Preparation of Intensity-Duration-Frequency (IDF) Curves for Stormwater Drainage System Design

Abstract

Stormwater management is crucial for urban infrastructure design to mitigate flooding risks. This report presents a comprehensive methodology for preparing Intensity-Duration-Frequency (IDF) curves, essential for understanding rainfall characteristics and designing effective stormwater drainage systems. The study includes data preparation, statistical analysis, design calculations, and hydraulic considerations. Results showcase the relationship between rainfall intensity, duration, and return period, facilitating robust infrastructure design.

Table of Contents

1. Introduction

Stormwater management is essential in urban infrastructure design to mitigate flooding risks and ensure public safety. Preparation of Intensity-Duration-Frequency (IDF) curves is critical for understanding rainfall characteristics and designing effective stormwater drainage systems.

2. Methodology

Data Preparation: Raw rainfall data was imported and analyzed to visualize intensity distribution.

Outlier Detection: Box plots were employed to identify and remove outliers for data accuracy.

Statistical Analysis: Fitting rainfall data to Gumbel and log-normal distributions aided in selecting the best-fit distribution.

Intensity Calculation: log normal and Gumbel functions were developed to calculate rainfall intensity at various return periods.

3. Results

Distribution Fitting: Summary statistics of Gumbel and log-normal distributions demonstrated their suitability for different time intervals.

Intensity-Duration-Frequency (IDF) Curves: Graphical representations depicted the relationship between rainfall intensity, duration, and return period.

4. Design Calculations for Stormwater Infrastructure

Constant Calculations: Constants were computed for concentration time and peak flow discharge calculations.

Peak Flow Discharge Estimation: Computation of peak flow discharge and time of concentration for each manhole.

Pipe Sizing: Calculations for pipe diameters to ensure adequate conveyance capacity.

Elevation Estimations and Hydraulic Design: Calculations of upstream and downstream crown and inverted elevations for proper alignment.

5. Storm Intensity Calculation

Utilization of developed intensity calculation function to determine storm intensity.

6. Hyetograph Calculation

Calculation of hyetograph using the alternative block method for given time intervals.

7. Conclusion

Preparation of IDF curves and subsequent design calculations are crucial for developing resilient stormwater drainage infrastructure. Understanding rainfall patterns and estimating peak flows enable effective management of stormwater runoff, reducing flood risk, and enhancing urban resilience to extreme weather events.

8. various tables -

K	0.3141
A	-227.0.6 seconds
X	0.072
N	-0.5049

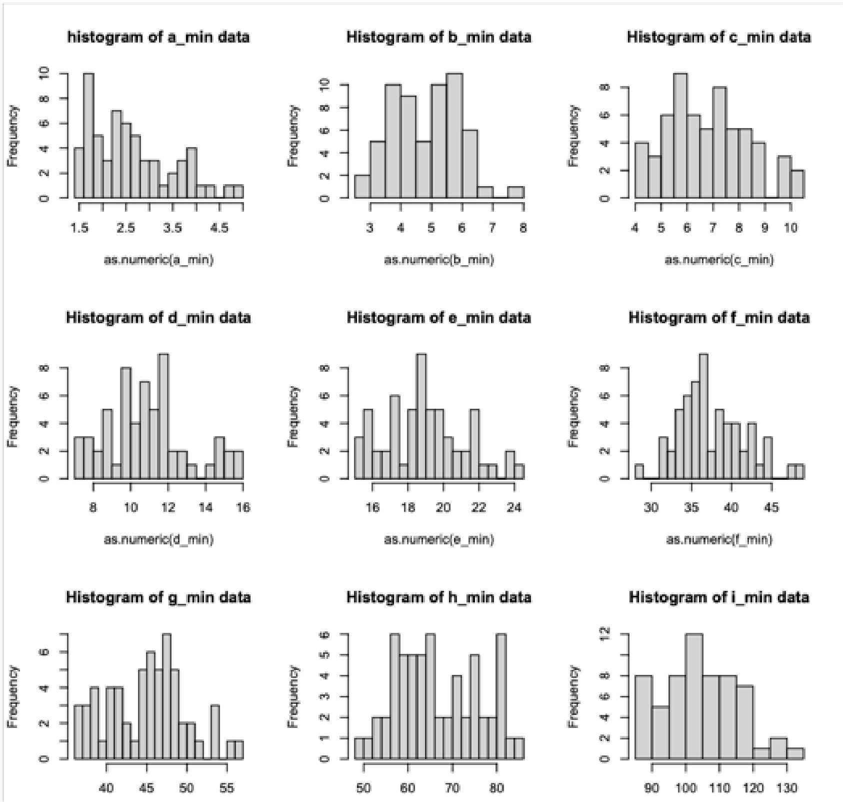
	Q_of_each_manhole	ti_of_each_manhole
1	0.00552498	12.579575
2	0.01304957	56.1487789
3	0.01731768	68.5403184
4	0.01423971	80.9024939
5	0.00765932	100.919139
6	0.02338619	126.715535
7	0.00506702	9.72930784
8	0.00334041	9.37531302

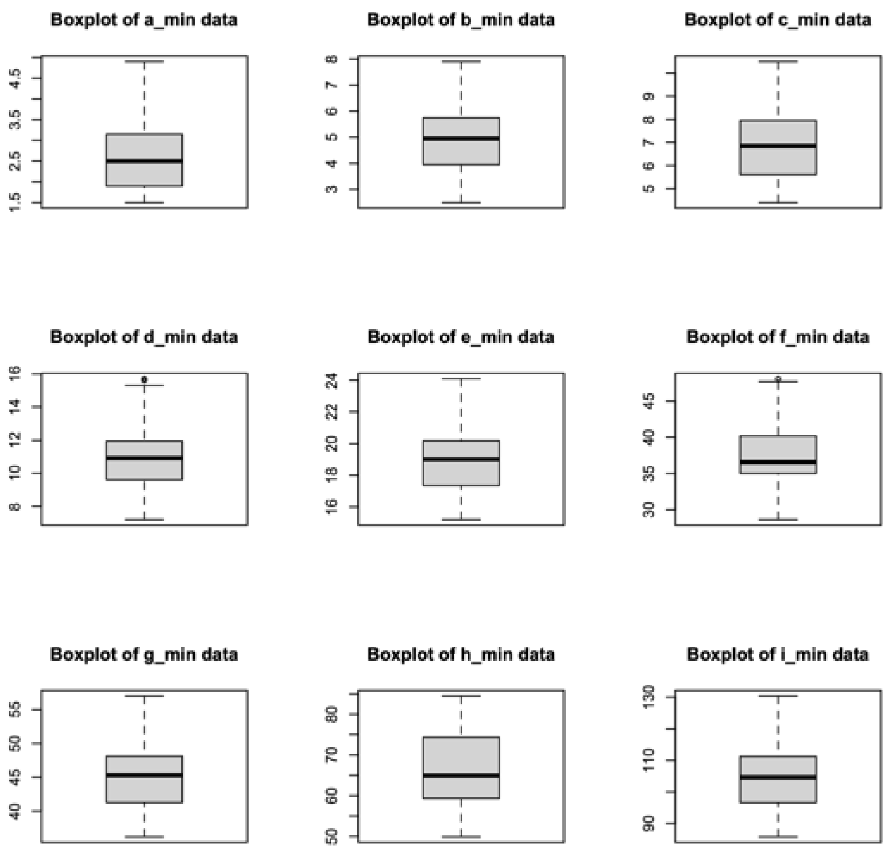
curb location	inlet length	Spread of gutter
11	0.789	2.33
21	1.165	2.02
31	1.233	1.98
41	1.434	1.78
51	1.494	1.76
61	2.009	1.43
16	1.678	1.34
17	1.112	

	Name of starting point of each pipe	Vertical distance between to hole	up stream crown elevation	down stream crown elevation	up stream inverted elevation	down stream inverted elevation	diameter of pipeline
1	11	3	139.1	136.1	138.65	135.65	0.45
2	21	1.68	138.3	136.62	137.85	136.17	0.45
3	31	1.4	137.5	136.1	137.05	135.65	0.45
4	41	1	136.6	135.6	136.15	135.15	0.45
5	51	1.5	135.4	133.9	134.95	133.45	0.45
6	16	2.1	134.2	132.1	133.75	131.65	0.45
7	17	1.2	133.6	132.4	133.15	131.95	0.45

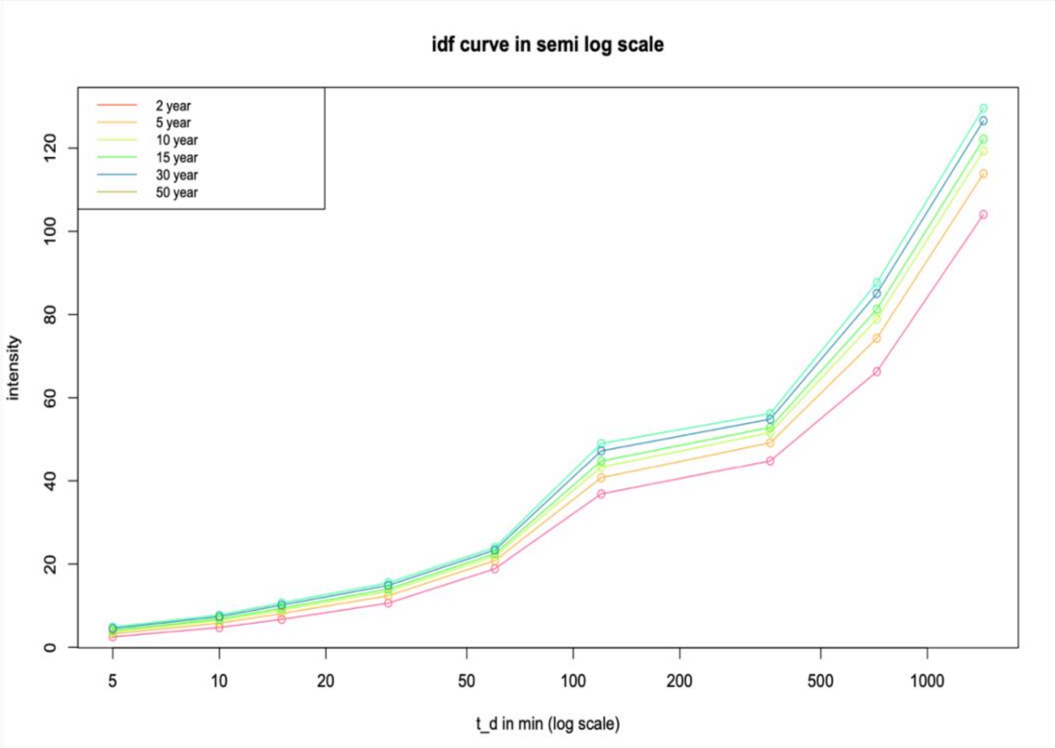
List of Graphs

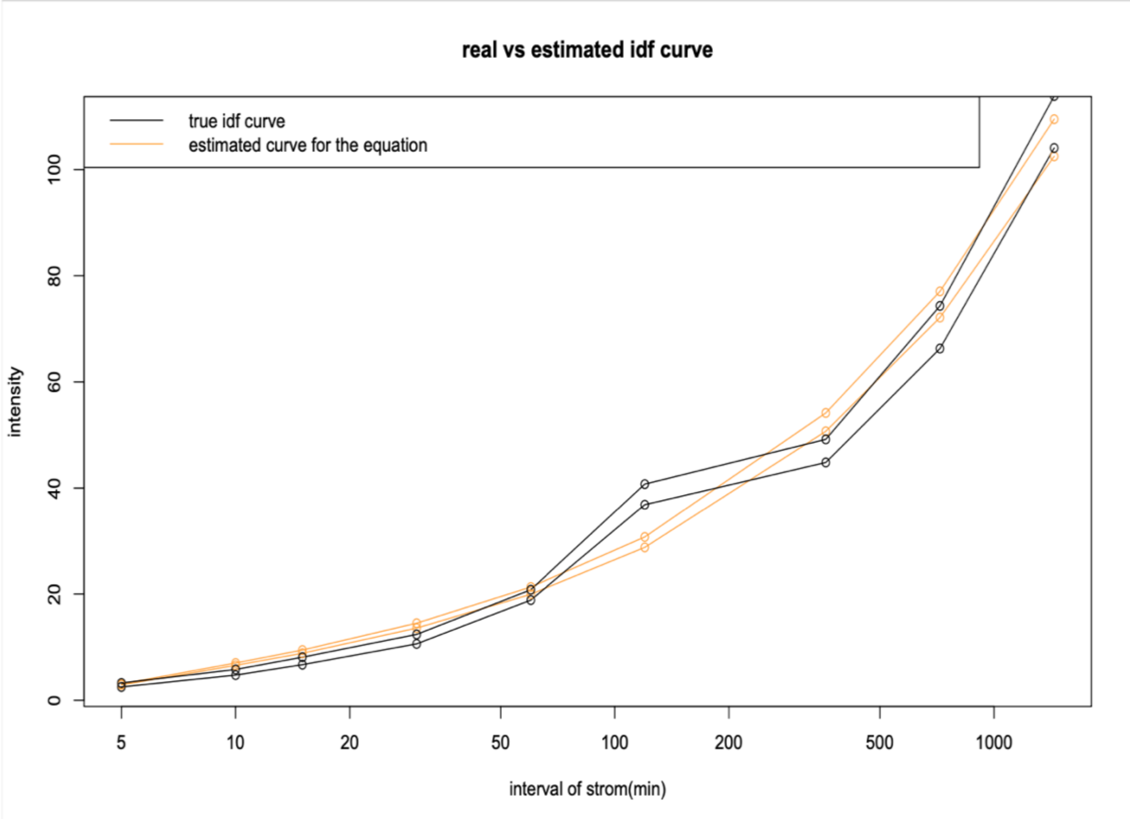
1. Distribution Fitting: Summary Statistics



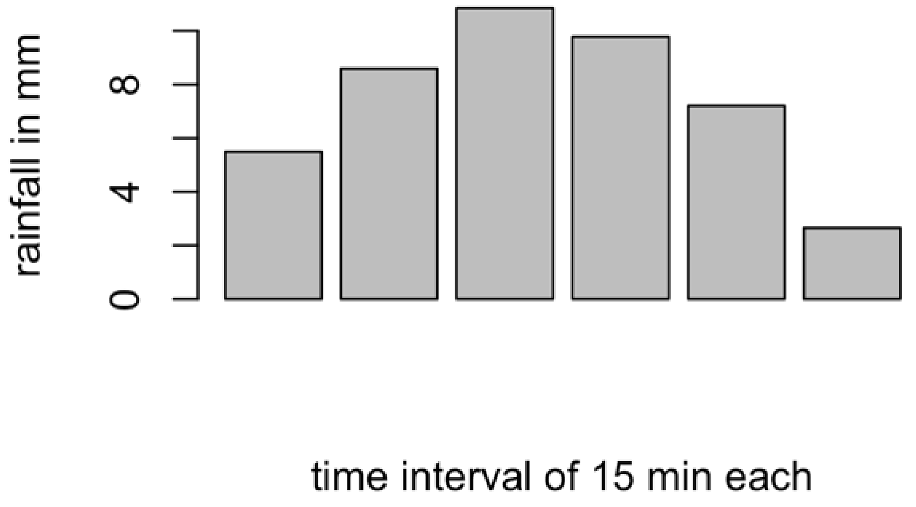


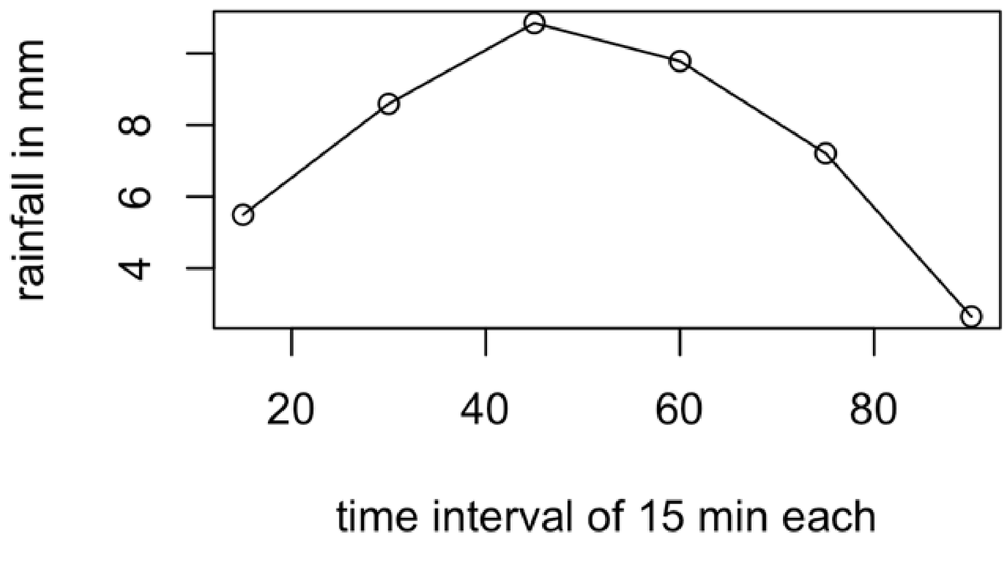
2. Intensity-Duration-Frequency (IDF) Curves


idf curve in semi log scale
2 year
5 year
10 year
15 year
30 year
50 year
intensity
t_d in min (log scale)
0
20
40
60
80
100
120
5
10
20
50
100
200
500
1000


real vs estimated idf curve
true idf curve
estimated curve for the equation
intensity
interval of strom(min)
0
20
40
60
80
100
5
10
20
50
100
200
500
1000

3. Hyetograph





Various answers –

Part A

Fitted the equation for intensity the list of parameters found is in the list of tables

Part B

Developed a Strom drainage system all the findings are in the list of tables

Part C

The developed intensity calculation function from Part A was employed to determine storm intensity, providing insights into the potential rainfall impacts on the drainage system.
And it came out to be 96 mm approx.

Part D

Time in min	Rainfall in mm
15	5.49246174
30	8.59094214
45	10.8459409
60	9.78254441
75	7.20830417
90	2.6527492

And the hydrograph of this table is attached in the list of graphs section