MATH-264 Introduction to Statistics

Credit Hours: 3-0

Prerequisites: MATH-263 Probability Theory

Course Objectives: An understanding of random phenomena is becoming increasingly important in today's world within social and political sciences, finance, life sciences and many other fields. In this course the students are trained to set up mathematical models of processes and systems that are affected by chance. The students would learn techniques of estimation of parameters, confidence intervals, hypothesis testing and quality control.

Core Contents: Introduction to Descriptive Statistics, Distributions of Sampling Statistics, The method of maximum likelihood, Testing Statistical Hypotheses, Hypothesis Tests Concerning Two Populations, Analysis of Variance, Linear Regression, Chi-Squared Goodness-of-Fit Tests, Quality Control.

Detailed Course Contents: Distributions of Sampling Statistics: Sample Mean, Central LimitTheorem, Distribution of the Sample Variance of a Normal Population.

The method of Maximum Likelihood: Point Estimator of a Population Mean, Estimating a Population Variance.

Estimation: Interval Estimators of the Mean of a Normal Population with Known Population Variance, Lower and Upper Confidence Bounds, Interval Estimators of the Mean of a Normal Population with Unknown Population Variance, Lower and Upper Confidence Bounds.

Testing Statistical Hypotheses: Hypothesis Tests and Significance Levels, Tests Concerning the Mean of a Normal Population: Case of Known Variance, One-Sided Tests, The t Test for the Mean of a Normal Population: Case of Unknown Variance.

Hypothesis Tests Concerning Two Populations: Testing Equality of Means of Two Normal Populations: Case of Known Variances, Testing Equality of Means; Unknown Variances and Large Sample Sizes, Testing Equality of Means; Small-Sample Tests when the Unknown Population Variances are Equal.

Analysis of Variance: Introduction to Analysis of Variance, One-Factor Analysis of Variance, Two-Factor Analysis of Variance; Introduction and Parameter Estimation, Two-Factor Analysis of Variance; Testing Hypotheses.

Linear Regression: Introduction to Linear Regression, Simple Linear Regression Model, Estimating the Regression Parameters, Error Random Variables, Testing the Hypothesis that $\beta = 0$, Coefficient of Determination, Sample Correlation.

Chi-Squared Goodness-of-Fit Tests: Introduction to Chi-Squared Goodness-of-Fit Tests, Testing for Independence in Populations Classified according to Two

Characteristics, Testing for Independence in Contingency Tables with Fixed Marginal Totals.

Quality Control: Introduction to Quality Control, The $\bar{X}$ Control Chart for Detecting a Shift in the Mean when the Mean and Variance Are Unknown, S Control Charts, Control Charts for Fraction Defective.

Course Outcomes: After the successful completion of the course, the students areexpected to understand:

- basic principles of collection and presentation of data along with some important features
- point and interval estimation of population parameters
- how different hypothesis regarding characteristics of population parameters are tested
- variance and regression analysis and quality control charts.

Text Book: Sheldon M. Ross, Introductory Statistics (3^{th} Edition) Elsevier, 2010.

Reference Books:

1. F. Daly, D. J. Hand, M. C. Jones , A. D. Lunn , K. J. McConway, Elementsof Statistics, Pearson Education, 1995. (referred as FK)
2. M. H. DeGroot and M. J. Schervish: Probability and Statistics (3^{th} Edition) Addison-Wesley, 2002.
   A. Papoulis, Probability Random Variables and Stochastic Processes, (3^{th}Edition) McGraw Hill, 1991.
3. R. A. Johnson, Probability and Statistics for Engineers, Prentice-Hall 1994.
4. R. E. Walpole, R. H. Myers, S. L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists (7^{th} Edition), Prentice Hall, 2002.

Students will be required to implement the contents in SPSS

Weekly Breakdown		
Week	***Section***	***Topics***
1	7.3,7.4, 7.6	Sample Mean, Central Limit Theorem, Distribution of the Sample Mean,Distribution of the Sample Variance of a Normal Population.
2	6.3**(FK)**	The method of Maximum Likelihood,
3	8.2, 8.4	Point Estimator of a Population Mean, Estimating a Population Variance.
4	8.5,8.6	Interval Estimators of the Mean of a Normal Population with Known Population Variance, Lower and Upper Confidence Bounds, Interval Estimators of the Mean of a Normal Population with Unknown Population Variance, Lower and Upper Confidence Bounds.
5	9.2-9.4	Hypothesis Tests and Significance Levels, Tests Concerning the Mean of aNormal Population: Case of Known Variance, One-Sided Tests, The t Testfor the Mean of a Normal Population: Case of Unknown Variance.
6	10.2,10.3	Testing Equality of Means of Two Normal Populations: Case of KnownVariances, Testing Equality of Means: Unknown Variances and Large Sample Sizes.

7	10.4, 10.5	Testing Equality of Means: Small-Sample Tests when the Unknown Population Variances are Equal, Paired-Sample t Test.
8	11.1, 11.2	Introduction to Analysis of Variance, One-Factor Analysis of Variance.
9	**Mid Semester Exam**	
10	11.3,11.4	Two-Factor Analysis of Variance: Introduction and Parameter Estimation, Two- Factor Analysis of Variance: Testing Hypotheses.
11	12.1-12.3	Introduction to Linear Regression, Simple Linear Regression Model, Estimating the Regression Parameters.
12	12.4,12.5, 12.9	Error Random Variables, Testing the Hypothesis that $\beta = 0$, Coefficient ofDetermination, Problems, Sample Correlation.
13	13.1, 3.2	Introduction to Chi-Squared Goodness-of-Fit Tests**.**
14	13.3, 13.4	Testing for Independence in Populations Classified according to Two Characteristics, Testing for Independence in Contingency Tables with FixedMarginal Totals.
15	15.1, 15.2	Introduction to Quality Control, The X Control Chart for Detecting a Shift inthe Mean. When the Mean and Variance are unknown, S Control Charts.
16	15.3	Control Charts for Fraction Defective.
17		Review
18	**End Semester Exam**	