective weights for marital status*

| Expert            | Single | Married | Divorced |
|-------------------|--------|---------|----------|
| 1                 | 0.1111 | 0.2778  | 0.6111   |
| 2                 | 0.1111 | 0.6111  | 0.2778   |
| 3                 | 0.2778 | 0.6111  | 0.1111   |
| 4                 | 0.2778 | 0.6111  | 0.1111   |
| 5                 | 0.6111 | 0.1111  | 0.2778   |
| 6                 | 0.2778 | 0.6111  | 0.1111   |
| 7                 | 0.1111 | 0.2778  | 0.6111   |
| 8                 | 0.1111 | 0.6111  | 0.2778   |
| 9                 | 0.6111 | 0.1111  | 0.2778   |
| 10                | 0.1111 | 0.2778  | 0.6111   |
| Subjective Weight | 0.2611 | 0.4111  | 0.3278   |
| Rank              | 3      | 1       | 2        |

Table 4.2 illustrated the subjective weights for each sub-indicator for the marital status that were calculated using Equation (3.7). The subjective weights show that married household heads are the most important indicator of poverty in terms of marital status. One of the reasons for this might be due to the increase in expenses as the number of family member increases (Mrówczyńska, Skiba, Bazan-Krzywoszańska, & Sztubecka, 2020).

#### 4.3.2 Indicator 2: Education level

The education level indicator has four sub-indicators which are no schooling, primary school, secondary school, and tertiary. Based on Table 4.3, all experts have given the

same rank for all sub-indicators with no schooling ranking first and tertiary education falling last. This demonstrates a strong agreement between all experts in where no schooling should be the strongest indicator for poverty in Kedah.

Table 4.3

*Ranking of each sub-indicator of education level by experts*

| Expert | No Schooling | Primary School | Secondary School | Tertiary |
|--------|--------------|----------------|------------------|----------|
| 1      | 1            | 2              | 3                | 4        |
| 2      | 1            | 2              | 3                | 4        |
| 3      | 1            | 2              | 3                | 4        |
| 4      | 1            | 2              | 3                | 4        |
| 5      | 1            | 2              | 3                | 4        |
| 6      | 1            | 2              | 3                | 4        |
| 7      | 1            | 2              | 3                | 4        |
| 8      | 1            | 2              | 3                | 4        |
| 9      | 1            | 2              | 3                | 4        |
| 10     | 1            | 2              | 3                | 4        |

By using ROC weighting method, the subjective weights of education level are shown in Table 4.4

Table 4.4

*Subjective weight of education level by using ROC weighting method*

| Expert            | No Schooling | Primary School | Secondary School | Tertiary |
|-------------------|--------------|----------------|------------------|----------|
| 1                 | 0.5208       | 0.2708         | 0.1458           | 0.0625   |
| 2                 | 0.5208       | 0.2708         | 0.1458           | 0.0625   |
| 3                 | 0.5208       | 0.2708         | 0.1458           | 0.0625   |
| 4                 | 0.5208       | 0.2708         | 0.1458           | 0.0625   |
| 5                 | 0.5208       | 0.2708         | 0.1458           | 0.0625   |
| 6                 | 0.5208       | 0.2708         | 0.1458           | 0.0625   |
| 7                 | 0.5208       | 0.2708         | 0.1458           | 0.0625   |
| 8                 | 0.5208       | 0.2708         | 0.1458           | 0.0625   |
| 9                 | 0.5208       | 0.2708         | 0.1458           | 0.0625   |
| 10                | 0.5208       | 0.2708         | 0.1458           | 0.0625   |
| Subjective Weight | 0.5208       | 0.2708         | 0.1458           | 0.0625   |
| Rank              | 1            | 2              | 3                | 4        |

Subsequently, this led to the no schooling sub-indicator having the highest weightage whereas the tertiary sub-indicator had the lowest weightage since it was ranked the least important indicator for poverty by all experts as shown in Table 4.4.

#### 4.3.3 Indicator 3: Occupation

Unemployment, self-employment, and paid employment are the three sub-indicators of the occupation aspect for poverty in Kedah. According to Table 4.5, experts have ranked these sub-indicators according to their importance.



Table 4.5

*Ranking of each sub-indicator of occupation by experts*

| Expert | Unemployment | Self-employment | Paid employment |
|--------|--------------|-----------------|-----------------|
| 1      | 1            | 2               | 3               |
| 2      | 1            | 2               | 3               |
| 3      | 1            | 2               | 3               |
| 4      | 1            | 2               | 3               |
| 5      | 1            | 2               | 3               |
| 6      | 1            | 2               | 3               |
| 7      | 1            | 2               | 3               |
| 8      | 1            | 2               | 3               |
| 9      | 1            | 2               | 3               |
| 10     | 1            | 2               | 3               |

Table 4.6

*Subjective weight of occupation by using ROC weighting method*

| Expert            | Unemployment | Self-employment | Paid employment |
|-------------------|--------------|-----------------|-----------------|
| 1                 | 0.6111       | 0.2778          | 0.1111          |
| 2                 | 0.6111       | 0.2778          | 0.1111          |
| 3                 | 0.6111       | 0.2778          | 0.1111          |
| 4                 | 0.6111       | 0.2778          | 0.1111          |
| 5                 | 0.6111       | 0.2778          | 0.1111          |
| 6                 | 0.6111       | 0.2778          | 0.1111          |
| 7                 | 0.6111       | 0.2778          | 0.1111          |
| 8                 | 0.6111       | 0.2778          | 0.1111          |
| 9                 | 0.6111       | 0.2778          | 0.1111          |
| 10                | 0.6111       | 0.2778          | 0.1111          |
| Subjective Weight | 0.6111       | 0.2778          | 0.1111          |
| Rank              | 1            | 2               | 3               |

Table 4.6 shows that unemployment sub-indicator has the highest subjective weight compared to the others. This outcome is to be expected since a majority of those that are unemployed generally have no source of income.

#### 4.3.4 Indicator 4: Living Standard

Electricity, water resources, types of toilets, cooking fuel and floor are the sub-indicators for the living standard indicator. In Table 4.7, experts had ranked the sub-indicator according to their opinion regarding poverty in Kedah.

Table 4.7

*Ranking of each sub-indicator of living standard by experts*

| Expert | Electricity | Water Resources | Types of Toilets | Cooking Fuel | Floor |
|--------|-------------|-----------------|------------------|--------------|-------|
| 1      | 2           | 1               | 5                | 3            | 4     |
| 2      | 2           | 1               | 4                | 3            | 5     |
| 3      | 1           | 2               | 4                | 3            | 5     |
| 4      | 2           | 1               | 5                | 4            | 3     |
| 5      | 1           | 2               | 4                | 3            | 5     |
| 6      | 2           | 1               | 5                | 3            | 4     |
| 7      | 2           | 1               | 5                | 3            | 4     |
| 8      | 2           | 1               | 3                | 4            | 5     |
| 9      | 1           | 2               | 4                | 3            | 5     |
| 10     | 2           | 1               | 5                | 3            | 4     |

Table 4.8

*Subjective weight of living standard by using ROC weighting method*

| Expert | Electricity | Water Resources | Types of Toilets | Cooking Fuel | Floor  |
|--------|-------------|-----------------|------------------|--------------|--------|
| 1      | 0.2567      | 0.4567          | 0.0400           | 0.1567       | 0.0900 |
| 2      | 0.2567      | 0.4567          | 0.0900           | 0.1567       | 0.0400 |
| 3      | 0.4567      | 0.2567          | 0.0900           | 0.1567       | 0.0400 |
| 4      | 0.2567      | 0.4567          | 0.0400           | 0.0900       | 0.1567 |

Table 4.8 *Continued*

|                   |        |        |        |        |        |
|-------------------|--------|--------|--------|--------|--------|
| 5                 | 0.4567 | 0.2567 | 0.0900 | 0.1567 | 0.0400 |
| 6                 | 0.2567 | 0.4567 | 0.0400 | 0.1567 | 0.0900 |
| 7                 | 0.2567 | 0.4567 | 0.0400 | 0.1567 | 0.0900 |
| 8                 | 0.2567 | 0.4567 | 0.1567 | 0.0900 | 0.0400 |
| 9                 | 0.4567 | 0.2567 | 0.0900 | 0.1567 | 0.0400 |
| 10                | 0.2567 | 0.4567 | 0.0400 | 0.1567 | 0.0900 |
| Subjective Weight | 0.3167 | 0.3967 | 0.0717 | 0.1433 | 0.0717 |
| Rank              | 2      | 1      | 4      | 3      | 4      |

Based on the calculation of ROC weighting method, Table 4.8 shows that water resources were the most important sub-indicator for living standard with a weightage of 0.3967, followed by electricity, cooking fuel, types of toilets, and floor.

#### 4.3.5 Indicator 5: Strata

Strata has two sub-indicators which are urban and rural. Based on Table 4.9, all experts were assigned to rural areas as the most important factors of poverty.

Table 4.9

*Ranking of each sub-indicator of strata by experts*

| Expert | Urban | Rural |
|--------|-------|-------|
| 1      | 2     | 1     |
| 2      | 2     | 1     |
| 3      | 2     | 1     |
| 4      | 2     | 1     |
| 5      | 2     | 1     |
| 6      | 2     | 1     |
| 7      | 2     | 1     |

Table 4.9 *Continued*

|    |   |   |
|----|---|---|
| 8  | 2 | 1 |
| 9  | 2 | 1 |
| 10 | 2 | 1 |

Table 4.10

*Subjective weight of strata by using ROC weighting method*

| <b>Expert</b>     | <b>Urban</b> | <b>Rural</b> |
|-------------------|--------------|--------------|
| 1                 | 0.2500       | 0.7500       |
| 2                 | 0.2500       | 0.7500       |
| 3                 | 0.2500       | 0.7500       |
| 4                 | 0.2500       | 0.7500       |
| 5                 | 0.2500       | 0.7500       |
| 6                 | 0.2500       | 0.7500       |
| 7                 | 0.2500       | 0.7500       |
| 8                 | 0.2500       | 0.7500       |
| 9                 | 0.2500       | 0.7500       |
| 10                | 0.2500       | 0.7500       |
| Subjective Weight | 0.2500       | 0.7500       |
| Rank              | 2            | 1            |

The result shown in Table 4.10 proved that rural have the highest subjective weightage for strata indicator.

#### **4.3.6 Indicator 6: Residential**

Residential has five sub-indicators which are Semi-D, Shop-Lot, Bungalow, Terrace and Flat. Again, each sub-indicator was ranked by the same experts as in Table 4.11.

Table 4.11

*Ranking of each sub-indicator of residential by experts*

| Expert | Semi-D | Shop-Lot | Bungalow | Terrace | Flat |
|--------|--------|----------|----------|---------|------|
| 1      | 4      | 3        | 5        | 2       | 1    |
| 2      | 4      | 5        | 2        | 1       | 3    |
| 3      | 4      | 3        | 5        | 2       | 1    |
| 4      | 3      | 4        | 5        | 1       | 2    |
| 5      | 3      | 4        | 5        | 2       | 1    |
| 6      | 4      | 3        | 5        | 2       | 1    |
| 7      | 4      | 3        | 5        | 2       | 1    |
| 8      | 4      | 3        | 5        | 2       | 1    |
| 9      | 3      | 4        | 5        | 2       | 1    |
| 10     | 4      | 3        | 5        | 2       | 1    |

Table 4.12

*Subjective weight of residential by using ROC weighting method*

| Expert            | Semi-D | Shop-Lot | Bungalow | Terrace | Flat   |
|-------------------|--------|----------|----------|---------|--------|
| 1                 | 0.0900 | 0.1567   | 0.0400   | 0.2567  | 0.4567 |
| 2                 | 0.0900 | 0.0400   | 0.2567   | 0.4567  | 0.1567 |
| 3                 | 0.0900 | 0.1567   | 0.0400   | 0.2567  | 0.4567 |
| 4                 | 0.1567 | 0.0900   | 0.0400   | 0.4567  | 0.2567 |
| 5                 | 0.1567 | 0.0900   | 0.0400   | 0.2567  | 0.4567 |
| 6                 | 0.0900 | 0.1567   | 0.0400   | 0.2567  | 0.4567 |
| 7                 | 0.0900 | 0.1567   | 0.0400   | 0.2567  | 0.4567 |
| 8                 | 0.0900 | 0.1567   | 0.0400   | 0.2567  | 0.4567 |
| 9                 | 0.1567 | 0.0900   | 0.0400   | 0.2567  | 0.4567 |
| 10                | 0.0900 | 0.1567   | 0.0400   | 0.2567  | 0.4567 |
| Subjective Weight | 0.1100 | 0.1250   | 0.0617   | 0.2967  | 0.4067 |
| Rank              | 4      | 3        | 5        | 2       | 1      |

Table 4.12 shows the results of ROC weighting method for residential indicator. It shows that most experts deem flats as the main type of residential property which indicates poverty.

#### 4.3.7 Indicator 7: Comfortability

The comfortability indicator consists of two sub-indicators which are the number of bedroom(s) and the size of household. Table 4.13 shows the ranking of each sub-indicator given by the experts.

Table 4.13

*Ranking of each sub-indicator of comfortability by the experts*

| Expert | Number of Bedroom(s) | Size of Household |
|--------|----------------------|-------------------|
| 1      | 1                    | 2                 |
| 2      | 2                    | 1                 |
| 3      | 2                    | 1                 |
| 4      | 2                    | 1                 |
| 5      | 2                    | 1                 |
| 6      | 2                    | 1                 |
| 7      | 2                    | 1                 |
| 8      | 2                    | 1                 |
| 9      | 2                    | 1                 |
| 10     | 1                    | 2                 |

Table 4.14

*Subjective weight of comfortability by using ROC weighting method*

| Expert            | Number of Bedroom(s) | Size of Household |
|-------------------|----------------------|-------------------|
| 1                 | 0.7500               | 0.2500            |
| 2                 | 0.2500               | 0.7500            |
| 3                 | 0.2500               | 0.7500            |
| 4                 | 0.2500               | 0.7500            |
| 5                 | 0.2500               | 0.7500            |
| 6                 | 0.2500               | 0.7500            |
| 7                 | 0.2500               | 0.7500            |
| 8                 | 0.2500               | 0.7500            |
| 9                 | 0.2500               | 0.7500            |
| 10                | 0.7500               | 0.2500            |
| Subjective Weight | 0.3500               | 0.6500            |
| Rank              | 2                    | 1                 |

Overall, Table 4.14 indicates that the size of the household was more important than the number of bedrooms in a house.

#### **4.3.8 Multi-indicator Poverty**

Multi-indicator is when combining all the previous listed indicators results in a total of seven indicators which are marital status, education level, occupation, living standard, strata, residential, and comfortability. Experts were then required to rank each of these indicators based on their importance in defining poverty as shown in Table 4.15.



Table 4.15

*Ranking of each indicator by experts*

| Expert | Marital Status | Education level | Occupation | Living Standard | Strata | Residential | Comfortability |
|--------|----------------|-----------------|------------|-----------------|--------|-------------|----------------|
| 1      | 3              | 2               | 1          | 4               | 5      | 6           | 7              |
| 2      | 3              | 2               | 1          | 4               | 5      | 6           | 7              |
| 3      | 5              | 2               | 1          | 3               | 4      | 6           | 7              |
| 4      | 3              | 4               | 1          | 2               | 5      | 6           | 7              |
| 5      | 3              | 2               | 1          | 4               | 5      | 7           | 6              |
| 6      | 4              | 2               | 1          | 5               | 3      | 6           | 7              |
| 7      | 7              | 2               | 1          | 3               | 6      | 5           | 4              |
| 8      | 4              | 2               | 1          | 5               | 3      | 7           | 6              |
| 9      | 3              | 2               | 1          | 4               | 5      | 7           | 6              |
| 10     | 3              | 2               | 1          | 4               | 5      | 6           | 7              |



Table 4.16

*Subjective weights of the sub-indicators by using ROC weighting method*

| Expert            | Marital Status | Education level | Occupation | Living Standard | Strata | Residential | Comfortability |
|-------------------|----------------|-----------------|------------|-----------------|--------|-------------|----------------|
| 1                 | 0.1561         | 0.2276          | 0.3704     | 0.1085          | 0.0728 | 0.0442      | 0.0204         |
| 2                 | 0.1561         | 0.2276          | 0.3704     | 0.1085          | 0.0728 | 0.0442      | 0.0204         |
| 3                 | 0.0728         | 0.2276          | 0.3704     | 0.1561          | 0.1085 | 0.0442      | 0.0204         |
| 4                 | 0.1561         | 0.1085          | 0.3704     | 0.2276          | 0.0728 | 0.0442      | 0.0204         |
| 5                 | 0.1561         | 0.2276          | 0.3704     | 0.1085          | 0.0728 | 0.0204      | 0.0442         |
| 6                 | 0.1085         | 0.2276          | 0.3704     | 0.0728          | 0.1561 | 0.0442      | 0.0204         |
| 7                 | 0.0204         | 0.2276          | 0.3704     | 0.1561          | 0.0442 | 0.0728      | 0.1085         |
| 8                 | 0.1085         | 0.2276          | 0.3704     | 0.0728          | 0.1561 | 0.0204      | 0.0442         |
| 9                 | 0.1561         | 0.2276          | 0.3704     | 0.1085          | 0.0728 | 0.0204      | 0.0442         |
| 10                | 0.1561         | 0.2276          | 0.3704     | 0.1085          | 0.0728 | 0.0442      | 0.0204         |
| Subjective Weight | 0.1247         | 0.2156          | 0.3704     | 0.1228          | 0.0902 | 0.0399      | 0.0364         |
| Rank              | 3              | 2               | 1          | 4               | 5      | 6           | 7              |

The values of the subjective weights of each indicator are reported as in Table 4.16. The results show that occupation has the highest weightage, meaning that it was ranked as the most important factor towards poverty in Kedah (0.3704). This is followed by education level (0.2156), marital status (0.1247), living standard (0.1228), strata (0.0902), residential (0.0399) and comfortability (0.0364).

#### **4.4 Objective Weights**

The data for the objective weights was collected from ICU JPM that consist of the e-Kasih database. By applying the formula for the CRITIC weighting method as outlined in Section 3.4.2, there are six stages required to determine weights of the indicator and the sub-indicators.

##### **4.4.1 Poor Category**

###### **4.4.1.1 Indicator 1: Marital Status**

Table 4.17 displays the data for marital status indicator, including the minimum and maximum value for single, married, and divorced household head. Minimum and maximum value were determined to calculate the decision matrix.

Table 4.17

*Minimum and maximum value for single, married and divorced for poor category*

| No            | Districts     | Marital Status |         |          |
|---------------|---------------|----------------|---------|----------|
|               |               | Single         | Married | Divorced |
| 1             | Baling        | 63             | 1187    | 454      |
| 2             | Bandar Baharu | 11             | 213     | 133      |
| 3             | Kota Setar    | 96             | 1117    | 564      |
| 4             | Kuala Muda    | 107            | 1576    | 846      |
| 5             | Kubang Pasu   | 82             | 1250    | 519      |
| 6             | Kulim         | 31             | 408     | 238      |
| 7             | Langkawi      | 14             | 277     | 156      |
| 8             | Padang Terap  | 29             | 543     | 266      |
| 9             | Pendang       | 24             | 414     | 166      |
| 10            | Pokok Sena    | 23             | 278     | 214      |
| 11            | Sik           | 79             | 1056    | 518      |
| 12            | Yan           | 22             | 429     | 203      |
| Minimum Value |               | 11             | 213     | 133      |
| Maximum Value |               | 107            | 1576    | 846      |

**Step 1:** Normalized decision matrix by using Equation (3.2) and Equation (3.3) as shown in Table 4.18.

For example, since single status at Baling is cost indicator, hence Equation (3.3) was applied.

$$X_{jk} = \frac{X_{jk}^{max} - X_{jk}}{X_{jk}^{max} - X_{jk}^{min}}, j = 1, 2, \dots, 12, \quad k = 1, 2, 3$$

$$X_{11} = \frac{107 - 63}{107 - 11}$$

$$X_{11} = 0.4583$$

Next, since married status at Baling is cost indicator, Equation (3.3) was applied.

$$X_{jk} = \frac{X_{jk}^{max} - X_{jk}}{X_{jk}^{max} - X_{jk}^{min}}, j = 1, 2, \dots, 12, \quad k = 1, 2, 3$$

$$X_{12} = \frac{1576 - 1187}{1576 - 213}$$

$$X_{12} = 0.2854$$

Next, since divorced status is benefit indicator, then Equation 3.2 was applied.

$$X_{jk} = \frac{X_{jk} - X_{jk}^{min}}{X_{jk}^{max} - X_{jk}^{min}}, \quad j = 1, 2, \dots, 12, \quad k = 1, 2, 3$$

$$X_{13} = \frac{454 - 133}{846 - 133}$$

$$X_{13} = 0.4502$$

Then, the calculation of the normalization of marital status as shown in STEP 1, also applied for the other districts and the results presented in table 4.18

Table 4.18

*Normalized decision matrix of marital status for poor category*

| No | Districts     | Marital Status |         |          |
|----|---------------|----------------|---------|----------|
|    |               | Single         | Married | Divorced |
| 1  | Baling        | 0.4583         | 0.2854  | 0.4502   |
| 2  | Bandar Baharu | 1.0000         | 1.0000  | 0.0000   |
| 3  | Kota Setar    | 0.1146         | 0.3368  | 0.6045   |
| 4  | Kuala Muda    | 0.0000         | 0.0000  | 1.0000   |
| 5  | Kubang Pasu   | 0.2604         | 0.2392  | 0.5414   |
| 6  | Kulim         | 0.7917         | 0.8569  | 0.1473   |
| 7  | Langkawi      | 0.9688         | 0.9530  | 0.0323   |
| 8  | Padang Terap  | 0.8125         | 0.7579  | 0.1865   |
| 9  | Pendang       | 0.8646         | 0.8525  | 0.0463   |
| 10 | Pokok Sena    | 0.8750         | 0.9523  | 0.1136   |
| 11 | Sik           | 0.2917         | 0.3815  | 0.5400   |
| 12 | Yan           | 0.8854         | 0.8415  | 0.0982   |

Step 2: Calculate the standard deviation for each indicator by using the equation (3.4).

$$\sigma_k = \sqrt{\sum \frac{(X_{jk} - \mu)^2}{N}}, \quad X_j = 1, 2, \dots, 12,$$

For single status, by substituting  $N = 12$ ,  $\mu = 0.6102$ ,

$$\sigma_1 = \sqrt{\sum \frac{(X_{j1} - 0.6102)^2}{12}}$$

$$\sigma_1 = 0.3452$$

Hence, the results of married and divorced status are shown in Table 4.19.

Table 4.19

*Standard deviation of marital status indicator for poor category*

| Marital Status     | Single | Married | Divorced |
|--------------------|--------|---------|----------|
| Standard Deviation | 0.3452 | 0.3320  | 0.2967   |

Step 3: Calculate the linear correlation coefficient between the vectors  $X_j$  and  $X_k$ . The results are shown in Table 4.20.

Table 4.20

*Correlation of the sub-indicators of marital status indicator for poor category*

| Indicator             |                 | Marital Status |         |          |
|-----------------------|-----------------|----------------|---------|----------|
|                       | Indicators      | Single         | Married | Divorced |
| <b>Marital Status</b> | <b>Single</b>   | 1              | 0.9637  | -0.9720  |
|                       | <b>Married</b>  | 0.9637         | 1       | -0.9648  |
|                       | <b>Divorced</b> | -0.9720        | -0.9648 | 1        |

**Step 4:** Determine the quantity of the information related to each indicator by using the Equation (3.6)

Table 4.21

*The value of  $C_k$ , amount of information for the marital status indicator for poor category*

| Marital Status | Single | Married | Divorced |
|----------------|--------|---------|----------|
| $C_k$          | 0.6932 | 0.6643  | 1.1682   |

**Step 5:** For the final step in CRITIC weighting method is to determine the weightage by using the formula as in Equation (3.7).

Table 4.22

*The weightage value and the ranking of the marital status indicator for poor category*

| Indicator             | Indicators      | Weightage Value | Ranking |
|-----------------------|-----------------|-----------------|---------|
| <b>Marital Status</b> | <b>Single</b>   | 0.2745          | 2       |
|                       | <b>Married</b>  | 0.2630          | 3       |
|                       | <b>Divorced</b> | 0.4625          | 1       |

Table 4.22 shows the ranking, standard deviation, and weightage value for each sub-indicator for marital status. It is demonstrated that divorced households are the most important sub-indicator while married households are the least significant one. The results are similar to the subjective weights.

#### 4.4.1.2 Indicator 2: Education level

In order to obtain objective weightage value, the same steps of CRITIC weighting method as shown in 4.4.1.1 were applied to all the indicators. The table of minimum and maximum value, normalized decision matrix, correlation of sub-indicators for Indicator 2 until Indicator 7 are listed in Appendix A.

Table 4.23

*The weightage value and the ranking of the education level indicator for poor category*

| Indicator       | Sub-indicator | Weightage value | Ranking |
|-----------------|---------------|-----------------|---------|
| Education level | No Schooling  | 0.2577          | 1       |
|                 | Primary       | 0.2486          | 2       |
|                 | Secondary     | 0.2459          | 4       |
|                 | Tertiary      | 0.2478          | 3       |

Similar to the subjective weight calculations, Table 4.23 showed that the no-schooling sub-indicator was ranked the highest objective weightage. However, the objective weights suggest that the least important sub-indicator is secondary school instead of tertiary education as deemed by the experts.

#### 4.4.1.3 Indicator 3: Occupation

Table 4.24 shows the occupation indicator, the rankings obtained for the objective weights of each sub-indicator are also similar to the subjective weights. This suggests that both data and the experts viewed employment status as the main benchmark for poverty.

Table 4.24

*The weightage value and the ranking of the occupation indicator for poor category*

| Indicator  | Sub-indicator   | Weightage Value | Ranking |
|------------|-----------------|-----------------|---------|
| Occupation | Unemployment    | 0.4389          | 1       |
|            | Self-employment | 0.2970          | 2       |
|            | Paid employment | 0.2640          | 3       |

#### 4.4.1.4 Indicator 4: Living Standard

Table 4.25

*The weightage value and the ranking of the living standard indicator for poor category*

| Indicator       | Sub-indicator    | Weightage Value | Ranking |
|-----------------|------------------|-----------------|---------|
| Living Standard | Electricity      | 0.1469          | 4       |
|                 | Water Resources  | 0.1708          | 2       |
|                 | Types of toilets | 0.1652          | 3       |
|                 | Cooking Fuel     | 0.1278          | 5       |
|                 | Floor            | 0.3894          | 1       |

According to Table 4.25, it is shown that floor was the most significant sub-indicator for the living standard indicator when using the CRITIC weighting method. Nevertheless, the data suggest different importance of living standard compared to expert's opinions.

#### 4.4.1.5 Indicator 5: Strata

As demonstrated in Table 4.26, rural areas in Kedah are the primary causes of poverty according to the objective weighting method, similar to the subjective weighting method.

Table 4.26

*The weightage value and the ranking of the strata indicator for poor category*

| Indicator | Sub-indicator | Standard Deviation | Weightage Value | Rank |
|-----------|---------------|--------------------|-----------------|------|
| Strata    | Urban         | 0.3079             | 0.4361          | 2    |
|           | Rural         | 0.3981             | 0.5639          | 1    |



#### 4.4.1.6 Indicator 6: Residential

The outcomes of the CRITIC weighting method for the residential indicator are shown in Table 4.27.

Table 4.27

*The weightage value and the ranking of the residential indicator for poor category*

| Indicator   | Sub-indicator | Standard Deviation | Weightage Value | Rank |
|-------------|---------------|--------------------|-----------------|------|
| Residential | Semi-D        | 0.3320             | 0.1562          | 3    |
|             | Shop Lot      | 0.2887             | 0.1357          | 5    |
|             | Bungalow      | 0.4107             | 0.1908          | 2    |
|             | Terrace       | 0.2780             | 0.1475          | 4    |
|             | Flat          | 0.3039             | 0.3698          | 1    |

It has been demonstrated that the most significant sub-indicator of poverty in Kedah is the flat, followed by bungalow, semi-D, terrace, and shop lot.

#### 4.4.1.7 Indicator 7: Comfortability

In the other hand, Table 4.28 explains household size have higher impact on comfortability for poor category rather than number of rooms.

Table 4.28

*The weightage value and the ranking of the comfortability indicator for poor category*

| Indicator      | Sub-indicator   | Standard Deviation | Weightage Value | Rank |
|----------------|-----------------|--------------------|-----------------|------|
| Comfortability | Number of rooms | 0.3371             | 0.3956          | 2    |
|                | Household size  | 0.5149             | 0.6044          | 1    |

#### 4.4.2 Hardcore poor Category

The weights of the indicators and sub-indicators for the hardcore poor category were determined using the CRITIC weighting method, which was also applied in this section.

##### 4.4.2.1 Indicator 1: Marital Status

Table 4.29 shows the CRITIC weighting calculation's results. The lowest and maximum values for single, married, and divorced people are shown in Table 4.30.

Table 4.29

*Minimum and maximum value for single, married and divorced for hardcore poor category*

| No            | Districts     | Marital Status |         |          |
|---------------|---------------|----------------|---------|----------|
|               |               | Single         | Married | Divorced |
| 1             | Baling        | 58             | 1545    | 511      |
| 2             | Bandar Baharu | 10             | 222     | 84       |
| 3             | Kota Setar    | 88             | 1657    | 773      |
| 4             | Kuala Muda    | 77             | 1596    | 809      |
| 5             | Kubang Pasu   | 55             | 1587    | 632      |
| 6             | Kulim         | 20             | 438     | 189      |
| 7             | Langkawi      | 15             | 246     | 151      |
| 8             | Padang Terap  | 19             | 850     | 266      |
| 9             | Pendang       | 19             | 741     | 228      |
| 10            | Pokok Sena    | 35             | 559     | 241      |
| 11            | Sik           | 78             | 1900    | 628      |
| 12            | Yan           | 34             | 658     | 277      |
| Minimum Value |               | 10             | 222     | 84       |
| Maximum Value |               | 88             | 1900    | 809      |

**Step 1:** Normalized decision matrix

To normalize the decision matrix, the calculations as in section 4.4.1.1 were applied.

Table 4.30

*Normalized decision matrix of marital status indicator for hardcore poor category*

| No | Districts     | Marital Status |         |          |
|----|---------------|----------------|---------|----------|
|    |               | Single         | Married | Divorced |
| 1  | Baling        | 0.3846         | 0.2116  | 0.5890   |
| 2  | Bandar Baharu | 1.0000         | 1.0000  | 0.0000   |
| 3  | Kota Setar    | 0.0000         | 0.1448  | 0.9503   |
| 4  | Kuala Muda    | 0.1410         | 0.1812  | 1.0000   |
| 5  | Kubang Pasu   | 0.4231         | 0.1865  | 0.7559   |
| 6  | Kulim         | 0.8718         | 0.8713  | 0.1448   |
| 7  | Langkawi      | 0.9359         | 0.9857  | 0.0924   |
| 8  | Padang Terap  | 0.8846         | 0.6257  | 0.2510   |
| 9  | Pendang       | 0.8846         | 0.6907  | 0.1986   |
| 10 | Pokok Sena    | 0.6795         | 0.7992  | 0.2166   |
| 11 | Sik           | 0.1282         | 0.0000  | 0.7503   |
| 12 | Yan           | 0.6923         | 0.7402  | 0.2662   |

**Step 2:** Calculate the standard deviation for each indicator by using the equation (3.4).

Table 4.31

*Standard deviation of marital status indicator for hardcore poor category*

| Marital Status     | Single | Married | Divorced |
|--------------------|--------|---------|----------|
| Standard Deviation | 0.3406 | 0.3496  | 0.3376   |

Step 3: Calculate the linear correlation coefficient between the vectors  $X_j$  and  $X_k$ . The results are shown in Table 4.32.

Table 4.32

*Correlation of the marital status indicator for hardcore poor category*

| Indicator      |            | Marital Status |         |          |
|----------------|------------|----------------|---------|----------|
|                | Indicators | Single         | Married | Divorced |
| Marital Status | Single     | 1              | 0.9234  | -0.9624  |
|                | Married    | 0.9234         | 1       | -0.9401  |
|                | Divorced   | -0.9624        | -0.9401 | 1        |

**Step 4:** Determine the quantity of the information related to each indicator by using the Equation (3.6)

Table 4.33

*The value of  $C_k$ , amount of information for the marital status indicator for hardcore poor category*

| Marital Status | Single | Married | Divorced |
|----------------|--------|---------|----------|
| $C_k$          | 0.6944 | 0.7050  | 1.3175   |

**Step 5:** For the final step in CRITIC weighting method is to determine the weightage by using the formula as in Equation (3.7).

Table 4.34

*The weightage value and the ranking of the marital status indicator for hardcore poor category*

| Indicator      | Indicators | Weightage Value | Ranking |
|----------------|------------|-----------------|---------|
| Marital Status | Single     | 0.2556          | 3       |
|                | Married    | 0.2595          | 2       |
|                | Divorced   | 0.4849          | 1       |

The ranking of the marital status indicators and the weightage value of each indicator are shown in Table 4.34. It is shown that the most significant sub-indicator of marital status was the divorced status of the head of the household, which had a value of 0.4849. This was followed by married status, which had a value of 0.2595 and single status, which had a value of 0.2556.

#### 4.4.2.2 Indicator 2: Education level

The table for minimum and maximum value, normalized decision matrix, correlation of sub-indicators for Indicator 2 until Indicator 7 are listed in Appendix A.

Table 4.35

*The weightage value and the ranking of the education level indicator for hardcore poor category*

| Indicator       | Sub-indicator | Weightage value | Ranking |
|-----------------|---------------|-----------------|---------|
| Education level | No Schooling  | 0.2439          | 3       |
|                 | Primary       | 0.2354          | 4       |
|                 | Secondary     | 0.2745          | 1       |
|                 | Tertiary      | 0.2463          | 2       |

Compared to the sub-indicator of secondary school, which has the greatest weight of 0.2745, tertiary school is ranked second in Table 4.53 with a weight of 0.2463. With 0.2439 and 0.2354 respectively, no schooling and primary school followed next as depicted in Table 4.35.

#### 4.4.2.3 Indicator 3: Occupation

Table 4.36 shows that the sub-indicator of occupation with the highest ranking was unemployment, with a score of 0.3280. This was followed by paid employment, with a score of 0.2364 and self-employment with a score of 0.2183.

Table 4.36

*The weightage value and the ranking of the occupation indicator for hardcore poor category*

| Indicator  | Sub-indicator   | Weightage Value | Ranking |
|------------|-----------------|-----------------|---------|
| Occupation | Unemployment    | 0.4878          | 1       |
|            | Self-employment | 0.2317          | 3       |
|            | Paid employment | 0.2806          | 2       |

#### 4.4.2.4 Indicator 4: Living Standard

Table 4.37 shows that the floor was the most significant sub-indicator for the living standard indicator, which was calculated using the CRITIC weighting method, with a significance score of 0.3576. This was followed by water resources (0.2030), types of toilets (0.1548), cooking fuel (0.1498), and electricity (0.1347).

Table 4.37

*The weightage value and the ranking of the living standard indicator for hardcore poor category*

| Indicator       | Sub-indicator    | Weightage Value | Ranking |
|-----------------|------------------|-----------------|---------|
| Living Standard | Electricity      | 0.1347          | 5       |
|                 | Water Resources  | 0.2030          | 2       |
|                 | Types of toilets | 0.1548          | 3       |
|                 | Cooking Fuel     | 0.1498          | 4       |
|                 | Floor            | 0.3576          | 1       |

#### 4.4.2.5 Indicator 5: Strata

According to the objective weighting method, urban areas in Kedah are the main contributors to poverty compared to rural areas, as shown in Table 4.38.

Table 4.38

*The weightage value and the ranking of the strata indicator for hardcore poor category*

| Indicator | Sub-indicator | Standard Deviation | Weightage Value | Rank |
|-----------|---------------|--------------------|-----------------|------|
| Strata    | Urban         | 0.3552             | 0.5144          | 1    |
|           | Rural         | 0.3353             | 0.4856          | 2    |

#### 4.4.2.6 Indicator 6: Residential

Table 4.39 displays the results of the CRITIC weighting method for the residential indicator. According to the results the flat is the most important sub-indicator of residential, followed by terraces, semi-Ds, shop lot and bungalow. The ranking is different from the subjective weighting method, where shop-lot was ranked third instead of fourth.

Table 4.39

*The weightage value and the ranking of the residential indicator for hardcore poor category*

| Indicator   | Sub-indicator | Weightage Value | Rank |
|-------------|---------------|-----------------|------|
| Residential | Semi-D        | 0.1613          | 3    |
|             | Shop Lot      | 0.1567          | 4    |
|             | Bungalow      | 0.1502          | 5    |
|             | Terrace       | 0.1828          | 2    |
|             | Flat          | 0.3490          | 1    |

#### 4.4.2.7 Indicator 7: Comfortability

Similar to poor category, instead of number of rooms, household size has a greater effect on comfortability for the hardcore poor category.

Table 4.40

*The weightage value and the ranking of the comfortability indicator for hardcore poor category*

| Indicator      | Sub-indicator   | Weightage Value | Rank |
|----------------|-----------------|-----------------|------|
| Comfortability | Number of rooms | 0.3896          | 2    |
|                | Household size  | 0.6104          | 1    |

#### 4.4.3 Indicators

Table 4.41 summarizes the values of the objective weights of the indicators. The findings indicate that strata and comfortability have the highest weightage, followed by marital status, education level and occupation, living standard and residential. The findings appear to contradict the subjective weight, as strata and comfortability have the highest weightage.

Table 4.41

*The objective weight of indicators for hardcore poor category*

| Indicator       | Objective weight | Ranking |
|-----------------|------------------|---------|
| Marital Status  | 0.1493           | 3       |
| Education level | 0.1119           | 5       |
| Occupation      | 0.1439           | 3       |
| Living Standard | 0.0896           | 6       |
| Strata          | 0.2239           | 1       |
| Residential     | 0.0896           | 6       |
| Comfortability  | 0.2239           | 1       |



#### 4.5 Aggregated Weights

To achieve the first objective, the CRITIC weighting method and the ROC weighting method were aggregated. Results shown in Table 4.42 are the aggregated weights for indicators of poverty.

Table 4.42

*Aggregated weights for indicators of poverty*

| Indicator       | $w_j^{obj}$ | Rank | $w_j^{sub}$ | Rank | Aggregated Weights | Rank |
|-----------------|-------------|------|-------------|------|--------------------|------|
| Marital Status  | 0.1493      | 3    | 0.1247      | 3    | 0.1464             | 4    |
| Education level | 0.1119      | 4    | 0.2156      | 2    | 0.1899             | 2    |
| Occupation      | 0.1119      | 4    | 0.3704      | 1    | 0.3262             | 1    |
| Living Standard | 0.0896      | 6    | 0.1228      | 4    | 0.0865             | 5    |
| Strata          | 0.2239      | 1    | 0.0902      | 5    | 0.1588             | 3    |
| Residential     | 0.0896      | 6    | 0.0399      | 6    | 0.0281             | 7    |
| Comfortability  | 0.2239      | 1    | 0.0364      | 7    | 0.0640             | 6    |

As reported in Table 4.42, there are differences in the ranking between both subjective and objective methods. By using the subjective weighting method, the highest weightage is occupation indicator while by using objective weighting method the highest weightage are strata and comfortability. Then, this study aggregated both subjective and objective weights to overcome the drawbacks of these two methods. Thus, Table 4.42 shows that occupation has the highest aggregated weight with a value of 0.3262 followed by education level (0.1899), strata (0.1588), marital status (0.1464), living standard (0.0865), comfortability (0.0640) and residential (0.0281).

Then, aggregated weights for sub-indicators of poverty for poor and hardcore poor categories are presented in Table 4.43 and 4.44. By referring to the aggregated weight on Table 4.43 and 4.44, it is shown that there is similar ranking between poor and hardcore

poor categories except for residential indicator. The highest weightage for marital status indicator is divorced followed by married and single. While for education level indicator, it is shown that no schooling is the highest weightage while tertiary is the lowest weightage. On the other side, unemployment has the highest weightage for occupation indicator followed by self-employment, and paid employment. Meanwhile, for living standard indicator, the highest weightage is water resources followed by electricity, floor, cooking fuel and types of toilets. For the poor category, instead of urban, rural also has a higher effect on strata for the hardcore poor category. It is also demonstrated that household size is the most important sub-indicator while number of rooms is the least significant one. According to Table 4.43, flats are the most significant sub-indicators of residential followed by terrace, semi-D, shop lot, and bungalow. Compared to the hardcore poor category on Table 4.44, shop-lot was placed third rather than fourth.

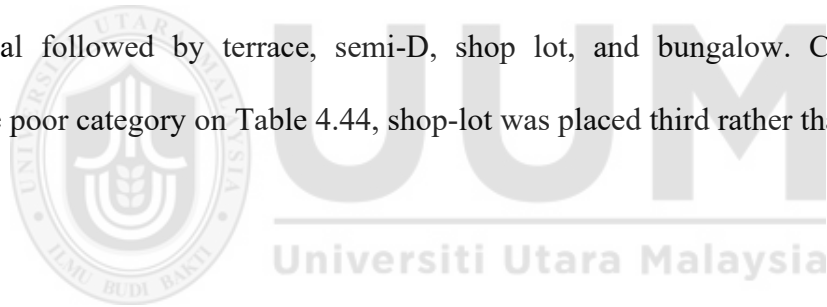


Table 4.43

*Aggregated weights for sub-indicators of poverty for poor category*

| Indicator       | Sub-indicator    | $w_j^{obj}$ | Rank | $w_j^{sub}$ | Rank | Aggregated Weight | Rank |
|-----------------|------------------|-------------|------|-------------|------|-------------------|------|
| Marital Status  | Single           | 0.2745      | 2    | 0.2611      | 3    | 0.2162            | 3    |
|                 | Married          | 0.2630      | 3    | 0.4111      | 1    | 0.3263            | 2    |
|                 | Divorced         | 0.4625      | 1    | 0.3278      | 2    | 0.4575            | 1    |
| Education level | No Schooling     | 0.2577      | 1    | 0.5208      | 1    | 0.5308            | 1    |
|                 | Primary          | 0.2486      | 2    | 0.2708      | 2    | 0.2662            | 2    |
|                 | Secondary        | 0.2459      | 4    | 0.1458      | 3    | 0.1418            | 3    |
|                 | Tertiary         | 0.2478      | 3    | 0.0625      | 4    | 0.0612            | 4    |
| Occupation      | Unemployment     | 0.3547      | 1    | 0.4208      | 1    | 0.5405            | 1    |
|                 | Self-employment  | 0.2573      | 2    | 0.2083      | 2    | 0.1941            | 2    |
|                 | Paid employment  | 0.1856      | 3    | 0.1042      | 3    | 0.0700            | 3    |
| Living Standard | Electricity      | 0.1469      | 4    | 0.3167      | 2    | 0.2699            | 2    |
|                 | Water resources  | 0.1708      | 2    | 0.3967      | 1    | 0.3932            | 1    |
|                 | Types of Toilets | 0.1652      | 3    | 0.0717      | 4    | 0.0687            | 5    |
|                 | Cooking Fuel     | 0.1278      | 5    | 0.1433      | 3    | 0.1063            | 4    |
|                 | Floor            | 0.3894      | 1    | 0.0717      | 4    | 0.1620            | 3    |

Table 4.43

*Continued*

|                |                 |        |   |        |   |        |   |
|----------------|-----------------|--------|---|--------|---|--------|---|
| Strata         | Urban           | 0.4361 | 2 | 0.2500 | 2 | 0.2050 | 2 |
|                | Rural           | 0.5639 | 1 | 0.7500 | 1 | 0.7950 | 1 |
| Residential    | Semi-D          | 0.1562 | 3 | 0.1100 | 4 | 0.0716 | 3 |
|                | Shop Lot        | 0.1357 | 5 | 0.1250 | 3 | 0.0706 | 4 |
|                | Bungalow        | 0.1908 | 2 | 0.0617 | 5 | 0.0490 | 5 |
|                | Terrace         | 0.1475 | 4 | 0.2967 | 2 | 0.1823 | 2 |
|                | Flat            | 0.3698 | 1 | 0.4067 | 1 | 0.6265 | 1 |
| Comfortability | Number of rooms | 0.3956 | 2 | 0.3500 | 2 | 0.2872 | 2 |
|                | Household size  | 0.6044 | 1 | 0.6500 | 1 | 0.7128 | 1 |

Table 4.44

*Aggregated weights for sub-indicators of poverty for hardcore poor category*

| Indicator       | Sub-Indicator    | $w_j^{obj}$ | Rank | $w_j^{sub}$ | Rank | Aggregated Weights | Rank |
|-----------------|------------------|-------------|------|-------------|------|--------------------|------|
| Marital Status  | Single           | 0.2556      | 3    | 0.2611      | 3    | 0.2008             | 3    |
|                 | Married          | 0.2595      | 2    | 0.4111      | 1    | 0.3210             | 2    |
|                 | Divorced         | 0.4849      | 1    | 0.3278      | 2    | 0.4782             | 1    |
| Education Level | No Schooling     | 0.2439      | 3    | 0.5208      | 1    | 0.5160             | 1    |
|                 | Primary          | 0.2354      | 4    | 0.2708      | 2    | 0.2589             | 2    |
|                 | Secondary        | 0.2745      | 1    | 0.1458      | 3    | 0.1626             | 3    |
|                 | Tertiary         | 0.2463      | 2    | 0.0625      | 4    | 0.0625             | 4    |
| Occupation      | Unemployment     | 0.2439      | 2    | 0.4208      | 1    | 0.4173             | 1    |
|                 | Self-employment  | 0.2354      | 3    | 0.2083      | 2    | 0.1994             | 2    |
|                 | Paid employment  | 0.2745      | 1    | 0.1042      | 3    | 0.1162             | 3    |
| Living Standard | Electricity      | 0.1347      | 5    | 0.3167      | 2    | 0.2352             | 2    |
|                 | Water resources  | 0.2030      | 2    | 0.3967      | 1    | 0.4439             | 1    |
|                 | Types of Toilets | 0.1548      | 3    | 0.0717      | 5    | 0.0612             | 5    |
|                 | Cooking Fuel     | 0.1498      | 4    | 0.1433      | 3    | 0.1184             | 4    |
|                 | Floor            | 0.3576      | 1    | 0.0717      | 4    | 0.1413             | 3    |

Table 4.44

*Continued*

|                |                 |        |   |        |   |        |   |
|----------------|-----------------|--------|---|--------|---|--------|---|
| Strata         | Urban           | 0.5144 | 1 | 0.2500 | 2 | 0.2609 | 2 |
|                | Rural           | 0.4856 | 2 | 0.7500 | 1 | 0.7391 | 1 |
| Residential    | Semi-D          | 0.1613 | 3 | 0.1100 | 4 | 0.0731 | 4 |
|                | Shop Lot        | 0.1567 | 4 | 0.1250 | 3 | 0.0807 | 3 |
|                | Bungalow        | 0.1502 | 5 | 0.0617 | 5 | 0.0382 | 5 |
|                | Terrace         | 0.1828 | 2 | 0.2967 | 2 | 0.2234 | 2 |
|                | Flat            | 0.3490 | 1 | 0.4067 | 1 | 0.5847 | 1 |
| Comfortability | Number of rooms | 0.3896 | 2 | 0.3500 | 2 | 0.2820 | 2 |
|                | Household size  | 0.6104 | 1 | 0.6500 | 1 | 0.7180 | 1 |

## **4.6 Development on Poverty Index**

The PI was calculated by using SAW method as in Equation 3.10 for poor and hardcore poor category. The greater the value of index, the higher its ranking will be for poverty in Kedah.

### **4.6.1 Poor Category**

Based on Table 4.45 it is shown that Bandar Baharu has the highest Marital Status Index value of 0.6144 which indicated that it has the highest poverty incidence, whereas Baling with an index value of 0.3418 shows that it is the province with the lowest poverty incidence in Kedah. While it is shown that Kuala Muda lies at the top of the Education Level Index and Pendang has the lowest poverty incidence in Kedah in terms of education level. For the Occupation Index, it is shown that Kuala Muda with records the highest poverty incidence whereas Pendang displayed the lowest poverty incidence in Kedah.

Moreover, Sik (0.7836) has the highest Living Standard Index and Bandar Baharu (0.0628) has the lowest Living Standard Index in Kedah. Furthermore, it is shown that Baling (0.8167) has the highest Strata Index and Langkawi (0.1541) has the lowest Strata Index in Kedah. While it is shown that Kuala Muda has the highest Residential Index with a value of 0.6488 and Baling was the lowest Residential Index with a value of 0.0539 in Kedah. Kubang Pasu has the highest Comfortability Index with a value of 0.9999 and Baling with a value of 0.7138 has the lowest Comfortability Index in Kedah.

Table 4.45

*Sub PI for poor category by district in Kedah*

| No | Districts     | Marital<br>Status<br>Index | Highest<br>Education<br>Index | Income<br>Index | Living<br>Standard<br>Index | Strata<br>Index | Residential<br>Index | Comfortability<br>Index |
|----|---------------|----------------------------|-------------------------------|-----------------|-----------------------------|-----------------|----------------------|-------------------------|
| 1  | Baling        | <b>0.3418</b>              | 0.5916                        | 0.3888          | 0.6677                      | <b>0.8167</b>   | 0.0539               | <b>0.7138</b>           |
| 2  | Bandar Baharu | <b>0.6144</b>              | 0.3199                        | 0.4287          | <b>0.0628</b>               | 0.2040          | 0.2098               | 0.9043                  |
| 3  | Kota Setar    | 0.3920                     | 0.5354                        | 0.4824          | 0.3875                      | 0.5645          | 0.1428               | 0.8574                  |
| 4  | Kuala Muda    | 0.5238                     | <b>0.8219</b>                 | <b>0.7207</b>   | 0.6592                      | 0.7775          | 0.2047               | 0.9043                  |
| 5  | Kubang Pasu   | 0.3653                     | 0.6328                        | 0.4713          | 0.5285                      | 0.8094          | <b>0.0469</b>        | <b>1.0000</b>           |
| 6  | Kulim         | 0.3758                     | 0.3029                        | 0.3908          | 0.1648                      | 0.2867          | 0.1213               | 0.9043                  |
| 7  | Langkawi      | 0.5052                     | 0.3533                        | 0.3152          | 0.2170                      | <b>0.1541</b>   | 0.1603               | 0.9043                  |
| 8  | Padang Terap  | 0.3539                     | 0.5070                        | 0.2921          | 0.2078                      | 0.4749          | <b>0.3424</b>        | 0.8574                  |
| 9  | Pendang       | 0.3567                     | <b>0.3022</b>                 | <b>0.2794</b>   | 0.1460                      | 0.4851          | 0.1796               | 0.8574                  |
| 10 | Pokok Sena    | 0.4691                     | 0.3031                        | 0.3405          | 0.1091                      | 0.3115          | 0.1875               | 0.8574                  |
| 11 | Sik           | 0.3760                     | 0.7354                        | 0.3862          | <b>0.7836</b>               | 0.7479          | 0.0989               | 0.8574                  |
| 12 | Yan           | 0.3799                     | 0.3377                        | 0.2936          | 0.1713                      | 0.3282          | 0.1793               | 0.8574                  |



Next, Table 4.46 shows a PI for poor category by districts in Kedah.

Table 4.46

*PI for poor category by districts in Kedah*

| Rank | Districts     | Poverty Index |
|------|---------------|---------------|
| 1    | Kuala Muda    | 0.7128        |
| 2    | Kubang Pasu   | 0.5576        |
| 3    | Sik           | 0.5474        |
| 4    | Baling        | 0.5107        |
| 5    | Kota Setar    | 0.4969        |
| 6    | Bandar Baharu | 0.3958        |
| 7    | Padang Terap  | 0.3906        |
| 8    | Kulim         | 0.3640        |
| 9    | Pokok Sena    | 0.3549        |
| 10   | Langkawi      | 0.3461        |
| 11   | Pendang       | 0.3434        |
| 12   | Yan           | 0.3376        |

Based on Table 4.46, it is seen that Kuala Muda has the highest PI with a value 0.7128 and Yan has the lowest with a value of 0.3376 in Kedah. Kuala Muda is known as a fishing community in Kedah and its proximity to the sea, it has a higher prevalence of poverty than the other districts. As a result, the PI of Kuala Muda's that has been created has been impacted by this aspect of occupation and residential. While Yan has many tourism and recreation areas such as Tanjung Dawai and Gunung Jerai that could attract tourists and bring in more visitors while enhancing Yan's revenue and growing the economy. This might have impacted Yan's PI.

#### 4.6.2 Hardcore Poor Category

Table 4.47

*Sub PI for hardcore poor category by district in Kedah*

| No | Districts            | Marital<br>Status Index | Higher<br>Education Index | Income<br>Index | Living<br>Standard Index | Strata Index  | Residential<br>Index | Comfortability<br>Index |
|----|----------------------|-------------------------|---------------------------|-----------------|--------------------------|---------------|----------------------|-------------------------|
| 1  | Baling               | 0.3828                  | 0.6102                    | 0.4525          | <b>0.8443</b>            | 0.7254        | 0.0729               | 0.7863                  |
| 2  | Bandar<br>Baharu     | <b>0.5714</b>           | 0.3106                    | 0.4653          | 0.0706                   | 0.3488        | 0.2346               | 0.7863                  |
| 3  | Kota Setar           | 0.5228                  | 0.6264                    | 0.6342          | 0.3638                   | 0.5059        | 0.3467               | <b>0.9060</b>           |
| 4  | Kuala Muda           | 0.5490                  | 0.6081                    | <b>0.6605</b>   | 0.4339                   | 0.5075        | <b>0.6207</b>        | 0.7863                  |
| 5  | Kubang Pasu          | 0.4550                  | 0.5807                    | 0.5250          | 0.4011                   | 0.6761        | 0.0733               | 0.7863                  |
| 6  | Kulim                | 0.3748                  | 0.2694                    | 0.3421          | 0.1542                   | 0.2107        | 0.1539               | <b>0.9060</b>           |
| 7  | Langkawi             | 0.5128                  | 0.3506                    | 0.4289          | 0.1371                   | 0.1110        | 0.2628               | 0.7863                  |
| 8  | Padang Terap         | 0.3468                  | 0.4326                    | 0.3057          | 0.1823                   | 0.5408        | 0.3773               | 0.7863                  |
| 9  | Pendang              | 0.3366                  | 0.3112                    | 0.2791          | 0.2027                   | 0.4847        | 0.1492               | 0.8803                  |
| 10 | Pokok Sena           | 0.3273                  | 0.3031                    | 0.2933          | 0.1457                   | 0.4186        | 0.1578               | <b>0.9060</b>           |
| 11 | Sik                  | 0.4345                  | <b>0.8042</b>             | 0.5000          | 0.8243                   | <b>0.7783</b> | 0.1182               | 0.7863                  |
| 12 | Yan                  | 0.3311                  | 0.2765                    | 0.3207          | 0.1758                   | 0.3625        | 0.1718               | 0.7863                  |
|    | Aggregated<br>Weight | 0.1321                  | 0.1713                    | 0.3923          | 0.0780                   | 0.1432        | 0.0254               | 0.0578                  |

Table 4.48

*PI for hardcore poor category by district in Kedah*

| No | Districts     | Poverty Index |
|----|---------------|---------------|
| 1  | Sik           | <b>0.6155</b> |
| 2  | Kuala Muda    | 0.6034        |
| 3  | Kota Setar    | 0.5871        |
| 4  | Baling        | 0.5496        |
| 5  | Kubang Pasu   | 0.5409        |
| 6  | Bandar Baharu | 0.4180        |
| 7  | Padang Terap  | 0.3865        |
| 8  | Langkawi      | 0.3747        |
| 9  | Pendang       | 0.3471        |
| 10 | Pokok Sena    | 0.3378        |
| 11 | Yan           | 0.3323        |
| 12 | Kulim         | 0.3283        |

Table 4.47 shows the sub PI for hardcore poor category in Kedah. Bandar Baharu has the highest Marital Status Index value of 0.5714 while Pokok Sena has the lowest Marital Status Index in Kedah, with an index value of 0.3273. In terms of education level, Sik has the highest Education Level Index, whereas Kulim has the lowest Education Level Index in Kedah. Kuala Muda also records the highest Occupation Index, while Pendang displays the lowest Occupation Index. Baling has the highest Living Standard Index of 0.8443, whereas Bandar Baharu has the lowest Living Standard Index of 0.0706 in Kedah. Sik has the highest Strata Index of 0.7783, while Langkawi has the lowest Strata Index of 0.1110 in Kedah. Kuala Muda has the highest Residential Index with a value of 0.6207, and Baling has the lowest Residential Index with a value of 0.0729 in Kedah. Finally, Kota Setar, Kulim and Pokok Sena have the highest Comfortability Index.

## 4.7 Beta Regression Modelling

This study applied the beta regression analysis to the PI as a response variable.

### 4.7.1 Poor Category

Coefficients of the beta regression and their standard errors as seen in Table 4.49 includes the significance of the independent variables  $x_1 - x_7$ .

Table 4.49

*Beta regression coefficients for poor category*

| Parameter | Estimate | Std. error | Z stat | p-value      |
|-----------|----------|------------|--------|--------------|
| $x_1$     | 0.5763   | 0.0321     | 17.940 | 2e-16 ***    |
| $x_2$     | 0.8099   | 0.5388     | 15.030 | 2e-16 ***    |
| $x_3$     | 1.6032   | 0.03406    | 47.069 | 2e-16 ***    |
| $x_4$     | 0.2466   | 0.0350     | 7.050  | 1.78e-12 *** |
| $x_5$     | 0.5841   | 0.0206     | 28.316 | 2e-16 ***    |
| $x_6$     | 0.0520   | 0.0257     | 2.026  | 0.0428*      |
| $x_7$     | 0.1758   | 0.0361     | 4.866  | 1.14e-06***  |
| $\phi$    | -2.0280  | 0.03612    |        |              |

Signif. code: \*\*\*0.05

The values in Table 4.49 show that all covariates are statistically significant as the values are lower than the significant level of  $\alpha=0.05$ .

It can be observed that a positive relationship exist between the mean response (PI) and the Marital Status Index ( $x_1$ ), Education Level Index ( $x_2$ ), Occupation Index ( $x_3$ ), Living Standard Index ( $x_4$ ), Strata Index ( $x_5$ ), Residential Index ( $x_6$ ) and Comfortability Index ( $x_7$ ).

For instance, the highest coefficient is associated with the Occupation Index ( $x_3$ ) with an estimated value of 1.6032. This suggests that, holding all other covariates constant, a one-unit increase in the Occupation Index is associated with a 1.6032 increase in the mean response (PI).

The beta regression model for poor category are as follows:

$$g(\mu) = -2.0280 + 0.5763x_1 + 0.8099x_2 + 1.6032x_3 + 0.2466x_4 + 0.5841x_5 \\ + 0.0520x_6 + 0.1758x_7$$

In terms of practical significance, the findings show that the seven independent variables have a significant impact on the mean response (PI) for the poor category. This information can be useful for policymakers and organizations working to improve poverty-related outcomes by identifying the key factors that are associated with poverty. The findings can inform future research and policy interventions aimed at reducing poverty and improving the well-being of individuals and communities.

#### **4.7.2 Hardcore Poor Category**

Similar to the previous category, the significance of the independent variables  $x_1 - x_7$  is included in the coefficients of the beta regression model and their standard errors as shown in Table 4.50.

Table 4.50

*Beta regression coefficients for hardcore poor category*

| Parameter | Estimate | Std. error | Z stat | p-value   |
|-----------|----------|------------|--------|-----------|
| $x_1$     | 0.6506   | 0.0148     | 43.91  | 2e-16 *** |
| $x_2$     | 0.7236   | 0.0095     | 76.39  | 2e-16 *** |
| $x_3$     | 1.5225   | 0.0127     | 120.12 | 2e-16 *** |
| $x_4$     | 0.3143   | 0.0049     | 64.36  | 2e-16 *** |
| $x_5$     | 0.6024   | 0.0053     | 114.19 | 2e-16 *** |
| $x_6$     | 0.1123   | 0.0042     | 27.02  | 2e-16 *** |
| $x_7$     | 0.2209   | 0.0104     | 21.14  | 2e-16 *** |
| $\phi$    | -2.0671  | 0.0112     |        |           |

Signif. code: \*\*\*0.05

The values in Table 4.50 show that all covariates are statistically significant obtaining a significant level of  $\alpha=0.05$ . This shows that all the indicators are important to the PI for hardcore poor category.

There is a positive relationship between the mean response (PI) and the Marital Status Index ( $x_1$ ), Education Level Index ( $x_2$ ), Occupation Index ( $x_3$ ), Living Standard Index ( $x_4$ ), Strata Index ( $x_5$ ), Residential Index ( $x_6$ ) and Comfortability Index ( $x_7$ ).

The beta regression model for hardcore poor category are as follows:

$$g(\mu) = -2.0671 + 0.6506x_1 + 0.7236x_2 + 1.5225x_3 + 0.3143x_4 + 0.6024x_5 \\ + 0.1123x_6 + 0.2209x_7$$

For instance, the Education Level Index ( $x_2$ ) has a coefficient of 0.7236, indicating that a one-unit increase in the index is associated with a 0.7236-unit increase in the mean response (PI), all other variables being held constant. Similarly, a one-unit increase in the Occupation Index ( $x_3$ ) is associated with a 1.5225-unit increase in the mean response.

Finally, the findings of this study have potential implications for future research or practical applications. The significant predictors identified in the beta regression model may guide the design of poverty reduction interventions targeting the hardcore poor. For example, policymakers may prioritize interventions that aim to improve education, occupation, and living standards, as these were identified as significant predictors of poverty in the hardcore poor category.

#### **4.8 Summary of the chapter**

The findings of this chapter are: a) the main indicator and the sub-indicators of the poverty in Kedah by all districts were defined, b) the aggregated weights were computed by combining the subjective experts' opinions and the objective data driven values c) PI was developed to rank the level of poverty for both the poor and the hardcore poor categories among the 12 districts, d) The relationship between the main indicators and Sub-indicators of PI were determined by using beta regression model.

## **CHAPTER FIVE**

### **CONCLUSION**

#### **5.1 Summary**

In general, this study has achieved all the objectives. The first objective was to compute the aggregated weights for the poverty indicators by aggregating subjective weights and objective weights. This study applied the ROC weighting method and CRITIC weighting method to achieve this. Seven indicators were considered in this study as the main indicators of poverty in Kedah. Overall, the aggregated weights show that the most important indicator that defines poverty in Kedah is the occupation, followed by education level, strata, marital status, living standard, comfortability and residential.

The second objective of this study was to develop a PI to rank the districts according to their PI values by using the Simple Additive Weighting method. Based on the results, the district that attained the highest PI for the poor category is Kuala Muda while district with the lowest PI for the poor category was Bandar Baharu. Meanwhile for the hardcore poor category, the district with the highest PI is Sik while the lowest PI district for hardcore poor category Bandar Baharu.

Lastly, the beta regression analysis was used to model the relationship between the main indicators and sub-indicators of PI. It is shown that there is a positive relationship between main indicators and sub-indicators of PI.

#### **5.2 Limitation of the Study**

Even though this study has accomplished all the set objectives, there are still a few



limitations that need to be considered. The main limitation within this study is lack of data. Several indicators must be taken into consideration to study poverty in developing nations and more precisely, Malaysia. Weights of the indicators might be less precise due to a lack of data.

Secondly, this study was conducted during the Covid-19 pandemic era. This leads to limited movement for data collection due to the Movement Controlled Order (MCO) implemented by Malaysia during the pandemic. A substantial amount of time was allocated for data collection which may have led to other important factors to be disregarded in this study.

### **5.3 Recommendation**

Based on the constraints observed and the conclusions of the study, it is recommended that for future research, more poverty indicators should be included in the study. This can be achieved by collecting more secondary data from DOSM.

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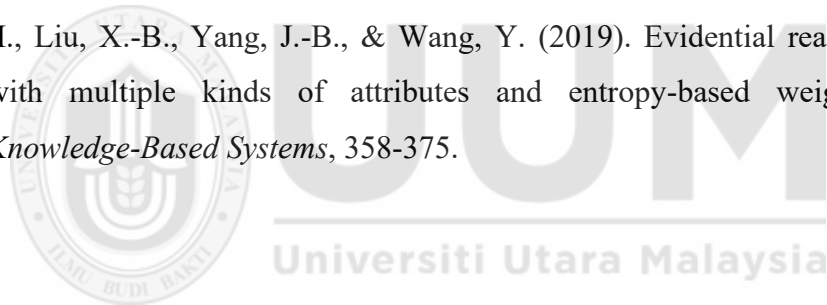
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## APPENDIX A

### Result of Critic Weighting Method Calculation

#### Poor Category

#### Indicator 2: Education Level

*Minimum and maximum value for no schooling, primary, secondary, and tertiary*

| No | Districts     | Education Level |         |           |          |
|----|---------------|-----------------|---------|-----------|----------|
|    |               | No Schooling    | Primary | Secondary | Tertiary |
| 1  | Baling        | 194             | 823     | 669       | 18       |
| 2  | Bandar Baharu | 54              | 143     | 154       | 6        |
| 3  | Kota Setar    | 205             | 626     | 889       | 57       |
| 4  | Kuala Muda    | 327             | 965     | 1190      | 47       |
| 5  | Kubang Pasu   | 256             | 673     | 876       | 46       |
| 6  | Kulim         | 78              | 288     | 298       | 13       |
| 7  | Langkawi      | 68              | 201     | 173       | 5        |
| 8  | Padang Terap  | 180             | 384     | 262       | 12       |
| 9  | Pendang       | 67              | 264     | 265       | 8        |
| 10 | Pokok Sena    | 79              | 189     | 237       | 10       |
| 11 | Sik           | 295             | 751     | 581       | 26       |
| 12 | Yan           | 82              | 280     | 286       | 6        |
|    | Minimum Value | 54              | 143     | 154       | 5        |
|    | Maximum Value | 327             | 965     | 1190      | 57       |

*Normalized decision matrix*

| Districts     | Education Level |         |           |          |
|---------------|-----------------|---------|-----------|----------|
|               | No Schooling    | Primary | Secondary | Tertiary |
| Baling        | 0.5128          | 0.8273  | 0.5029    | 0.7500   |
| Bandar Baharu | 0.0000          | 0.0000  | 1.0000    | 0.9808   |
| Kota Setar    | 0.5531          | 0.5876  | 0.2905    | 0.0000   |
| Kuala Muda    | 1.0000          | 1.0000  | 0.0000    | 0.1923   |
| Kubang Pasu   | 0.7399          | 0.6448  | 0.3031    | 0.2115   |
| Kulim         | 0.0879          | 0.1764  | 0.8610    | 0.8462   |
| Langkawi      | 0.0513          | 0.0706  | 0.9817    | 1.0000   |
| Padang Terap  | 0.4615          | 0.2932  | 0.8958    | 0.8654   |
| Pendang       | 0.0476          | 0.1472  | 0.8929    | 0.9423   |
| Pokok Sena    | 0.0916          | 0.0560  | 0.9199    | 0.9038   |
| Sik           | 0.8828          | 0.7397  | 0.5878    | 0.5962   |
| Yan           | 0.1026          | 0.1667  | 0.8726    | 0.9808   |

*Correlation of the sub-indicator in education level indicator*

| Indicator | Sub-indicator | Education Level |         |           |          |
|-----------|---------------|-----------------|---------|-----------|----------|
|           |               | No Schooling    | Primary | Secondary | Tertiary |
| Education | No Schooling  | 1               | 0.9357  | -0.8705   | -0.7857  |
|           | Primary       | 0.9357          | 1       | -0.9132   | -0.7585  |
|           | Secondary     | -0.8705         | -0.9132 | 1         | 0.9236   |
|           | Tertiary      | -0.7857         | -0.7585 | 0.9236    | 1        |

**Indicator 3: Occupation**

*Minimum and maximum value for unemployment, self-employment, and paid employment*

| District      | Occupation   |                 |                 |
|---------------|--------------|-----------------|-----------------|
|               | Unemployment | Self-employment | Paid employment |
| Baling        | 395          | 803             | 506             |
| Bandar Baharu | 119          | 113             | 125             |
| Kota Setar    | 501          | 643             | 633             |
| Kuala Muda    | 796          | 713             | 1020            |
| Kubang Pasu   | 495          | 811             | 545             |
| Kulim         | 214          | 156             | 307             |
| Langkawi      | 106          | 167             | 174             |
| Padang Terap  | 206          | 438             | 194             |
| Pendang       | 144          | 288             | 172             |
| Pokok Sena    | 160          | 230             | 125             |
| Sik           | 387          | 891             | 375             |
| Yan           | 170          | 305             | 179             |
| Minimum value | 106          | 113             | 125             |
| Maximum value | 796          | 891             | 1020            |

*Normalized decision matrix*

| <b>Districts</b> | <b>Occupation</b>   |                        |                        |
|------------------|---------------------|------------------------|------------------------|
|                  | <b>Unemployment</b> | <b>Self-employment</b> | <b>Paid employment</b> |
| Baling           | 0.4188              | 0.1131                 | 0.5743                 |
| Bandar Baharu    | 0.0188              | 1.0000                 | 1.0000                 |
| Kota Setar       | 0.5725              | 0.3188                 | 0.4324                 |
| Kuala Muda       | 1.0000              | 0.2288                 | 0.0000                 |
| Kubang Pasu      | 0.5638              | 0.1028                 | 0.5307                 |
| Kulim            | 0.1565              | 0.9447                 | 0.7966                 |
| Langkawi         | 0.0000              | 0.9306                 | 0.9453                 |
| Padang Terap     | 0.1449              | 0.5823                 | 0.9229                 |
| Pendang          | 0.0551              | 0.7751                 | 0.9475                 |
| Pokok Sena       | 0.0783              | 0.8496                 | 1.0000                 |
| Sik              | 0.4072              | 0.0000                 | 0.7207                 |
| Yan              | 0.0928              | 0.7532                 | 0.9397                 |

*Correlation of sub-indicator in occupation indicator*

| Indicator  | occupation      |              |                 |                 |
|------------|-----------------|--------------|-----------------|-----------------|
|            | Sub-indicator   | Unemployment | Self-employment | Paid employment |
| Occupation | Unemployment    | 1            | -0.7834         | -0.9832         |
|            | Self-employment | -0.7834      | 1               | 0.7016          |
|            | Paid employment | -0.9832      | 0.7016          | 1               |



**Indicator 4: Living Standard**

*Minimum and maximum value for electricity, water resources, types of toilets, cooking, and floor.*

| Districts     | Living Standard |                 |                  |              |       |
|---------------|-----------------|-----------------|------------------|--------------|-------|
|               | Electricity     | Water Resources | Types of toilets | Cooking Fuel | Floor |
| Baling        | 1               | 279             | 1553             | 37           | 814   |
| Bandar Baharu | 0               | 9               | 290              | 9            | 151   |
| Kota Setar    | 4               | 7               | 1543             | 50           | 949   |
| Kuala Muda    | 13              | 45              | 1691             | 76           | 884   |
| Kubang Pasu   | 10              | 27              | 1560             | 57           | 819   |
| Kulim         | 2               | 13              | 530              | 26           | 276   |
| Langkawi      | 5               | 18              | 397              | 25           | 215   |
| Padang Terap  | 3               | 10              | 794              | 25           | 376   |
| Pendang       | 1               | 21              | 572              | 16           | 293   |
| Pokok Sena    | 1               | 10              | 474              | 12           | 224   |
| Sik           | 11              | 214             | 1537             | 42           | 776   |
| Yan           | 1               | 29              | 593              | 19           | 346   |
| Minimum value | 0               | 7               | 290              | 9            | 151   |
| Maximum value | 13              | 279             | 1691             | 76           | 949   |

*Normalized decision matrix*

| Districts     | Living Standard |                 |                  |              |        |
|---------------|-----------------|-----------------|------------------|--------------|--------|
|               | Electricity     | Water Resources | Types of toilets | Cooking Fuel | Floor  |
| Baling        | 0.0769          | 1.0000          | 0.9015           | 0.4179       | 0.1692 |
| Bandar Baharu | 0.0000          | 0.0074          | 0.0000           | 0.0000       | 1.0000 |
| Kota Setar    | 0.3077          | 0.0000          | 0.8944           | 0.6119       | 0.0000 |
| Kuala Muda    | 1.0000          | 0.1397          | 1.0000           | 1.0000       | 0.0815 |
| Kubang Pasu   | 0.7692          | 0.0735          | 0.9065           | 0.7164       | 0.1629 |
| Kulim         | 0.1538          | 0.0221          | 0.1713           | 0.2537       | 0.8434 |
| Langkawi      | 0.3846          | 0.0404          | 0.0764           | 0.2388       | 0.9198 |
| Padang Terap  | 0.2308          | 0.0110          | 0.3597           | 0.2388       | 0.7180 |
| Pendang       | 0.0769          | 0.0515          | 0.2013           | 0.1045       | 0.8221 |
| Pokok Sena    | 0.0769          | 0.0110          | 0.1313           | 0.0448       | 0.9085 |
| Sik           | 0.8462          | 0.7610          | 0.8901           | 0.4925       | 0.2168 |
| Yan           | 0.0769          | 0.0809          | 0.2163           | 0.1493       | 0.7556 |

*Correlation of sub-indicator in living standard indicator*

|                 |                  | Living Standard |                 |                  |              |         |
|-----------------|------------------|-----------------|-----------------|------------------|--------------|---------|
|                 |                  | Electricity     | Water Resources | Types of toilets | Cooking Fuel | Floor   |
| Living Standard | Electricity      | 1               | 0.1715          | 0.6995           | 0.8488       | -0.6528 |
|                 | Water Resources  | 0.1715          | 1               | 0.5312           | 0.2169       | -0.4747 |
|                 | Types of toilets | 0.6995          | 0.5312          | 1                | 0.8893       | -0.9892 |
|                 | Cooking Fuel     | 0.8488          | 0.2169          | 0.8893           | 1            | -0.8836 |
|                 | Floor            | -0.6528         | -0.4747         | -0.9892          | -0.8836      | 1       |
|                 |                  |                 |                 |                  |              |         |

**Indicator 5: Strata**

*Minimum and maximum value for urban and rural*

| Districts     | Strata |       |
|---------------|--------|-------|
|               | Urban  | Rural |
| Baling        | 62     | 1642  |
| Bandar Baharu | 44     | 313   |
| Kota Setar    | 593    | 1184  |
| Kuala Muda    | 892    | 1637  |
| Kubang Pasu   | 171    | 1680  |
| Kulim         | 116    | 561   |
| Langkawi      | 155    | 292   |
| Padang Terap  | 27     | 811   |
| Pendang       | 12     | 592   |
| Pokok Sena    | 30     | 485   |
| Sik           | 117    | 1536  |
| Yan           | 55     | 599   |
| Minimum value | 12     | 292   |
| Maximum value | 892    | 1680  |

*Normalized decision matrix*

| No | Districts     | Strata |        |
|----|---------------|--------|--------|
|    |               | Urban  | Rural  |
| 1  | Baling        | 0.9432 | 0.9726 |
| 2  | Bandar Baharu | 0.9636 | 0.0151 |
| 3  | Kota Setar    | 0.3398 | 0.6427 |
| 4  | Kuala Muda    | 0.0000 | 0.9690 |
| 5  | Kubang Pasu   | 0.8193 | 1.0000 |
| 6  | Kulim         | 0.8818 | 0.1938 |
| 7  | Langkawi      | 0.8375 | 0.0000 |
| 8  | Padang Terap  | 0.9830 | 0.3739 |
| 9  | Pendang       | 1.0000 | 0.2161 |
| 10 | Pokok Sena    | 0.9795 | 0.1390 |
| 11 | Sik           | 0.8807 | 0.8963 |
| 12 | Yan           | 0.9511 | 0.2212 |

*Correlation of sub-indicator in strata indicator*

| Indicator | Sub-indicator | Strata  |         |
|-----------|---------------|---------|---------|
|           |               | Urban   | Rural   |
| Strata    | Urban         | 1       | -0.4763 |
|           | Rural         | -0.4763 | 1       |

**Indicator 6: Residential**

*Minimum and maximum value for semi-D, shop lot, bungalow, terrace, flat*

| Districts     | Residential |          |          |         |      |
|---------------|-------------|----------|----------|---------|------|
|               | Semi-D      | Shop Lot | Bungalow | Terrace | Flat |
| Baling        | 54          | 3        | 1577     | 70      | 0    |
| Bandar Baharu | 6           | 1        | 301      | 49      | 0    |
| Kota Setar    | 62          | 2        | 1540     | 134     | 36   |
| Kuala Muda    | 86          | 10       | 1633     | 718     | 78   |
| Kubang Pasu   | 50          | 6        | 1681     | 108     | 4    |

Continued

|               |    |    |      |     |    |
|---------------|----|----|------|-----|----|
| Kulim         | 47 | 0  | 518  | 109 | 2  |
| Langkawi      | 18 | 4  | 411  | 11  | 0  |
| Padang Terap  | 6  | 1  | 824  | 5   | 0  |
| Pandang       | 8  | 2  | 579  | 14  | 0  |
| Pokok Sena    | 10 | 1  | 483  | 21  | 0  |
| Sik           | 25 | 6  | 1604 | 15  | 0  |
| Yan           | 16 | 2  | 625  | 10  | 1  |
| Minimum value | 6  | 0  | 301  | 5   | 0  |
| Maximum value | 86 | 10 | 1681 | 718 | 78 |

*Normalized decision matrix*

| Districts     | Residential |          |          |         |        |
|---------------|-------------|----------|----------|---------|--------|
|               | Semi-D      | Shop Lot | Bungalow | Terrace | Flat   |
| Baling        | 0.4000      | 0.7000   | 0.0754   | 0.9088  | 0.0000 |
| Bandar Baharu | 1.0000      | 0.9000   | 1.0000   | 0.9383  | 0.0000 |
| Kota Setar    | 0.3000      | 0.8000   | 0.1022   | 0.8191  | 0.4615 |
| Kuala Muda    | 0.0000      | 0.0000   | 0.0348   | 0.0000  | 1.0000 |
| Kubang Pasu   | 0.4500      | 0.4000   | 0.0000   | 0.8555  | 0.0513 |
| Kulim         | 0.4875      | 1.0000   | 0.8428   | 0.8541  | 0.0256 |
| Langkawi      | 0.8500      | 0.6000   | 0.9203   | 0.9916  | 0.0000 |
| Padang Terap  | 1.0000      | 0.9000   | 0.6210   | 1.0000  | 0.0000 |
| Pandang       | 0.9750      | 0.8000   | 0.7986   | 0.9874  | 0.0000 |
| Pokok Sena    | 0.9500      | 0.9000   | 0.8681   | 0.9776  | 0.0000 |
| Sik           | 0.7625      | 0.4000   | 0.0558   | 0.9860  | 0.0000 |
| Yan           | 0.8750      | 0.8000   | 0.7652   | 0.9930  | 0.0128 |

*Correlation of sub-indicator in residential indicator*

| Indicator   |               | Residential |          |          |         |         |
|-------------|---------------|-------------|----------|----------|---------|---------|
|             | Sub-indicator | Semi-D      | Shop Lot | Bungalow | Terrace | Flat    |
| Residential | Semi-D        | 1.0000      | 0.6039   | 0.7393   | 0.7746  | -0.7707 |
|             | Shop Lot      | 0.6039      | 1.0000   | 0.6790   | 0.7244  | -0.6574 |
|             | Bungalow      | 0.7393      | 0.6790   | 1.0000   | 0.4521  | -0.4903 |
|             | Terrace       | 0.7746      | 0.7244   | 0.4521   | 1.0000  | -0.9430 |
|             | Flat          | -0.7707     | -0.6574  | -0.4903  | -0.9430 | 1.0000  |

**Indicator 7: Comfortability***Minimum and maximum value for number of room(s) and household size*

| Districts     | Comfortability    |                |
|---------------|-------------------|----------------|
|               | Number of room(s) | Household size |
| Baling        | 4                 | 4              |
| Bandar Baharu | 3                 | 5              |
| Kota Setar    | 2                 | 4              |
| Kuala Muda    | 3                 | 5              |
| Kubang Pasu   | 2                 | 5              |
| Kulim         | 3                 | 5              |
| Langkawi      | 3                 | 5              |
| Padang Terap  | 2                 | 4              |
| Pendang       | 2                 | 4              |
| Pokok Sena    | 2                 | 4              |
| Sik           | 2                 | 4              |
| Yan           | 2                 | 4              |
| Minimum value | 2                 | 4              |
| Maximum value | 4                 | 5              |

*Normalized decision matrix*

| Districts     | Comfortability  |                |
|---------------|-----------------|----------------|
|               | Number of rooms | Household size |
| Baling        | 0.0000          | 0.0000         |
| Bandar Baharu | 0.5000          | 1.0000         |
| Kota Setar    | 1.0000          | 0.0000         |
| Kuala Muda    | 0.5000          | 1.0000         |
| Kubang Pasu   | 1.0000          | 1.0000         |
| Kulim         | 0.5000          | 1.0000         |
| Langkawi      | 0.5000          | 1.0000         |
| Padang Terap  | 1.0000          | 0.0000         |
| Pendang       | 1.0000          | 0.0000         |
| Pokok Sena    | 1.0000          | 0.0000         |
| Sik           | 1.0000          | 0.0000         |
| Yan           | 1.0000          | 0.0000         |

*Correlation of sub-indicator in comfortability indicator*

| <b>Indicator</b> | <b>Sub-indicator</b> | <b>Comfortability</b>  |                       |
|------------------|----------------------|------------------------|-----------------------|
|                  |                      | <b>Number of rooms</b> | <b>Household size</b> |
| Comfortability   | Number of rooms      | 1                      | -0.3928               |
|                  | Household size       | -0.3928                | 1                     |



### Hardcore poor category

#### Indicator 2: Education Level

Minimum and maximum value for no schooling, primary, secondary, and tertiary

| No | Districts     | Education Level |         |           |          |
|----|---------------|-----------------|---------|-----------|----------|
|    |               | No Schooling    | Primary | Secondary | Tertiary |
| 1  | Baling        | 262             | 1011    | 819       | 22       |
| 2  | Bandar Baharu | 49              | 122     | 140       | 5        |
| 3  | Kota Setar    | 317             | 850     | 1285      | 66       |
| 4  | Kuala Muda    | 301             | 854     | 1277      | 50       |
| 5  | Kubang Pasu   | 312             | 672     | 1226      | 64       |
| 6  | Kulim         | 78              | 242     | 320       | 7        |
| 7  | Langkawi      | 82              | 187     | 135       | 8        |
| 8  | Padang Terap  | 203             | 437     | 482       | 13       |
| 9  | Pendang       | 130             | 355     | 484       | 19       |
| 10 | Pokok Sena    | 129             | 282     | 406       | 18       |
| 11 | Sik           | 396             | 1149    | 1021      | 40       |
| 12 | Yan           | 110             | 325     | 516       | 18       |
|    | Minimum Value | 49              | 122     | 135       | 5        |
|    | Maximum Value | 396             | 1149    | 1285      | 66       |

*Normalized decision matrix*

| Districts     | Education Level |         |           |          |
|---------------|-----------------|---------|-----------|----------|
|               | No Schooling    | Primary | Secondary | Tertiary |
| Baling        | 0.6138          | 0.8656  | 0.4052    | 0.7213   |
| Bandar Baharu | 0.0000          | 0.0000  | 0.9957    | 1.0000   |
| Kota Setar    | 0.7723          | 0.7089  | 0.0000    | 0.0000   |
| Kuala Muda    | 0.7262          | 0.7128  | 0.0070    | 0.2623   |
| Kubang Pasu   | 0.7579          | 0.5355  | 0.0513    | 0.0328   |
| Kulim         | 0.0836          | 0.1168  | 0.8391    | 0.9672   |
| Langkawi      | 0.0951          | 0.0633  | 1.0000    | 0.9508   |
| Padang Terap  | 0.4438          | 0.3067  | 0.6983    | 0.8689   |
| Pendang       | 0.2334          | 0.2269  | 0.6965    | 0.7705   |
| Pokok Sena    | 0.2305          | 0.1558  | 0.7643    | 0.7869   |
| Sik           | 1.0000          | 1.0000  | 0.2296    | 0.4262   |
| Yan           | 0.1758          | 0.1977  | 0.6687    | 0.7869   |

*Correlation of the sub-indicator in education level indicator*

| Indicator | Sub-indicator | Education Level |         |           |          |
|-----------|---------------|-----------------|---------|-----------|----------|
|           |               | No Schooling    | Primary | Secondary | Tertiary |
| Education | No Schooling  | 1               | 0.9448  | -0.9145   | -0.8313  |
|           | Primary       | 0.9448          | 1       | -0.8455   | -0.6965  |
|           | Secondary     | -0.9145         | -0.8455 | 1         | 0.9510   |
|           | Tertiary      | -0.8313         | -0.6965 | 0.9510    | 1        |

**Indicator 3: Occupation**

*Minimum and maximum value for unemployment, self-employment, and paid employment*

| District      | Occupation   |                 |                 |
|---------------|--------------|-----------------|-----------------|
|               | Unemployment | Self-employment | Paid employment |
| Baling        | 583          | 1069            | 462             |
| Bandar Baharu | 108          | 110             | 98              |
| Kota Setar    | 857          | 935             | 726             |
| Kuala Muda    | 890          | 807             | 785             |
| Kubang Pasu   | 694          | 1004            | 576             |
| Kulim         | 217          | 214             | 216             |
| Langkawi      | 158          | 134             | 120             |
| Padang Terap  | 286          | 664             | 185             |
| Pendang       | 249          | 489             | 250             |
| Pokok Sena    | 232          | 409             | 194             |
| Sik           | 662          | 1506            | 438             |
| Yan           | 296          | 426             | 247             |
| Minimum value | 108          | 110             | 98              |
| Maximum value | 890          | 1506            | 785             |



*Normalized decision matrix*

| District      | Occupation   |                 |                 |
|---------------|--------------|-----------------|-----------------|
|               | Unemployment | Self-employment | Paid employment |
| Baling        | 0.6074       | 0.3130          | 0.4702          |
| Bandar Baharu | 0.0000       | 1.0000          | 1.0000          |
| Kota Setar    | 0.9578       | 0.4090          | 0.0859          |
| Kuala Muda    | 1.0000       | 0.5007          | 0.0000          |
| Kubang Pasu   | 0.7494       | 0.3596          | 0.3042          |
| Kulim         | 0.1394       | 0.9255          | 0.8282          |
| Langkawi      | 0.0639       | 0.9828          | 0.9680          |
| Padang Terap  | 0.2276       | 0.6032          | 0.8734          |
| Pendang       | 0.1803       | 0.7285          | 0.7787          |
| Pokok Sena    | 0.1586       | 0.7858          | 0.8603          |
| Sik           | 0.7084       | 0.0000          | 0.5051          |
| Yan           | 0.2404       | 0.7736          | 0.7831          |

*Correlation of sub-indicator in occupation indicator*

| Indicator  | Occupation      |              |                 |
|------------|-----------------|--------------|-----------------|
|            | Sub-indicator   | Unemployment | Paid employment |
| Occupation | Unemployment    | 1            | -0.7990         |
|            | Self-employment | -0.7990      | 1               |
|            | Paid employment | -0.9825      | 0.6907          |

#### Indicator 4: Living Standard

*Minimum and maximum value for electricity, water resources, types of toilets, cooking, and floor.*

| Districts     | Living Standard |                 |                  |              |       |
|---------------|-----------------|-----------------|------------------|--------------|-------|
|               | Electricity     | Water Resources | Types of toilets | Cooking Fuel | Floor |
| Baling        | 12              | 474             | 1975             | 33           | 1006  |
| Bandar Baharu | 3               | 13              | 252              | 6            | 162   |
| Kota Setar    | 13              | 23              | 2223             | 68           | 1370  |
| Kuala Muda    | 22              | 54              | 1726             | 72           | 882   |
| Kubang Pasu   | 19              | 32              | 1980             | 66           | 1066  |
| Kulim         | 8               | 23              | 484              | 19           | 283   |
| Langkawi      | 8               | 20              | 345              | 21           | 185   |
| Padang Terap  | 7               | 26              | 1079             | 28           | 478   |
| Pendang       | 8               | 39              | 915              | 29           | 463   |
| Pokok Sena    | 5               | 28              | 785              | 21           | 380   |
| Sik           | 10              | 450             | 2421             | 43           | 1187  |
| Yan           | 4               | 45              | 846              | 23           | 565   |
| Minimum value | 3               | 13              | 252              | 6            | 162   |
| Maximum value | 22              | 474             | 2421             | 72           | 1370  |

*Normalized decision matrix*

| Districts     | Living Standard |                 |                  |              |        |
|---------------|-----------------|-----------------|------------------|--------------|--------|
|               | Electricity     | Water Resources | Types of toilets | Cooking Fuel | Floor  |
| Baling        | 0.4737          | 1.0000          | 0.7944           | 0.4091       | 0.3013 |
| Bandar Baharu | 0.0000          | 0.0000          | 0.0000           | 0.0000       | 1.0000 |
| Kota Setar    | 0.5263          | 0.0217          | 0.9087           | 0.9394       | 0.0000 |
| Kuala Muda    | 1.0000          | 0.0889          | 0.6796           | 1.0000       | 0.4040 |
| Kubang Pasu   | 0.8421          | 0.0412          | 0.7967           | 0.9091       | 0.2517 |
| Kulim         | 0.2632          | 0.0217          | 0.1070           | 0.1970       | 0.8998 |
| Langkawi      | 0.2632          | 0.0152          | 0.0429           | 0.2273       | 0.9810 |
| Padang Terap  | 0.2105          | 0.0282          | 0.3813           | 0.3333       | 0.7384 |
| Pendang       | 0.2632          | 0.0564          | 0.3057           | 0.3485       | 0.7508 |
| Pokok Sena    | 0.1053          | 0.0325          | 0.2457           | 0.2273       | 0.8195 |
| Sik           | 0.3684          | 0.9479          | 1.0000           | 0.5606       | 0.1515 |
| Yan           | 0.0526          | 0.0694          | 0.2739           | 0.2576       | 0.6664 |

*Correlation of sub-indicator in living standard indicator*

|                 |                  | Living Standard |                 |                  |              |         |
|-----------------|------------------|-----------------|-----------------|------------------|--------------|---------|
|                 |                  | Electricity     | Water Resources | Types of toilets | Cooking Fuel | Floor   |
| Living Standard | Electricity      | 1               | 0.1223          | 0.6708           | 0.9075       | -0.6533 |
|                 | Water Resources  | 0.1223          | 1               | 0.5895           | 0.0771       | -0.4977 |
|                 | Types of toilets | 0.6708          | 0.5895          | 1                | 0.8072       | -0.9801 |
|                 | Cooking Fuel     | 0.9075          | 0.0771          | 0.8072           | 1            | -0.8305 |
|                 | Floor            | -0.6533         | -0.4977         | -0.9801          | -0.8305      | 1       |
|                 |                  |                 |                 |                  |              |         |

**Indicator 5: Strata**

*Minimum and maximum value for urban and rural sub-indicators*

| Districts     | Strata |       |
|---------------|--------|-------|
|               | Urban  | Rural |
| Baling        | 75     | 2039  |
| Bandar Baharu | 29     | 287   |
| Kota Setar    | 894    | 1624  |
| Kuala Muda    | 854    | 1628  |
| Kubang Pasu   | 194    | 2080  |
| Kulim         | 138    | 509   |
| Langkawi      | 184    | 228   |
| Padang Terap  | 37     | 1098  |
| Pendang       | 39     | 949   |
| Pokok Sena    | 43     | 792   |
| Sik           | 193    | 2413  |
| Yan           | 83     | 886   |
| Minimum value | 29     | 228   |
| Maximum value | 894    | 2413  |

*Normalized decision matrix*

| No | Districts     | Strata |        |
|----|---------------|--------|--------|
|    |               | Urban  | Rural  |
| 1  | Baling        | 0.9468 | 0.8288 |
| 2  | Bandar Baharu | 1.0000 | 0.0270 |
| 3  | Kota Setar    | 0.0000 | 0.6389 |
| 4  | Kuala Muda    | 0.0462 | 0.6407 |
| 5  | Kubang Pasu   | 0.8092 | 0.8476 |
| 6  | Kulim         | 0.8740 | 0.1286 |
| 7  | Langkawi      | 0.8208 | 0.0000 |
| 8  | Padang Terap  | 0.9908 | 0.3982 |
| 9  | Pendang       | 0.9884 | 0.3300 |
| 10 | Pokok Sena    | 0.9838 | 0.2581 |
| 11 | Sik           | 0.8104 | 1.0000 |
| 12 | Yan           | 0.9376 | 0.3011 |

*Correlation of sub-indicator in strata indicator*

| Indicator | Sub-indicator | Strata  |         |
|-----------|---------------|---------|---------|
|           |               | Urban   | Rural   |
| Strata    | Urban         | 1       | -0.3327 |
|           | Rural         | -0.3327 | 1       |

**Indicator 6: Residential**

*Minimum and maximum value for semi-D, shop lot, bungalow, terrace, flat*

| Districts     | Residential |          |          |         |      |
|---------------|-------------|----------|----------|---------|------|
|               | Semi-D      | Shop Lot | Bungalow | Terrace | Flat |
| Baling        | 60          | 5        | 1992     | 54      | 3    |
| Bandar Baharu | 12          | 0        | 274      | 30      | 0    |
| Kota Setar    | 126         | 9        | 2152     | 172     | 59   |
| Kuala Muda    | 115         | 4        | 1646     | 609     | 108  |
| Kubang Pasu   | 75          | 3        | 2051     | 141     | 4    |
| Kulim         | 43          | 1        | 479      | 120     | 4    |
| Langkawi      | 15          | 1        | 379      | 14      | 3    |
| Padang Terap  | 15          | 1        | 1113     | 5       | 1    |
| Pendang       | 29          | 2        | 939      | 18      | 0    |
| Pokok Sena    | 27          | 3        | 790      | 14      | 1    |
| Sik           | 44          | 9        | 2539     | 14      | 0    |
| Yan           | 28          | 1        | 913      | 26      | 1    |
| Minimum value | 12          | 0        | 274      | 5       | 0    |
| Maximum value | 126         | 9        | 2539     | 609     | 108  |

*Normalized decision matrix*

| Districts     | Residential |          |          |         |        |
|---------------|-------------|----------|----------|---------|--------|
|               | Semi-D      | Shop Lot | Bungalow | Terrace | Flat   |
| Baling        | 0.5789      | 0.4444   | 0.2415   | 0.9189  | 0.0278 |
| Bandar Baharu | 1.0000      | 1.0000   | 1.0000   | 0.9586  | 0.0000 |
| Kota Setar    | 0.0000      | 0.0000   | 0.1709   | 0.7235  | 0.5463 |
| Kuala Muda    | 0.0965      | 0.5556   | 0.3943   | 0.0000  | 1.0000 |
| Kubang Pasu   | 0.4474      | 0.6667   | 0.2155   | 0.7748  | 0.0370 |
| Kulim         | 0.7281      | 0.8889   | 0.9095   | 0.8096  | 0.0370 |
| Langkawi      | 0.9737      | 0.8889   | 0.9536   | 0.9851  | 0.0278 |
| Padang Terap  | 0.9737      | 0.8889   | 0.6296   | 1.0000  | 0.0093 |
| Pendang       | 0.8509      | 0.7778   | 0.7064   | 0.9785  | 0.0000 |
| Pokok Sena    | 0.8684      | 0.6667   | 0.7722   | 0.9851  | 0.0093 |
| Sik           | 0.7193      | 0.0000   | 0.0000   | 0.9851  | 0.0000 |
| Yan           | 0.8596      | 0.8889   | 0.7179   | 0.9652  | 0.0093 |

*Correlation of sub-indicator in residential indicator*

| Indicator   | Residential   |         |          |          |         |         |
|-------------|---------------|---------|----------|----------|---------|---------|
|             | Sub-indicator | Semi-D  | Shop Lot | Bungalow | Terrace | Flat    |
| Residential | Semi-D        | 1       | 0.6543   | 0.6651   | 0.7527  | -0.8198 |
|             | Shop Lot      | 0.6543  | 1        | 0.8658   | 0.1917  | -0.3591 |
|             | Bungalow      | 0.6651  | 0.8658   | 1        | 0.2669  | -0.3182 |
|             | Terrace       | 0.7527  | 0.1917   | 0.2669   | 1       | -0.9352 |
|             | Flat          | -0.8198 | -0.3591  | -0.3182  | -0.9352 | 1       |

**Indicator 7: Comfortability**

*Minimum and maximum value for number of room(s) and household size*

| Districts     | Comfortability    |                |
|---------------|-------------------|----------------|
|               | Number of room(s) | Household size |
| Baling        | 3                 | 5              |
| Bandar Baharu | 3                 | 5              |
| Kota Setar    | 3                 | 6              |
| Kuala Muda    | 3                 | 5              |
| Kubang Pasu   | 3                 | 5              |
| Kulim         | 3                 | 6              |
| Langkawi      | 3                 | 5              |
| Padang Terap  | 3                 | 5              |
| Pendang       | 2                 | 5              |
| Pokok Sena    | 3                 | 6              |

Continued

|               |   |   |
|---------------|---|---|
| Sik           | 3 | 5 |
| Yan           | 3 | 5 |
| Minimum value | 2 | 5 |
| Maximum value | 3 | 6 |

Normalized decision matrix

| Districts     | Comfortability  |                |
|---------------|-----------------|----------------|
|               | Number of rooms | Household size |
| Baling        | 0.0000          | 0.0000         |
| Bandar Baharu | 0.0000          | 0.0000         |
| Kota Setar    | 0.0000          | 1.0000         |
| Kuala Muda    | 0.0000          | 0.0000         |
| Kubang Pasu   | 0.0000          | 0.0000         |
| Kulim         | 0.0000          | 1.0000         |
| Langkawi      | 0.0000          | 0.0000         |
| Padang Terap  | 0.0000          | 0.0000         |
| Pendang       | 1.0000          | 0.0000         |
| Pokok Sena    | 0.0000          | 1.0000         |
| Sik           | 0.0000          | 0.0000         |
| Yan           | 0.0000          | 0.0000         |

Correlation of sub-indicator in comfortability indicator

| Indicator      | Comfortability  |                 |                |
|----------------|-----------------|-----------------|----------------|
|                | Sub-indicator   | Number of rooms | Household size |
| Comfortability | Number of rooms | 1               | -0.1741        |
|                | Household size  | -0.1741         | 1              |

## APPENDIX B

### Questionnaire through jotform.com

English (US)

### The level of importance of poverty indicators in Kedah

Notes: You can change to your preferred language at the top right corner

Dear sir/madam,

I am Nuril Asyikin Binti Mohamad, a master's student (Matric Number: 826270) in Statistics at School of Quantitative Sciences, Universiti Utara Malaysia.

Currently, I am conducting a research under the supervision of Prof. Dr. Maznah Binti Mat Kasim and Dr. Nor Hasliza Binti Mat Desa.

In order to complete my research, the following questionnaire have been designed to determine the level of importance of poverty indicators in Kedah.

Therefore, you are cordially invited to answer the questions in both sections. Please note that all information is strictly used for the purpose of research and will be kept as private and confidential.

Your co-operation to fill up this survey is highly appreciated.

---

**Personal Information:**

Organization \*

Work Experience \*

Level of Education \*

E-mail \*

example@example.com

**SECTION B**

For this section, respondents are required to prioritize each of the dimension that affects the poverty in Kedah according to their importance.

**DIMENSION**

Instruction:

please rank the following dimension in order of importance towards poverty, with

1: the most important dimension towards poverty

7: the least important dimension towards poverty

**Marital Status \***

Please enter the rank between 1-7

**Highest Education \***

Please enter the rank between 1-7

**Income \***

Please enter the rank between 1-7

**Living Standard \***

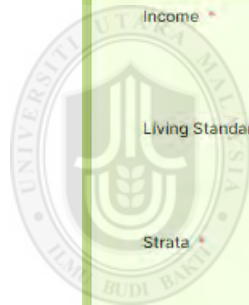
Please enter the rank between 1-7

**Strata \***

Please enter the rank between 1-7

**Residential (type of occupied dwelling) \***

Please enter the rank between 1-7



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Comfortability \*

ex: 1

Please enter the rank between 1-7

Additional notes\*\*

Marital Status

Single, Married, Divorced

Highest Education

No Schooling, Primary School, Secondary School, Tertiary

Income

Types of Occupation and Household Income

Living Standard / Basic Amenities

Access to utilities at home. Such As Electricity, Water Resources, Types of Toilet, Cooking Fuel, Types of Material Buildings

Strata

Urban and Rural

Residential (type of occupied dwelling)

Bungalow, Semi-D, Terrace, Shop-Lot, Flat

Comfortability

Number of bedrooms, size of household

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English (US)

SECTION C

For this section, respondents are required to prioritize each of the indicators that affects the poverty in Kedah according to their importance. Please noted that to choose one rank for one Indicator.

1) MARITAL STATUS

Instruction: Please rank the following indicator in order of importance towards poverty, with

1: the most important indicator towards poverty

3: the least important indicator towards poverty

Single \*

ex: 1

Please enter the rank between 1-3

Married \*

ex: 1

Please enter the rank between 1-3

Divorced \*

ex: 1

Please enter the rank between 1-3

## 2) EDUCATION

Instruction: Please rank the following indicators in order of importance towards poverty, with

1: the most important indicator towards poverty

4: the least important indicator towards poverty

No Schooling \*

Please enter the rank between 1-4

Primary School \*

Please enter the rank between 1-4

Secondary School \*

Please enter the rank between 1-4

Tertiary \*

Please enter the rank between 1-4

Additional notes\*\*

No schooling

Head of household who not complete schooling or not receiving any certificate.

Primary School

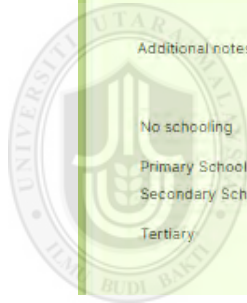
UPSR or below.

Secondary School

SRP/PMR/LCE/SPM/SPVM/SMU/MCE or equivalent.

Tertiary

Certificate obtained from college, polytechnic, institutions public or private university, higher institution or equivalent.



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### 3) INCOME

Instruction:

please rank the following indicators in order of importance towards poverty, with

1: the most important indicator towards poverty

4: the least important indicator towards poverty

Unemployed \*

Please enter the rank between 1-4

Self-employment \*

Please enter the rank between 1-4

Paid-employment \*

Please enter the rank between 1-4

Total of Household Income \*

Please enter the rank between 1-4



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#### 4) LIVING STANDARD

Instruction:

please rank the following indicators in order of importance towards poverty, with

1: the most important indicator towards poverty

5: the least important indicator towards poverty

Electricity \*

Please enter the rank between 1-5

Water Resources \*

Please enter the rank between 1-5

Sanitation \*

Please enter the rank between 1-5

Cooking Fuel \*

Please enter the rank between 1-5

Building Materials \*

Please enter the rank between 1-5

Additional notes\*\*

Electricity

No access to electricity

Water

No access to safe water resources for drinking, washing and bathing

Types of toilet

Do not have Flush Toilet

Cooking Fuel

Household who does not have stove (cooks with wood, carbon)

Floor

Not using stone and concrete building material

#### 5) STRATA

Instruction:

please rank the following indicators in order of importance towards poverty, with

1: the most important indicator towards poverty

2: the least important indicator towards poverty

Urban \*

Please enter the rank between 1-2

Rural \*

Please enter the rank between 1-2

## 6) RESIDENTIAL

Instruction:

please rank the following indicators in order of importance towards poverty, with

1: the most important indicator towards poverty

5: the least important indicator towards poverty

Semi-D \*

Please enter the rank between 1-5

Shop-Lot \*

Please enter the rank between 1-5

Bungalow \*

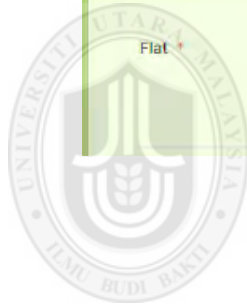
Please enter the rank between 1-5

Terrace \*

Please enter the rank between 1-5

Flat \*

Please enter the rank between 1-5



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## 7) COMFORTABILITY

Instruction:

please rank the following indicators in order of importance towards poverty, with

1: the most important indicator towards poverty

2: the least important indicator towards poverty

Number of Bedroom(s) \*

Please enter 1 or 2

Size of Household \*

Please enter 1 or 2

Additional notes\*\*

Number of  
bedroom(s)

Number of bedrooms in a house

Size of Household

The total number of a person or group who live together and make common provisions for food and other living essentials.

If you have any query or interested to know about the result and findings of this research, please do not hesitate to contact me at +60175570554 or via my email: [nuril\\_asyikin2@ahsgs.uum.edu.my](mailto:nuril_asyikin2@ahsgs.uum.edu.my), or my main supervisor's email: [nliza@uum.edu.my](mailto:nliza@uum.edu.my).

# THANK YOU!

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Submit