

UNIVERSITI TEKNOLOGI MARA

**REGIONALIZATION FREQUENCY ANALYSIS
OF SHORT DURATION RAINFALL
FOR PENINSULAR MALAYSIA**

EDDY AFFIRUL HAZRIL BIN HAMZAH

Thesis submitted in fulfilment of the requirements
for the degree of
Master of Science

Faculty of Civil Engineering

March 2005

ACKNOWLEDGEMENTS

Alhamdulillah. All praise is due to Allah, The Almighty, The Most Gracious, and The Most Merciful, for giving me the strength, health, in order to complete this research work. I would like to express my sincere appreciation to my project supervisor, *Dato' Prof. Dr. Ir. Sahol Hamid bin Abu Bakar*, Deputy Vice Chancellor (Academic), UiTM Shah Alam, whose professional approach, guidance, expert advice and supports in all aspects, for making my study a reality. I would like to extend my gratitude to *Associate Professor Dr. Ismail bin Atan*, as my co-supervisor for his untiring assistance, suggestions, full co-operations and interests shown in my research study.

Special thanks to my field supervisor, *Ir Mohd Zaki bin Mat Amin*, Senior Researcher of National Hydraulic Research Institute Malaysia (NAHRIM), whose keen interest, untiring guidance, suggestions and gratefully acknowledged throughout the study. Thanks also to the other staff of Hydrology and Water Resources Division, Irrigation and Drainage Department of Malaysia (DID), especially to, *Hj. Azmi bin Md. Jafri*, Senior Assistance Director for his necessary assistance, guidance, information and supplying the hydrological data and related materials during the course of this study.

Sincere thanks for Ministry of Science Technology and Environment (MOSTE) in providing me a special scholarship under Pasca Graduate Scheme for the research study in completing the degree of Master of Science in Civil Engineering.

Special individual thanks to my beloved wife *Pn. Jusmairomaizani binti Jusoh*, and my daughter *Adryana Nabihah* for their patience and continuous encouragements. Last but not least, to my dearest father and mother *Hj. Hamzah bin Ali* and *Hjh Jamaiah binti Nasri*, my wife's parents *Hj Jusoh bin Hassan* and *Hjh. Maimun @ Zaharah binti Che' Yaacob*, in providing supports and continuous encouragements during the completion of this study period.

TABLE OF CONTENTS

TITLE PAGE	Page
ACKNOWLEDGEMENTS	ii
TABLE OF CONTENTS	iii
LIST OF TABLES	vii
LIST OF FIGURES	ix
LIST OF ABBREVIATIONS	xiv
ABSTRACT	xvi
CHAPTER ONE: INTRODUCTION : RESEARCH FRAMEWORK	1
1.1 General	1
1.2 Objectives	2
1.3 Scope of the Research Study	3
1.4 Significance of the Research	3
1.5 Organization of the Thesis	4
CHAPTER TWO: LITERATURE REVIEW	5
2.1 Introduction	5
2.2 Frequency Analysis	6
2.3 Regional Frequency Analysis Review	7
2.4 Homogeneity	13
2.5 Probability Plots	14
2.6 Probability Distributions	16
2.7 Parameter Estimation Review	17
2.8 Method of Moments (MOM)	18
2.9 Method of L-moments (L-MOM)	19

Regionalization Frequency Analysis of Short Duration Rainfall for Peninsular Malaysia

ABSTRACT

Rainfall frequency of various intensities and durations are used extensively in the design floods and management of many water resources projects involving natural hazards due to extreme rainfall events.

In Malaysia, it has been the practice to estimate design rainfall based on at-site data. Through this study, *regional estimation* has been recommended as an alternative technique to estimate design rainfall. The choice of this proposed technique will definitely improve the accuracy of design rainfall, which will reduce the uncertainties of at-site data and to overcome unavailability of long data records for estimation of flood quantiles at ungauged sites.

In this study, regional frequency analysis was used based on the L-moments methodology, which involves four main stages namely screening of the data, identification of homogeneous region, and choice of the frequency distribution and the estimation of the frequency distribution. The analysis was conducted according to the index flood method but expressed in terms of rainfall. The main objectives were to identify the homogeneous region and to develop the regional frequency curves or growth curves.

In this study, Peninsular Malaysia was divided into 3 regions. From the twelve rainfall durations investigated, the results showed that, R1 region belongs to 'acceptably homogeneous' region for 30-minutes to 24-hours durations except of 15-

minutes, 48-hours and 72-hours durations. For R2 region, it was classified as 'possibly heterogeneous' region for 15-minutes, 12-hours and 24-hours durations while other durations were homogeneous. Then for R3 region, it was classified as 'acceptably homogeneous' for 15-minutes to 4-hours durations. Most of the regions were represented by GLO and GEV distributions. Based on the assessment through the estimated regional growth curves by Monte-Carlo simulation, RMSE for each region gives an acceptable value, ranging from a minimum of 0.8% that appeared in R1 for 45-minutes and 1-hour durations, to a maximum of 13.8%, which appeared in R3 for 72-hours duration. The RMSEs values were satisfactorily low to enable good quantile estimation with confidence.