Salem State College  
Mathematics Department  
Spring, 2007

Course: MSM 709: Data, Statistics and Probability for Middle School Teachers  
Course webpage: http://salemstate.edu/~lpoitevin/Spring-2007/stats.html  
Room: SB 307  
Schedule: Tue 3:30 - 5:50  
Instructor: L. Pedro Poitevin, Assistant Professor  
Office: Sullivan Building 308B  
Office hours: MWF: 1:30-2:30; TuTh: 10:00 - 11:00  
Office phone number: (978) 542-6995  
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Course description: A hands-on course on statistics and probability theory intended to provide middle school teachers with a working knowledge and insight into the deeper aspects of the subject matter, as well as with some useful tools for the development of appropriate lesson plans.

Course goals:

1. To help teachers develop a good conceptual understanding of statistics;
2. To provide teachers opportunities to play with data and actually do statistics.

Learning objectives: A student who passes this course should be able to:

1. Identify the Who, What, When, Where, Why, and How of data, or recognize when some of this information has not been provided;
2. Identify the cases and variables in any data set;
3. Classify a variable as categorical or quantitative;
4. Identify the units in which a given quantitative variable has been measured;
5. Summarize the distribution of a categorical variable with a frequency table;

6. Display the distribution of a categorical variable with a bar chart or pie chart;

7. Make and examine a contingency table;

8. Make and examine displays of the conditional distributions of one variable for two or more groups;

9. Examine the association between categorical variables by comparing conditional and marginal percentages;

10. Describe any anomalies or extraordinary features revealed by the display of a variable;

11. Describe and discuss patterns found in a contingency table and associated displays of conditional distributions;

12. Identify an appropriate display for any quantitative variable;

13. Guess the shape of the distribution of a variable by knowing something about the data;

14. Display the distribution of a quantitative variable with a stem-and-leaf display, a dotplot, or a histogram.

15. Make a timeplot of data that may vary over time;

16. Describe the distribution of a quantitative variable in terms of its shape, center, and spread;

17. Compare the distributions of two or more groups by comparing their shapes, centers, and spreads;

18. Describe patterns over time shown in a timeplot;

19. Discuss any outliers in the data, noting how they deviate from the overall pattern of the data;

20. Select a suitable measure of center and a suitable measure of spread for a variable based on information about its distribution;
21. Compute the mean and median of a set of data;
22. Compute the standard deviation and IQR of a set of data;
23. Create a five-number summary of a variable;
24. Construct a boxplot by hand from a five-number summary;
25. Explain why the median and IQR resist the effects of outliers, while the mean and standard deviation do not;
26. Explain why in a skewed distribution the mean is pulled in the direction of skewness relative to the median;
27. Explain how adding a constant and multiplying by a constant changes the center or spread of a variable;
28. Recognize when standardization can be used to compare values;
29. Recognize when a Normal model is appropriate;
30. Calculate the $z$-score of an observation;
31. Compare values from two different distributions using their $z$-scores;
32. Use Normal models and the 68-95-99.7 Rule to estimate the percentage of observations falling within one, two, or three standard deviations of the mean;
33. Find the percentage of observations falling below any value in a Normal model;
34. Check whether a variable follows a Normal model by making a Normal probability plot;
35. Recognize when interest in the pattern of possible relationship between two quantitative variables suggests making a scatterplot;
36. Make a scatterplot by hand or with technology;
37. Compute the correlation of two variables;
38. Explain the significance of correlation;
39. Explain why correlation is not sufficient for establishing a cause-effect relationship;
40. Read a correlation table produced by a statistics program;
41. Find a regression equation from the summary statistics for each variable and the correlation between variables;
42. Find a regression equation using statistics software and find the slope and intercept values in the regression output table;
43. Use regression to predict a value of $y$ for a given $x$;
44. Identify response ($y$) and explanatory ($x$) variables in context;
45. Check for conditions that ensure that computing a linear regression makes sense;
46. Explain why the least squares slope is easily affected by extreme values;
47. Display residuals from a linear model by making a scatterplot of residuals against predicted values or against the $x$-variable;
48. Explain how removing outliers can affect a regression model;
49. Look for high-leverage points by examining the distribution of the $x$-values or by recognizing them in a scatterplot of the data, and understand how they can affect a linear model;
50. Recognize when a well chosen re-expression may help you improve and simplify your analysis;
51. Re-express data with powers and find an effective re-expression for your data using software;
52. Recognize random outcomes in a real-world situation;
53. Recognize when a simulation might usefully model random behavior in the real world;
54. Explain the basic concepts and terminology of sampling;
55. Report possible sources of bias in a sample;
56. Explain the basic principles of sound experimental design;
57. Explain the importance of a control group and the need for a placebo treatment in some experimental studies;
58. Explain the basic definitions and rules of probability;
59. Calculate probabilities using elementary rules;
60. Explain when variables are independent;
61. Use a tree diagram to understand conditional probabilities and reverse conditioning;
62. Recognize random variables;
63. Find the probability model for a random variable;
64. Find the mean and variance of a random variable;
65. Determine the new mean and standard deviation after adding a constant, multiplying by a constant, or adding or subtracting two independent random variables;
66. Tell if a situation involves Bernoulli trials;
67. Choose whether to use a Geometric or Binomial model for a random variable involving Bernoulli trials;
68. Explain the appropriate conditions for using a Geometric, Binomial, or Normal model;
69. Find the expected value of a Geometric model;
70. Calculate Geometric probabilities;
71. Find the mean and standard deviation of a Binomial model;
72. Calculate Binomial probabilities;
73. Explain the meaning of the Central Limit Theorem;
74. Construct a one-proportion z-interval;
75. Explain the significance of confidence intervals;
76. State the null and alternative hypotheses for a one-proportion z-test;
77. Enumerate conditions that must be true for a one-proportion z-test to be appropriate and examine data for violations of those conditions;
78. Perform a one-proportion $z$-test;
79. Complete a hypothesis test for a population proportion;
80. Interpret the meaning of a $P$-value in nontechnical language;
81. State the null and alternative hypotheses for testing the difference between two population proportions;
82. Examine data for violations of conditions that would make inference about the difference between two population proportions unwise or invalid;
83. Find a confidence interval for the difference between two proportions;
84. Perform a significance test of the natural null hypothesis that two population proportions are equal;
85. Compute and interpret a $t$-test for the population mean;
86. Compute and interpret a $t$-based confidence interval for the population mean;
87. Explain the meaning of a confidence interval for a population mean;
88. Identify the assumptions required for $t$-tests and $t$-based confidence intervals;
89. Perform a two-sample $t$-test;
90. Perform a pooled $t$-test;
91. Find a paired confidence interval;
92. Perform a paired $t$-test;
93. Recognize whether a design that compares two groups is paired or not;
94. Recognize when a test of goodness-to-fit, a test of homogeneity, or a test of independence would be appropriate for a table of counts;
95. Display and interpret counts in a two-way table;
96. Use the chi-square tables to perform chi-square tests;
97. Compute a chi-square test;
98. Examine the standardized residuals to explain the nature of the deviations from the null hypothesis;

99. Interpret chi-square as a test of goodness-to-fit, homogeneity, and independence.

**Textbook:** De Veaux, Velleman, and Bock’s *Stats: Data and Models*, ISBN 0-321-20054-3 (Required)

**Homework:** Homework will be assigned each class session, but not collected. These assignments will be posted on the course web page. Problems from the homework will be used on quizzes and possibly the final exam.

**Quizzes and Class Work:** There will be a quiz given at the beginning of almost every class meeting. I will drop the lowest quiz grade and compute the average of the remaining scores to count for two thirds of the course grade. The quizzes will be based very closely on problems from the homework and in-class handouts. There will be no make up quizzes without either consultation with me prior to the quiz or written documentation of an unavoidable absence. While I will not take attendance in this class, it is expected that students will attend every class. Moreover, each student is responsible for completing all course requirements and for keeping up with all that goes on in the course irrespective of attendance.

**Exams:** There will be a cumulative final exam, which will count for one third of the course grade.
Tentative Schedule:

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Statement on Equality of Access: Salem State College is committed to providing equal access to educational experience for all students in compliance with Section 504 of The Rehabilitation Act and The Americans with Disabilities Act and to providing all reasonable academic accommodations, aids and adjustments. Any student who has a documented disability should speak with the instructor immediately. Students with disabilities who have not previously done so should provide documentation to and schedule an appointment with the Office for Students with Disabilities and obtain appropriate services.