**Computing Flood Frequency Analysis using HEC-SSP**

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CE 374K Hydrology

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The goal of this exercise is to enable you to do a frequency analysis of annual maximum discharges using the Colorado River at Austin (USGS Gage 08158000) as an example dataset. The annual maximum discharges for water years 1900 to 2010 are given at: <http://www.caee.utexas.edu/prof/maidment/ce374KSpring2011/HECSSP/Colorado.xlsx> A water year is a period from 1 October of the previous calendar year through 30 September of the current calendar year. These data are plotted below. A series of dams were built on the Colorado River above Austin during the 1930’s and it is obvious from the graph that they had a significant impact on the flood flows from about 1940 onwards, so we’ll analyze the data in two periods: 1900 to 1940 and 1941 to 2010.

**Analysis of Recurrence Intervals**

The data for 1900 to 1913 are given below. I have marked the years in which an annual maxiumum discharge equal to or exceeding QT = 100,000 cfs occurs, ie Q ≥ 100,000 cfs. The recurrence interval, τ, is the number of years in between occurrences of Q ≥ QT, which in this case is 8 years for the first recurrence and then 6 years for the second recurrence. The Return Period, T = E(τ) or the average recurrence interval for the data set.



*To be turned in: Assume the design discharge is 30,000 cfs and determine the return period of this annual maximum discharge in the period 1900 to 1940, and in the period 1941-2010. What was the annual probability, p, of having a flood discharge of at least 30,000 cfs flowing through Austin in the Colorado River before 1940? After 1940?*

**Using HEC-SSP**

Rather than designating a design discharge and then determining its return period, what we really want to do is to designate a return period and determine the corresponding design discharge. To do that, we’re going to use the HEC-SSP program or Hydrologic Engineering Center, Statistical Software Program, Version 2.0, which can be obtained from <http://www.hec.usace.army.mil/software/hec-ssp/> It employs the Log Pearson Type III probability model using the procedures outlined in Bulletin 17B, Guidelines for Determining Flood Flow Frequency, <http://water.usgs.gov/osw/bulletin17b/dl_flow.pdf> Obtain HEC-SSP and install it on your own computer, or use the software installed for you in ECJ 3.302.

Open HEC-SSP

 

Create a new study by opening **File/New Study**



Add a study name and description, and store the study in a convenient file location:



Use **Data/New** to get some data for our study:



Add a Name and Description of the data and select **Get USGS Station ID’s by State** (and select Texas in the list of states that is offered). There are 1060 such sites in Texas. Only a few of them are shown below.



Click on the pull down menu for USGS Station ID’s and select station **08158000**



**Check the box** next to this station’s information, and scroll down to the bottom of the screen, and click on **Import to Study DSS File**. You should see some information about data being imported into your project.



Close the data selection window.

Now in your main display window, you should see some data references displayed. Right click on the Colorado-Austin data and **Plot** them.





You should see a plot like the one shown above. This has values recorded from 1898 to 2010 and one “historical flood” that occurred on the 7th of July 1869 and was estimated to be 550,000 cfs. Now that is a serious amount of water! It is clear that there is a significant break in the flood discharges around 1940.

*To be turned in: A plot of the flood discharges for the annual peak flows of the Colorado River at Austin including all the data and the historical flood.*

**Frequency Analysis of Flood Discharges**

Begin a new analysis by selecting **Analysis/New/ Bulletin 17B Flow Frequency**



Add a Name and Description, set the **Flow Data Set** to **Colorado-Austin**, and set the **DSS Range** to **01Jan1900** to **31Dec1940**



Hit **Apply**, **Compute**, and **Plot Curve**, and you should get a result like the one shown below:



And if you hit View Report, you’ll be able to scroll down the resulting report and get a display like the one shown below:



*To be turned in: A plot and a table of results for the frequency analysis for the Colorado River at Austin for the period 1900 to 1940.*

Now, do a similar analysis for the period 1941 to 2010. Start a **Analysis/New** as you did before, and enter the data as:



Hit Apply, Compute and Plot Curve and you should get a result like the one below.

Use File/Save Study to store the results of your analysis





To be Turned In: *A plot and a table of results for the frequency analysis for the Colorado River at Austin for the period 1941 to 2010. Using the “Computed Curve Flows” make a comparison of the 2, 5, 10, 50 and 100 year design discharges for the two periods. By what amount did the construction of the dams reduce the 100 year flood flow of the Colorado River at Austin? What are the 95% confidence limits on the 100 year flood discharge estimate for the “After Dams” condition?*

**Summary of items to be turned in:**

(1) *Assume the design discharge is 30,000 cfs and determine the return period of this annual maximum discharge in the period 1900 to 1940, and in the period 1941-2010. What was the annual probability, p, of having a flood discharge of at least 30,000 cfs flowing through Austin in the Colorado River before 1940? After 1940?*

*(2) A plot of the flood discharges for the annual peak flows of the Colorado River at Austin including all the data and the historical flood.*

*(3) A plot and a table of results for the frequency analysis for the Colorado River at Austin for the period 1900 to 1940.*

*(4) A plot and a table of results for the frequency analysis for the Colorado River at Austin for the period 1941 to 2010. Using the “Computed Curve Flows” make a comparison of the 2, 5, 10, 50 and 100 year design discharges for the two periods. By what amount did the construction of the dams reduce the 100 year flood flow of the Colorado River at Austin? What are the 95% confidence limits on the 100 year flood discharge estimate for the “After Dams” condition?*

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