MISSOURI WESTERN STATE UNIVERSITY

COLLEGE OF LIBERAL ARTS AND SCIENCES

DEPARTMENT OF COMPUTER SCIENCE, MATHEMATICS, AND PHYSICS

COURSE NUMBER: MAT 432

COURSE NAME: Mathematical Statistics

COURSE DESCRIPTION:

A continuation of MAT 332 to include the theory and applications of estimation, hypothesis testing, regression and correlation, analysis of variance and nonparametric statistics.

PREREQUISITE:

Grade of C or higher in MAT 332.

TEXT:

COURSE OBJECTIVES:

The overall objectives of the course MAT 432, Mathematical Statistics, are to enable students to:

1. Apply the theory of probability in MAT 332 to derive elementary statistical techniques.
2. Become competent in the application of statistical techniques.
3. Pursue further study in fields requiring knowledge of calculus-based statistics.

STUDENT COMPETENCIES:

In order to meet the overall objectives, the successful student will be able to:

1. Compute estimators for various population parameters based on sample statistics.
2. Determine if a given estimator of a parameter is an unbiased estimator.
3. Determine if an unbiased estimator has minimum variance.
4. Compare efficiencies of estimators.
5. Determine if an unbiased estimator is a consistent estimator.

6. Determine if an estimator is a sufficient estimator.

7. Find an estimator by the method of moments.

8. Find the likelihood function relative to a sample.

9. Find the maximum likelihood estimator using the likelihood function.

10. Define “confidence interval” for given level of significance.

11. Determine confidence intervals for means, proportions, and variances.

12. Determine confidence intervals for the differences of means and the differences of proportions.

13. Determine confidence internals for the ratio of two variances.

14. Define Type I and Type II errors.

15. Determine the power of an hypothesis test.

16. Perform classical tests of hypotheses concerning means, proportions, and variances.

17. Computer the P-value of a statistic.

18. Use the P-value to test hypotheses.

19. Apply the Neyman-Pearson Lemma to determine criteria for the best critical region of a given size.

20. Use the Likelihood Ratio to test an hypothesis.

21. Compute means and variances of jointly distributed random variables.

22. Compute the covariance of jointly distributed random variables.

23. Compute the coefficient of correlation from the variances and covariance of jointly distributed random variables.

24. Compute the coefficient of correlation for a set of bivariate data.

25. Use the method of least squares to obtain the line of best fit for bivariate data.

26. Compute multiple regression coefficients for linear models.

COURSE OUTLINE:

I. Sampling Distributions and the Central Limit Theorem
   A. Sampling Distributions Related to the Normal Distribution
   B. The Central Limit Theorem
   C. A Proof of the Central Limit Theorem
   D. The Normal Approximation to the Binomial Distribution

II. Estimation
   A. The Bias and Mean Square Error of Point Estimators
   B. Some Common Unbiased Point Estimators
   C. Evaluating the Goodness of a Point Estimator
   D. Confidence Intervals
   E. Selecting the Sample Size
   F. Small-Sample Confidence Intervals for Means
   G. Confidence Intervals for Variance

III. Properties of Point Estimators and Methods of Estimation
   A. Relative Efficiency
   B. Consistency
   C. Sufficiency
   D. The Rao-Blackwell Theorem and Minimum-Variance Unbiased Estimation
   E. The Method of Moments
   F. The Method of Maximum Likelihood
   G. Some Large-Sample Properties of Maximum-Likelihood Estimators

IV. Hypothesis Testing
   A. Elements of a Statistical Test
   B. Common Large-Sample Tests
   C. Calculating Type II Error Probabilities and Finding the Sample Size for Z Tests
   D. Relationships Between Hypothesis-Testing Procedures and Confidence Intervals
   E. Another Way to Report the Results of a Statistical Test: Attained Significance Levels, or p-Values
   F. Some Comments on the Theory of Hypothesis Testing
   G. Small-Sample Hypothesis Testing for Means
   H. Testing Hypotheses Concerning Variances
   I. Power of Tests and the Neyman-Pearson Lemma
   J. Likelihood Ratio Tests

V. Linear Models and Estimation by Least Squares
   A. Linear Statistical Models
   B. The Method of Least Squares
   C. Properties of the Least-Squares Estimators: Simple Linear Regression
   D. Inferences Concerning the Parameters
   E. Inferences Concerning Linear Functions of the Model Parameters: Simple Linear Regression
   F. Predicting a Particular Value of Y by Using Simple Linear Regression
   G. Correlation
   H. Some Practical Examples

I. Fitting the Linear Model by Using Matrices
J. Linear Functions of the Model Parameters: Multiple Linear Regression
K. Inferences Concerning Linear Functions of the Model Parameters: Multiple Linear Regression
L. Predicting a Particular Value of *Y* by Using Multiple Regression
M. A Hypothesis Test for Coefficients of a Multiple Regression Model