HWRM-301: STATISTICAL METHODS IN HYDROLOGY (THEORY) (02 credit hrs)

PRE-REQUISITE: F.Sc. or equivalent

LEARNING OUTCOMES

- This course will provide an introduction to the basic concepts of statistics and its application in hydrology.
- The students will learn to perform various statistical analyses (consistency and homogeneity test, estimating the measures of central tendency, dispersion and symmetry etc.) on hydrological data.
- The students will learn the concepts of frequency distributions and learn about flood frequency analysis
- The students will get used to the concepts of hypothesis testing.
- Students will learn about the correlations and regression analysis.

CONTENTS

This course provides an introduction to the statistical theories, flood frequency analysis and probability theories and their applications in hydrology. This course will also provide an correlation and regression analyses as well as hypothesis testing.

THEORY

Unit-I: Introduction and Basic Concepts

1.1. Introduction to Statistics and definitions
1.2. Applications of Statistics in Hydrology
1.3. Statistical presentation of Hydrologic data
1.4. Consistency and homogeneity of data
1.5. Probability and Axioms of Probabilities
1.6. Properties of Random Variable

Unit-II: Statistical Analysis of Hydrological Data

2.1. **M**easures of central tendency, dispersion and symmetry.
2.2. Expectation and estimation.
2.3. Discrete and continuous probability distributions, especially normal and extreme-value distributions.

Unit-III: Frequency Analysis

3.1. Return Period
3.2. Extreme Value Distributions
3.3. Frequency Analysis using Frequency Factors
3.4. Probability Plotting
3.5. Confidence Limits

Unit-IV: Correlation and Regression

4.1. Correlation Analysis, Serial or Auto-Correlation, Cross-Correlation, Inferences on Correlation Coefficient, Kendall's Rank Correlation Test
4.2. Simple Linear Regression, Estimation of Parameters, Goodness of Regression
4.3. Multiple Linear Regression, Estimation of Parameters, Goodness of Regression

Unit-V: Hypothesis Testing

5.1. The t-distribution

5.2. Chi-Square Distribution
5.3. Tests Concerning Variances of Two Populations

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS

Sr. No.	Elements	Weightage	Details
1.	Mid Term Assessment	35%	It takes place at the mid-point of the semester
2.	Formative Assessment	25%	It is continuous assessment. It includes: classroom participation, attendance, assignments and presentation, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXT BOOKS / SUGGESTED READINGS

1. Haan, C, T. (1977). *Statistical Methods in Hydrology* 1st Edition Iowa State Pr ISBN-13: 978-0813815107
2. Harvey J. E. Rodda, Max A. Little (2016). *Understanding Mathematical and Statistical Techniques in Hydrology an Examples-based Approach 1st Edition* Wiley-Blackwell ISBN-13: 978-1444335491
3. Vujica V. Yevjevich (2010). *Probability and Statistics in Hydrology Second Edition* Water Resources Pubns ISBN-13: 978-1887201605
4. Maity, R. (2018). *Statistical Methods in Hydrology and Hydro climatology (Springer Transactions in Civil and Environmental Engineering) 1st ed* Springer ISBN-13: 978-9811087783
5. Haan, C.T., (2002) *Statistical Methods in Hydrology, 2nd edition*, Iowa State Press,

HWRM-301: STATISTICAL METHODS IN HYDROLOGY (LAB) (01 Credit hr)

PRE-REQUISITE: F.Sc. or equivalent

LEARNING OUTCOMES:

- This course will get practical knowledge about the statistical applications in hydrology.
- The students will be able to calculate the measures of central tendency, dispersion and symmetry for different hydrometer logical variables.
- They will practice on distribution fitting and parameter estimation techniques.
- The students will be able to perform flood frequency analyses on real flow data
- They will become conversant with different software packages and their applications in performing statistical analysis on hydrological data.

CONTENTS

This course if design to make student learn about various statistical analysis on hydrological records along with the practical applications on probability distributions, frequency analysis using real hydrological data. This course also includes practical applications of different software's packages for statistical analyses in hydrology.

PRACTICAL

Unit-I: Statistical Analysis of Hydrological Data

1.1. Practical examples on measures of central tendency, dispersion and symmetry
1.2. Estimation of correlation of different hydrometeorological variables
1.3. Practical applications of simple and multiple regression analysis for hydrological data sets

Unit-II: Probability Distributions

2.1. Distribution fitting
2.2. Parameter estimation problems
2.3. Comparisons of different frequency distributions goodness of fit analysis

Unit-III: Frequency Analyses

3.1. Estimation return levels and return periods for hydrological data using frequency distributions
3.2. Flood frequency analysis of different rivers of Pakistan

Unit-IV Software Packages for Statistics

4.1. Statistical Analysis using MS Excel
4.2. Introduction to R- Programming for Statically analysis of Hydrological data
4.3. Introduction to MATLAB- Programming for Statistical analysis of Hydrological data

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
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