MISSOURI WESTERN STATE UNIVERSITY

COLLEGE OF LIBERAL ARTS AND SCIENCES

DEPARTMENT OF COMPUTER SCIENCE, MATHEMATICS, AND PHYSICS

COURSE NUMBER: MAT 111E

COURSE NAME: Introductory Statistics

COURSE DESCRIPTION:

> A general introduction to statistics for students whose academic interests involve the analysis and interpretation of data. Emphasis is placed on the development of statistical thinking and the use of technology. Topics include graphical and numerical methods for summarizing univariate and bivariate data, basic probability, discrete and continuous probability distributions, linear regression, characteristics of good study designs, confidence intervals and hypothesis testing. Same as MAT 111.
> (4 credit hours: 3 hours lecture, 2 hours lab)

PREREQUISITE:

> ACT math subscore of at least 18 or a sufficient score on the math placement exam or successful completion of MAT 083 or departmental approval.

TEXT:
> *Introductory Statistics – Exploring the World Through Data* (ebook w/MyStatLab Access), Gould and Ryan, 2nd Edition, Pearson, ISBN 978-0-321-97841-7.

TECHNOLOGY:

> Data analysis is performed throughout the course using StatCrunch. StatCrunch is a web-based statistical software and is included with Pearson's MyStatLab for use in this course.

COURSE OBJECTIVES:

This course is intended to satisfy the general studies mathematics requirement for a baccalaureate degree. Students completing this course are provided the opportunity to acquire knowledge and skills to think critically, reason analytically, and enhance their understanding of fundamental mathematical concepts and their applications. This goal is achieved by familiarizing students with the basic concepts and applications of descriptive and inferential statistics. Specifically, students will learn how to:

1.   Use statistical software to organize data in the form of tables, charts, and graphs.

2.   Compute measures of central tendency and measures of dispersion for a set of data.

3. Apply probability rules to determine the probability of a given event.

4. Determine the probabilities of discrete (i.e., binomial) and continuous (i.e., normal) random variables.

5. Determine the mean and standard deviation of a binomial distribution.

6. Determine the mean and standard deviation of sampling distributions.

7. Determine confidence intervals for population parameters.

8. Perform tests of hypotheses involving population parameters.

9. Compute and interpret the correlation coefficient.

10. Determine the least squares regression line.

STUDENT COMPETENCIES:

1. Effectively use statistical software for data analysis.

2. Construct and interpret frequency distributions and bar charts.
    (Statistical Reasoning I.D.1, I.D.2)

3. Construct and interpret histograms, stemplots, dot plots, and boxplots.
    (Statistical Reasoning I.A.1, I.A.2, I.B.2)

4. Compare distributions of data sets using appropriate graphs.
    (Statistical Reasoning I.B.2, I.D.2)

5. Describe the shape of a distribution. *(Statistical Reasoning I.A.1, I.A.2)*

6. Determine the median, quartiles, and interquartile range for a set of data.
    (Statistical Reasoning I.A.2, I.B.1)

7. Compute the mean and standard deviation for a set of data. *(Statistical Reasoning I.B.1)*

8. Use the z-score as a measure of location within a distribution. *(Statistical Reasoning I.B.1)*

9. Construct scatterplots to identify patterns and relationships. *(Statistical Reasoning I.C.1)*

10. Compute and interpret the correlation coefficient. *(Statistical Reasoning I.C.2)*

11. Determine the least squares regression line. *(Statistical Reasoning V.A.1)*

12.   Interpret the coefficients of the regression equation in the context of the problem.
      (Statistical Reasoning V.A.1)

13.   Use the regression line to compute predicted values.

14.   Distinguish between a random sample and the population of interest.
      (Statistical Reasoning II.A.1)

15.   Distinguish between a sample statistic and a population parameter.

16.   Explain the difference between a census and a survey. *(Statistical Reasoning II.B.2)*

17.   Distinguish between observational and experimental studies. *(Statistical Reasoning II.A.2)*

18.   Identify key features of observational and experimental studies.
      (Statistical Reasoning II.B.1, II.C.1, II.C.2)

19.   Explain when a cause-and-effect conclusion may not be valid for a study.
      (Statistical Reasoning II.C.3)

20.   Identify types of bias and potential causes of bias in survey results.
      (Statistical Reasoning II.B.1, II.B.3)

21.   Distinguish between random selection and random assignment.
      (Statistical Reasoning II.A.3)

22.   Explain the purpose and importance of randomization for a study design.
      (Statistical Reasoning II.C.1, II.C.3)

23.   Determine theoretical and empirical probabilities. *(Statistical Reasoning III.A.1, III.A.2)*

24.   Use computer simulation to illustrate long-run relative frequency.
      (Statistical Reasoning III.A.1)

25.   Determine a conditional probability.

26.   Compute binomial probabilities.

27.   Determine the mean and standard deviation of a binomial distribution.
      (Statistical Reasoning III.B.2)

28.   Determine probabilities and percentiles of a normal random variable.
      (Statistical Reasoning III.B.1)

29.   Distinguish between discrete and continuous random variables, and describe various
      probability distributions. *(Statistical Reasoning III.B.1, III.B.2, III.B.3)*

30. Explain the difference between the distribution of a sample and a sampling distribution. *(Statistical Reasoning III.C.1)*

31. Determine the mean, standard deviation, and shape of the distribution of the sample mean. *(Statistical Reasoning III.C.2, III.C.4)*

32. Determine the mean, standard deviation, and shape of the distribution of the sample proportion. *(Statistical Reasoning III.C.2, III.C.4)*

33. Explain the relationship between sample size and standard error. *(Statistical Reasoning III.C.3)*

34. Determine whether the conditions for using the Central Limit Theorem are satisfied. *(Statistical Reasoning III.C.4, IV.A.1)*

35. Determine a confidence interval for a single population mean and for a single population proportion. *(Statistical Reasoning IV.A.1, IV.A.2)*

36. Determine a confidence interval for the difference of two population means and for the difference of two population proportions. *(Statistical Reasoning IV.A.1, IV.A.3)*

37. Explain the meaning of confidence level in the context of confidence intervals. *(Statistical Reasoning IV.A.4)*

38. Perform hypothesis tests for a single population proportion and for the difference of two population proportions. *(Statistical Reasoning IV.B.2)*

39. Perform hypothesis tests for a single population mean and for the difference of two population means. *(Statistical Reasoning IV.B.2, IV.B.3)*

40. State the null and alternative hypotheses for a hypothesis test.

41. Verify the assumptions of a hypothesis test are satisfied. *(Statistical Reasoning III.C.4, IV.B.1)*

42. Explain the p-value and use it to decide whether or not to reject a null hypothesis. *(Statistical Reasoning IV.B.5)*

43. State the conclusion resulting from a hypothesis test in the appropriate context. *(Statistical Reasoning IV.B.4)*

44. Describe the Type I and Type II errors in a hypothesis test. *(Statistical Reasoning IV.B.4)*

45. Distinguish between statistical significance and practical significance. *(Statistical Reasoning IV.B.5)*

46. Explain the relation between a confidence interval and a two-sided hypothesis test.

COURSE OUTLINE:

    I.   Introduction to Data
    II.   Picturing Variation with Graphs
    III.   Numerical Summaries of Center and Variation
    IV.   Regression Analysis: Exploring Associations between Variables
    V.   Modeling Variation with Probability
    VI.   Modeling Random Events: The Normal and Binomial Models
    VII.   Survey Sampling and Inference
    VIII. Hypothesis Testing for Population Proportions
    IX.   Inferring Population Means
    X.   Associations Between Categorical Variables

GENERAL EDUCATION GOALS AND COMPETENCIES:

As noted above, this course is intended to satisfy the general studies mathematics requirement for a baccalaureate degree. Upon successful completion of this course, the following state-level goals and competencies will have been met:

I.   Skills Areas
    a. Communicating
        Students will demonstrate the ability to…
        6. Use mathematical and statistical models, standard quantitative symbols and various graphical tactics to present information with clarity, accuracy and precision.
    b. Higher-Order Thinking
        Students will demonstrate the ability to…
        1. Recognize the problematic elements of presentations of information and argument and to formulate diagnostic questions for resolving issues and solving problems.
        2. Use linguistic, mathematical or other symbolic approaches to describe problems, identify alternative solutions, and make reasoned choices among those solutions.
        3. Analyze and synthesize information from a variety of sources and apply the results to resolving complex situations and problems.
        4. Defend conclusions using relevant evidence and reasoned arguments.
        5. Reflect on and evaluate their critical-thinking processes.
II.   Knowledge Areas
    c. Mathematics
        Students will demonstrate the ability to…
        1. Describe contributions to society from the discipline of mathematics.
        2. Recognize and use connections within mathematics and between mathematics and other disciplines.
        3. Read, interpret, analyze and synthesize quantitative data (e.g., graphs, tables, statistics, survey data) and make reasoned estimates.
        4. Formulate and use generalizations based upon pattern recognition.

5. Apply and use mathematical models (e.g., algebraic, geometric, statistical) to solve problems.