

THE PROBABILITY DISTRIBUTION OF  
DAILY RAINFALL DISTRIBUTION IN KLANG  
VALLEY

INTAN NAJIHA AKHMAR BINTI  
SAHARUDDIN

B. ENG(HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG



## **SUPERVISOR'S DECLARATION**

I/We\* hereby declare that I/We\* have checked this thesis/project\* and in my/our\* opinion, this thesis/project\* is adequate in terms of scope and quality for the award of the degree of Bachelor (Hons.) of Civil Engineering.

---

(Supervisor's Signature)

Full Name : PUAN SHAIRUL ROHAZIAWATI BINTI SAMAT

Position : LECTURER

Date : 19 JUNE 2017

---

(Co-supervisor's Signature)

Full Name : ENCIK NORASMAN BIN OTHMAN

Position : LECTURER

Date : 19 JUNE 2017



## **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 : INTAN NAJIHA AKHMAR BINTI SAHARUDDIN

ID Number : AA13189

Date : 19 JUNE 2017

THE PROBABILITY DISTRIBUTION OF DAILY RAINFALL DISTRIBUTION IN  
KLANG VALLEY

INTAN NAJIHA AKHMAR BINTI SAHARUDDIN

Thesis submitted in fulfillment of the requirements  
for the award of the  
Bachelor Degree in Civil Engineering

Faculty of Civil Engineering and Earth Resources  
UNIVERSITI MALAYSIA PAHANG

19 JUNE 2017

## **ACKNOWLEDGEMENTS**

Firstly, all praise be upon Allah, the Al Mighty, and peace and prosperity to the noble Prophet, his family, his companions and upon those who follow his path and guide. As depend on Him, I managed to complete the research successfully.

Secondly, from the beginning until the completion of this research, my genuine appreciation and grateful thanks goes to my supervisor, Pn. Shairul Rohaziawati Binti Samat from Faculty of Civil Engineering & Earth Resources, Universiti Malaysia Pahang for their kindness in helping me understanding the whole process in completing this thesis. Thanks for reading, feedback, support and advice for me in order to finish my research.

Thirdly, I would like to express my gratitude to Department of Irrigation and Drainage (DID) staffs, for assisting and cooperation toward me during my research time. My gratitude also dedicated to all lecturers, who has involved directly or indirectly, for their encouragement support, advice, and sharing knowledge regarding on my research study.

In addition, I would like to extend my deeply thankful to my entire friend for their understanding and guidance. Thank you for all the great fun moments that we have shared together. Next, a special thanks to everyone that had involved directly or indirectly in my research. Thanks for your kindness. Last but not least, a special thanks to my family for the continuous support and encouragement.

## TABLE OF CONTENT

<b>DECLARATION</b>	
<b>TITLE PAGE</b>	
<b>ACKNOWLEDGEMENTS</b>	<b>ii</b>
<b>ABSTRAK</b>	<b>iii</b>
<b>ABSTRACT</b>	<b>iv</b>
<b>TABLE OF CONTENT</b>	<b>v</b>
<b>LIST OF TABLES</b>	<b>ix</b>
<b>LIST OF FIGURES</b>	<b>x</b>
<b>LIST OF SYMBOLS</b>	<b>xiii</b>
<b>LIST OF ABBREVIATIONS</b>	<b>xiv</b>
<b>CHAPTER 1 INTRODUCTION</b>	<b>1</b>
1.1 Background of Study	1
1.2 Problem Statement	<b>Error! Bookmark not defined.</b> 2
1.3 Objectives	6
1.4 Scope of Study	<b>Error! Bookmark not defined.</b>
1.5 Significance of Study	6
<b>CHAPTER 2 STYLES</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
2.1 Introduction	8
2.2 Floods in Malaysia	<b>Error! Bookmark not defined.</b>
2.2.1 Type of Flood	<b>Error! Bookmark not defined.</b>
2.2.2 Factors Cause Flood	<b>Error! Bookmark not defined.</b> 1

2.2.3	Effect of Flood	13
2.3	Hydrological Cycle	<b>Error! Bookmark not defined.</b>
2.4	Probability Distribution	<b>Error! Bookmark not defined.16</b>
2.4.1	Normal	18
2.4.2	Log Normal	19
2.4.3	Log-Pearson Type III	20
2.4.4	Generalized Extreme Value (GEV)	21
2.4.5	Gumbel	22
2.5	Method of Parameter Estimation	24
2.5.1	Method of Moment	25
2.5.2	Maximum likelihood	<b>Error! Bookmark not defined.25</b>
2.5.3	Least Square	25
2.6	Outlier	25
2.6.1	Z-Score	26
2.6.2	Standard Deviation (SD) Method	<b>Error! Bookmark not defined.</b>
2.6.3	Testing for Outliers	<b>Error! Bookmark not defined.</b>
2.7	Goodness of Fits	<b>Error! Bookmark not defined.29</b>
2.7.1	Kolmogorov-Smirnov	<b>Error! Bookmark not defined.30</b>
2.7.2	Anderson-Darling Test	<b>Error! Bookmark not defined.31</b>
2.7.3	Chi-Square	<b>Error! Bookmark not defined.31</b>
2.8	Software for Probability Distribution	32
2.8.1	EasyFit	<b>Error! Bookmark not defined.32</b>
2.8.2	Matlab	<b>Error! Bookmark not defined.32</b>
2.8.3	SPSS	<b>Error! Bookmark not defined.33</b>

<b>CHAPTER 3 METHODOLOGY</b>	<b>34</b>
3.1 Introduction	34
3.2 Flow Chart	35
3.3 Study Area	36
3.4 Data Collection	36
3.5 Outlier	38
3.6 Method of Annual Distribution	39
3.6.1 Normal Distribution Function	<b>Error! Bookmark not defined.</b>
3.6.2 Gamma Distribution Function	<b>Error! Bookmark not defined.40</b>
3.7 Goodness of Fit	<b>Error! Bookmark not defined.40</b>
3.7.1 Kolmogorov-Smirnov Test	<b>Error! Bookmark not defined.41</b>
3.7.2 Chi-Square Test	41
3.8 Maximum Daily Rainfall Intensity for ARI	<b>Error! Bookmark not defined.42</b>
3.9 Software for Probability Distribution	<b>Error! Bookmark not defined.46</b>
3.9.1 EasyFit	46
<b>CHAPTER 4 RESULTS AND DISCUSSION</b>	<b>47</b>
4.1 Introduction	47
4.2 Data Used In This Study	48
4.2.1 2818110 SMK Bdr Tasik Kesuma at Semenyih, Selangor	49
4.2.2 2913001 P/Kwln P/S Telok Gong at Selangor	50
4.2.3 2913122 JPS Pulau Lumut at Selangor	51
4.2.4 2917001 Setor JPS Kajang at Selangor	51
4.2.5 3113087 Ldg. Sg. Kapar at Selangor	52
4.2.6 3114085 Ldg. North Hummock at Selangor	52
4.2.7 3114086 Ldg. Harpenden at Selangor	53
4.2.8 3115079 Pusat Penyel. Getah at Sg. Buloh, Selangor	53



4.2.9	3118102 Sek.Keb.Kg.Lui at Selangor	54
4.2.10	3119001 Sawah Sg. Lui at Selangor	54
4.2.11	3313060 Ldg. Sg. Buloh at Selangor	55
4.2.12	3116006 Ldg. Edinburgh Site 2 at W.Persekutuan	55
4.2.13	3216001 Kg. Sg. Tua at W.Persekutuan	56
4.2.14	3216004 Sek.Men J. Keb Kepong at W.Persekutuan	56
4.2.15	3217001 Ibu Bekalan Km. 16 at Gombak, W.Persekutuan	57
4.2.16	3217002 Empangan Genting Klang at W.Persekutuan	57
4.2.17	3217001 Ibu Bekalan KM 11 at Gombak, W.Persekutuan	58
4.3	Data Analysis and Discussion	58
4.3.1	Testing for outliers	59
4.3.2	Fitting the Probability Distributions	60
4.3.3	Parameter Estimation	78
4.3.4	The Goodness of Fit	80
4.3.5	ARI of AMS Daily Rainfall Intensity	82
<b>CHAPTER 5 CONCLUSION</b>		87
5.1	Introduction	87
5.1	Conclusion	87
5.1	Recommendation	87
<b>REFERENCES</b>		90

## LIST OF TABLES

Table 2.1	Description of various probability distribution functions.
Table 2.2	Computation and Masking Problem of the Z-Score
Table 3.1	Station for Klang Valley
Table 3.2	Log-Pearson Type III Distributions
Table 4.1	Statistical characteristics of the data series
Table 4.2	Annual Maximum Daily Rainfall and Year
Table 4.3	Outliers for each data series
Table 4.4	Summary of probability density function, the range of the variable, and the distribution's parameters
Table 4.5	Estimated parameters for Normal and Log-Pearson Type III Distributions under study
Table 4.6	Chi-Square Test for all data series
Table 4.7	Kolmogorov Smirnov test for all data series
Table 4.8	Frequency Factor based on Return Period
Table 4.9	Data for Station 2818110

## LIST OF FIGURES

- Figure 1.1 Taman Sentosa, Klang came to a halt after a flash flood **Error! Bookmark not defined.**
- Figure 1.2 Flash floods on the road heading to the Subang Airport
- Figure 1.3 A flash flood along the SPRINT highway **Error! Bookmark not defined.**
- Figure 2.1 Hydrological Cycle
- Figure 2.2 Illustration of Convective, Orographic, and Cyclonic Rain
- Figure 2.3 Normal Distribution
- Figure 2.4 Log-Normal Distribution
- Figure 2.5 Log-Pearson Type III Distribution
- Figure 2.6 Generalized Extreme Value (GEV) Distribution
- Figure 2.7 Gumbel Distribution
- Figure 3.1 Flow chart of methodology
- Figure 3.2 Klang Valley
- Figure 3.3 Hydrological stations in Klang Valley
- Figure 3.4 Application of EasyFit in desktop
- Figure 3.5 Application of Matlab in desktop
- Figure 3.6 Application of SPSS in desktop
- Figure 4.1 Annual Maximum Daily Rainfall for SMK Bdr Tasik Kesuma
- Figure 4.2 Annual Maximum Daily Rainfall for P/Kwln P/S Telok Gong
- Figure 4.3 Annual Maximum Daily Rainfall of JPS Pulau Lumut
- Figure 4.4 Annual Maximum Daily Rainfall for Setor JPS Kajang
- Figure 4.5 Annual maximum daily rainfall for Ldg Sg. Kapar
- Figure 4.6 Annual maximum daily rainfall of Ldg North Hummock
- Figure 4.7 Annual maximum daily rainfall for Ldg Harpenden
- Figure 4.8 Annual maximum daily rainfall for Pusat Penyelidikan Getah
- Figure 4.9 Annual maximum daily rainfall for Sek. Keb. Kg. Lui
- Figure 4.10 Annual maximum daily rainfall for Sawah Sg. Lui
- Figure 4.11 Annual maximum daily rainfall for Ldg Sg. Buloh
- Figure 4.12 Annual maximum daily rainfall for Ldg Edinburgh Site 2
- Figure 4.13 Annual maximum daily rainfall of Kg. Sg. Tua
- Figure 4.14 Annual maximum daily rainfall for Sek. Men. J. Keb. Kepong
- Figure 4.15 Annual maximum daily rainfall for Ibu Bekalan KM 16
- Figure 4.16 Annual maximum daily rainfall for Empangan Genting Klang

- Figure 4.17 Annual maximum daily rainfall for Ibu Bekalan KM 11
- Figure 4.18 Plotted probability density function of Normal Distribution
- Figure 4.19 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.20 Plotted probability density function of Normal Distribution
- Figure 4.21 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.22 Plotted probability density function of Normal Distribution
- Figure 4.23 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.24 Plotted probability density function of Normal Distribution
- Figure 4.25 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.26 Plotted probability density function of Normal Distribution
- Figure 4.27 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.28 Plotted probability density function of Normal Distribution
- Figure 4.29 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.30 Plotted probability density function of Normal Distribution
- Figure 4.31 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.32 Plotted probability density function of Normal Distribution
- Figure 4.33 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.34 Plotted probability density function of Normal Distribution
- Figure 4.35 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.36 Plotted probability density function of Normal Distribution
- Figure 4.37 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.38 Plotted probability density function of Normal Distribution
- Figure 4.39 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.40 Plotted probability density function of Normal Distribution
- Figure 4.41 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.42 Plotted probability density function of Normal Distribution

- Figure 4.43 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.44 Plotted probability density function of Normal Distribution
- Figure 4.45 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.46 Plotted probability density function of Normal Distribution
- Figure 4.47 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.48 Plotted probability density function of Normal Distribution
- Figure 4.49 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.50 Plotted probability density function of Normal Distribution
- Figure 4.51 Plotted probability density function of Log-Pearson Type III Distribution
- Figure 4.52 Result by Percentage for Chi-Square Test
- Figure 4.53 Result by Percentage for Kolmogorov-Smirnov Test

## LIST OF SYMBOLS

$P$	maximum precipitation
$N_x$	Annual rainfall at missing data station
$N_i$	Annual rainfall at neighbor station
$n$	The number neighbor station whose data are used
$P_x$	The missing precipitation
$P_n$	The precipitation value at n station
$N$	The total number of record
$x$	Mean of the sample
$P_T$	The frequency precipitation
$S$	Standard deviation of P value
$P_{ave}$	The average of the maximum precipitation in a specific duration
$T_d$	Duration in hours
$P^*_T$	The frequency precipitation
$p$	Mean Precipitation
$I$	Intensity
$S^*$	Standard deviation of P* value
$K_T$	The Pearson frequency factor
$T$	Return period (years)

## LIST OF ABBREVIATIONS

DID	Department of Irrigation and Drainage
MSMA 2	Urban Stormwater Management Manual Second Edition
LP3	Log-Pearson Type III
LN	Log-Normal
IDF	Intensity-Duration-Frequency
GEV	Generalized Extreme Value Distribution