Syllabus for OC-3140 (3-2)

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Course Description

This course is designed for educating students with the basic theories on probability and statistics and methodologies for METOC data analysis.

Basic theories and methodologies of probability and statistics for meteorological and oceanic (METOC) data analysis including air-ocean data description, probability distribution, fitting and testing METOC probability models, sampling and sampling distributions, estimation of METOC mean and variability, hypothesis testing, analysis of METOC variability, METOC statistical prediction (regression), and METOC ensemble prediction.

Office Hours:

Educating students is my highest priority. You may come to my office any time from 7 am to 6 pm.

Course Grade

Lab/Homework 30%
Mid-Term 25%
Final Exam 45%

Course Outline

Chapter 1 Introduction

- 1.1. Two Kinds of Processes
- 1.2. METOC Data Analysis and Management
- 1.3. Population and Sample
- 1.4. METOC Variables and Data
- 1.5. What is Statistics?
- 1.6. METOC Statistical Models
- 1.7. METOC Measurement
- 1.8. Steps in METOC Data Analysis

Chapter 2 METOC Data Description
• 2.1. Descriptive Statistics
• 2.2. Ordered Data and Percentiles
• 2.3. Frequency Distribution
• 2.4. Measures of Central Tendency
• 2.5. Measure of Dispersion
• 2.6. Measures of Distribution Shape
• 2.7. Graphical Presentation Techniques
• 2.8. Descriptive Statistics for Two or More Variables

Chapter 3 Probability Distributions

• 3.1. What Is Probability?
• 3.2. Probability and Statistics
• 3.3. Probability Distribution of Random Variables
• 3.4. Descriptive Measures of Probability Distribution Functions
• 3.5. Discrete Probability Distribution Models
• 3.6. Continuous Probability Distributions

Chapter 4 Fitting and Testing METOC Probability Models

• 4.1. Determining Probability Models from METOC Data
• 4.2. Fitting Probability Models
• 4.3. Chi-Square Test
• 4.4. Kolmogorov-Smirnov (K-S) Test

Chapter 5 Sampling and Sampling Distributions

• 5.1. Sampling and Random Sampling
• 5.2. Sampling Distribution
• 5.3. Sampling Distribution of Means
• 5.4. Central Limit Theorem (CLT)
• 5.5. Sampling Distribution of the Difference between Two Means
• 5.6. Probability Distributions for Statistics
• 5.7. Monte Carlo Simulation
• 5.8. Re-Sampling

Chapter 6 Estimation of METOC Mean and Variability

• 6.1. Point Estimation
• 6.2. Interval Estimation
• 6.3. Confidence Interval of the Mean (Climatological Value)
• 6.4. Confidence Interval of the Variance (METOC Variability)
• 6.5. Confidence Interval on the Proportion
• 6.6. Confidence Interval on the Difference of Means
• 6.7. Confidence Interval on the Difference between Two Proportions
• 6.8. Confidence Intervals Using Resampling

Chapter 7 Hypothesis Testing
• 7.1. Hypothesis
• 7.2. Significance Level
• 7.3. Types of Errors
• 7.4. One-sided and Two-sided Testing
• 7.5. Parametric Testing
• 7.6. Hypothesis Testing on the Mean (Climatology)
• 7.7. Hypothesis Testing on the Variance (Variability)
• 7.8. Hypothesis Testing on the Proportion
• 7.9. Hypothesis Testing on the Difference of Two Means
• 7.10. Relationship between Hypothesis Testing and Interval Estimation
• 7.11. Goodness-of-fit Test

Chapter 8 Analysis of METOC Variability

• 8.1. One-factor Analysis of Variance (ANOVA)
• 8.2. Partitioning of METOC Variability
• 8.3. Mathematical Model of One-way ANOVA
• 8.4. Multiple Comparisons
• 8.5. Two-Factor ANOVA

Chapter 9 METOC Statistical Prediction

• 9.1. Regression Equation and Coefficients
• 9.2. Analysis of Prediction Errors
• 9.3 Outliers of Statistical Prediction
• 9.4. ANOVA
• 9.5. Goodness-of-fit Measures
• 9.6. Confidence Intervals of the METOC Statistical Prediction
• 9.7 Hypothesis Testing on Regression Coefficients

Chapter 10 METOC Ensemble Prediction

• 10.1. Why Do We Need Ensemble
• 10.2. Basic Concepts of Ensemble Prediction
• 10.3. Products of Ensemble Prediction