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9TH MALAYSIA STATISTICS CONFERENCE
Department of Statistics, Malaysia
Dealing with Uncertainties: Unearthing Measures for Recovery

# Statistical Modelling of Annual Maximum Rainfall Data in Selangor

**ABSTRACT**: The purpose of this study is to assess patterns of extreme rainfall in Selangor. The Generalised Extreme Value distribution appears to outperform the Generalized Pareto Distribution in modelling the annual maximum rainfall series from 8 selected stations. The estimated return period of 5,10, 50, 100-year for each stations based on the best fitting model for the periods of entire record data have been computed. The result shows that most any of the rainfall stations are expected to exceed the maximum level once every 50 years.

## BACKGROUND

- Malaysia is a tropical country, and its climate is characterized by uniform temperature, high humidity and abundant rainfall throughout the year with annual average rainfall is within 200 to 250 mm.
- 869 flood incidents were reported in 2020 (2019: 535 incidents). The highest flood incidence was reported in Sarawak with 225 incidents, followed by Selangor (132 incidents) and Perak (100 incidents) (DOSM, 2021).
- The government spend large amounts of money on flood mitigation projects in urban and rural areas. Therefore, it is important to correctly predict extreme rainfall events.

## LITERATURE REVIEW

- Nashwan et al., (2019) estimated non-stationary return periods of extreme rainfall events in different locations of peninsular Malaysia using hourly rainfall data.
- Najeebullah et al., (2018) assess the spatial patterns in the trends of annual and seasonal rainfall amounts and extremes in Peninsular Malaysia.
- Syafrina et al., (2019) study the indices of extreme rainfall intensity in Peninsular Malaysia.

## METHODOLOGY

Modeling annual maximum rainfall of several stations in Selangor using extreme value theory.

→ Determining the best model by comparing between Generalized Extreme Value (GEV) distribution and Generalized Pareto Distribution.

→ Use the selected model to predict the future occurrence of extreme rainfall.

## RESULTS AND DISCUSSION

### Generalized Extreme Value (GEV)

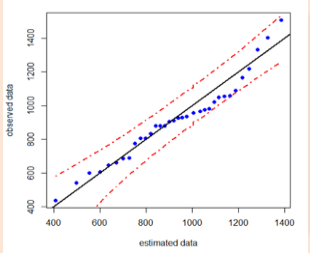
$$F(x;\mu,\sigma,\xi) = \begin{cases} exp\left[-\left(1+\xi\frac{x-\mu}{\sigma}\right)^{-\frac{1}{\xi}}\right], & \xi \neq 0 \\ exp\left[-exp\left(-\frac{x-\mu}{\sigma}\right)\right], & \xi = 0 \end{cases}$$

### Generalized Pareto Distribution

$$F(x) = \begin{cases} 1-[1+\xi\, x/\sigma]^{-1/\xi}, & \xi \neq 0 \\ 1-\exp -x/\sigma\,, & \xi = 0 \end{cases}$$

### Return Level

| RAINFALL STATIONS | RETURN PERIODS (YEARS) | | | |
|---|---|---|---|---|
| | 5 | 10 | 50 | 100 |
| LDG. BATU UNTONG | 422.54 | 474.43 | 650.71 | 846.15 |
| PUSAT PENYEL. GETAH | 448.20 | 479.38 | 535.52 | 558.47 |
| LDG. SG. BULOH | 389.06 | 405.67 | 418.01 | 419.00 |
| LDG. RAJA MUSA | 396.45 | 431.47 | 500.15 | 532.53 |
| HOSPITAL K. KUBU BAHRU | 561.53 | 622.18 | 740.35 | 795.42 |
| LDG. SG. GUMUT | 557.53 | 606.08 | 706.56 | 758.25 |
| LDG. SG. BERNAM | 361.00 | 396.00 | 434.89 | 441.68 |
| LDG. SG. KAPAR | 394.71 | 449.15 | 530.30 | 554.36 |




Q-Q plot with 95% tolerance interval shows well fit of GEV distribution for annual maximum rainfall data.

## CONCLUSION

- GEV distribution is a best-fit probability distribution for the extreme rainfall event in Selangor.
- The advantage of modeling annual maximum rainfall using GEV distribution is that it can be used to predict the occurrence of maximum rainfall in the future.
- For further work, the next study can consider the presence of covariate in the model such as temperature and atmospheric particulate since Selangor is industrial state.

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