Purpose:
This course is designed as an introduction to descriptive and inferential statistics, emphasizing applications in Education and related social and behavioral science disciplines. Content covered includes organization and display of data, measures of central tendency and variability, distributions and data transformations, correlation and measures of association, methods of estimation and prediction, probability, sampling, assorted sampling distributions, and testing one and two sample statistical hypotheses (means, variances, correlation coefficients, proportions) via z- and t- tests for single, independent, and correlated samples.

Goals:
Students should strive toward the following nine goals:

1) Recognize, define and comprehend statistical terms, symbols, and concepts.
2) Organize quantitative data descriptively.
3) Compute statistical indexes from either raw data or from partially analyzed results.
4) Interpret descriptive statistical indices and results of inferential procedures.
5) Use and apply statistical formulas and tables correctly.
6) Select the appropriate descriptive or inferential procedure.
7) Reason statistically with reference to problem recognition, application, use of findings, and interpretation and conclusions based on results.
8) Recognize and supply the assumptions underlying statistical procedures, and properties of statistical methods and procedures.
9) Form conclusions based on statistical analyses in consideration of sampling.

Required Text:

All class readings come from the Shavelson text and are required. Readings should be completed before the lecture on the topic.

*Graduate Assistants and Instructors for PRE 711 (Office – 645 Pearson):*

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Office hours will be discussed at the first PRE 711 session
Supplementary Readings:


Comparable in coverage to Shavelson. A good companion text for “hearing and seeing” it done another way. A little easier treatment, but good and sound.


The main text (Shavelson) is for learning and doing statistics. This book (Jaeger) is geared more toward understanding statistics. Provides good conceptual understanding, de-emphasizes mathematical procedures.


Recommended for those who suffer from statistics anxiety and/or need a review of mathematical procedures (algebra). Concise and reader-friendly. Covers the basics of introductory statistics (plus simple, one-way ANOVA). Reviews mathematical procedures (walks through computations) and aims to reduce stat anxiety.

Assignments:

Reading assignments from the required text are given on the following page. Lecture presentations (PowerPoint slides) will be available on Blackboard not later than two (2) hours before the lecture. I assume that the assigned readings for a topic will be read prior to the class. Problem exercises exist throughout and at the end of each chapter. While solutions to these problems are not required, it is strongly recommended that you work through at least some of them. Answers are provided at the end of each chapter.

Three (3) assignments will be distributed during the semester. They are to be completed and turned in by the date specified. They are to be completed by the individual; they are not group projects. The date they are due will most likely coincided with the scheduled examinations. The assignments will be distributed via email about 10 days before they are due.

Examinations and Grades

Completing the assignments satisfactorily will result in a minimum grade of C for the course. Two in-class plus a comprehensive final examination, will be administered. Content tested will be that identified by the course objectives, which follow. Both selected and constructed response questions will be used on exams. Each in-class examination will contribute 30% to your grade, the final exam the remaining 40%. Grades will be assigned as follows: 88-100% mastery = A; 79-87% mastery = B; 70-78% mastery = C; 69-62% mastery = D; and, below 62% = F.
Course Outline/Topics and Readings

1) Introduction and Fundamental concepts in Statistics  
   (Chapters 1 and 2 in Shavelson)

2) Frequency Distributions, Distribution Shape, and Graphic Presentation of Data  
   (Chapter 3 + Appendix 1)

3) Measures of Central Tendency  
   (Chapter 4)

4) Measures of Variability  
   (Chapter 4)

   ------------ Exam I ------------

5) Standard Scores, Score Transformations, and the Normal Curve  
   (Chapter 5)

6) Correlation Methods  
   (Chapters 6, pp. 376-388)

7) Bivariate Linear Regression and Prediction  
   (Chapter 7)

   ------------ Exam II ------------

8) Sampling, Probability, Sampling Distributions, and Statistical Inferences  
   (Chapters 8 and 9)

9) Error, Power, Estimation, and Hypothesis Testing: Test of Means, Variances,  
   Correlations and Proportions for One and Two (Independent and Correlated) Samples  
   (Chapters 10, 11 and 12)

10) Chi-Square Tests: Tests of Fit, Independence, and k- Sample Distributions  
    (Chapters 19)

   ------------ Pre 710 Final Exam ------------
PRE 710  
Statistical Methods I -- Course Objectives

1. Provide two definitions of statistics.
2. Describe the role of statistics in the research process.
3. Describe the role of statistics in the evaluation process.
4. Compare the role of statistics to the role of research design and measurement in conducting research or evaluation.
5. Differentiate between (a) variables and constants, (b) populations and samples, and (c) parameters and estimates.
6. Discuss the utility of descriptive and inferential statistics.
7. Discuss the role of measurement in research and its relationship to statistics.
8. Identify the characteristics that define the four levels of measurement: nominal, ordinal, interval and ratio.
9. Distinguish between discrete and continuous variables and provide examples of each.
10. Identify the appropriate level of measurement associated with a variable described in an example.
11. Explain the purpose of sampling in research.
12. Define a sampling unit and provide examples of research wherein the sampling unit is different.
13. Differentiate between random and systematic sampling errors.
14. Define random sampling.
15. Draw a random sample using a table of random numbers for a given situation.
16. Distinguish between a stratified and a proportional stratified sample.
17. Define and provide examples of  
   (a) systematic sampling  
   (b) accidental sampling  
   (c) purposive sampling
18. Discuss the relationship between random sampling and statistical inference.
19. Analyze and describe the sampling plan provided in an example of a research study.
20. Construct a frequency distribution for qualitative or quantitative data.
21. Determine each of the following indices given appropriate data from a frequency distribution
   (a) relative proportions and percents
   (b) apparent score limits
   (c) exact score limits
   (d) interval width
   (e) midpoint
   (f) cumulative frequency

22. Construct and interpret a histogram from a given set of data.

23. Construct and interpret a frequency polygon from a given set of data.

24. Construct and interpret an ogive from a given set of data.

25. Construct and interpret a stem and leaf plot from a given set of data.

26. Construct and interpret a box and whisker plot from a given set of data.

27. Calculate and interpret percentile points and percentile ranks.

28. Identify a distribution shape in relation to its symmetry, skewness and kurtosis.

29. Define and identify the characteristics of mean, median and mode independently and in relation to each other.

30. Compute the mean, median and mode from a given set of data.

31. Calculate the mean for combined groups.

32. Solve statistical computational expressions that use sigma notations.

33. For a given situation, select a representative measure of central tendency.

34. Interpret indices of central tendency for a given set of data.

35. Identify the relationship among measures of central tendency in symmetrical and skewed distributions.

36. Discuss the need for measures of variability.

37. Identify characteristics of and compute the range, interquartile, semi-interquartile range, variance and standard deviation for a given set of data.

38. Distinguish, apply procedures for calculating, and comparatively evaluate the range, interquartile range, semi-interquartile range, variance and standard deviation on population and samples.

39. Identify properties of the variance and standard deviation.

40. Interpret findings that report the variance and standard deviation.

41. Comparatively interpret findings using the mean and standard deviation in normal distributions.
42. Identify the effects of score transformations on the mean, variance and standard deviation.

43. Define z- (or standard) scores.

44. Convert raw scores to z-scores for a given set of data.

45. Identify characteristics of z-scores and a z-score distribution.

46. Indicate advantages and disadvantages of z-scores.

47. Interpret performance based on z-score units of measurement.

48. Convert z-scores to other standard score scales.

49. Recognize properties of symmetrical distributions.

50. Define the normal curve.

51. Determine the proportion of area under the unit normal curve that lies in an interval bounded by specific z-scores (s).

52. Identify specific z-scores associated with a proportionate area of the unit normal curve.

53. Convert from z-scores or normal curve proportionate areas to raw scores.

54. Normalize raw scores.

55. Interchangeably transform z-scores and percentiles using the unit normal curve.

56. Interpret data in bivariate frequency distribution.

57. Compute the Pearson Product Moment Correlation coefficient for a given set of data using the a) z-score, b) deviation, or c) raw score formulas.

58. Interpret results involving correlation coefficients.

59. Identify properties of correlation coefficients.

60. Identify factors that affect the magnitude of the correlation coefficients.

61. Distinguish between linear and curvilinear relationships.

62. Identify and describe covariance as a measure of relationship.

63. Describe measurement scale characteristics that determine the correlation coefficient to be computed.

64. Select the appropriate correlation coefficient for two variables with specific characteristics.

65. Predict the effect that manipulation of a given set of data will have on the correlation coefficient.
66. Distinguish the role of the correlation model to the role of the regression model.
67. In a prediction situation, identify the predictor variable and the criterion variable.
68. Identify and interpret the three components of the general linear model.
69. Discuss regression analysis in terms of the principle of least squares.
70. Define the elements in the equation for a straight line.
71. Explain the function of the constants $\beta$ and $a$ in the equation for a straight line.
72. For a given set of data, compute and interpret the regression coefficient and the intercept.
73. Compute predicted scores from a regression equation.
74. Fit a regression equation to data displayed as a bivariate frequency distribution.
75. Define error of prediction in relation to the assumption of homoscedasticity.
76. Compute and interpret the standard error of estimate.
77. Use the standard error of estimate with predicted scores to interpret the likelihood of prediction.
78. Identify the relationship between the correlation and the regression coefficients.
79. Use available summary statistics to solve for elements in the regression equation.
80. Predict the effect of increasing or decreasing the variability of variables on the regression equation.
81. Interpret the correlation coefficient in relation to predicted score variance.
82. Explain the regression to the mean effect.
83. Interpret the coefficient of determination.
84. Describe the process of statistical inference.
85. Identify the role of probability in inferential statistics.
86. Estimate the likelihood of events by chance using basic probability rules.
87. Define characteristics of the binomial probability distribution.
88. Translate areas under the normal curve into probability statements.
89. Identify the probability of a given binomial event using the binomial probability distribution and the normal curve.
90. Assuming normality, represent the likelihood of given events by their original scale units.
91. Define sampling distribution.

92. In consideration of the central limit theorem, identify the characteristics of the sampling distribution of the mean.

93. Relate the concept of a sampling distribution to the process of statistical inference.

94. Define the statistical terms unbiased, efficient, consistency, and sufficient.

95. Define and compute the standard error of the mean.

96. Distinguish between and apply point and interval estimation.

97. Use the normal curve and the standard error of the mean to test hypotheses concerning the population mean.

98. Interpret estimation of population characteristics from sample estimators using probability statements.

99. Discuss the role of hypothesis testing in the context of the research process.

100. Formulate research hypotheses from given research situations.

101. Translate research questions into null hypotheses.

102. Prepare alternative hypotheses from null hypotheses.

103. Recognize that statistical decisions are formed as probability statements based on observations from sample data.

104. Define the following terms, relating them to the process of statistical inference: (a) Type I error, (b) Type II error, (c) level of significance, (d) power, (e) critical value(s), (f) rejection region, (g) region of nonrejection, (h) directional or one-tailed hypotheses, and (i) nondirectional or two-tailed hypotheses.

105. Test hypotheses for large samples appropriate for making inferences about the mean of the population.

106. Given the necessary information, compute the power of a statistical test.

107. Identify factors affecting the power of a statistical test.

108. Determine sample size for a research question in consideration of statistical power.

109. Interpret findings resulting from a statistical test of the hypothesis.

110. Define the general process for testing a null hypothesis.

111. Describe the $t$ distributions and differentiate them from the normal curve.

112. Discuss the concept of “degrees of freedom” and their roles in $t$ tests.
113. For given information, identify critical values of $t$ needed to test hypotheses.

114. Test hypotheses for large or small samples appropriate to make inferences about the:

(a) Mean of a population,
(b) Equality of two population means for independent samples, and
(c) Equality of two population means for dependent (correlated) samples.

115. Identify assumptions associated with $t$ tests involving population means.

116. Contrast results formed from test of independent and dependent samples.

117. Interpret findings from $t$ tests in light of the research question and sample data.

118. Demonstrate an understanding of the general hypothesis testing process.

119. Recognize properties of sampling distributions as probability distributions.

120. Identify and distinguish characteristics that describe the following probability distributions used in statistical inference:

(a) normal distribution,
(b) $t$ distribution,
(c) chi square distribution, and
(d) $F$ distribution.

121. From information given, identify the proper critical value(s) needed to test a hypothesis requiring the normal, $t$, chi square, or $F$ distributions.

122. Select, compute and interpret results when testing hypotheses for making inferences about:

(a) population correlation coefficient,
(b) equality of two population correlation coefficients for independent samples,
(c) equality of two dependent correlation coefficients,
(d) variance of a population,
(e) equality of two population variances using independent samples,
(f) equality of two population variances using dependent samples,
(g) population proportion,
(h) equivalence of two population proportions from independent samples, and
(i) frequencies for single sample fit, bivariate relationship, and $k$-independent sample equivalence.