

Flood Return Interval Analysis

EA30

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Introduction

- ▶ Flood return interval analysis is used in hydrology to estimate the likelihood of flood events.
- ▶ It helps in infrastructure planning, risk assessment, and environmental studies.
- ▶ Based on statistical analysis of historical flood data
- ▶ Key concepts include return period, annual exceedance probability, and plotting position.

Key Definitions

- ▶ **Return Period (T):** The average interval of time between floods of a certain magnitude or greater.
- ▶ **Annual Exceedance Probability (AEP):** The probability that a flood of a certain magnitude will be equaled or exceeded in any given year.

$$T = \frac{1}{P} \quad \text{or} \quad P = \frac{1}{T}$$

Data Requirements

- ▶ Annual peak discharge data for a river or stream.
- ▶ Data should span multiple decades for reliable analysis.
- ▶ Quality control and consistency checks are essential.

Plotting Position Formula

- ▶ Used to estimate return periods from ranked data.
- ▶ Common formula: **Weibull's Formula**

$$T = \frac{n + 1}{m}$$

where:

- ▶ n = number of years of record
- ▶ m = rank of the flood (1 = highest)

Example Calculation

- ▶ 10 years of peak discharge data
- ▶ Rank the largest flood ($m=1$)
- ▶ Return period:

$$T = \frac{10 + 1}{1} = 11 \text{ years}$$

- ▶ This flood has a 1 in 11 chance (9.1%) of occurring each year.

Limitations

- ▶ Assumes stationarity (climate does not change over time).
- ▶ Sensitive to outliers and record length.
- ▶ Doesn't predict exact timing, only probability.

Applications

- ▶ Designing bridges, culverts, and levees.
- ▶ Floodplain zoning and insurance.
- ▶ Climate change impact studies.

Conclusion

- ▶ Flood return interval analysis is a critical tool in hydrology.
- ▶ Helps quantify flood risk based on historical data.
- ▶ Should be combined with modern models and climate data for future projections.

References

- ▶ Chow, V.T., Maidment, D.R., and Mays, L.W. (1988). *Applied Hydrology*.
- ▶ USGS Water Resources: <https://water.usgs.gov/>

Analysis Steps

- ▶ Select Site from USGS database.
- ▶ Make sure it has a long record, +30 years.
- ▶ Create new folder in Rstudio Server
- ▶ Upload data to R
- ▶ Download marc's R functions from github.com
- ▶ Upload marc's R script functions to Rstudio

Analysis Steps

- ▶ Create Rmd File – type all your code into the Rmd file!
- ▶ get path for R functions
- ▶ Add R block that includes

```
source("path/return_interval_functions.R")
```

- ▶ assign mysite (use quotes!)
- ▶ assign Q_max (as highest peak flow of interest in 2025)
- ▶ obtain peak flow data using function
- ▶ plot the data using function
- ▶ if time, split data and plot two time frames