Environmental Geology – Flood Recurrence Intervals

Fall 2019

The purpose of the laboratory activity is to gain a better understanding of flood frequency.

Get the data

1. Ski to http://waterdata.usgs.gov/usa/nwis/sw
2. Click: 'peak flow data'
3. Select: 'state/territory' then click 'submit'
4. Choose a state, then click: 'submit'
5. Click on a site number (data should cover at least 50 years)
6. Copy the URL and save it in a spreadsheet.
7. Select 'tab-separated file'
8. Parse the data into Excel (or paste Unicode text)
9. Rename Sheet 1 to 'all data'
10. Save your work.

Organize the data

1. Make a second copy of the data in Sheet 2 and label it 'working data'
2. Remove all rows above the headers for the data (i.e. the variable descriptions)
3. Delete all columns except for date (peak_dt), discharge (peak_va), and gage height (gage_ht)
4. Remove other extraneous information and label five columns:

Date	Recurrence interval (y)	Discharge (cfs)	gage height (ft)	Rank (m)

Run the numbers

1. Determine the rank by sorting by discharge (largest on top).
2. Put a '1' in a cell in the Rank column corresponding to the highest discharge, and fill the remaining cells (using the **+** cursor).
3. Calculate the recurrence interval (R) for each year using the following formula: $R = (n+1)/m$
4. Where R= recurrence interval, n=number of years of record, and m=rank
5. The '+1' term accounts for the fact that there is always a probability that a flood will occur that is larger than the largest flood on record.
6. Save your work.

Graph the data for discharge vs. recurrence interval

1. Create a discharge (y-axis) vs. recurrence interval (x-axis).
2. Select the discharge and recurrence interval data in the spreadsheet.
3. Insert a scatter plot.
4. Set the x-axis (R) to a log scale.
5. Add major and minor gridlines to the graph.
6. Add a best-fit logarithmic line to the data.
7. Extend the best-fit line forward to the maximum value on the graph
8. Add axis titles and remove extraneous information.
9. Adjust significant figures on axis labels.

10. Save your work.

Questions

1. What is the recurrence interval for the largest discharge?

2. What is the discharge for a 25-year flood? 50-year flood? 100-year flood?

3. The annual exceedance probability, P_e, is the probability that a given discharge will occur in a given year. It is calculated as the inverse of the recurrence interval, R.

   $$P_e = 1/R \times 100$$

   Therefore, a probability that a flood with a ten-year recurrence interval will occur in any year is 1/10 = 0.1 or 10%. Create a new column on the spreadsheet and calculate the P_e for each discharge (use one place after the decimal point).

4. What is the probability of the highest ranked discharge?

5. What is the probability of the 20^{th} ranked discharge?

6. Calculate the mean annual peak discharge by summing the peak annual discharges and dividing by the number of years. Put the calculations in the column just below the last peak annual discharge on the spreadsheet (no decimal points). What is the peak annual discharge for the stream?

7. Build a stage discharge relationship. Put stage on the y-axis, discharge on the x-axis, and set both axes as logarithmic.