Appendix A

Learning Objectives for Statistical Methods

The following learning objectives have been prepared to assist you in your preparation for the master's comprehensive examination in the area of statistics. A review of content related to these learning objectives should provide you with the foundation required for a successful mastery of the content.

1. Students should be familiar with the terminology and special notation of statistical analysis. The terminology consists of the following:
    a. Statistical Terms
        i. Population
        ii. Sample
        iii. Parameter
        iv. Statistic
        v. Descriptive Statistics
        vi. Inferential Statistics
        vii. Sampling Error
    b. Measurement Terms
        i. Operational definition
        ii. Nominal
        iii. Ordinal
        iv. Interval
        v. Ratio
        vi. Discrete variable
        vii. Continuous variable
        viii. Real limits
    c. Research Terms
        i. Correlation method
        ii. Experimental method
        iii. Independent variable
        iv. Dependent variable
        v. Non-experimental method
        vi. Quasi-independent variable
2. Students should learn how statistical techniques fit into the general process of science
3. Students should learn the notation, particularly summation notation.
4. Students should understand the concept of a frequency distribution as an organized display showing where all of the individual scores are located on the scale of measurement.
5. Students should be able to organize data into a regular or a grouped frequency distribution table, and understand data that are presented in a table.

6. Students should be able to organize data into frequency distribution graphs, including bar graphs, histograms, polygons, and ogives. Also, students should be able to understand data that are presented in a graph.
7. Students should understand that most population distributions are drawn as smooth curves showing relative proportions rather than absolute frequencies.
8. Students should be able to describe locations within a distribution using percentiles and percentile ranks, and they should be able to compute percentiles and ranks using interpolation when necessary.
9. Students should understand the purpose of measuring central tendency
10. Students should be able to define and compute each of the three measures of central tendency (Mean, Median, Mode).
11. Students should understand how the mean is affected when a set of scores is modified (a new score is added, a score is removed, or a score is changed).
12. Students should understand the circumstances in which each of the their measures is appropriate.
13. Students should understand how the three measures of central tendency are related to each other in symmetrical and skewed distributions.
14. Students should be able to draw and to understand figures/graphs that display several different means (or medians) representing different treatment conditions or different groups.
15. Students should understand the general purpose for measuring variability and they should be able to recognize the difference between scores with high variability versus scores with low variability.
16. Students should be able to define and calculate the range and the inter-quartile range, but they should also realize that these are both relatively crude measures of variability.
17. Students should understand the concept of standard deviation as measuring the standard distance from the mean.
18. Students should be able to calculate SS (sum of square d deviations) variance, and standard deviation for a sample and for a population. In addition, they should understand the concept of an unbiased statistic and the correction for bias that is used in the formula for sample variance.
19. Students should understand that a z-score provides a precise description of a location in a distribution.
20. Students should be able to transform X values into z-scores, and transform z-scores into X values.
21. Students should understand and be able to describe the effects of standardizing a distribution by transforming the entire set of X values into z-scores.
22. Students should be able to use z-scores to transform any distribution into a standardized distribution with a pre-determined mean and a pre-determined standard deviation.
23. Students should understand the basic definition of probability and the underlying assumption of random sampling.

24. Students should be able to use the unit normal table to find probabilities for specific scores in a normal distribution, and to find the scores that correspond to specific proportions of a normal distribution.
25. Students should be able to find percentiles and percentile ranks in a normal distribution.
26. Students should be able to define the distribution of sample means and, for a specific sampling situation, describe the distribution by identifying its shape, the expected value of M, and the standard error of M.
27. Students should understand that each sample mean, M, has a location in the distribution of sample means that can be described by a z-score equal to

$$z = \frac{M - m}{s_M}$$

28. Using the distribution of sample means, z-scores and the unit normal table, students should be able to determine probabilities corresponding to specific sample means.
29. Students should understand the logic of hypothesis testing
30. Students should be able to state the hypotheses and locate the critical region.
31. Students should be able to conduct a hypothesis test using a z-score statistic and make a statistical decision.
32. Students should be able to define and differential Type I and Type II errors.
33. Students should understand the purpose of measuring effect size and power, and they should be able to compute Cohen's d.
34. Students should be able to incorporate a directional prediction into the hypothesis and conduct a directional (one-tailed) test.
35. Students should understand when a t statistic is used (instead of a z-score) for hypothesis testing.
36. Students should be able to perform a hypothesis test using the t statistic. This includes computing basic statistics for the sample (mean and variance) and computing the estimate standard error the sample mean.
37. Students should be able to compute Cohen's d and the percentage of variance accounted for (r^2) to measure effect size.
38. Students should understand the structure of a research study that produces data appropriate for an independent-measures t hypothesis test.
39. Students should be able to use the independent-measures t statistic to test hypotheses about the mean difference between two populations or between two treatment conditions.
40. Students should be able to evaluate the magnitude of the mean difference by computing either Cohen's d or r^2 (the percentage of variance accounted for).
41. Students should understand the structure of a research study that produces data appropriate for a repeated-measures t hypothesis test.
42. Students should be able to use the repeated-measures t statistic to test hypotheses about the mean difference between two treatment conditions.

43. Students should be able to evaluate the magnitude of the mean difference by computing either Cohen's d or r^2 (the percentage of variance accounted for).
44. Students should understand the relative advantages and disadvantages of repeated-measures studies compared to independent-measures studies, and should recognize the situations where each type of study is appropriate.
45. Students should understand the Pearson correlation as a descriptive statistic that measures and describes the relationship between two variables.
46. Students should be able to compute the Pearson correlation using either the definitional or the computational formula for SP (the sum of products of deviations).
47. Students should understand the Spearman correlation and how it differs from the Pearson correlation in terms of data that it uses and the type of relationship that it measures.
48. Students should understand the concept of a linear equation including the slope and Y-intercept.
49. Students should understand the concept of a least-squared-error solution.
50. Students should understand and be able to compute the linear regression equation for predicting Y values from the X values in a set of correlation data.
51. Students should understand the basic purpose for analysis of variance and the general logic that underlies this statistical procedure.
52. Students should be able to perform an analysis of variance to evaluate the data from a single-factor, independent-measures research study.
53. Students should understand when post tests are necessary and the purpose that they serve.
54. Students should be able to compute eta-squared (the percentage of variance accounted for) to measure effect size for the sample means in an analysis of variance.
55. Students should recognize the research situations where a chi-square test is appropriate.
56. Students should be able to conduct a chi-square test for goodness of fit to evaluate a hypothesis about the shape (proportions) of a population distribution.
57. Students should be able to conduct a chi-square test for independence to evaluate the relationship between two variables in the population.
58. Students should be able to evaluate the effect size (strength of relationship) for a chi-square test of independence by computing either a phi-coefficient (for a 2x2 data matrix) or Cramer's V (for a larger data matrix).