DETERMINATION OF RAINFALL TREND AT UNIVERSITI MALAYSIA PAHANG (UMP) CAMPUS AT GAMBANG AND PEKAN USING BOX-PLOT METHOD

MUHAMMAD ZARIF BIN MD. UZAIRIN

B. ENG (HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG

UNIVERSITI MALAYSIA PAHANG

DECLARATION OF THESIS AND COPYRIGHT

Author's Full Name : MUHAMMAD ZARIF BIN MD. UZAIRIN

Date of Birth : 02 DECEMBER 1993

Title : DETERMINATION OF RAINFALL TREND AT UNIVERSITI MALAYSIA PAHANG (UMP) CAMPUS AT GAMBANG AND PEKAN USING BOX-PLOT METHOD

Academic Session : 2018/2019

I declare that this thesis is classified as:

☐	CONFIDENTIAL	(Contains confidential information under the Official Secret Act 1997)*
☐	RESTRICTED	(Contains restricted information as specified by the organization where research was done)*
☑	OPEN ACCESS	I agree that my thesis to be published as online open access (Full Text)

I acknowledge that Universiti Malaysia Pahang reserves the following rights:

1. The Thesis is the Property of Universiti Malaysia Pahang
2. The Library of Universiti Malaysia Pahang has the right to make copies of the thesis for the purpose of research only.
3. The Library has the right to make copies of the thesis for academic exchange.

Certified by:

_____	_____
(Student's Signature)	(Supervisor's Signature)
931202-02-5245	NADIATUL ADILAH BINTI AHMAD ABDUL GHANI
New IC/Passport Number	Name of Supervisor
Date: 30 MAY 2019	Date: 30 MAY 2019

NOTE : * If the thesis is CONFIDENTIAL or RESTRICTED, please attach a thesis declaration letter.

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

_____

(Student's Signature)

Full Name : MUHAMMAD ZARIF BIN MD. UZAIRIN

ID Number : AA15045

Date : 30 MAY 2019

DETERMINATION OF RAINFALL TREND AT UNIVERSITI MALAYSIA PAHANG (UMP) CAMPUS AT GAMBANG AND PEKAN USING BOX-PLOT METHOD

MUHAMMAD ZARIF BIN MD. UZAIRIN

Thesis submitted in fulfillment of the requirements
for the award of the
B. Eng (Hons.) Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

MAY 2019

ACKNOWLEDGEMENTS

Alhamdulillah. All praise be to Allah the All Mighty. The one and only God who has given me the strength to help and guiding me in completing this thesis.

I am grateful and would like to express my sincere gratitude to my supervisor Nadiatul Adilah binti Ahmad Abdul Ghani for her germinal ideas, invaluable guidance, continuous encouragement and constant support in making this thesis possible. I appreciate her consistent support from the first day I began the final year project to these concluding moments. I am truly grateful for her tolerance of my naive mistakes. I also sincerely thanks for the time spent proofreading and correcting my many mistakes.

My sincere thanks go to all members of the staff of the hydraulic and hydrology laboratory, UMP, who helped me in many ways to carry out my research. Many special thanks go to all my friends for their help, inspirations and supports during this study.

I acknowledge my sincere indebtedness and gratitude to my parents, Md. Uzairin bin Saidin and Afliza binti Che Jaafar for their love, dream and sacrifice throughout my life. I acknowledge their sincerity and consistent encouragement for me to carry on my higher studies in Malaysia. I am also grateful to my family for their sacrifice, patience, and understanding that lead to this work possible. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to attain my goals.

ABSTRAK

Perubahan iklim merujuk kepada perubahan dari segi pemendakan. Fenomena ini telah pun bermula merubah corak hujan dalam Malaysia. Data hujan, data suhu, dan data evaporasi dikumpul dan direkodkan setiap bulan untuk memaparkan hubungan antara hujan, suhu dan evaporasi untuk menentukan corak kitaran hidrologi. Kaitan yang diperolehi dapat memaparkan corak cuaca di kampus Universiti Malaysia Pahang (UMP) di Gambang dan di Pekan. Dengan pemantauan kondisi cuaca, ia boleh membantu dalam mengawal aktiviti di UMP. Selain itu, data cuaca juga amatlah penting di dalam kehidupan seharian kita kerana hujan merupakan salah satu pertimbangan yang penting dalam membentuk larian kenderaan dan juga kawalan hakisan. Perubahan aliran dalam pengedaran hujan juga memberikan satu kesan kepada analisa hidrolgi terutama yang berkait dengan rekod sejarah hujan. Dengan itu, kaedah "box-plot" digunakan dalam menentukan corak aliran hujan dalam kitaran hidrologi. Ia telah ditunjukkan bahawa data hujan yang telah dikumpul setiap peristiwa hujan adalah berbeza setiap tahun, sebagai satu contoh untuk tahun 2016, sebanyak 991.4 mm telah dikumpulkan dan tahun berikutnya mengurang kepada 605.5 mm di tahun 2017 dan untuk tahun 2018 meningkat semula kepada 1020.9 mm untuk data di UMP Pekan. Manakala di kawasan UMP Gambang, sebanyak 1072.8 mm direkodkan untuk tahun 2016, kemudian mengurang sedikit pada tahun berikutnya, 2017 kepada 972.5 mm dan di tahun 2018 meningkat semula kepada 1309.8 mm. Ia menunjukkan setiap tahun terdapat perubahan dari segi peningkatan dan penurunan dari segi peristiwa hujan untuk kedua-dua kampus UMP.

ABSTRACT

Climate change leads to changes in precipitation. This phenomenon has already begin to transform rainfall pattern in Malaysia. Rainfall data, temperature data, and evaporation data are collected and recorded monthly to display the relationship between rainfall, temperature, and evaporation to determine the pattern of hydrologic cycle. The relationship obtained, would also display the weather pattern at campus Universiti Malaysia Pahang (UMP) in Gambang and Pekan. By monitoring of the weather conditions, it can help in controlling the activity in the UMP. Besides, weather data is very important in our life as the rainfall is an important consideration in design runoff conveyance and erosion control. Changing trend in rainfall distribution also gives an effect on hydrological analysis especially related to historical rainfall record. Box-plot method is employed to determine the rainfall trend of hydrologic cycle. It is shown that the rainfall data that was collected that the rainfall event differs every year, as an example for 2016, a total of 991.4 mm was collected and year after it decreased to 605.5 mm in 2017 and for 2018 raised slightly to 1020.9 for UMP Pekan. Whereas for UMP Gambang, 1072.8 mm in 2016, and also decreased slightly to 972.5 mm in 2017 and in 2018 increased to 1309.8 mm. Shows that each year that there are some increasing and decreasing trend of rainfall for each UMP campuses.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

°C	Celcius
%	Percentage
mm	millimeter

LIST OF ABBREVIATIONS

UMP	Universiti Malaysia Pahang
KK2	Kolej Kediaman 2
USB	Universal Serial Bus
Box-Plot	Box and whiskers Plot
Jan	January
Feb	February
Mar	March
Apr	April
Jun	June
Jul	July
Aug	August
Sep	September
Oct	October
Nov	November
Dec	December

CHAPTER 1

INTRODUCTION

1.1 Background of study

The normal features of the climate of Malaysia are uniform temperature, extensive rainfall and high humidity. Rainfall being predominant form of precipitation causing stream flow, especially the flood flow in a river. The magnitude of precipitation varies with time and space. Malaysia is observed to have a tropical climate, means the average temperature of the country, usually ranges from 21 °C to 32 °C and the humidity is range in between 70% to 90%. The climate is affected by the northeast and southwest monsoons, tropical wind that alternative during the course of the year. The direction of the wind in this inter-monsoon season is variable and usually more than 10 knots. Due to the seasonal rainfall in Malaysia, the probability of occurrence of rainfall amount is varied during the whole year. The northeast monsoon blows from November to March and the southwest monsoon from May to September. The primary goal of this project is to conduct experimental studies to identify the trend of rainfall event at UMP Gambang and Pekan campus.

1.2 Problem statement

Daily human activity is influenced by weather conditions, monitoring of weather conditions can help in controlling the activity. The behavior of and pattern changes of the weather is not all the same in the UMP Gambang and UMP Pekan area and its nearest place. It is important to monitor and study the pattern of weather at surrounding. Other than that, the weather consists of wind, humidity, temperature and precipitation. The pattern and trend of weather at Gambang and Pekan area can be identify by making analysis study of hydrological data from hydrological station.

1.3 Research Objectives

The objectives of this study are as following:-

i. To determine rainfall trend at UMP Gambang and Pekan campus.

ii. Set up and improving weather station in UMP Pekan campus.

1.4 Scopes of Study

This study focuses on determining the hydrology pattern. The hydrology data are obtained from the hydrology devices set up at Universiti Malaysia Pahang (UMP) Gambang and Pekan campus. The hydrology data is then organised and analysed to obtain the rainfall trend. The rainfall data will be collected and be focused on data from 2016 until 2019, which for the 2019 will only be collected from January until March and as for 2016, 2017 and until July of 2018 the data is collected from the past researches that have been working on collecting the rainfall data. The data will be based on daily, monthly and yearly data.

1.5 Significant of study

This study can help many future construction company, people to plan their daily activities and also future researchers for planning their schedule and also to complete their works. All the result results collected in this study will be compiled and a weather database for UMP can be recorded. The study also can identify the rainfall pattern of UMP Gambang and UMP Pekan area.

CHAPTER 2

LITERATURE REVIEW

2.1 Malaysian Climate

Malaysia is located at South East part of Asia where Peninsular Malaysia and East Malaysia is separated by the South China Sea. There are thirteen states and three federal territories in the country. Malaysia is observed to have a tropical climate, means the average temperature of the country are usually range from 21 °C to 32 °C and the humidity is range in between 70% to 90% (Tangang et al, 2012). The climate is affected throughout the year by the northeast and southwest monsoon, tropical winds that oscillate. From November to March the northeast monsoon blows and from May to September the southwest monsoon blows.

It is expected that climate change will cause adverse health effects. Due to heat stress or respiratory disease due to air pollution, a direct impact could be dead, while indirect effects could include increased food and water-borne diseases resulting from changes in rainfall pattern. There are numerous impact for the climate change due to natural course and anthropogenic activities. The amount and the times for extreme event to happen are increasing in future (Sunyer et al, 2012). In addition, the increase in temperature and rainfall will affect the water resources (Wang et al., 2013). Vector-borne diseases such as malaria and dengue fever could increase as temperature changes increase the vector's availability of appropriate reproduction environments. Furthermore, climate change will affect the production and consumption of electricity and the oil and gas industries. Due to increased coastal erosion, the operating and maintenance costs of electricity producers will be significantly increased to provide the necessary protection for power plants along the coast. An increase in air and water temperature will reduce plant efficiency and power output, resulting in higher cost of

production. There will also be an increase in the consumption of electricity if there is a rise in the air temperature, as it would result in an increased use of air conditioning (Gleick. P.H, 1989).

2.2 Rainfall

Rainfall is the amount of rain falling in a place over a given period of time. The rainfall in Malaysia depends on two monsoon seasons, which is monsoon from the southwest and monsoon from the northeast. The Southwest Monsoon seasons originating from Australia's deserts usually started between May and August, while the Northeast Monsoon seasons originating from China and the North Pacific begin between November and February. The magnitude of precipitation varies with time and space (Subramanya, 2013). Besides, there are two transition period of inter-monsoon period, which usually start from March to April and from September to October which brings heavy rainfall. The direction of the wind in this inter-monsoon season is variable and usually more than 10 knots (Ho & Yusof, 2012). Due to the seasonal rainfall in Malaysia, the probability of occurrence of rainfall amount is varied during the whole year (Suhaila & Jemain, 2009).

Peninsular Malaysia's seasonal rainfall variation can be divided into three main types. The first is over the eastern coastal districts, the months with maximum rainfall are November, December and January, while June and July are the driest month in most districts. The second is over the rest of the Peninsular with the exception of the southwest coastal area, the monthly rainfall pattern shows two periods of maximum rainfall separated by two periods of minimum rainfall. The primary maximum generally occurs in October-November, whereas the secondary maximum generally occurs in the northwest region in April-May, the primary minimum occurs in January-February with the secondary minimum in June-July, while the secondary minimum occurs elsewhere in June-July with the secondary minimum in February. The third is the pattern of rainfall over the southwest coastal area is greatly affected by early morning from May to August, resulting in no longer discernible double maximum and minimum pattern. The month of October and November is with maximum rainfall and the month of February with minimum rainfall. The maximum of March-April-May and the minimum of June-July are absent or indifferent.

The rainfall is an important consideration in design runoff conveyance and erosion control system. The rain gauge can be measure the amount of rainfall since it has a quite high level of accuracy in measuring the amount of rainfall (Pettazi & Salson, 2012).

2.3 Hydrological cycle

The hydrologic cycle is a conceptual model that describes the storage and movement of water between the bio-sphere, atmosphere, lithosphere, and the hydrosphere (see figure 2.1). Water on our planet can be stored in any one of the following major reservoirs: atmosphere, oceans, lakes, rivers, soils, glaciers, snowfields, and groundwater. Water moves from one reservoir to another by way of processes like evaporation, condensation, precipitation, deposition, runoff, infiltration, sublimation, transpiration, melting, and groundwater flow. The oceans supply most of the evaporated water found in the atmosphere. Of this evaporated water, only 91% of it is returned to the ocean basins by way of precipitation. The remaining 9% is transported to areas over landmasses where climatological factors induce the formation of precipitation. The resulting imbalance between rates of evaporation and precipitation over land and ocean is corrected by runoff and groundwater flow to the oceans (Hubbart, 2010).

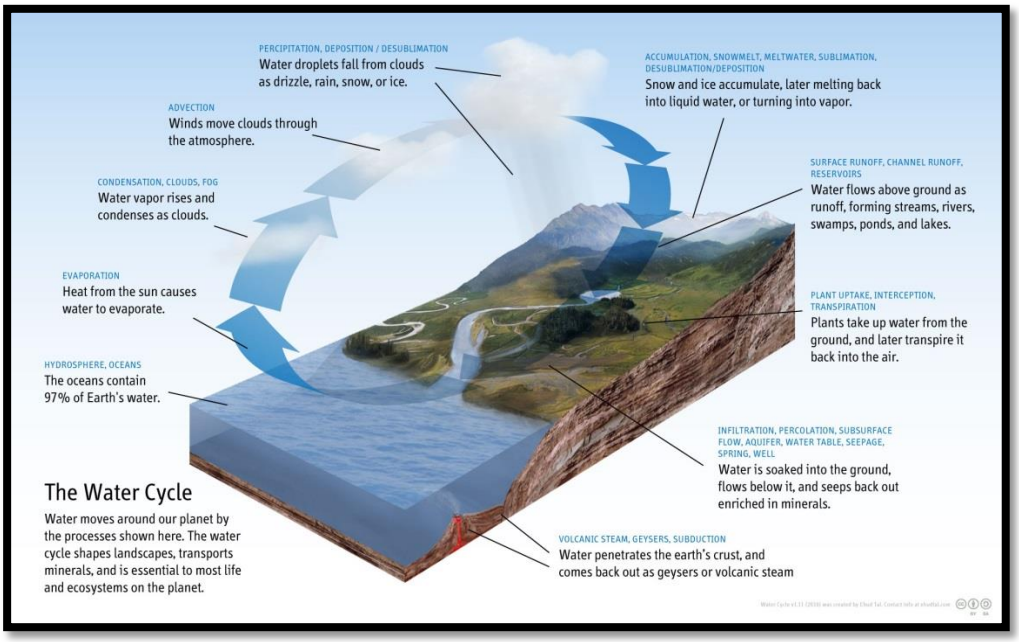


Figure 2.1: Hydrological cycle

2.4 Impact of climate change

The weather change includes the change of weather parameter such as change of temperature, change of wind speed and change of relative humidity. The change of the weather parameters may affect the amount of rainfall during the specific time. The climate change is issues that arise during 21st century with comprise a lots of environment problems (IPCC,2007). The impact of climate change mainly affects agriculture, forestry, public health, energy and water, as well as coastal resources, in several sectors in Malaysia. One of the sectors heavily affected by extreme climate change is agriculture. Examples of direct and indirect effects of extreme climate change are physical damage, loss of crop harvest, decrease in productivity, vigor, and other crop potentials.

The effects of natural course and anthropogenic activities on climate change are numerous. The amount and the times for extreme event to happen are increase in future (Sunyer et al, 2012). In addition, the increase in temperature and rainfall will affect the water resources (Wang et al., 2013). Since the availability of water resources depends mostly on climatic conditions, reducing the adverse effect from climate variable to water resources is important. Agricultural and forestry activities depend on water resources. Because of the effects of climate change, water resource availability will be scarce and affect the industrial and also aquatic life ecosystem. As a result of climate change, the surface and groundwater water quality will be affected. The drinking water supply can be contaminated and increases the risk of disease.

Besides, there are negative effects on the agriculture production. Due to heavy precipitation which increases the moisture, the production of crops will decrease because of excessive soil moisture content. In contrast, the area which suffers from drought will increase too (Bates et al 2008).

2.5 Precipitation

The term precipitation is the product of atmospheric water vapour condensation that falls under gravity to the ground. It denotes from the atmosphere all forms of water that reach the earth. Rainfall, snowfall, hail, frost and dew are the common forms. Only the first two of these contribute substantial amounts of water. The predominant forms

of precipitation that cause streams are rainfall. The magnitude of precipitation varies with time and space. Differences in the magnitude of rainfall in various parts of a country at a given time and variations of rainfall at a place in various seasons of the year are obvious and need no elaboration. It is this variation that is responsible for many hydrological problems, such as floods and droughts (Subramanya, 2013).

2.6 Weather station

Studying the weather is a remote part of science. It will be able to study faraway places weather without ever having to go there. A weather station is a weather observation facility with tools and equipment to monitor atmospheric conditions to study the weather. It helps people measure wind, air pressure, rainfall, moisture and temperature. The explanation and demonstration will be to see how each instrument is used to measure weather before using the instruments. From there, in the future, everyone will know and use it on their own. All data will be collected from the instruments used and compared with the weather data of the station in Kuantan. To search for patterns and trends, all weather data collected from the previous one week period will use and analyze it using graph, chart and averages. Data interpretation will be based on computational skills. The weather can be described from the graph or chart and how weather affects everyday life.

2.7 Rain gauge

A rain gauge is an instrument that can be used in a given time period to measure the amount of rainfall received in the area. Rain gauge is a simple tool that can be installed and used. The reading amount of rainfall is in inches or millimeters. Rain gauges are the most worldwide used devices for in-situ point measurements of precipitation intensity and duration, especially for the Tipping-Bucket rain gauge since it can not only accurately measure rainfall intensity from low-to-intermediate level, but also recording remotely with reliability and suitability (Song, 2016).

In addition, rain gauges must be placed in an area of exposure where there are no obstacles to blocking the rain, such as buildings or trees. This also prevents the water collected on the roofs of buildings or trees from dripping into the rain gauge after a rainfall, resulting in inaccurate measurements.

2.8 Box-Plot method

There are a lot of methods that can be used in order to measure the rainfall event, the box-plot method can also be used to determine the event of rainfall. According to (Banacos, 2011) boxplot is the form of summary of a given dataset which includes, the median, the interquartile range and the computation and the meaning each of the values are described below.

i. The median

Median is the middle data observation in a ranked of any dataset and as a measure for central tendency of the data and the same as the 50^{th} percentile of a data.

ii. The interquartile range

The box represents the middle 50% of the ranked data and is drawn from the lower quartile value to the upper quartile value which is the 25^{th} until 75^{th} percentile.

iii. The outer range

The whiskers represent an outer range and are drawn as a vertical lines extending outward from the ends of the box. This whisker represents the maximum and minimum of said data for the sample.

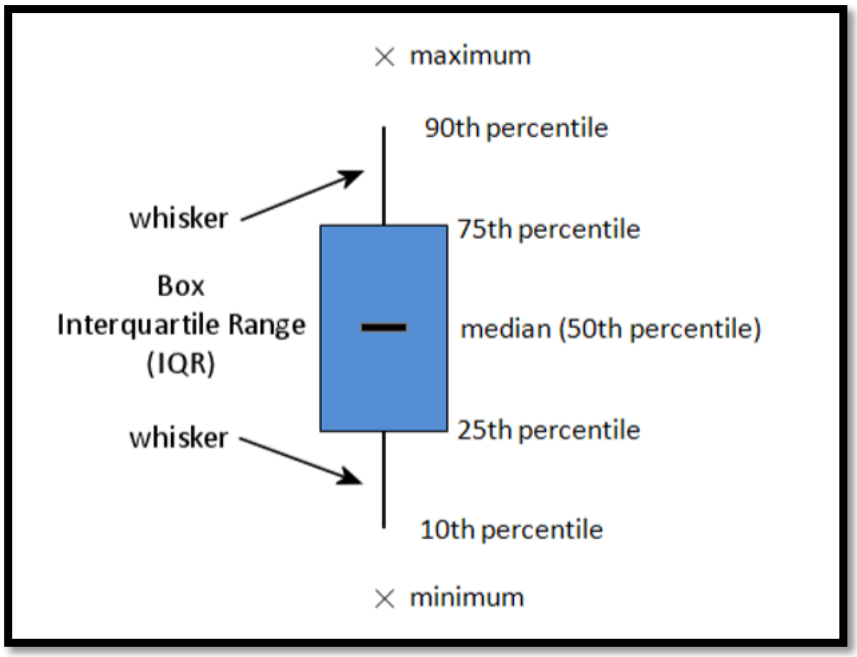


Figure 2.2: Example of box-plot data when interpreted (source: Banacos P.C. 2011)

Figure 2.2 above shows what the box-plot will represent the data when it is plotted.

CHAPTER 3

METHODOLOGY

3.1 Introduction

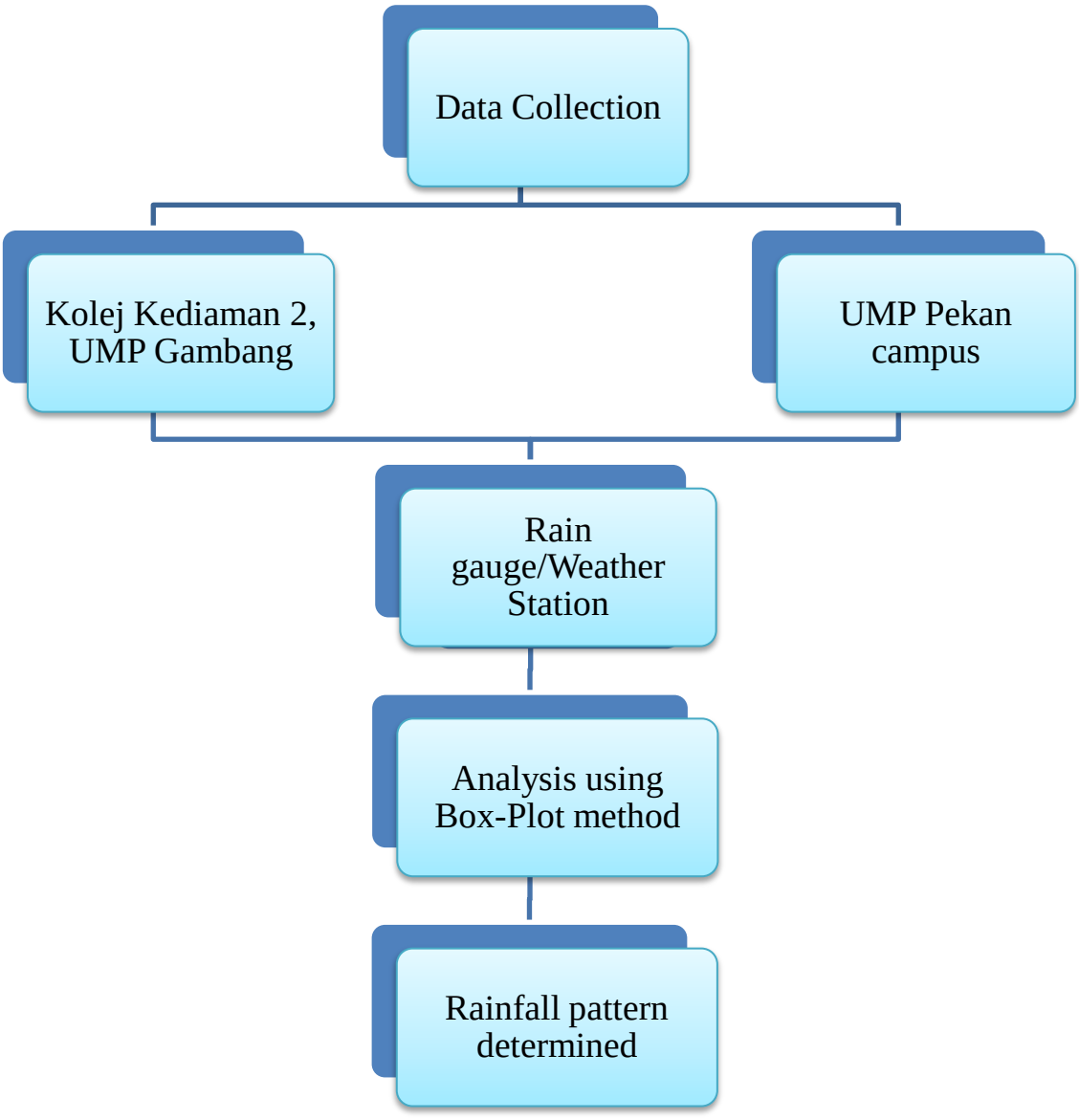


Figure 3.1: Methodology Flow Chart

Figure 3.1 is the methodology flow chart which shows how the flow of the research for the data is carried out in order to obtain the expected results for the research.

3.2 Study Area

Figure 3.2: Map of Peninsular Malaysia

Figure 3.2 shows the Pahang state in the map of Peninsular Malaysia. There is eleven districts in Pahang which is Lipis, Jerantut, Raub, Bentong, Bera, Rompin, Pekan, Maran, Temerloh, Cameron Highland, and Kuantan. Kuantan is a small but lively city off the East Coast of Malaysia, which also the capital of the state of Pahang. Over the years, rapid modernization and development has transformed Kuantan from what was originally a quiet, quiet city into a rapidly growing city. Pahang is Peninsular Malaysia's largest state and Kuantan is its capital city, located along the East Coast with 35960 square kilometers of land. It is about two-thirds of Pahang's land area covered by dense tropical rainforest, making it a natural treasure repository for Malaysia. In the Pahang you will find almost all the highland retreats, some beautiful islands and beaches. Pahang tropical monsoon climate brings with it a uniform temperature range 21 °C to 32 °C whereas the relative humidity varies from 62% (mild humidity) to 92% (very humidity). On the average, the driest month for is on February whereas on

December is the wettest month. Average precipitation per year 2014 is between 274.3mm to 674.7mm.(Website MMD 2013, Average rainfall for 2013).

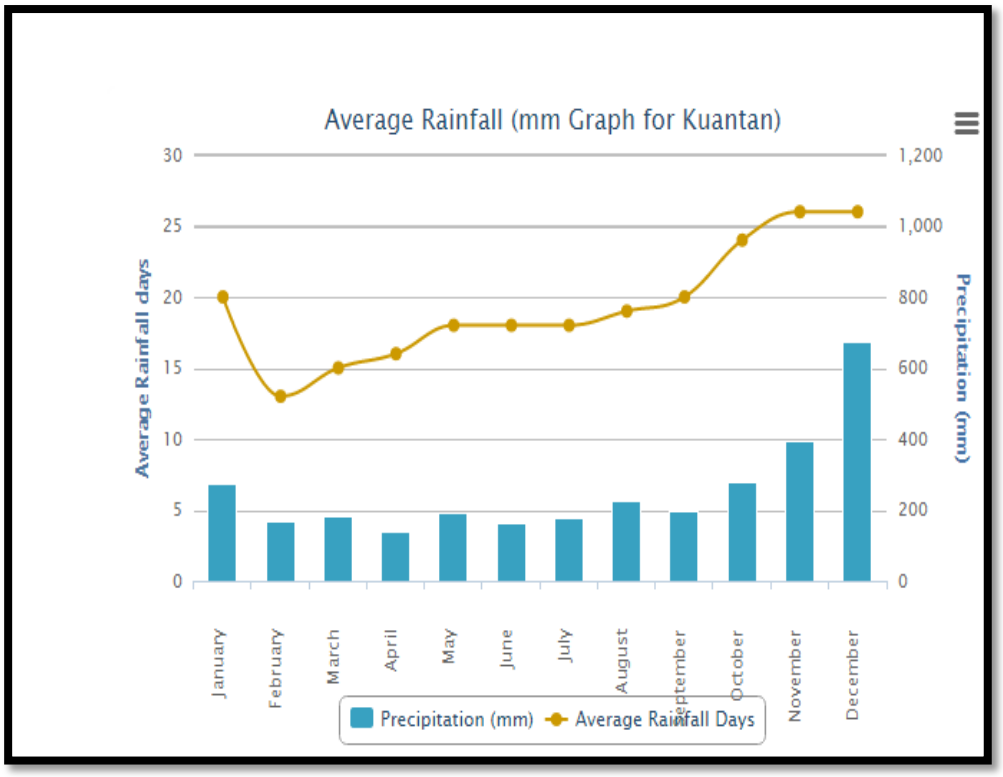


Figure 3.3: The graph show the highest precipitation for 2013 in December 674.7mm and the highest Average Rainfall for 2013 at December 26mm

Gambang is the study area in Kuala Kuantan's "mukim." There are 6 "mukim" of Sungai Karang, Penor, Hulu Kuantan, Hulu Lepar, Beserah, and Kuala Kuantan in the Kuantan district. The study area is Gambang for more detail, and people know it because it is almost the East Coast Expressway exit. East Coast Expressway is Malaysia's main highway. It is an extension of Karak Expressway, which start from Karak to Kuala Lumpur. It provides a link from the West Coast of Peninsular Malaysia to the East Coast of Peninsular Malaysia.

3.2.1 Location of Rain Gauge at UMP Gambang

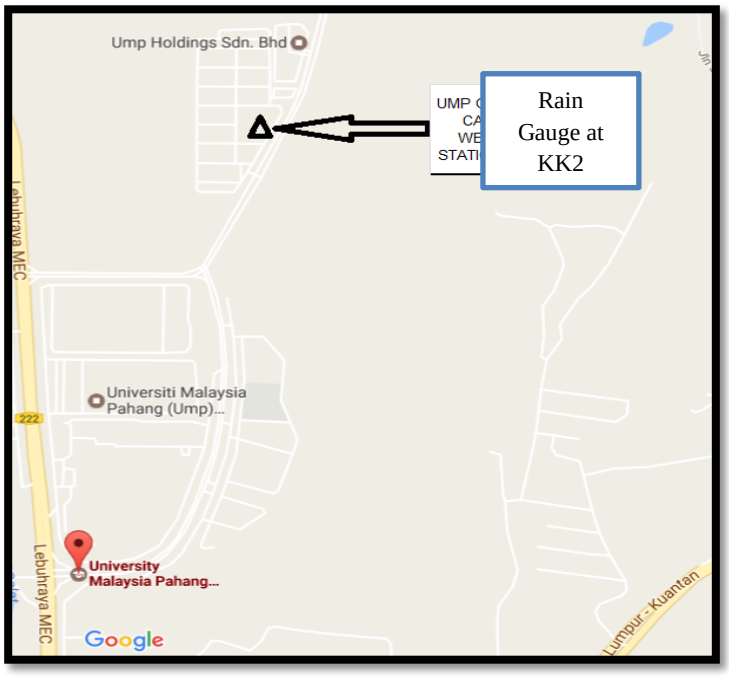


Figure 3.4: Location of rain gauge at Kolej Kediaman 2, UMP Gambang

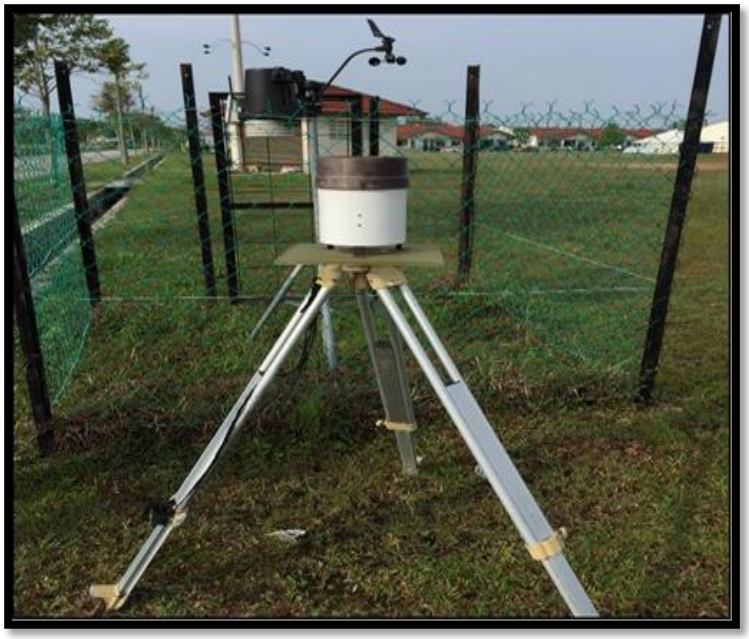


Figure 3.5: Rain gauge at Kolej Kediaman 2, UMP Gambang

The rain gauge was set up at the field at Kolej Kediaman 2 (KK2) in Universiti Malaysia Pahang (UMP) campus Gambang. The location both tool are same place on next position. The field at Kolej Kediaman 2, Universiti Malaysia Pahang (UMP) is chosen due to the stability and compromise to fulfil the ideal criteria to set up a rain

gauge. The ideal location of the site should be free from obstacle, building and steep slopes which will be effect the data collection of the weather station.

3.2.2 Location of Weather Station at UMP Pekan

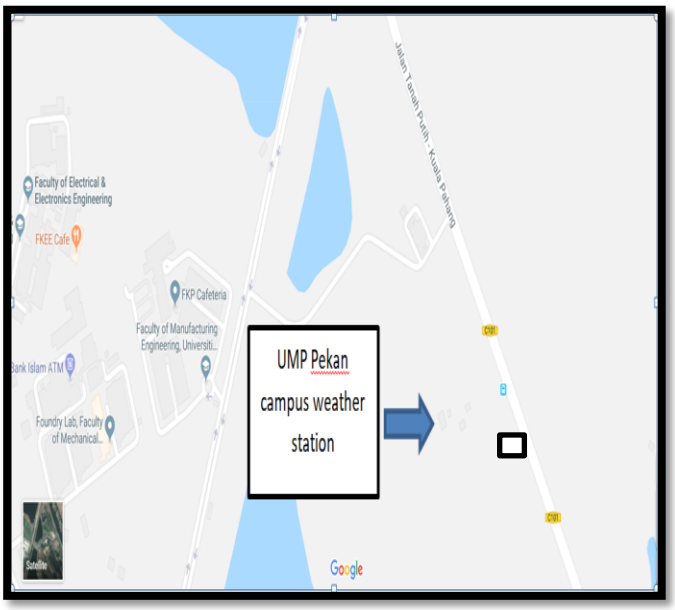


Figure 3.6: Location of weather station at UMP Pekan campus

Figure 3.7: Weather station at UMP Pekan

There is also weather station that is set up at UMP Pekan located near to the kindergarten that is inside the UMP Pekan. This site is chosen due the criteria for the research which is to compare the rainfall event between UMP Pekan and UMP

Gambang. Stationed here also is the rain gauge which located one meter apart from each other.

3.3 Collecting data from Rain gauge

The rainfall data from HOBO rain gauge is collected once a month from both rain gauge stations that situated in UMP Gambang and UMP Pekan campus, the data is collected by plugging in USB cable from the computer to the rain gauge in order to get the raw rainfall data. Both figure 3.8 and figure 3.9 shows the rainfall data collected from KK2 in UMP Gambang and UMP Pekan

Figure 3.8: Getting the data from the HOBO rain gauge in KK2 in UMP Gambang

Figure 3.9: Getting the rainfall data from HOBO rain gauge in UMP Pekan campus

3.4 Data Collection from Weather Station in UMP Pekan

At the same time with the planning and process to setting up and upgrading the weather station in Pekan, the weather station in Pekan is collected once a month. Figure 3.10 and 3.11 shows the data collected from weather station after transfer to PC and the data recorded from weather station. Figure 3.10 shows the data collected from weather station after transfer to PC. The Figure 3.11 shows the data recorded in the console from weather station.

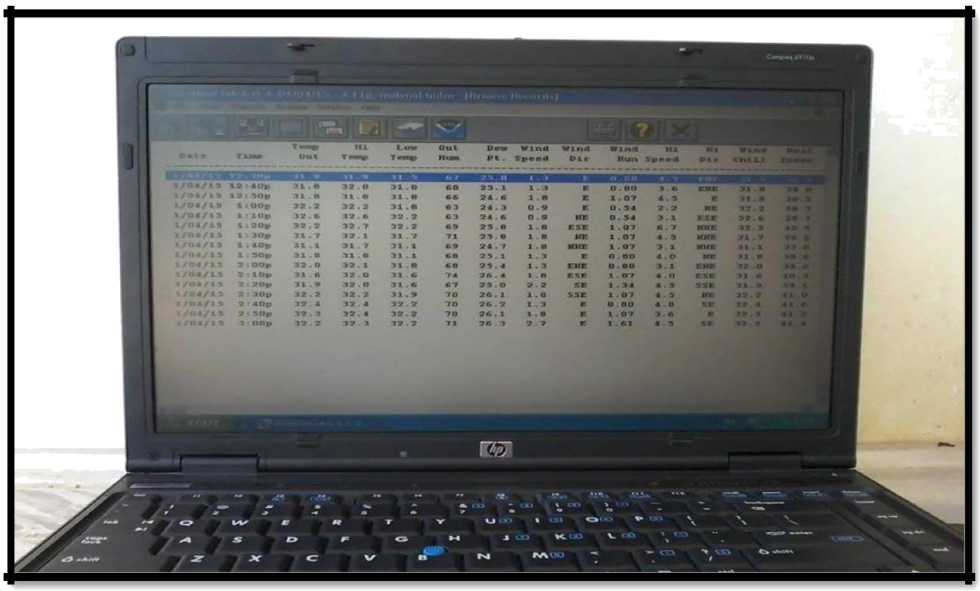


Figure 3.10: The data collected from weather station after transfer to PC

Figure 3.11: The data recorder from weather station

3.5 Analyze the data

After collecting the data from both UMP Gambang and UMP Pekan campus, the suitable method proposed to analyse the data is box-plot method. The purpose of using this method is the ability to be able to check the trend and skewness of the rainfall trend for UMP Gambang and UMP Pekan. The advantage of the box-plot method is that it is able compare multiple datasets side-by-side, as idealized in figure 3.12. Important characteristics of each dataset (central tendency, skewness, dispersion, and extremes) are very easy to interpret and visualize (Banacos, 2011).

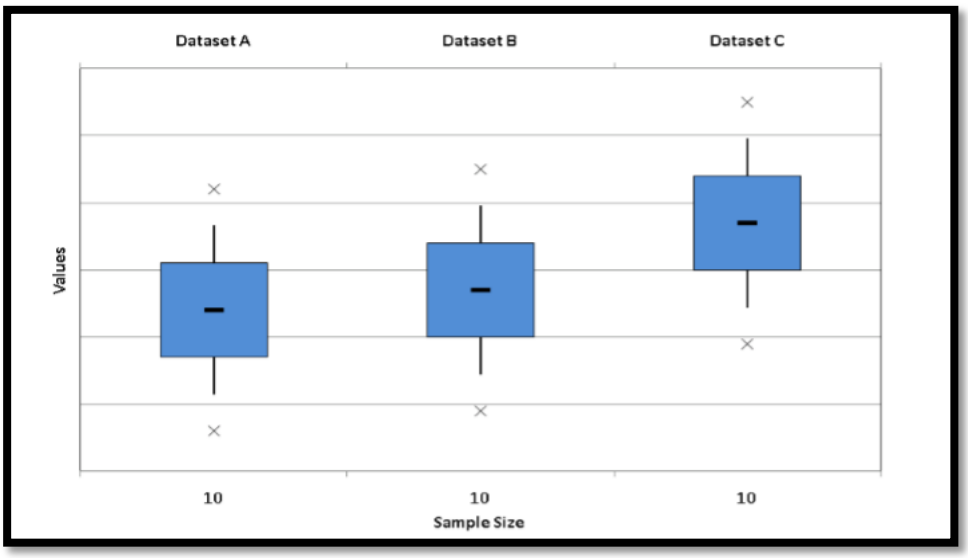


Figure 3.12: Example of datasets compared side-by-side (source: Banacos, 2011)

From the box plot too, the trend or skewness can be determined by using the rainfall data, below in figure 3.13 shows the idealized distribution example of rainfall data trend or skewness that can be determined by the shape of the box-plot that has been plotted by using dataset of rainfall data.

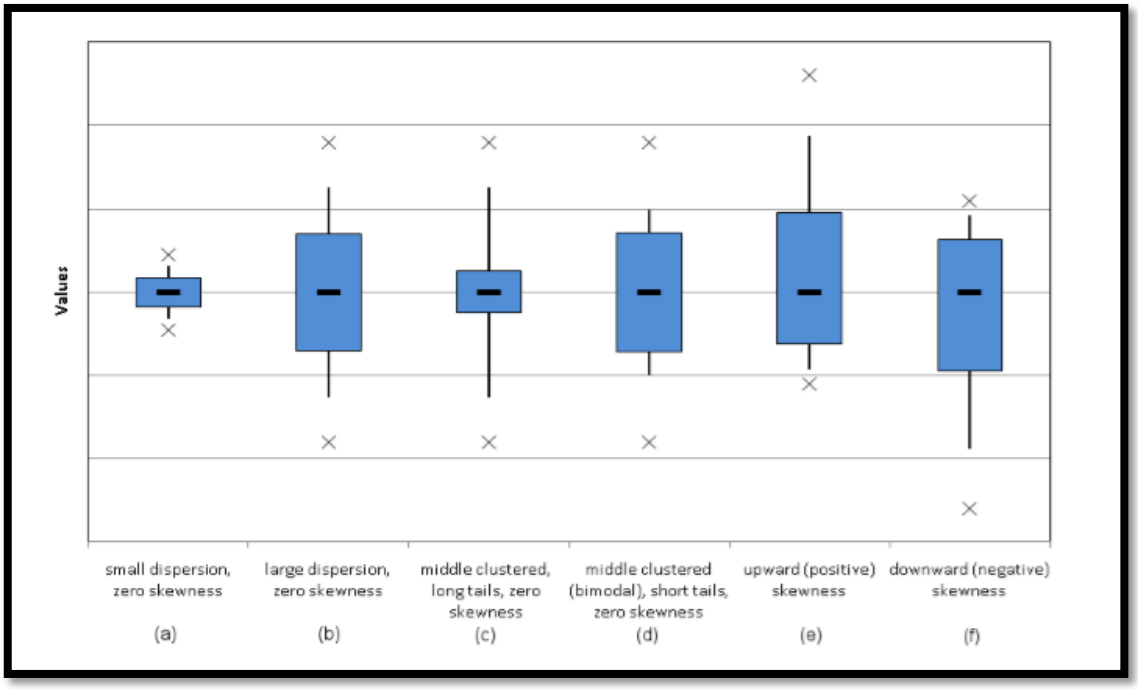


Figure 3.13: Idealized box-plot data distribution (source: Banacos, 2011)

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

The rainfall data that are collected is organized and analysed and is presented in this chapter. The data obtained is from the rain gauge that is taken from starting July 2018 until March 2019 and for 2016 until July 2018 is referred from the past researches and the following data is taken until March 2019.

4.2 Data Results for Box-Plot method

Below is the tabulation of data of raw rainfall data which has been tabulated which has been obtained from HOBO rain gauge which is located at UMP Gambang stationed at Kolej Kediaman 2 (KK2) and in UMP Pekan campus and also the results of the raw rainfall data converted to Box-Plot method.

Table 4.1: Data for year 2016 in KK2, UMP Gambang

Summary of Result For Gambang 2016			
Months of 2016	Total Rainfall (mm)	Cumulative Rainfall (mm)	Avg Rainfall per day (mm)
Jan-16	104.0	104.0	3.4
Feb-16	137.4	241.4	4.7
Mar-16	33.0	274.4	1.1
Apr-16	32.2	306.6	1.1
May-16	137.8	444.4	4.4
Jun-16	110	554.4	3.7
Jul-16	-	554.4	-
Aug-16	-	554.4	-
Sep-16	222.4	776.8	7.4
Oct-16	296.0	1072.8	9.5
Nov-16	-	1072.8	-
Dec-16	-	1072.8	-
summation	1072.8	1072.8	35.3

Table 4.1 shows the total rainfall data collected for year 2016 from the past researches for UMP Gambang situated in KK2. The data for month of July, August, November and December is lost. It can be seen that for the year 2016, October 2016 collected the highest total rainfall with a 296.0 mm of rainfall data compared to other months whereas the lowest being in April 2016 with a 32.0 mm of rainfall data. Starting of the year shows that there is a not much of trend of rainfall with it being in the hundreds range but it escalated to rise once going to September onwards. It can be concluded that the end of year is where rainfall truly starts.

Table 4.2: Data for year 2017 in KK2, UMP Gambang

Summary of Result For Gambang 2017			
Months of 2017	Total Rainfall (mm)	Cumulative Rainfall (mm)	Avg Rainfall per day (mm)
Jan-17	98.1	98.1	3.16
Feb-17	124.3	222.4	4.44
Mar-17	29.5	251.9	0.95
Apr-17	27.4	279.3	0.91
May-17	141.8	421.1	4.57
Jun-17	113.6	534.7	3.79
Jul-17	-	534.7	-
Aug-17	-	534.7	-
Sep-17	189.2	723.9	6.31
Oct-17	248.6	972.5	8.02
Nov-17	-	972.5	-
Dec-17	-	972.5	-
summation	972.5	972.5	32.15

Table 4.2 shows the total rainfall data collected for year 2017 from the past researches for UMP Gambang situated in KK2. The same can be said for year 2017 as in year 2016 where the data is lost in July, August, November, and December. But the trend is still the same as 2016 where October 2017 collected the most rainfall data with 248.6 mm whereas the lowest is in April 2017.

Table 4.3: Data for year 2018 in KK2, UMP Gambang

Summary of Result For Gambang 2018			
Months of 2018	Total Rainfall (mm)	Cumulative Rainfall (mm)	Avg Rainfall per day (mm)
Jan-18	-	0	-
Feb-18	-	0	-
Mar-18	-	0	-
Apr-18	23.8	23.8	0.79
May-18	102.8	126.6	3.32
Jun-18	194.4	321.0	6.48
Jul-18	76.6	397.6	2.47
Aug-18	52.2	449.8	1.68
Sep-18	173.8	623.6	5.79
Oct-18	236.2	859.8	7.62
Nov-18	183.4	1043.2	6.11
Dec-18	266.6	1039.8	8.60
summation	1309.8	1039.8	42.86

Table 4.3 shows the total rainfall data collected for year 2018 from the past researches for UMP Gambang situated in KK2. The data was continued collected by me onwards from month of August up until March of 2019. As for January until March the data may have lost because of equipment error. The highest data collected is in December 2018 with a 266.6 mm whereas the lowest is the same as in year 2016 and 2017 which is in April 2018 with a reading of 23.8 mm. This shows that rainfall trend tends to start at the end of the year for UMP Gambang and the season with the least amount of rainfall trend to occur is during April throughout the year which is the same as past years.

Table 4.4: Data for year 2019 in KK2, UMP Gambang

Summary of Result For Gambang 2019			
Months of 2019	Total Rainfall (mm)	Cumulative Rainfall (mm)	Avg Rainfall per day (mm)
Jan-19	108.8	108.8	3.51
Feb-19	77.4	186.2	2.76
Mar-19	10.0	196.2	0.33
Apr-19	-	196.2	-
May-19	-	196.2	-
Jun-19	-	196.2	-
Jul-19	-	196.2	-
Aug-19	-	196.2	-
Sep-19	-	196.2	-
Oct-19	-	196.2	-
Nov-19	-	196.2	-
Dec-19	-	196.2	-
summation	196.0	196.2	

Table 4.4 shows the total rainfall data collected for year 2019 from the past researches for UMP Gambang situated in KK2. The data is only collected up until March only where I stopped collecting the data. The highest data is in January 2019 with a 108.8 mm which it started to decrease from a rainy season from the end of the year of last year, whereas the lowest data is in March with 10.0 mm and it is where is stopped taking the data.

Table 4.5: Data for year 2016 in UMP Pekan

Summary of Result For Pekan 2016			
Months of 2016	Total Rainfall (mm)	Cumulative Rainfall (mm)	Avg Rainfall per day (mm)
Jan-16	-	0	-
Feb-16	75.7	75.7	2.61
Mar-16	41.3	117.0	1.33
Apr-16	27.5	144.5	0.92
May-16	211.8	356.3	6.83
Jun-16	58.2	414.5	1.94
Jul-16	83.0	497.5	2.68
Aug-16	109.7	607.2	3.54
Sep-16	84.3	691.5	2.81
Oct-16	299.9	991.4	9.67
Nov-16	-	-	-
Dec-16	-	-	-
summation	991.4	991.4	32.33

Table 4.5 shows the total rainfall data collected for year 2016 from the past researches for UMP Pekan. As for month of January, November and December the data is not present or recorded is that the data may have lost so a data for a full year is not able to achieve. As for the highest data, October 2016 is the highest with 299.9 mm and April 2016 is the lowest with 27.5 mm of rainfall data, this trend can be strengthen with the trend at UMP Gambang where similar trend occurs where April is the lowest and starting from October until the end of the year it start to get more trend of rainfall.

Table 4.6: Data for year 2017 in UMP Pekan

Summary of Result For Pekan 2017			
Months of 2017	Total Rainfall (mm)	Cumulative Rainfall (mm)	Avg Rainfall per day (mm)
Jan-17	-	0	-
Feb-17	15.3	15.3	0.55
Mar-17	23.6	38.9	0.76
Apr-17	28.5	67.4	0.95
May-17	12.1	79.5	0.39
Jun-17	33.8	113.3	1.13
Jul-17	40.2	153.5	1.30
Aug-17	91.3	244.8	2.95
Sep-17	81.5	326.3	2.72
Oct-17	279.2	605.5	9.01
Nov-17	-	605.5	-
Dec-17	-	605.5	-
summation	605.5	605.5	19.76

Table 4.6 shows the total rainfall data collected for year 2017 from the past researches for UMP Pekan. The same can be said as for 2016 data, where for in January, November and December the data is lost. The highest data of rainfall is the same as year before with October 2017 being the highest with 279.0 mm and the lowest is in May 2017 with 12.1 mm of rainfall data.

Table 4.7: Data for year 2018 in UMP Pekan

Summary of Result For Pekan 2018			
Months of 2018	Total Rainfall (mm)	Cumulative Rainfall (mm)	Avg Rainfall per day (mm)
Jan-18	-	0	-
Feb-18	-	0	-
Mar-18	-	0	-
Apr-18	-	0	-
May-18	5.1	5.1	0.16
Jun-18	6.9	12.0	0.23
Jul-18	6.7	18.7	0.22
Aug-18	7.6	26.3	0.25
Sep-18	42.4	68.7	1.41
Oct-18	261.9	330.6	8.45
Nov-18	343.6	674.2	11.45
Dec-18	346.7	1020.9	11.18
summation	1020.9	1020.9	33.35

Table 4.7 shows the total rainfall data collected for year 2018 which I carried on collecting from August until the end of the year As for the data for January until April 2018 the data is lost because of equipment error. As for this year, the highest data that recorded for rainfall data is in December 2018 with 346.7 mm and the lowest is in May 2018 with 5.10 mm. The trend is almost the same as in UMP Gambang where somewhere in April and May the rainfall is the lowest whereas when starting from October until the end of the year it continues to rise and the highest ranges from October until December.

Table 4.8: Data for year 2019 in UMP Pekan

Summary of Result For Pekan 2019			
Months of 2019	Total Rainfall (mm)	Cumulative Rainfall (mm)	Avg Rainfall per day (mm)
Jan-19	69.3	69.3	2.24
Feb-19	13.6	82.9	0.49
Mar-19	0.0	82.9	0.0
Apr-19	-	-	-
May-19	-	-	-
Jun-19	-	-	-
Jul-19	-	-	-
Aug-19	-	-	-
Sep-19	-	-	-
Oct-19	-	-	-
Nov-19	-	-	-
Dec-19	-	-	-
summation	82.9	82.9	2.73

Table 4.8 shows the total rainfall data collected for year 2019 which only up to March where I stopped collecting the rainfall data. The highest is in January 2019 with 69.3 mm and the lowest is in March with no data of rainfall where the heat wave started to hit the Pahang area starting from February and it can be seen from the rainfall data is started to plummet after January to February.

4.2.1 UMP Gambang Box-Plot data

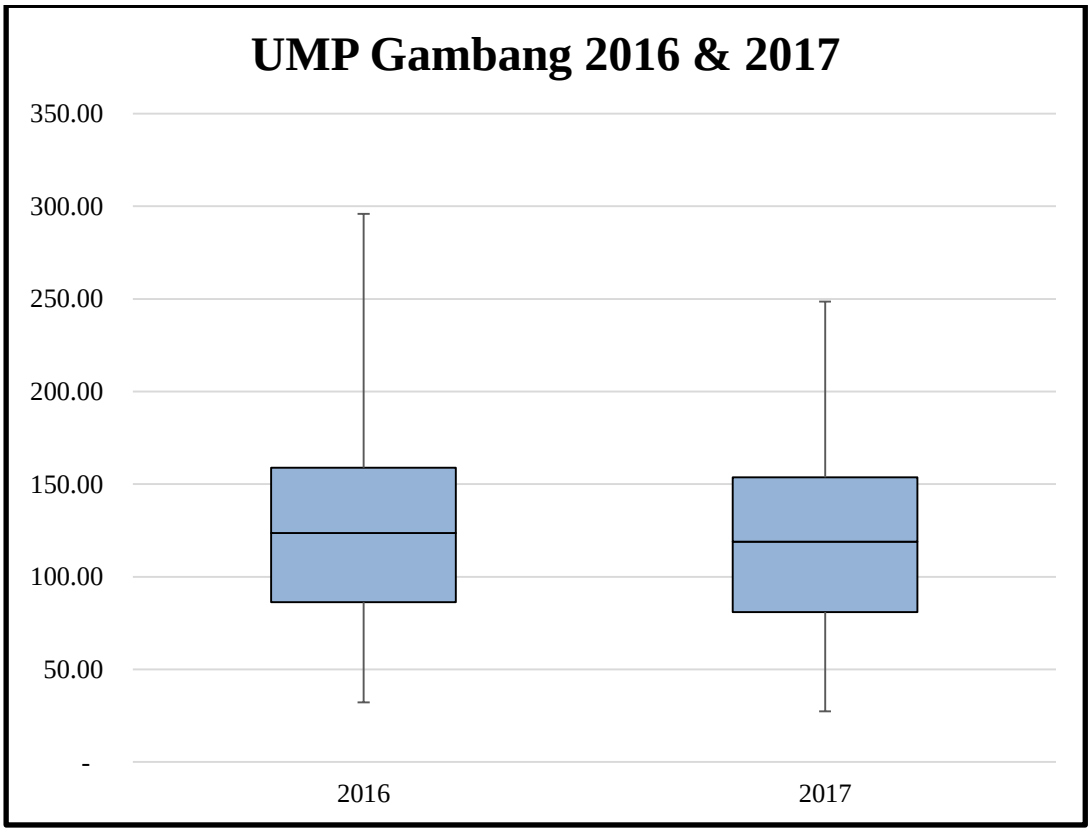


Figure 4.1: Box-plot data for UMP Gambang year 2016 and 2017

	2016	2017
Min	32.20	27.40
Q1	86.25	80.95
Median	123.70	118.95
Q3	158.95	153.65
Max	296.00	248.60
Box 1 - hidden	86.25	80.95
Box 2 - lower	37.45	38.00
Box 3 - upper	35.25	34.70
Whisker Top	137.05	94.95
Whisker Bottom	54.05	53.55

Table 4.9: Tabled Box-plot data for UMP Gambang year 2016 and 2017

From the figure 4.1 and table 4.9, the data that is presented is for rainfall data in UMP Gambang which is taken from KK2 rain gauge. For year 2016, the maximum whisker shows the highest captured rainfall data with amount of 296.0 mm in October, and the lowest whisker with amount of 32.2 mm of rainfall which is in April whereas for 2017, the highest and lowest rainfall data collected is 248.6 mm and 27.4 mm respectively which the highest collected is in October and lowest is in April. The median for both year 2016 and 2017 is 123.70 mm and 118.95 mm which represents the average of rainfall for respective years.

For year 2016, the box-plot as referred from the journal, it is tend towards upward (positive) skewness as in having a much more positive trend of rainfall data for that year with the whisker of the box-plot is much higher proportionate towards the upper box-plot than the lower whisker thus making it a positive trend for year 2016. As for year 2017, the proportion of the box-plot is almost the same, so it can be interpreted as a small dispersion of rainfall data with a zero trend. Thus from 2016 to 2017 there is a decreased of trend of rainfall from positive trend to zero trend.

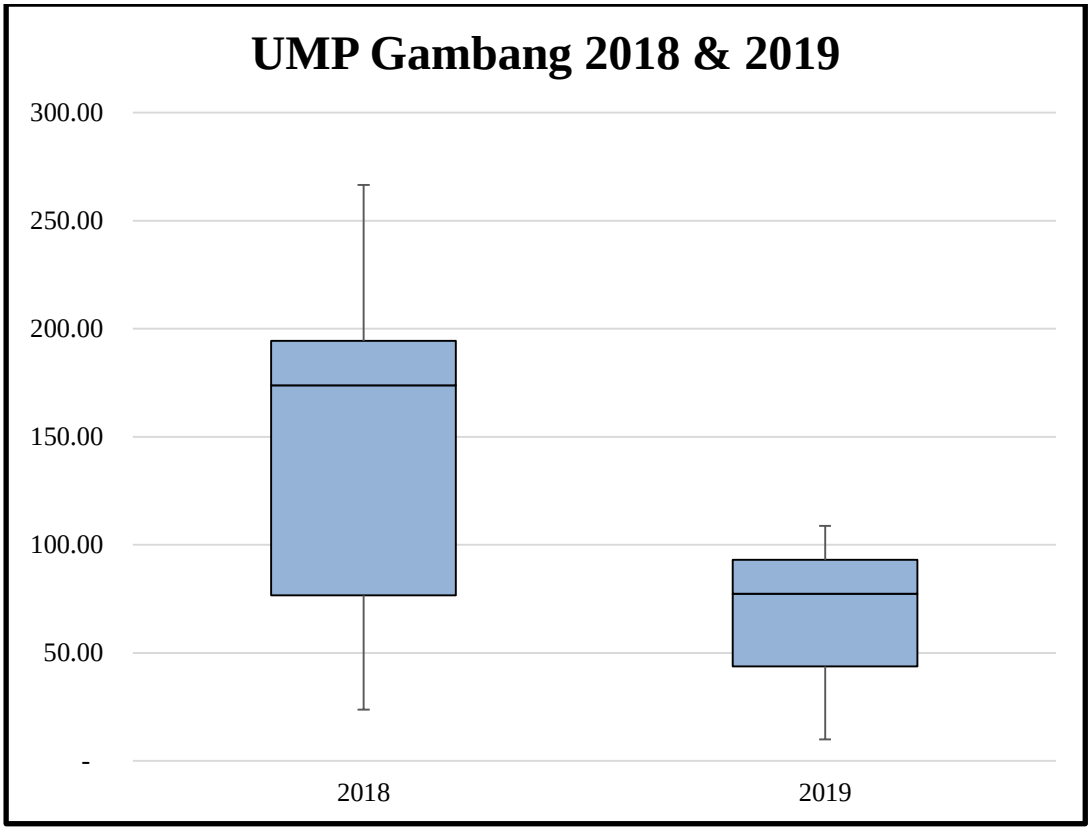


Figure 4.2: Box-plot data for UMP Gambang year 2018 and 2019

	2018	2019
Min	23.80	10.00
Q1	76.60	43.70
Median	173.80	77.40
Q3	194.40	93.10
Max	266.60	108.80
Box 1 - hidden	76.60	43.70
Box 2 - lower	97.20	33.70
Box 3 - upper	20.60	15.70
Whisker Top	72.20	15.70
Whisker Bottom	52.80	33.70

Table 4.10: Tabled Box-plot data for UMP Gambang year 2018 and 2019

From the figure 4.2 and table 4.10, the data that is presented is for rainfall data in UMP Gambang which is taken from KK2 rain gauge. For year 2018, the maximum whisker shows the highest captured rainfall data with amount of 266.6 mm in October, and the lowest whisker with amount of 23.8 mm of rainfall which is in April whereas for 2019, the highest and lowest rainfall data collected is 108.8 mm and 10.0 mm respectively which the highest collected is in January and lowest in March. Both year 2016 and 2017 median is 173.80 mm and 77.40 mm which represents the average rainfall for that year. Year 2019 is only collected up until March, so there is not much data to be used for its box-plot.

For year 2018, the box-plot as referred from the journal, it has large dispersion of data in the middle, thus makes it a large dispersion with a zero skewness as in the same trend as it was a year before which is the same as 2017. As for year 2019, the proportion of the whisker tends toward the minimum, so it can be interpreted as a downward (negative) skewness as in negative trend for the year 2019. Thus from 2017 to 2018 there is a no decrease or increase of trend of rainfall but from 2018 to 2019 there is a decreasedof trend zero trend to negative trend.

4.2.2 UMP Pekan Box-Plot data

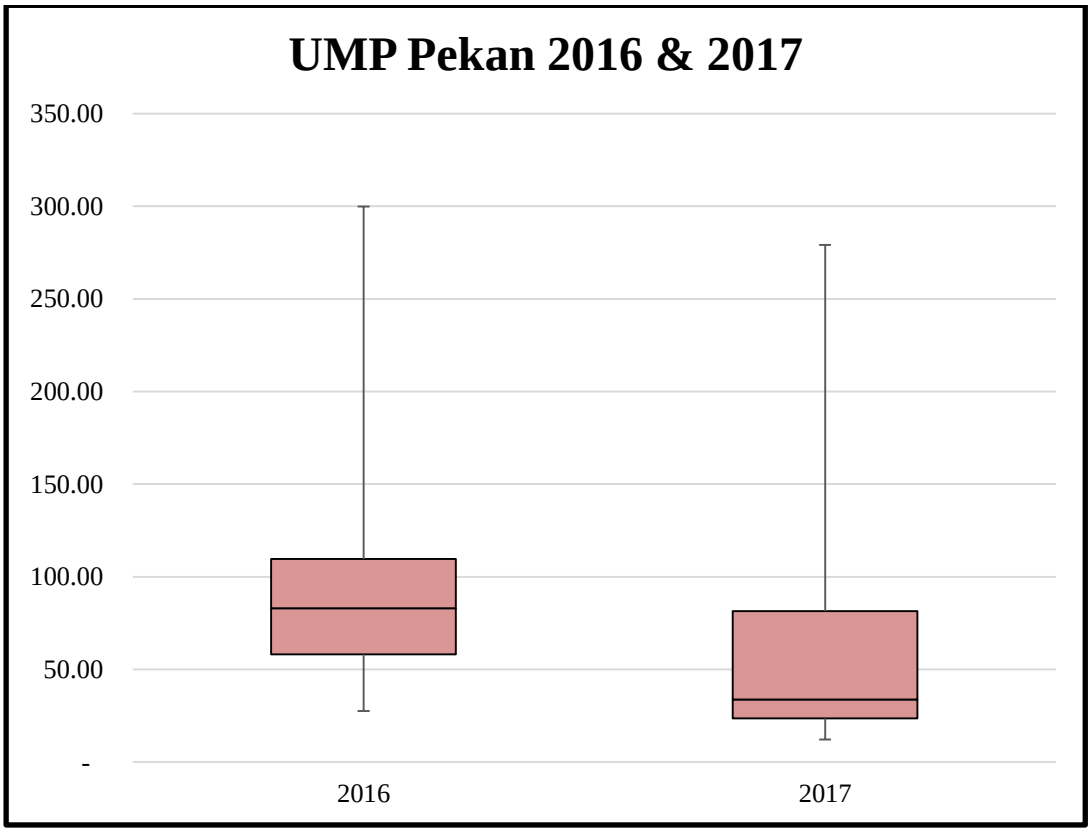


Figure 4.3: Box-Plot data for UMP Pekan for year 2016 and 2017

	2016	2017
Min	27.50	12.10
Q1	58.20	23.60
Median	83.00	33.80
Q3	109.70	81.50
Max	299.90	279.20
Box 1 - hidden	58.20	23.60
Box 2 - lower	24.80	10.20
Box 3 - upper	26.70	47.70
Whisker Top	190.20	197.70
Whisker Bottom	30.70	11.50

Table 4.11: Tabled Box-Plot data for UMP Pekan for year 2016 and 2017

From the figure 4.3 and table 4.11, the data that is presented is for rainfall data in UMP Pekan rain gauge. For year 2016, the maximum whisker shows the highest captured rainfall data with amount of 299.9 mm in October, and the lowest whisker with amount of 27.5 mm of rainfall which is in April whereas for 2017, the highest and lowest rainfall data collected is 279.2 mm and 15.3 mm respectively which the highest collected is in October and lowest is in February. Whereas for the median for both year 2016 and 2017 is 83.00 mm and 33.80 which represents the average of rainfall for both respective years.

For year 2016, the box-plot as referred from the journal, it is tend towards upward (positive) skewness as in having a much more positive trend of rainfall data for that year with the whisker of the box-plot is much higher proportionate towards the upper box-plot than the lower whisker thus making it a positive trend for year 2016. As for year 2017, the proportion of the box-plot tends to be the same as the year 2016, so it can also be interpreted as a upward (positive) skewness which is a positive trend. Thus from 2016 to 2017 there is a same trend of rainfall which is positive trend.

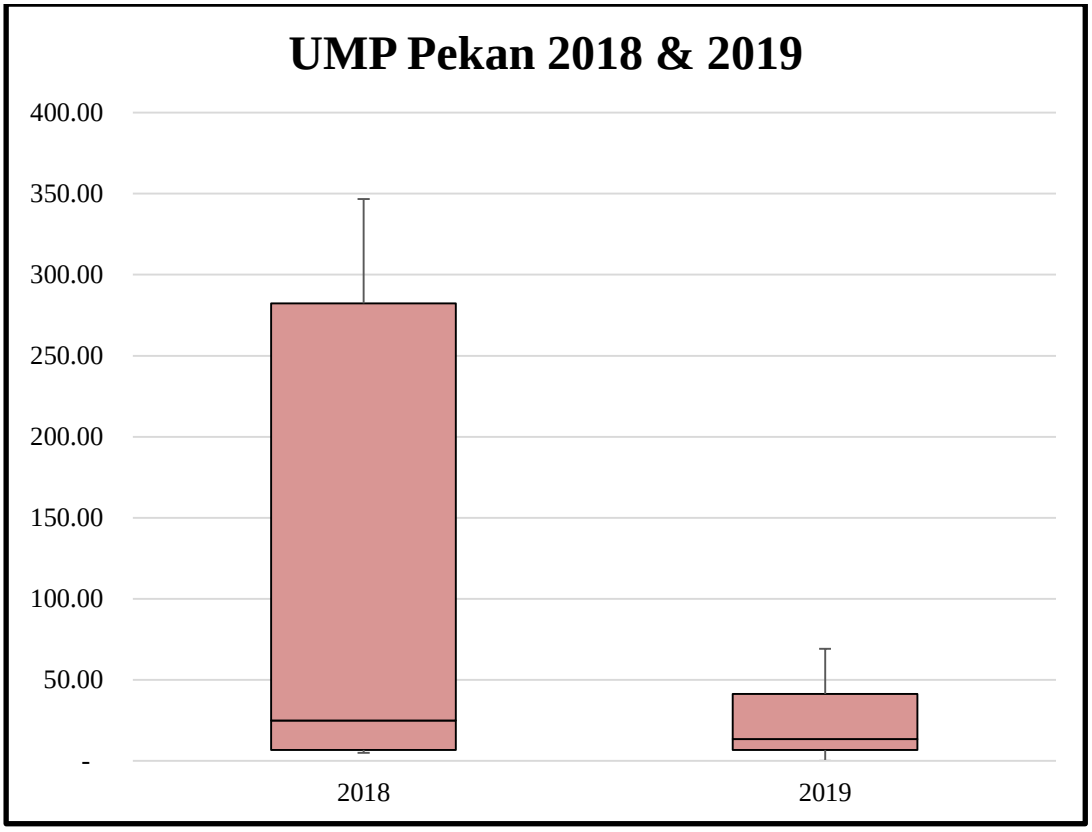


Figure 4.4: Box-Plot data for UMP Pekan for year 2018 and 2019

	2018	2019
Min	5.10	-
Q1	6.85	6.80
Median	25.00	13.60
Q3	282.33	41.45
Max	346.70	69.30
Box 1 - hidden	6.85	6.80
Box 2 - lower	18.15	6.80
Box 3 - upper	257.33	27.85
Whisker Top	64.38	27.85
Whisker Bottom	1.75	6.80

Table 4.12: Tabled Box-Plot data for UMP Pekan for year 2018 and 2019

From the figure 4.4 and table 4.12, the data that is presented is for rainfall data in UMP Pekan rain gauge. For year 2018, the maximum whisker shows the highest captured rainfall data with amount of 346.7 mm in December, and the lowest whisker with amount of 5.1 mm of rainfall which is in May whereas for 2019, the highest and lowest rainfall data collected is 69.3 mm and 0 mm respectively which the highest collected is in January and lowest in March. The median for both year 2018 and 2019 is 25.00 mm and 13.60 mm respectively which represents the average rainfall for that year. Year 2019 is only collected up until March, so there is not much data to be used for its box-plot.

For year 2018, the box-plot as referred from the journal, it has large dispersion of data in the middle, but has a high maximum whisker tends to be a upwards (positive) skewness so it can be classified as a positive trend for the year 2018. As for year 2019, the proportion is small and the dispersion is also small, thus it can be categorized as small dispersion, zero skewness as in no trend for the year 2019. Thus from 2017 to 2018 there is a no decrease of increase of trend of rainfall but from 2018 to 2019 there is a decreased of trend from positive trend to zero trend.

4.3 Rainfall data with temperature for UMP Gambang and UMP Pekan

Table 4.1 until Table 4.10 below are hydrological data that is obtained from the weather station in Kolej Kediaman 2 in UMP Gambang campus.

Table 4.13: Data for February 2016

Day	Temperature (˚C)		Rainfall (mm)		Total Rainfall (mm)
	Minimum	Maximum	Minimum	Maximum	
1	24.3	32.9	0	0.2	0.4
2	24.2	32.8	0	0.0	0.0
3	24.3	31.5	0	4.0	26.0
4	24.6	28.6	0	4.8	31.6
5	25.3	28.4	0	3.8	24.2
6	25.6	28.8	0	3.0	9.2
7	24.4	28.4	0	2.6	10.6
8	24.3	28.7	0	0.4	0.6
9	23.7	29.5	0	0.0	0.0
10	24.9	29.9	0	0.0	0.0
11	24.6	31.5	0	0.2	1.0
12	25.4	32.1	0	2.4	3.2
13	25.0	31.3	0	0.2	0.2
14	24.9	31.3	0	0.2	0.4
15	25.1	31.6	0	2.6	5.8
16	24.9	31.4	0	0.2	0.2
17	24.1	31.2	0	0.2	0.2
18	23.9	31.3	0	0.4	1.8
19	25.1	29.3	0	2.8	8.0
20	24.1	30.9	0	0.6	0.6
21	23.6	30.9	0	0.0	00
22	22.1	32.3	0	0.0	0.0
23	23.4	32.6	0	0.0	0.0
24	23.7	31.7	0	3.0	4.4
25	24.6	31.7	0	0.0	0.0
26	25.0	31.2	0	0.0	0.0
27	24.8	31.3	0	1.2	3.8
28	24.3	29.3	0	1.0	5.4
29	25.3	31.3	0	0.0	0.0

Table 4.13 shows a complete data for the month of February 2016. It is adequate to be analysed.

Table 4.14: Data for March 2016

Day	Temperature (˚C)		Rainfall (mm)		Total Rainfall (mm)
	Minimum	Maximum	Minimum	Maximum	
1	24.4	32.2	0	0.0	0.0
2	24.4	32.1	0	0.0	0.0
3	24.1	31.3	0	0.0	0.0
4	25.1	33.1	0	0.0	0.0
5	25.2	31.3	0	3.2	8.4
6	25.0	32.2	0	0.2	0.2
7	24.8	32.5	0	0.0	0.0
8	25.4	33.3	0	0.0	0.0
9	24.3	33.8	0	0.0	0.0
10	25.0	33.7	0	0.0	0.0
11	24.8	33.4	0	0.0	0.0
12	24.7	32.3	0	0.0	0.0
13	25.3	32.7	0	0.0	0.0
14	26.4	33.6	0	0.0	0.0
15	24.4	33.9	0	0.0	0.0
16	22.4	32.9	0	0.0	0.0
17	23.7	33.8	0	0.0	0.0
18	23.5	33.1	0	0.0	0.0
19	24.8	33.1	0	0.0	0.0
20	25.8	33.7	0	0.0	0.0
21	26.6	32.5	0	0.0	0.0
22	26.5	34.2	0	6.2	7.2
23	25.3	32.9	0	0.0	0.0
24	24.6	33.1	0	0.0	0.0
25	23.8	34.3	0	0.0	0.0
26	26.0	33.7	0	0.4	0.6
27	25.7	33.2	0	0.0	0.0
28	24.4	30.5	0	3.0	16.6
29	24.9	32.3	0	0.0	0.0
30	24.7	33.2	0	0.0	0.0
31	24.4	33.3	0	0.0	0.0

Table 4.14 shows a complete hydrological data for the month of March 2016.

Table 4.15: Data for April 2016

Day	Temperature (˚C)		Rainfall (mm)		Total Rainfall (mm)
	Minimum	Maximum	Minimum	Maximum	
1	24.7	33.8	0	0.0	0.0
2	25.2	33.3	0	0.0	0.0
3	24.4	32.7	0	0.2	0.4
4	25.8	33.8	0	0.0	0.0
5	25.6	32.8	0	0.0	0.0
6	24.9	34.4	0	0.0	0.0
7	23.4	35.0	0	0.0	0.0
8	24.1	33.8	0	0.0	0.0
9	24.6	34.1	0	0.0	0.0
10	33.8	25.4	0	0.0	0.0
11	26.7	36.2	0	0.6	0.6
12	26.7	34.9	0	2.2	6.0
13	25.8	34.5	0	0.6	1.2
14	25.6	35.8	0	3.4	5.0
15	26.0	32.3	0	0.2	0.4
16	25.8	35.3	0	0.0	0.0
17	25.9	34.4	0	6.8	9.6
18	25.6	33.9	0	0.0	0.0
19	26.0	35.2	0	0.0	0.0
20	25.8	35.2	0	1.6	1.8
21	25.8	34.2	0	0.0	0.0
22	26.0	33.8	0	0.0	0.0
23	25.9	33.8	0	1.2	1.8
24	25.8	33.7	0	0.8	1.6
25	25.3	35.9	0	0.4	0.4
26	25.0	34.8	0	0.0	0.0
27	26.0	34.4	0	0.0	0.0
28	26.4	34.6	0	0.8	2.8
29	26.7	34.4	0	0.0	0.0
30	25.7	35.4	0	0.2	0.6

Table 4.15 shows a complete hydrological data for the month of April 2016. This month is adequate to be analysed.

Table 4.16: Data for May 2016

Day	Temperature (˚C)		Rainfall (mm)		Total Rainfall (mm)
	Minimum	Maximum	Minimum	Maximum	
1	25.2	34.0	0	1.4	2.4
2	24.8	32.6	0	10.8	32.2
3	24.1	34.6	0	0.0	0.0
4	25.8	34.4	0	0.0	0.0
5	25.6	34.5	0	0.0	0.0
6	25.7	31.4	0	0.0	0.0
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	-	-	-	-	-
11	-	-	-	-	-
12	-	-	-	-	-
13	-	-	-	-	-
14	-	-	-	-	-
15	-	-	-	-	-
16	-	-	-	-	-
17	-	-	-	-	-
18	-	-	-	-	-
19	-	-	-	-	-
20	-	-	-	-	-
21	-	-	-	-	-
22	-	-	-	-	-
23	-	-	-	-	-
24	-	-	-	-	-
25	-	-	-	-	-
26	-	-	-	-	-
27	-	-	-	-	-
28	-	-	-	-	-
29	-	-	-	-	-
30	-	-	-	-	-
31	-	-	-	-	-

Table 4.16 is data for May 2016 is not complete. This is due to equipment error. Therefore data for may not be compared with other months to find the comparison.

Table 4.17: Data for June 2016

Day	Temperature (˚C)		Rainfall (mm)		Total Rainfall (mm)
	Minimum	Maximum	Minimum	Maximum	
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	-	-	-	-	-
11	-	-	-	-	-
12	-	-	-	-	-
13	-	-	-	-	-
14	-	-	-	-	-
15	-	-	-	-	-
16	-	-	-	-	-
17	-	-	-	-	-
18	-	-	-	-	-
19	-	-	-	-	-
20	-	-	-	-	-
21	-	-	-	-	-
22	-	-	-	-	-
23	-	-	-	-	-
24	-	-	-	-	-
25	-	-	-	-	-
26	-	-	-	-	-
27	-	-	-	-	-
28	-	-	-	-	-
29	-	-	-	-	-
30	-	-	-	-	-

Table 4.17 is data for June 2016 is also not complete due to equipment error. Month of June 2016 cannot be analysed and compared with other months.

.

Table 4.18: Data for July 2016

Day	Temperature (˚C)		Rainfall (mm)		Total Rainfall (mm)
	Minimum	Maximum	Minimum	Maximum	
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	23.1	34.6	0	18.2	39.6
10	24.1	33.1	0	0.4	1.6
11	23.8	34.5	0	0.2	0.2
12	24.9	34.6	0	0.2	0.2
13	24.7	33.7	0	1.2	1.2
14	24.1	34.1	0	0.2	0.2
15	23.6	33.4	0	3.6	4.8
16	24.8	31.7	0	6.2	12.8
17	23.4	34.6	0	3.2	8.8
18	23.4	34.2	0	2.6	8.2
19	23.6	31.8	0	4.0	5.4
20	23.4	32.7	0	4.0	14.4
21	23.3	32.6	0	0.0	0.0
22	23.6	29.1	0	0.0	0.0
23	23.5	32.1	0	0.2	0.2
24	23.7	33.4	0	4.6	9.2
25	23.2	30.1	0	0.2	0.2
26	23.2	31.5	0	10.0	28.6
27	22.9	25.1	0	0.0	0.0
28	-	-	-	-	-
29	-	-	-	-	-
30	-	-	-	-	-
31	-	-	-	-	-

Table 4.18 is data for July 2016 is also not complete due to equipment error. This month is not adequate to be analysed.

.

Table 4.19: Data for August 2016

Day	Temperature (˚C)		Rainfall (mm)		Total Rainfall (mm)
	Minimum	Maximum	Minimum	Maximum	
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	-	-	-	-	-
11	-	-	-	-	-
12	-	-	-	-	-
13	-	-	-	-	-
14	-	-	-	-	-
15	-	-	-	-	-
16	-	-	-	-	-
17	-	-	-	-	-
18	-	-	-	-	-
19	-	-	-	-	-
20	-	-	-	-	-
21	-	-	-	-	-
22	26.6	28.9	0	0.0	0.0
23	23.9	34.6	0	4.8	11.6
24	24.3	31.6	0	0.2	0.2
25	24.7	33.8	0	2.2	4.0
26	24.2	32.7	0	0.2	0.4
27	24.6	30.5	0	0.0	0.0
28	24.2	32.2	0	5.6	27.4
29	23.7	33.4	0	2.6	5.8
30	23.6	27.9	0	4.6	21.6
31	23.3	33.8	0	0.0	0.0

Table 4.19 is data for August 2016 is not complete due to equipment error. Therefore it is not suitable to be analysed.

Table 4.20: Data for September 2016

Day	Temperature (˚C)		Rainfall (mm)		Total Rainfall (mm)
	Minimum	Maximum	Minimum	Maximum	
1	24.7	33.6	0	5.0	8.0
2	23.3	32.7	0	0.0	0.0
3	23.3	34.5	0	0.0	0.0
4	23.8	33.1	0	5.2	6.0
5	24.0	34.3	0	0.2	0.2
6	23.3	33.6	0	11.0	25.0
7	23.5	30.8	0	0.0	0.0
8	23.2	31.6	0	15.4	37.4
9	23.1	33.2	0	0.2	0.2
10	23.4	33.1	0	0.0	0.0
11	24.3	33.9	0	0.2	0.6
12	23.6	31.8	0	7.4	14.4
13	23.7	34.2	0	0.0	0.0
14	24.1	32.9	0	5.8	7.8
15	24.2	34.8	0	1.6	5.0
16	24.1	33.2	0	0.0	0.0
17	24.4	32.2	0	0.2	0.8
18	22.7	33.4	0	8.6	27.6
19	22.3	33.2	0	0.2	0.6
20	24.2	32.8	0	0.0	0.0
21	23.7	29.4	0	14.0	40.2
22	23.4	28.9	0	0.2	1.2
23	23.3	33.3	0	0.4	1.2
24	23.4	33.6	0	0.2	0.4
25	22.4	30.5	0	5.0	25.6
26	23.1	33.4	0	0.0	0.0
27	22.3	34.3	0	3.2	17.8
28	23.0	32.9	0	0.6	1.0
29	24.1	32.1	0	0.2	0.2
30	32.7	32.9	0	1.0	1.2

Table 4.20 is data for September 2016 is complete and adequate to be analysed.

Table 4.21: Data for October 2016

Day	Temperature (˚C)		Rainfall (mm)		Total Rainfall (mm)
	Minimum	Maximum	Minimum	Maximum	
1	22.5	33.2	0	11.6	22.0
2	25.0	33.8	0	0.0	0.0
3	25.2	32.2	0	0.0	0.0
4	24.5	34.2	0	2.6	6.2
5	23.7	32.8	0	0.0	0.0
6	23.0	31.3	0	0.6	1.2
7	22.5	31.1	0	0.2	0.2
8	24.4	32.7	0	0.0	0.0
9	24.4	32.3	0	0.6	2.4
10	23.7	34.1	0	0.4	0.8
11	23.8	34.4	0	0.2	0.4
12	23.2	34.3	0	15.2	43.6
13	23.5	33.1	0	1.2	2.8
14	23.7	32.7	0	8.6	15.8
15	23.8	32.8	0	0.0	0.0
16	24.4	31.1	0	16.2	55.4
17	24.4	30.3	0	0.2	0.2
18	25.4	31.2	0	0.0	0.0
19	24.3	30.7	0	2.0	10.2
20	24.3	33.8	0	0.6	1.2
21	25.3	32.8	0	0.2	0.4
22	24.4	28.2	0	3.4	9.2
23	23.8	32.6	0	0.4	1.8
24	23.6	33.8	0	0.4	4.2
25	23.7	32.2	0	10.6	19.2
26	23.0	32.8	0	1.6	6.8
27	23.6	29.1	0	0.8	13.4
28	23.1	32.7	0	0.2	0.2
29	23.7	31.3	0	11.6	34.2
30	23.2	31.7	0	9.8	17.0
31	23.2	32.8	0	9.4	27.2

Table 4.21 is data for October 2016 and is complete and adequate to be analysed.

Table 4.22: Data for November 2016

Day	Temperature (˚C)		Rainfall (mm)		Total Rainfall (mm)
	Minimum	Maximum	Minimum	Maximum	
1	24.1	29.9	0	0.2	4.2
2	24.4	32.7	0	6.6	10.6
3	24.0	32.0	0	0.0	0.0
4	23.8	31.9	0	4.2	7.6
5	23.5	31.7	0	15.0	57.6
6	23.2	33.4	0	4.4	14.4
7	23.2	30.4	0	9.2	40.2
8	24.4	33.7	0	2.6	3.2
9	23.9	32.2	0	5.4	17.6
10	23.3	31.6	0	3.8	6.4
11	24.0	30.3	0	1.8	3.4
12	23.4	29.9	0	3.6	7.6
13	22.8	31.2	0	1.6	1.8
14	24.0	26.1	0	3.2	13.2
15	22.3	31.9	0	0.8	2.0
16	23.7	28.4	0	0.6	2.8
17	23.6	32.6	0	5.6	18.6
18	23.7	31.9	0	0.6	2.6
19	24.6	31.7	0	1.0	2.2
20	24.3	33.6	0	9.6	26.4
21	24.5	32.5	0	0.8	0.8
22	24.6	31.6	0	7.4	22.4
23	23.9	32.8	0	0.2	0.2
24	24.1	29.7	0	2.4	12.6
25	24.3	31.4	0	11.8	27.2
26	24.0	30.6	0	4.4	11.0
27	24.4	29.9	0	0.4	0.8
28	23.6	30.3	0	0.2	0.8
29	22.9	26.2	0	1.4	40.2
30	22.2	32.2	0	0.0	0.0

Table 4.22 shows data for November 2016. The data is complete and adequate to be analysed.

Table 4.23: Data for December 2016

Day	Temperature (˚C)		Rainfall (mm)		Total Rainfall (mm)
	Minimum	Maximum	Minimum	Maximum	
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	-	-	-	-	-
11	-	-	-	-	-
12	-	-	-	-	-
13	-	-	-	-	-
14	-	-	-	-	-
15	-	-	-	-	-
16	-	-	-	-	-
17	-	-	-	-	-
18	-	-	-	-	-
19	-	-	-	-	-
20	-	-	-	-	-
21	-	-	-	-	-
22	-	-	-	-	-
23	-	-	-	-	-
24	-	-	-	-	-
25	-	-	-	-	-
26	-	-	-	-	-
27	-	-	-	-	-
28	-	-	-	-	-
29	-	-	-	-	-
30	-	-	-	-	-

Table 4.23 is data for December 2016 is also not complete due to equipment error. Month of June 2016 cannot be analysed and compared with other months.

Table 4.24: Summary data for year 2016 in UMP Gambang

Months	Total Rainfall (mm)	Maximum Temperature (˚C)	Minimum Temperature (˚C)	Average Rainfall mm/day
Jan-16	52.0	33.6	23.6	1.7
Feb-16	137.4	32.9	22.1	4.7
Mar-16	33.0	34.3	22.4	1.1
Apr-16	32.2	36.2	23.4	1.1
May-16	34.6	34.6	24.1	1.1
Jun-16	0	0	0	0.0
Jul-16	135.6	34.6	22.9	4.4
Aug-16	71	34.6	23.3	2.3
Sep-16	222.4	34.8	22.3	7.4
Oct-16	296.0	33.3	22.2	9.5
Nov-16	358.4	29.7	23.4	11.9
Dec-16	0	0	0	0

In table 4.24, the incomplete data are in the months of May 2016, June 2016, July 2016, August 2016 and December 2016. Therefore these months are not really adequate to be analysed. This hydrological data from January 2016 until November 2016 are obtained from thesis of previous student so that further analysis of trend can be done for this research to compare with the box-plot method.

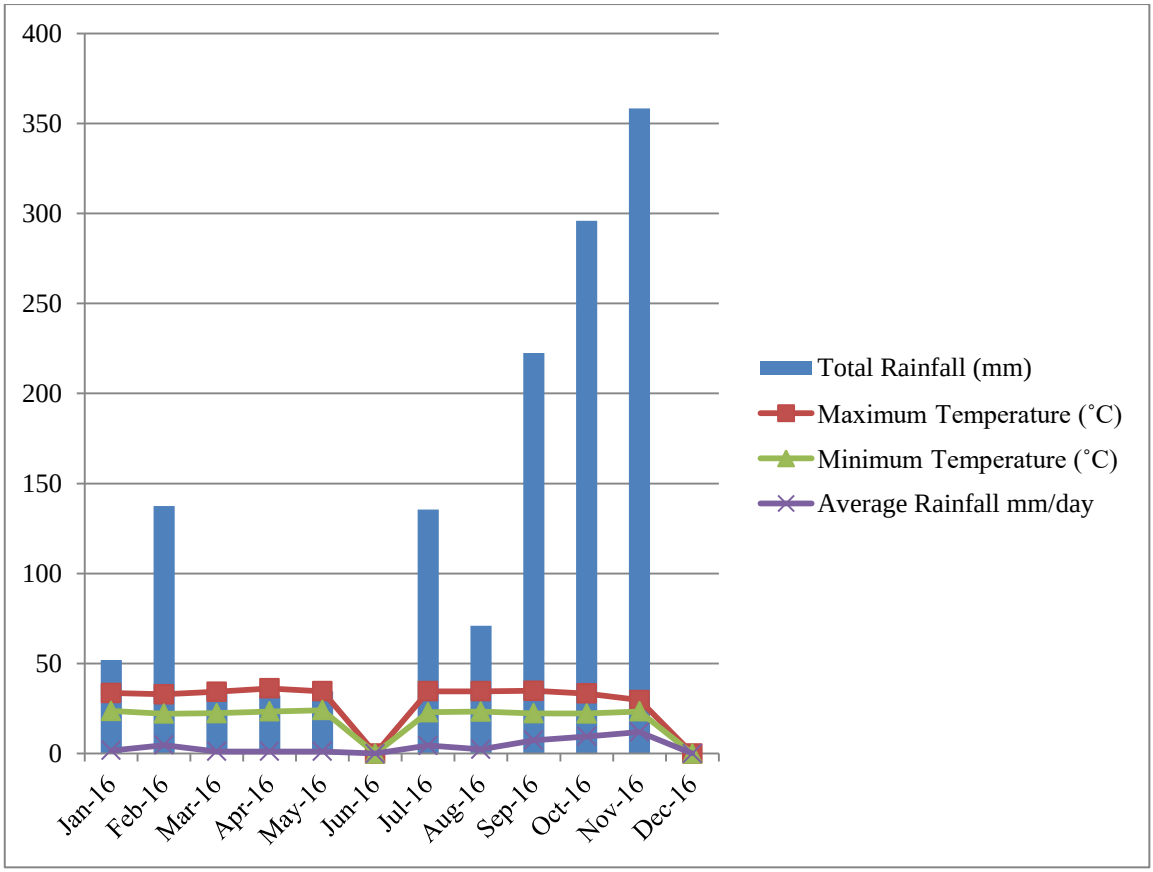


Figure 4.5: Bar chart for summary data of UMP Gambang 2016

Based on figure 4.5, data shows from January 2016 until December 2016. The highest total rainfall is the month of November 2016 which is 358.4mm. The lowest total evapotranspiration is also in the month of November which is 78.47mm. The minimum temperature is also in the same month which is 29.7˚C. November 2016 has the highest average rainfall compared to other months which is 11.9mm/day. This shows that rainfall can affect the temperature reading. April 2016 shows that the total rainfall value is low but it achieves the highest total of temperature compared to other month. From there, the total rainfall value starts to rise little by little and further increases in July 2016. After that the total rainfall starts to decrease again in August 2016 increase gradually again until it reach the highest peak on November 2016.On the other hand, the temperature shows that comes along with the rainfall trend, the temperature tends to drop lower during the rainfall period and it can be seen during the last month of the year where the temperature kept lowering and rainfall kept to increase.

Table 4.25: Summary data for year 2016 in UMP Pekan

Months	Total Rainfall (mm)	Average rainfall (mm/day)	Maximum Temperature (˚C)	Minimum Temperature (˚C)
Jan-16	0	0	0	0
Feb-16	75.7	2.6	38.8	23
Mar-16	41.3	1.3	37.4	22.6
Apr-16	27.5	0.9	40	23.2
May-16	211.8	6.8	41.1	23.4
Jun-16	58.2	1.9	40	22.7
Jul-16	83	2.7	39.5	22.3
Aug-16	109.7	3.5	40.2	22.5
Sep-16	91.5	3.1	39.4	21.1
Oct-16	299.9	9.7	41.3	21.9
Nov-16	0	0	0	0
Dec-16	0	0	0	0

Table 4.25 shows that the data for December 2015 is not complete. It is due to equipment error.

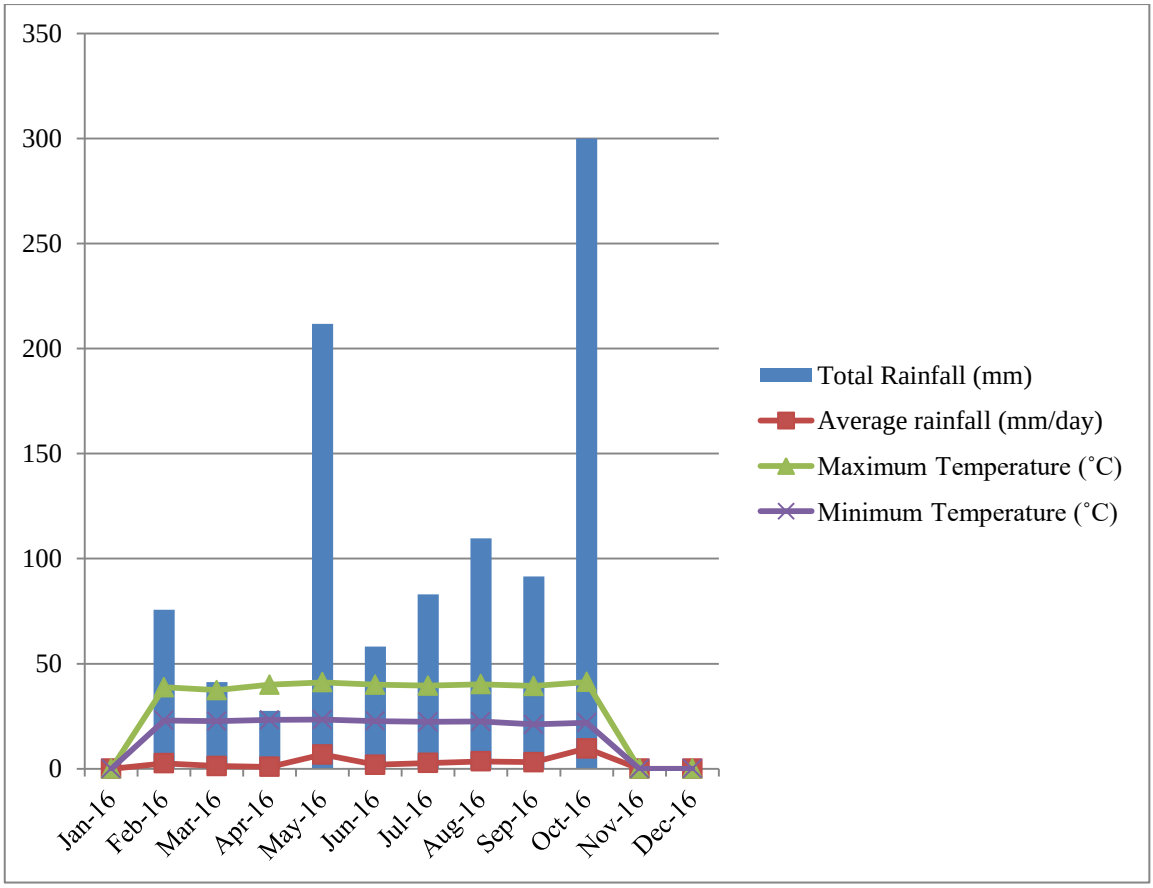


Figure 4.6: Bar chart for summary data of UMP Pekan 2016

Figure 4.6 shows data from October 2015 to October 2016. The data for the month of October 2015 until January 2016 are taken from previous thesis of student so that the figure 4.2 would show one year set of data. The highest total rainfall is in October 2016 which is 299.9mm. The highest maximum temperature is also in the same month which is 41.3˚C. This shows that the weather pattern in UMP Pekan campus is very different from the weather pattern in UMP gambang campus. This is due to different in location of weather station.

Table 4.26 and Table 4.27, and figure 4.7 and figure 4.8 below shows the hydrological data that is obtained from the weather station in Kolej Kediaman 2 in UMP Gambang and UMP Pekan.

Table 4.26: Summary data for UMP Gambang from April 2018 until March 2019

Month	Total Rainfall	Maximum Temperature	Minimum Temperature
Apr-18	23.8	34.7	23
May-18	102.8	41.6	21.1
Jun-18	194.4	41.5	22.7
Jul-18	76.6	40.4	22.7
Aug-18	52.2	41	22.8
Sep-18	173.8	40	23
Oct-18	236.2	41.2	21.7
Nov-18	183.4	39.3	23.6
Dec-18	266.6	40.2	22.1
Jan-19	108.8	39.1	21.4
Feb-19	77.4	39.2	20.7
Mar-19	10	41.6	20.2

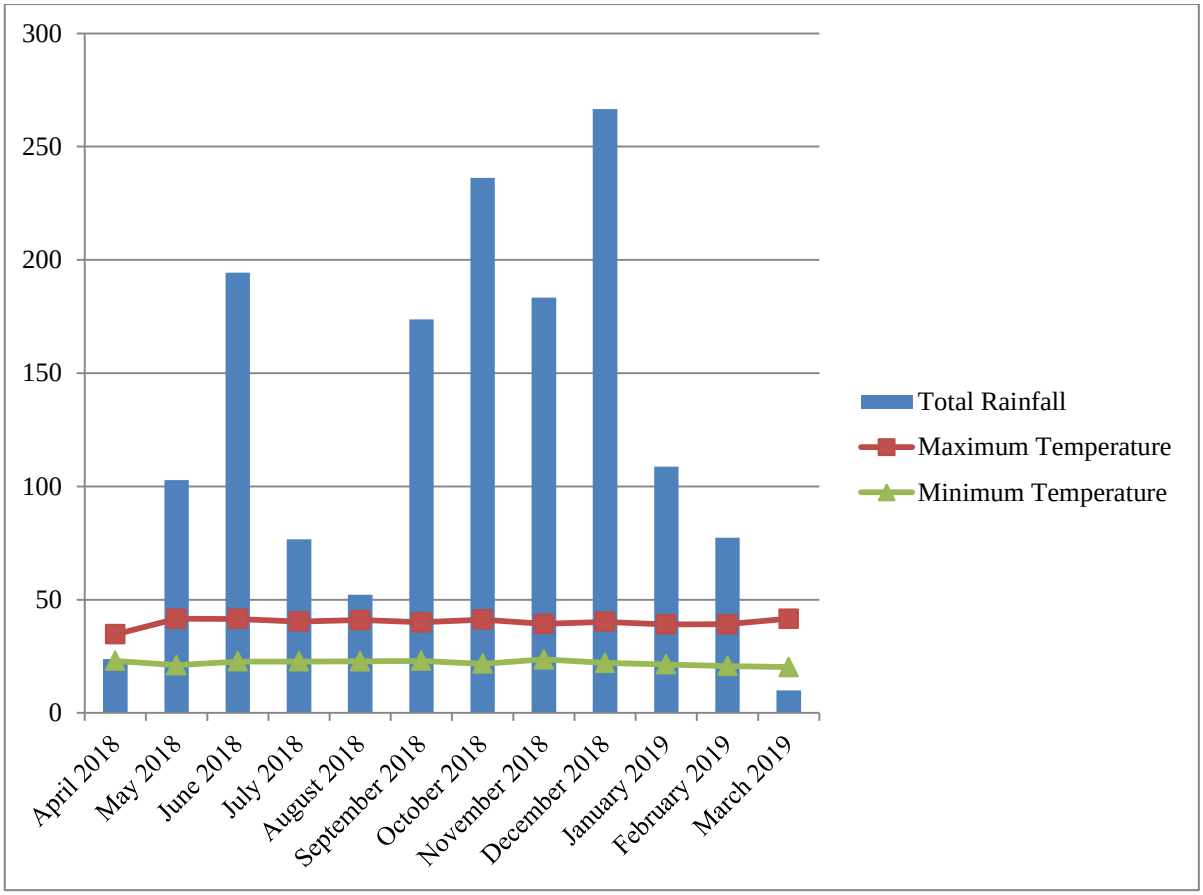


Figure 4.7: UMP Gambang rainfall and temperature data for April 2018 until March 2019

Figure 4.7 shows data from April 2018 to March 2019. The data for the month of April 2018 until July 2018 are taken from previous thesis of student so that the figure 4.5 would show one year set of data. The highest total rainfall is in December 2018 which is 266.6mm. The highest maximum temperature is in May 2018 which is 41.6 ˚C. For UMP Gambang there are about 8 times in a year span that the temperature raises above more than 40 ˚C. This shows that the weather pattern in UMP Gambang campus is slightly different from the weather pattern in UMP Pekan campus although the rainfall trend of increasing and decreasing is slightly the same which more rainfall occurs at the end of the year. As for the temperature, the difference is due to different in location of weather station.

Table 4.27: Summary data for UMP Pekan from April 2018 until March 2019

Month	Total Rainfall	Maximum Temperature	Minimum Temperature
Apr-18	-	-	-
May-18	5.1	41.6	23.4
Jun-18	6.9	39.7	22.3
Jul-18	6.7	38.6	21.7
Aug-18	7.6	38.3	20.5
Sep-18	42.4	38.8	21.9
Oct-18	261.9	41.6	22.0
Nov-18	343.6	39.5	22.6
Dec-18	346.7	39.1	22.8
Jan-19	69.3	39.7	22.0
Feb-19	13.6	37.7	21.9
Mar-19	0	38.8	21.1

Table 4.27 shows the data that have been taken by me for this research from August 2018 until March 2019, the data from April 2018 until July 2018 is taken from past researchers. The data from April 2018 is missing because of equipment error so there will be no valid data to be stored.

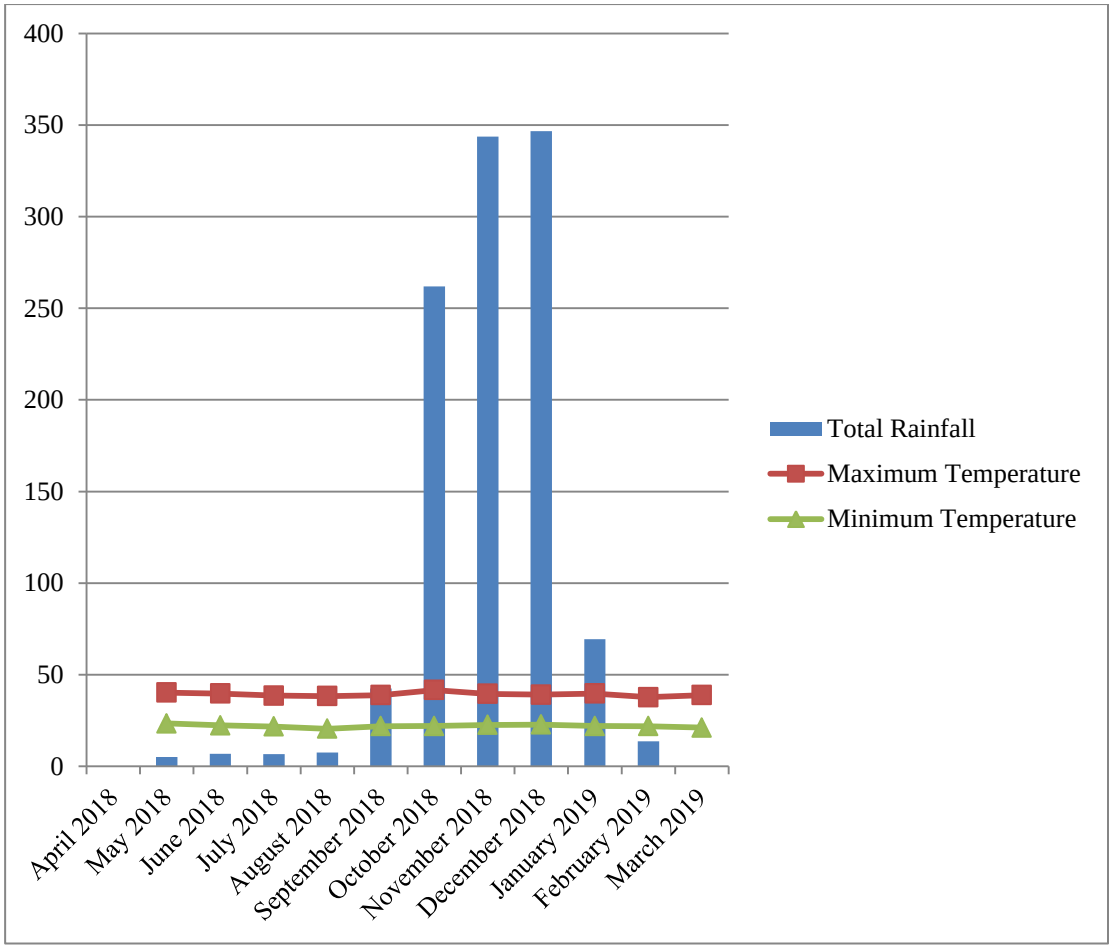


Figure 4.8: UMP Pekan rainfall and temperature data for April 2018 until March 2019

Figure 4.8 shows data from April 2018 to March 2019. All the data for the month are taken and collected by me for this research, the figure 4.6 would show one year set of data. The highest total rainfall is in December 2018 which is 346.7 mm. The highest maximum temperature is recorded to be in May 2018 and October 2018 which is 41.6˚C. This shows that the weather pattern in UMP Pekan campus is slightly different from the weather pattern in UMP Gambang campus but as for rainfall patter, from this chart point of view it shows that the rainfall pattern for UMP Pekan and UMP Gambang is slightly similar even though the places are far way and different but as for the temperature is quite different due to different in location of weather station.

Table 4.28: Summary data for UMP Gambang for total rainfall and average rainfall per month

Gambang		
Year	Total Rainfall (mm)	Average Rainfall per month (mm)
2016	1072.8	89.4
2017	972.5	81.04
2018	1309.8	109.15
2019	196.2	65.4

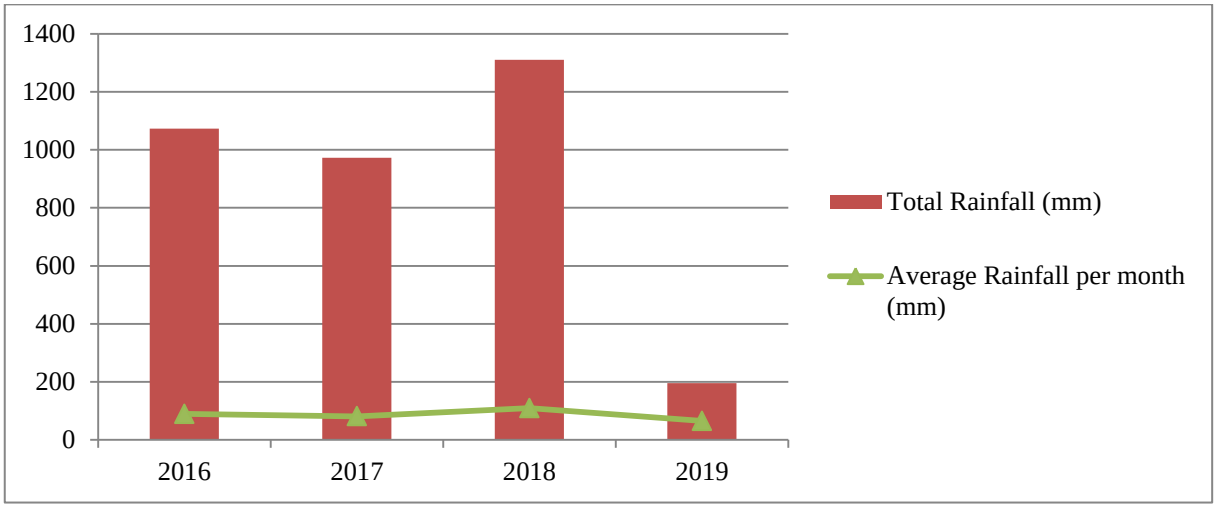


Figure 4.9: Bar chart summary data average rainfall per month and total rainfall UMP Gambang

Table 4.28 and figure 4.9 shows a summary data of UMP Gambang with a total rainfall data and average rainfall per month. As for the years that have been recorded within 4 years, the highest data of rainfall collected throughout the years is in year 2018 with a total of 1309.8 mm with averaging of 109.15 mm per month. Other than that, the lowest data excluding the year 2019 because lack of one year data, is the year 2017 with a total of 972.5 mm of rainfall data collected for that year and averaging with 81.04 per month of rainfall for that year. And as for figure 4.13 it shows that the trend of rainfall is high in 2016 and decreases in 2017 and then increases again in 2018 being the highest and decreases in 2019 but because of lack of data.

Table 4.29: Summary data for UMP Pekan for total rainfall and average rainfall per month

Pekan		
Year	Total Rainfall (mm)	Average Rainfall per month (mm)
2016	991.4	82.62
2017	994.7	82.89
2018	1020.9	85.08
2019	82.9	27.63

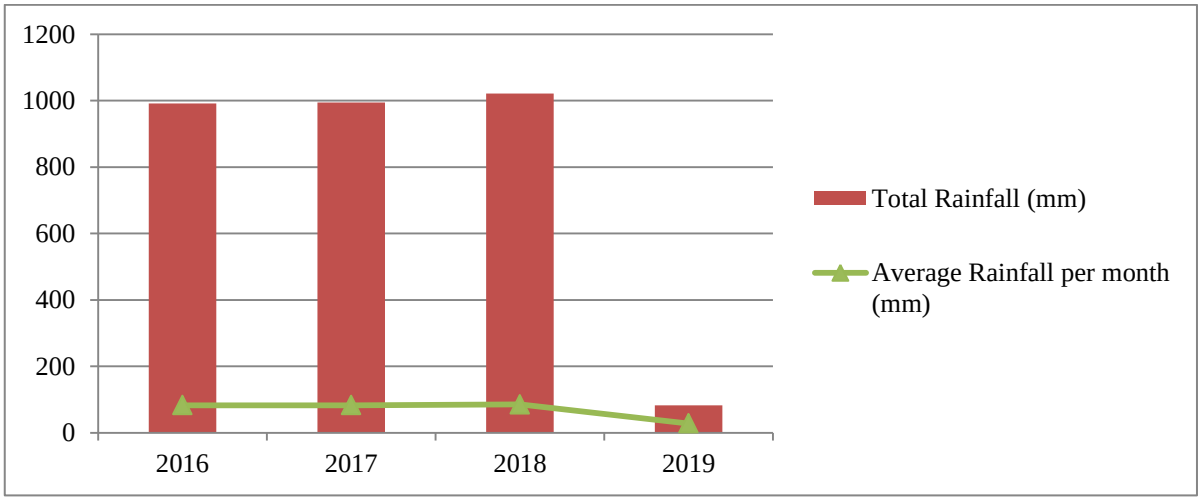


Figure 4.10: Bar chart summary data average rainfall per month and total rainfall UMP Gambang

Table 4.29 and figure 4.10 shows a summary data of UMP Gambang with a total rainfall data and average rainfall per month. As for the years that have been recorded within 4 years, the highest data of rainfall collected throughout the years is in year 2018 with a total of 1020.9 mm with averaging of 85.08 mm per month. Other than that, the lowest data excluding the year 2019 because lack of one year data, is the year 2016 with a total of 991.4 mm of rainfall data collected for that year and averaging with 86.62 per month of rainfall for that year. And as for figure 4.13 it shows that the trend of rainfall is the lowest in 2016 and slightly increases in 2017 and then increases again in 2018 being the highest and decreases in 2019 but because of lack of data.

4.4 Setting Up and Improving Weather Station in UMP Pekan

Figure 4.11: Setting up the weather station in UMP Pekan

In the figure 4.11, the weather station at UMP Pekan are set up before the installation of solar panel to make sure that the data that was stored up are not lost before linking the weather station control receiver to the solar panel.

Figure 4.12: Linking the weather station console to the solar panel

In figure 4.12, the weather station control receiver is being linked up to the solar panel, this is done corresponding to the objective two for this research in improving the weather station. This is also because that the weather station before this was plugged into a plug situated near the kindergarten, but the electricity was cut off and rendered the weather station control to be running on battery instead. Thus, after surviving on battery for long enough, the battery power has run out and thus making the data stored to be disappeared and by installing this solar panel, which are capable of powering up the weather station control receiver during the day and should also be enough throughout the night. From this, the loss of data could be avoided in the long run when next researcher wants to collect and compare the data collected from the weather station.

Figure 4.13: Solar panel that is installed to link with the weather console

Figure 4.14: Weather station console successfully linked up with the solar panel and powered up by the solar panel

CHAPTER 5

CONCLUSION

5.1 Conclusion

The objective no. 1 has been achieved. Weather at UMP Gambang campus shows that rainfall trend is varied throughout the year and would increase and decrease the following year. It can be concluded that near the end of each year which is around October to December, both UMP Gambang and UMP Pekan collected the highest rainfall data reading. Which mean that rain season mostly occurred around that period of time. For UMP Gambang the trend that has been collected from the box-plot method is that for year 2016 until 2019, the trend is positive for 2016, year after for 2017 is zero trend the same as 2018, and for 2019 the trend decreases towards negative trend. As for UMP Pekan, the trend that has been achieved and collected from the box-plot method is that the trend for 2016 until 2018 is a positive trend for the rainfall trend and as for 2019 there is no trend so there is a decrease from the year before. This happened because it could be also the lack of full monthly data collected since there missing data from the rain gauge.

Objective two is achieved in setting up weather station at UMP Pekan campus. From the installation of solar panel to the weather station console panel, the weather station console panel can operate much better and could prevent any loss of data from the weather station so that future researchers could make a more accurate presentation of rainfall data and be able to determine the rainfall trend to be more detailed.

5.2 Recommendation

A few recommendations are suggested to improve and help the further researcher in this field. The recommendation is based on the experience after conducting all the works. Below are some of recommendations for next researcher to have a better performance of this study. The recommendations are as follows:-

a) The next student should continue to collect more rainfall data in UMP Gambang and Pekan so that weather database for UMP can be recorded.

b) The duration for the collection data for weather station and rain gauge at Ump Gambang and Pekan should be prolonging to see clearly how the rainfall pattern in UMP area.

c) Regular checking on the rain gauge and weather station to avoid missing data.

REFERENCES

Amanda Sean Peik, L. (2017) 'Assessment of climate change impacts on rainfall series in Peninsular Madlaysia using statistical methods', p. 308.

Banacos, P. C. (2011) 'Eastern Region Technical Attachment Box and Whisker Plots for Local Climate Datasets : Interpretation and Creation using Excel 2007 / 2010', *Interpretation A Journal Of Bible And Theology*, Vol.1, pp. 2–20. doi: 10.1007/s00338-013-1085-2.

Parker, D. J., Priest, S. J. and Tapsell, S. M. (2008) 'Seasonal forecasting of Ethiopian Spring rains', *Meteorological Applications*, 15(January), pp. 73–83. doi: 10.1002/met.

Pettazi, A. and Salson,S., (2012). Combining radar and rain gauges rainfall estimates using conditional merging: A case study. In Erad 2012-The Sevnth European Conference On Radar In Meteorology and Hydrology

Gleick, P. H. (1989). *Climate change, hydrology, and water resources. Reviews of Geophysics, 27(3), 329.*doi:10.1029/rg027i003p00329

Hubbart, J.A. (2010). *Hydrologic cycle*. (n.d.). Retrieved January 02, 2017 (online) http://www.eoearth.org/view/article/153627/

Ho, M. K., & Yusof, F. (2012). Homogeneity Tests on Daily Rainfall Series in Peninsular Malaysia. *Int J Contemp Math Sciences*, 9-12.

Suhaila, J., & Jemain, A. A. (2009). A Comparison of the Peninsular of the Rainfall Patterns between Stations on the East and the West Coasts of Peninsular Malaysia Using the Smoothing Model of Rainfall Amounts. *Meteological Applications*, 391-401.

Subramanya, K. (2013). *Engineering Hydrology 4th edition.* New Delhi: Mcgraw Hill Education (India) Private Limited.

Pettazi, A., & Salson, S. (2012). *C*ombining Radar and Rain Gauges Rainfall Estimates using Conditional Merging: A case study. In Erad 2012-The Seventh European Conference on Radar in Meteorology and Hydrology.

Wang, K. (2013). *Engineering Hydrology 4th Edition.* New Delhi: McGraw Hill Education (India) Private Limited.

Tangang, F. T., Juneng, L., Salimun, E., Kwan, M. S., Loh, J. L., & Muhamad, H. (2012). Climate Change and Variability over Malaysia: Gaps in Science and Research Information. *Sains Malaysiana*, 1355-1366.

Song, Y. (2016). High Temporal Resolution Rainfall Information Retrieval from Tipping-Bucket Rain Gauge Measurements. *Procedia Engineering*, 1193-120

APPENDIX A
SAMPLE APPENDIX 1

		Temp	Hi	Low	Out	Dew	Wind	Wind	Wind	Hi	Hi	Wind	Heat	THW	THSW	
Date	Time	Out	Temp	Temp	Hum	Pt.	Speed	Dir	Run	Speed	Dir	Chill	Index	Index	Index	Bar
8/1/2019	1:00 PM	29.7	30	29.6	81	26.1	0	SSW	0	4.5	SSW	29.7	36.7	36.7	---	761
8/1/2019	1:30 PM	30.1	30.2	29.4	80	26.2	0	S	0	4.5	S	30.1	37.3	37.3	---	760.7
8/1/2019	2:00 PM	30.3	30.4	30.1	78	26.1	0.4	SSW	0.8	4	S	30.3	37.7	37.7	---	760.4
8/1/2019	2:30 PM	30.3	30.3	29.9	79	26.2	0	SSW	0	4	SSW	30.3	37.8	37.8	---	760
8/1/2019	3:00 PM	30.2	30.3	29.8	79	26.1	0	SSW	0	4	S	30.2	37.4	37.4	---	760
8/1/2019	3:30 PM	30.2	30.5	30.1	79	26.1	0	---	0	0	---	30.2	37.4	37.4	---	760
8/1/2019	4:00 PM	29.8	30.2	29.8	79	25.7	0	---	0	0	---	29.8	36.4	36.4	---	760
8/1/2019	4:30 PM	29.7	30.1	29.7	78	25.4	0	---	0	0	---	29.7	35.9	35.9	---	760
8/1/2019	5:00 PM	29.7	29.9	29.6	80	25.8	0	---	0	0	---	29.7	36.3	36.3	---	760
8/1/2019	5:30 PM	29.2	29.7	29.2	80	25.4	0	---	0	0	---	29.2	35.2	35.2	---	760
8/1/2019	6:00 PM	28.9	29.2	28.9	81	25.3	0	---	0	0	---	28.9	34.9	34.9	---	760
8/1/2019	6:30 PM	28.4	28.9	28.3	84	25.4	0	---	0	0	---	28.4	33.9	33.9	---	760

8/1/2019	7:00 PM	28	28.3	28	85	25.2	0	---	0	0	---	28	33.1	33.1	---	760
8/1/2019	7:30 PM	27.8	28	27.8	86	25.3	0	---	0	0	---	27.8	32.8	32.8	---	760
8/1/2019	8:00 PM	27.8	27.8	27.8	86	25.2	0	---	0	0	---	27.8	32.6	32.6	---	760
8/1/2019	8:30 PM	27.8	27.8	27.8	86	25.3	0	---	0	0	---	27.8	32.8	32.8	---	760
8/1/2019	9:00 PM	27.8	27.8	27.8	86	25.2	0	---	0	0	---	27.8	32.6	32.6	---	760
8/1/2019	9:30 PM	27.8	27.8	27.8	86	25.3	0	SSW	0	3.1	SSW	27.8	32.8	32.8	---	760
8/1/2019	10:00 PM	27.8	27.9	27.8	86	25.3	0	S	0	2.7	S	27.8	32.8	32.8	---	760
8/1/2019	10:30 PM	27.7	27.8	27.7	86	25.2	0.4	S	0.8	4	S	27.7	32.5	32.5	---	760
8/1/2019	11:00 PM	27.7	27.7	27.7	87	25.4	0	SSW	0	3.1	S	27.7	32.7	32.7	---	760
8/1/2019	11:30 PM	27.8	27.9	27.7	88	25.7	0	S	0	3.1	SSE	27.8	33.2	33.2	---	760
9/1/2019	12:00 AM	27.7	27.8	27.7	86	25.1	0	SW	0	3.1	SSW	27.7	32.3	32.3	---	760
9/1/2019	12:30 AM	27.7	27.7	27.6	88	25.5	0	WSW	0	3.1	WSW	27.7	32.7	32.7	---	760
9/1/2019	1:00 AM	27.6	27.7	27.6	86	25.1	0	SSW	0	2.7	SSW	27.6	32.2	32.2	---	760
9/1/2019	1:30 AM	27.6	27.7	27.6	87	25.3	0	SSW	0	0.9	SSW	27.6	32.4	32.4	---	760
9/1/2019	2:00 AM	27.4	27.6	27.4	87	25	0	SSW	0	1.8	S	27.4	31.8	31.8	---	760

9/1/2019	2:30 AM	27.2	27.4	27.2	88	25.1	0	SSW	0	2.7	SSW	27.2	31.4	31.4	---	760
9/1/2019	3:00 AM	27.5	27.5	27.2	87	25.1	0	SSW	0	2.2	S	27.5	32.1	32.1	---	760
9/1/2019	3:30 AM	27.2	27.5	27.2	89	25.2	0	SSW	0	2.7	S	27.2	31.6	31.6	---	760
9/1/2019	4:00 AM	27.1	27.2	26.9	90	25.3	0	SSE	0	2.2	SSE	27.1	31.4	31.4	---	760
9/1/2019	4:30 AM	26.4	27.1	26.4	91	24.8	0	---	0	0	---	26.4	30	30	---	760
9/1/2019	5:00 AM	26.9	26.9	26.3	88	24.7	0	SSW	0	0.9	SSW	26.9	30.7	30.7	---	760
9/1/2019	5:30 AM	27.2	27.3	26.9	87	24.9	0	SSW	0	1.8	SSW	27.2	31.3	31.3	---	760
9/1/2019	6:00 AM	27.3	27.3	27.2	84	24.4	0	SW	0	1.3	SSW	27.3	31.2	31.2	---	760
9/1/2019	6:30 AM	27.3	27.3	27.3	85	24.6	0	SW	0	0.4	SSW	27.3	31.3	31.3	---	760
9/1/2019	7:00 AM	26.9	27.4	26.9	87	24.6	0	WSW	0	3.6	SSW	26.9	30.7	30.7	---	760
9/1/2019	7:30 AM	27.2	27.2	26.9	88	25.1	0	SSW	0	1.8	SSW	27.2	31.4	31.4	---	760
9/1/2019	8:00 AM	27.8	27.8	27.2	86	25.3	0	SSW	0	3.1	SW	27.8	32.8	32.8	---	760
9/1/2019	8:30 AM	28.5	28.5	27.8	85	25.7	0	SSW	0	3.1	S	28.5	34.4	34.4	---	760
9/1/2019	9:00 AM	28.6	28.6	28.3	84	25.6	0	S	0	2.2	S	28.6	34.6	34.6	---	760
9/1/2019	9:30 AM	28.7	29.1	28.7	84	25.7	0	SSW	0	5.4	S	28.7	34.9	34.9	---	760

9/1/2019	10:00 AM	29.8	29.8	28.7	81	26.2	0	S	0	5.4	S	29.8	36.9	36.9	---	760
9/1/2019	10:30 AM	30	30	29.7	79	26	0	SSW	0	4.5	SSE	30	36.9	36.9	---	760
9/1/2019	11:00 AM	29.9	30.3	29.9	79	25.9	0.4	SSW	0.8	3.6	SSW	29.9	36.8	36.8	---	760
9/1/2019	11:30 AM	29.7	30	29.6	82	26.3	0.4	SSW	0.8	6.3	S	29.7	36.9	36.9	---	760
9/1/2019	12:00 PM	29.2	29.8	29.2	83	26	0.4	S	0.8	4.5	SSE	29.2	35.8	35.8	---	760
9/1/2019	12:30 PM	29.4	29.4	29.1	82	26	0	SSW	0	4.5	SSW	29.4	36.1	36.1	---	760
9/1/2019	1:00 PM	30.1	30.1	29.3	80	26.2	0	SSW	0	5.4	WSW	30.1	37.3	37.3	---	760
9/1/2019	1:30 PM	30.7	30.8	30.1	78	26.4	0.4	SSW	0.8	4.5	SSW	30.7	38.7	38.7	---	760
9/1/2019	2:00 PM	30.4	30.7	30.1	77	26	0.4	SSW	0.8	5.8	S	30.4	37.8	37.8	---	760
9/1/2019	2:30 PM	30.6	30.7	30.4	80	26.7	0.4	SSW	0.8	5.8	WSW	30.6	38.9	38.9	---	760
9/1/2019	3:00 PM	30.2	30.6	29.8	77	25.7	0.4	SSW	0.8	4.9	W	30.2	37.2	37.2	---	760
9/1/2019	3:30 PM	30.1	30.3	30.1	80	26.3	0.4	SSW	0.8	4.9	W	30.1	37.5	37.5	---	760
9/1/2019	4:00 PM	29.7	30.2	29.7	80	25.9	0.4	SSW	0.8	4.9	S	29.7	36.4	36.4	---	760
9/1/2019	4:30 PM	29.8	29.9	29.1	77	25.4	0.4	S	0.8	5.4	S	29.8	36.1	36.1	---	760
9/1/2019	5:00 PM	29.3	29.9	29.2	79	25.3	0.4	SSW	0.8	6.3	W	29.3	35.4	35.4	---	759.3

9/1/2019	5:30 PM	29.2	29.6	29.2	79	25.1	0.4	SSW	0.8	4.5	SSW	29.2	35.1	35.1	---	759.4
9/1/2019	6:00 PM	28.4	29.2	28.4	81	24.9	0	SSW	0	4	SSW	28.4	33.6	33.6	---	759.6
9/1/2019	6:30 PM	28.2	28.5	28.2	83	25.1	0	SSW	0	4	WSW	28.2	33.3	33.3	---	760.3
9/1/2019	7:00 PM	28.2	28.2	28.2	84	25.2	0	SSW	0	5.8	SSW	28.2	33.3	33.3	---	760.3
9/1/2019	7:30 PM	28.1	28.2	28	82	24.7	0	SSW	0	4.9	S	28.1	32.7	32.7	---	760.3
9/1/2019	8:00 PM	28	28.1	27.9	81	24.4	0.4	SSW	0.8	4	SW	28	32.4	32.4	---	760.3
9/1/2019	8:30 PM	27.9	28	27.9	82	24.6	0.4	SSW	0.8	4.5	S	27.9	32.4	32.4	---	760.3
9/1/2019	9:00 PM	27.9	27.9	27.9	83	24.8	0	SSW	0	6.3	WSW	27.9	32.6	32.6	---	760.3
9/1/2019	9:30 PM	27.9	27.9	27.8	83	24.7	0	SSW	0	4.5	SSE	27.9	32.4	32.4	---	760.3
9/1/2019	10:00 PM	27.9	27.9	27.9	84	24.9	0	SSW	0	3.1	SSW	27.9	32.6	32.6	---	760.3
9/1/2019	10:30 PM	27.8	27.9	27.8	84	24.9	0	SSW	0	3.6	WSW	27.8	32.4	32.4	---	760.3
9/1/2019	11:00 PM	27.8	27.8	27.8	85	25	0	SSW	0	3.6	S	27.8	32.4	32.4	---	760.3
9/1/2019	11:30 PM	27.8	27.8	27.8	85	25	0	S	0	3.1	SW	27.8	32.4	32.4	---	760.3
10/1/2019	12:00 AM	27.5	27.8	27.5	86	24.9	0	S	0	2.2	S	27.5	31.9	31.9	---	760.3
10/1/2019	12:30 AM	27.6	27.6	27.5	85	24.8	0	SSW	0	3.6	SW	27.6	31.9	31.9	---	760.3

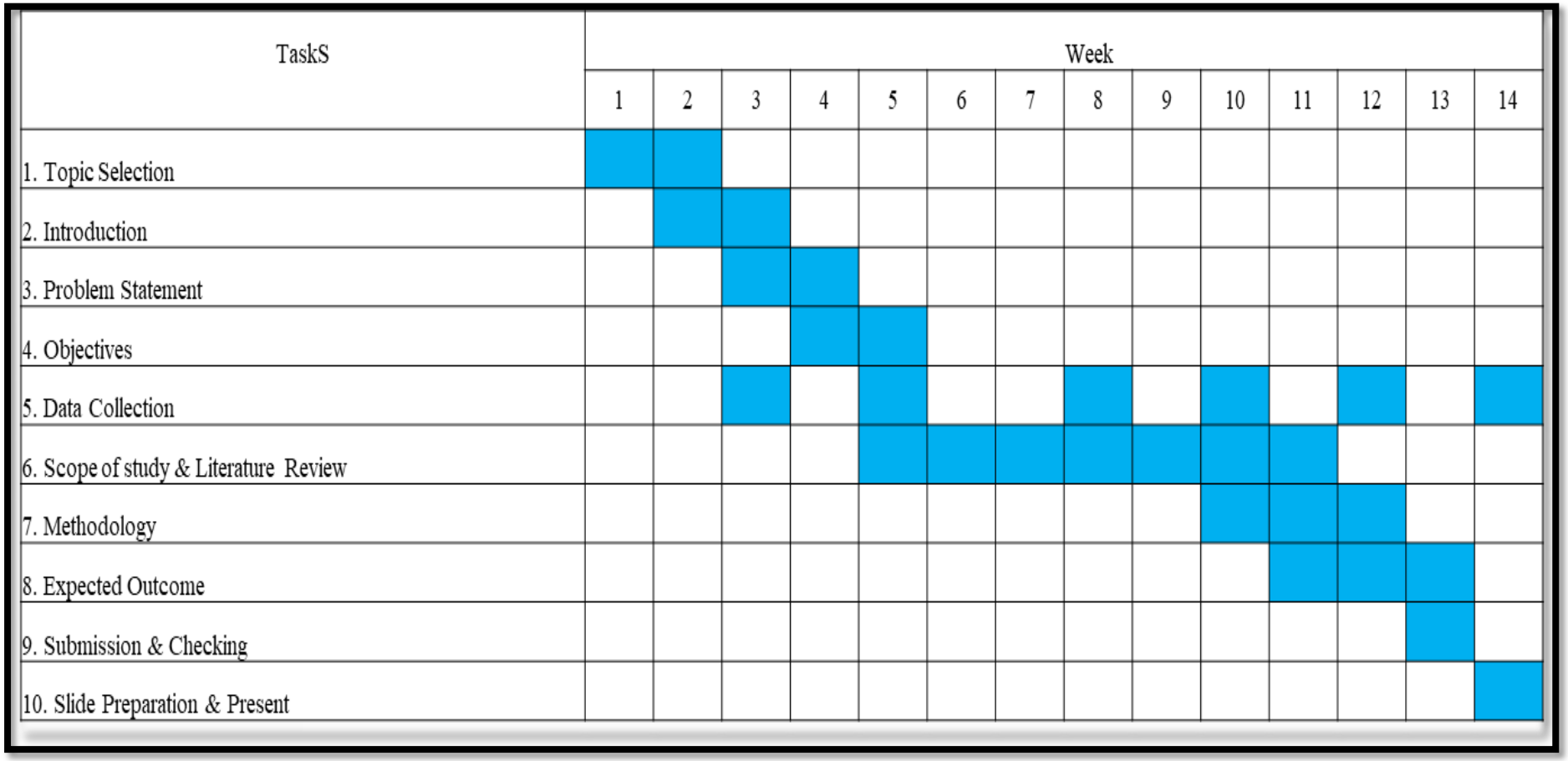
10/1/2019	1:00 AM	27.6	27.6	27.6	85	24.9	0	S	0	2.7	S	27.6	32	32	---	760.3
10/1/2019	1:30 AM	27.6	27.6	27.6	83	24.5	0	SSW	0	3.1	SSW	27.6	31.7	31.7	---	760.3
10/1/2019	2:00 AM	27.5	27.6	27.5	83	24.4	0	S	0	4	SSE	27.5	31.4	31.4	---	760.3
10/1/2019	2:30 AM	27.5	27.6	27.5	83	24.4	0	SSW	0	4	WSW	27.5	31.4	31.4	---	760.3
10/1/2019	3:00 AM	27.4	27.5	27.4	83	24.3	0	SSW	0	3.6	WSW	27.4	31.3	31.3	---	760.3
10/1/2019	3:30 AM	27.4	27.5	27.4	83	24.3	0	SSW	0	2.7	S	27.4	31.3	31.3	---	760.3
10/1/2019	4:00 AM	27.4	27.4	27.4	84	24.5	0	S	0	3.6	SSW	27.4	31.4	31.4	---	760.3
10/1/2019	4:30 AM	27.3	27.4	27.3	85	24.5	0	SSW	0	1.8	S	27.3	31.2	31.2	---	760.3
10/1/2019	5:00 AM	27.3	27.3	27.2	85	24.5	0	SSW	0	1.3	SW	27.3	31.2	31.2	---	760.3
10/1/2019	5:30 AM	27.3	27.3	27.3	85	24.5	0	SSW	0	2.2	SSW	27.3	31.2	31.2	---	760.3
10/1/2019	6:00 AM	27.3	27.3	27.3	85	24.6	0	S	0	1.3	WSW	27.3	31.3	31.3	---	760.3
10/1/2019	6:30 AM	27.3	27.3	27.3	84	24.4	0	S	0	4	SSE	27.3	31.2	31.2	---	760.3
10/1/2019	7:00 AM	27.3	27.3	27.2	84	24.4	0	SSW	0	3.1	SSE	27.3	31.2	31.2	---	760.3
10/1/2019	7:30 AM	27.4	27.4	27.3	84	24.4	0	WSW	0	3.1	SSW	27.4	31.3	31.3	---	760.3
10/1/2019	8:00 AM	27.8	27.8	27.4	85	25.1	0	---	0	0	---	27.8	32.6	32.6	---	760.3

10/1/2019	8:30 AM	27.8	27.8	27.7	85	25	0	SW	0	0.9	SSW	27.8	32.4	32.4	---	760.3
10/1/2019	9:00 AM	28.8	28.8	27.8	81	25.2	0	SW	0	4	WSW	28.8	34.7	34.7	---	760.3
10/1/2019	9:30 AM	28	29.4	28	87	25.6	0	SSW	0	3.6	SSW	28	33.4	33.4	---	760.3
10/1/2019	10:00 AM	28.9	28.9	27.8	84	26	0	SSW	0	3.1	SSE	28.9	35.6	35.6	---	760.3
10/1/2019	10:30 AM	29.4	29.4	28.9	81	25.8	0	S	0	3.6	S	29.4	35.9	35.9	---	760.3
10/1/2019	11:00 AM	29.8	29.8	29.2	80	26	0.4	SSW	0.8	4	SSW	29.8	36.7	36.7	---	760.3
10/1/2019	11:30 AM	28.9	29.8	28.8	83	25.8	0	SSW	0	4	SSW	28.9	35.4	35.4	---	760.3
10/1/2019	12:00 PM	29.9	30.3	28.9	78	25.7	0	SSW	0	4	SSE	29.9	36.6	36.6	---	760.3
10/1/2019	12:30 PM	29.9	30.3	29.8	79	25.9	0	SSW	0	2.2	SW	29.9	36.8	36.8	---	760.3
10/1/2019	1:00 PM	30.2	30.4	29.7	79	26.2	0.4	S	0.8	3.6	S	30.2	37.6	37.6	---	760.3
10/1/2019	1:30 PM	30.2	30.4	29.9	79	26.1	0.4	S	0.8	4.5	SSW	30.2	37.4	37.4	---	760.3
10/1/2019	2:00 PM	30.4	30.6	30.2	78	26.1	0	S	0	3.6	S	30.4	37.9	37.9	---	760.3
10/1/2019	2:30 PM	30.5	30.6	30.3	77	26	0.4	SSW	0.8	4.5	WSW	30.5	37.9	37.9	---	760.3
10/1/2019	3:00 PM	30.4	30.6	30.3	78	26.1	0.4	S	0.8	4.5	SSW	30.4	37.9	37.9	---	760.3
10/1/2019	3:30 PM	30	30.4	30	79	26	0.4	SSW	0.8	4	SSW	30	36.9	36.9	---	760.3

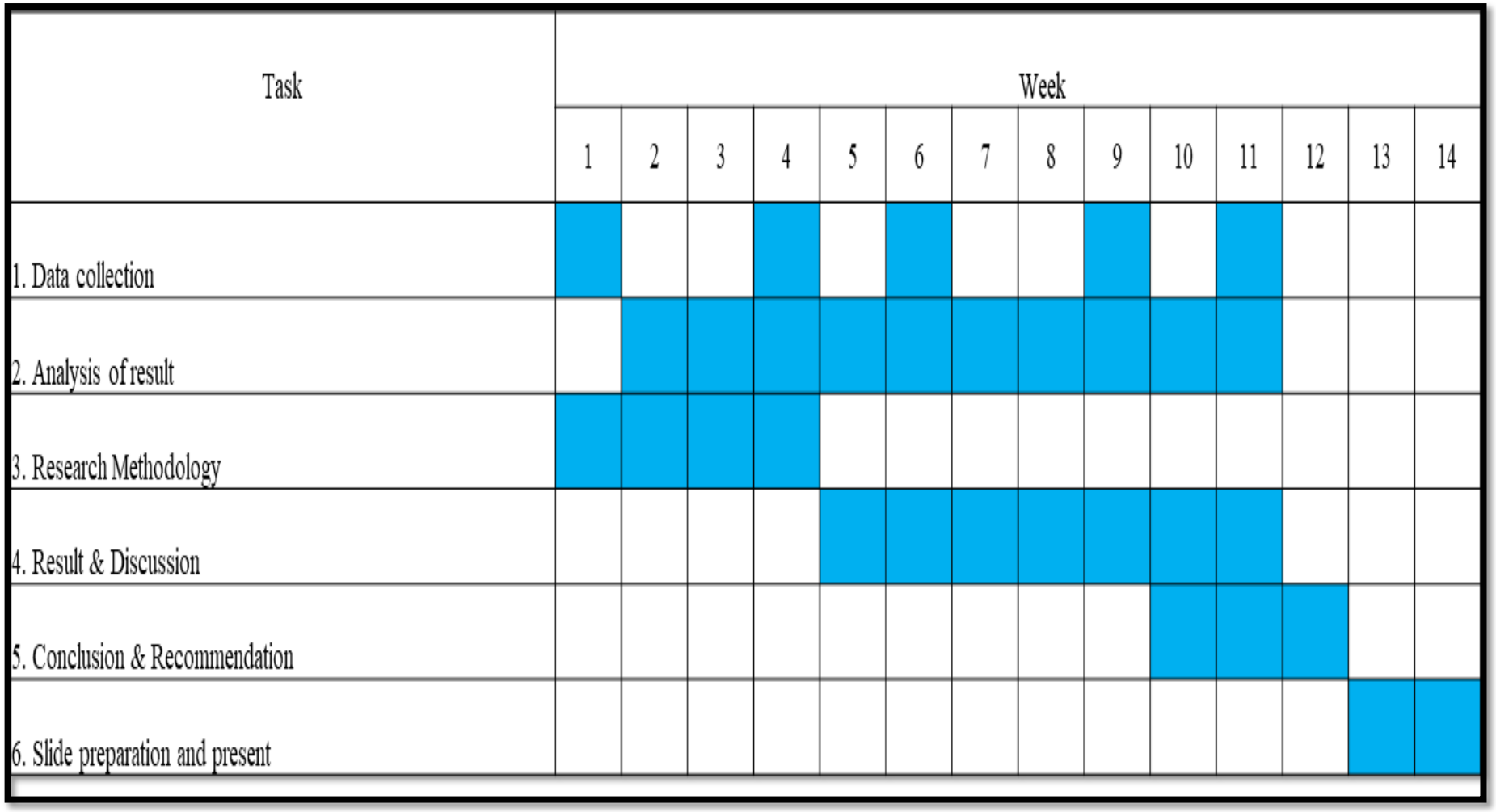
10/1/2019	4:00 PM	30.2	30.3	29.9	78	25.9	0.4	SSW	0.8	5.8	SSW	30.2	37.2	37.2	---	760.3
10/1/2019	4:30 PM	30	30.4	29.9	79	26	0.4	SSW	0.8	5.4	SSW	30	36.9	36.9	---	760.3
10/1/2019	5:00 PM	29.6	30	29	80	25.8	0	SSW	0	4	SSW	29.6	36.2	36.2	---	760.3
10/1/2019	5:30 PM	28.8	29.6	28.8	83	25.7	0	S	0	2.2	SSW	28.8	35.1	35.1	---	760.3
10/1/2019	6:00 PM	28.7	29	28.7	83	25.5	0	S	0	3.6	S	28.7	34.8	34.8	---	760.3
10/1/2019	6:30 PM	27.6	28.7	27.6	89	25.6	0	SSW	0	2.7	S	27.6	32.7	32.7	---	760.3
10/1/2019	7:00 PM	27.3	27.6	27.3	88	25.2	0	SSW	0	3.6	W	27.3	31.8	31.8	---	760.3
10/1/2019	7:30 PM	26.7	27.4	26.5	90	24.9	0.4	SSW	0.8	5.4	WSW	26.7	30.4	30.4	---	760.3
10/1/2019	8:00 PM	27.1	27.1	26.7	86	24.5	0	S	0	3.1	SSW	27.1	30.8	30.8	---	760.3
10/1/2019	8:30 PM	27.5	27.5	27.1	84	24.6	0	SSW	0	3.1	WSW	27.5	31.6	31.6	---	760.3
10/1/2019	9:00 PM	27.6	27.7	27.5	84	24.7	0	SSW	0	2.7	SSW	27.6	31.8	31.8	---	760.3
10/1/2019	9:30 PM	27.7	27.7	27.6	85	24.9	0	SSW	0	3.1	SSE	27.7	32.2	32.2	---	760.3
10/1/2019	10:00 PM	27.6	27.7	27.6	85	24.9	0	SSW	0	2.7	SSW	27.6	32	32	---	760.3
10/1/2019	10:30 PM	27.6	27.7	27.6	85	24.9	0	SSW	0	1.3	SW	27.6	32	32	---	760.3
10/1/2019	11:00 PM	27.7	27.7	27.6	84	24.7	0	SW	0	2.2	S	27.7	32	32	---	760.3

Data from Weather Station Pekan

APPENDIX B
SAMPLE APPENDIX 2



GANTT CHART FOR FYP1



GANTT CHART FYP2