Flood Return Interval Analysis

EA30

April 7, 2025

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.
- Download peak flow data (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
- ► get path for R functions
- ► Add R block with source("path/return_interval_functions.R")
- ► define station ID, dates, peak flow for 2025
- ► obtain peak flow data using function
- ► plot (if time, split data and plot)