Hydrologic Engineering Center

Training Course on

STATISTICAL METHODS IN HYDROLOGY

Davis, California

Course Objectives

The objectives of this course are to provide the participant with the background required for practical application of techniques for frequency, time series and regression analysis. Primary references for the course will be EM 1110-2-1415, "Hydrologic Frequency Analysis and Bulletin 17b, "Guidelines for Determining Flood Flow Frequency." Computer program STATS and commercial software packages will be used in workshop application problems.

SUMMARY

Day		Topic
Monday	am	Basic statistical analysis concepts and flood frequency analysis
	pm	Frequency analysis of regulated flows and stages
Tuesday	am	Time-series analysis and software
	pm	Regulated frequency curves for reservoir systems
Wednesday	am	Simple linear regression
	pm	Multiple linear regression
Thursday	am	Advanced frequency analysis
	pm	Monte Carlo analysis and Stochastic streamflow generation
Friday	am	Beyond Bulletin 17B. Case Study

STATISTICAL METHODS IN HYDROLOGY

8:00 – 9:00 a.m.	**Introduction - Course Overview**	
9:00 – 10:15 a.m.	1.1 Lecture:	**Basic Statistical Analysis**
	Discussion of basic concepts in statistics, random variables, sample statistics, inference, probability distributions, risk vs uncertainty.	
10:15 – 10:30 a.m.	Break	
10:30 – 11:30 a.m.	1.2 Lecture:	**Flow Frequency Analysis**
	Estimating flow-frequency curves using Bulletin 17b methodology, uncertainty estimates in frequency curves, low flow frequency analysis.	
11:30 – 12:00 p.m.	1.3 Lecture:	**History of Bulletin 17B**
	Why and How	
12:00 – 1:00p.m.	Lunch	
1:00 – 2:00 p.m.	1.4 Lecture:	**Regulated And Stage Frequency Analysis**
	Graphical frequency analysis, order statistics, estimation of uncertainty.	
2:00 – 2:15 p.m.	Break	
2:15 – 3:15 p.m.	1.5 Lecture:	**Regional Frequency Analysis**
	Worth of regionalized results, incorporating regional results into frequency computations, sensitivity of process to regional values, mapping techniques, applications to ungaged areas, uncertainty in regional frequency curves, regional skew.	
3:15 – 4:30 p.m.	1.6 Workshop:	**Frequency Analysis Of Regulated And Unregulated Frequency Curves**
	Perform frequency analysis of unregulated, regulated and stage frequency curves.	
4:30 – 5:00 p.m.	**Workshop Review**	

8:00 – 8:30 am	Review	
8:30- 9:30 a.m.	2.1 Lecture:	**Time-Series Analysis**
	Flow duration analysis, Volume duration analysis, Stochastic streamflow models, drought statistics, drought risk, relationship with low flow frequency analysis.	
9:30 – 9:45 a.m.	Break	
9:45 – 10:15 a.m.	2.2 Lecture:	**Coincident Frequency Analysis**
	Situations in which coincident frequency analysis is required, assumptions and technique to compute coincident frequency	
10:15 – 10:45 a.m.	2.3 Lecture:	**Description Of Program STATS**
	Capabilities of software, description of input, output, connection with DSS.	
10:45 – 12:15 p.m.	2.4 Workshop:	**Application Of Program STATS**
	Application of STATS to develop flow-duration and volume duration frequency curves.	
12:15 – 1:15 p.m.	Lunch	
1:15 – 1:45 p.m.	**Workshop Review**	
1:45 – 3:00 p.m.	2.5 Lecture:	**Unimpaired Flow Case Study**
	Discuss methodology for developing unimpaired flows, utilizing volume duration frequency curves, design storms and floods, and a case study illustrating flood frequency analyses in the Central Valley of California.	
3:00 – 3:15 p.m.	Break	
3:15 – 4:30 p.m.	2.6 Workshop:	
4:30 – 5:00 p.m.	**Workshop Review**	

8:00 – 8:30 am	Review	
8:30 – 9:30 a.m.	3.1 Lecture	**Frequency Analysis With Historical Information**
	Sources of information: historical, botanical, physical; maximum likelihood and weighted moment estimators, effective record length, value of information, with index flood, expected moment analysis	
9:30 – 9:45 a.m.	Break	
9:45 – 10:30 a.m.	3.2 Lecture:	**Linear Regression**
	Nature and theory of regression analysis: regression equation, computation of regression coefficient; regression constant; and correlation coefficient.	
10:30 – 11:30 a.m.	3.3 Workshop:	**Linear Regression By Computer**
	Demonstration and exercises with the regression analysis feature of Excel.	
11:30 – 12:00 p.m.	**Workshop Review**	
12:00 – 1:00 p.m.	Lunch	
1:00 – 1:45 p.m.	3.4 Lecture:	**Multiple Linear Regression**
	Regression equation, computation of coefficients, analysis of results.	
2:00 – 3:00 p.m.	3.5 Lecture:	**Applications Of Multiple Linear Regression**
	Application in hydrologic analyses, formulation of regression models, effects of non-linearities, transformations, interpreting results.	
3:00 – 3:15 p.m.	Break	
3:15 – 4:30 p.m.	3.6 Workshop:	**Multiple Linear Regression Application**
4:30 – 5:00 p.m.	**Workshop Review**	

8:00 – 8:30 a.m.	**Review**	
8:30 – 9:30 p.m.	4.1 Lecture:	**Forecasting with Principal Components Regression**
	Description of regression with Principal Components. Case Study of application to water supply forecasting in the Kootenai River basin	
9:30 – 9:45 a.m.	Break	
9:45 – 10:45 a.m.	4.2 Lecture	**Advanced Flood Frequency Analysis**
	Index flood method, regional shape estimators, results; GEV fitting and goodness-of-fit exercise. Selection of homogeneous regions, region of influence, normalized quantile regression, flood frequency paradigm, summary.	
11:00 – 12:00 a.m.	4.3 Lecture	**Regional Regression**
	Weighted and Generalized least squares for regional regression, regional skew estimation. Regional skew estimation exercise.	
12:00 – 1:00 p.m.	Lunch	
1:00 – 2:00 p.m.	4.4 Lecture:	**Monte Carlo Analysis**
	Replacing distribution with sample, integration. Risk-based uncertainty analysis.	
2:00 – 2:15 p.m.	Break	
2:15 – 3:15 p.m.	4.5 Lecture:	**Stochastic Streamflow Models**
	Capabilities of a stochastic streamflow model, input and output	
3:15 – 4:30 p.m.	4.6 Workshop:	**Applications Of Stochastic Stream Flow Models To Reservoir Sizing For Water Supply**
	Stochastic stream flow models will be used to analyze a particular water supply problem. Evaluating operating rules.	
4:30 – 5:00 p.m.	**Workshop Review**	

8:00 – 8:30 a.m.	**Review**	
8:30 – 9:30 a.m.	5.1 Lecture:	**Beyond Bulletin 17B**
	Modern methods that might be coming your way.	
9:30 – 9:45 a.m.	Break	
9:45-11:00 a.m.	5.2 Lecture:	**Sacramento Case Study**
	Description of an interior drainage study in Sacramento. Development of interior area stage/frequency function. Integration of watershed models, channel models, and coincident frequency analysis. Analysis of the impact of uncertainty.	
11:00-12:00 p.m.	**Critique and Completion Activities**	