

**MQM Comprehensive Examination
Statistics Minor**

Day 3

Directions: On this exam you must answer four questions. The first two (in Part I) are required, and you must choose two from among the remaining four questions in Part II. Begin each response on a new page, and clearly number the item to which you are responding.

Part I. Answer both items.

1. The math teachers in a sample had either a traditional, provisional or alternative teaching certificate. Each teacher was also asked to report their years of teaching experience. Then all the teachers took a test of subject matter knowledge (SMK). Two researchers proposed studying the teachers' SMK scores. One will use analysis of covariance, with the SMK scores as the outcome, certification type as a between-groups factor, and years of experience as the covariate. The other decided to create two groups of teachers – less experienced and more experienced, and will use a two-way certification-type X experience-level (3 X 2) ANOVA, with SMK scores as the outcome.
 - A. What are the assumptions of the two analyses?
 - B. What hypotheses are tested by these analyses? Describe the key differences between the hypotheses.
 - C. Is one of these analyses “better” than the other? Discuss the advantages and disadvantages of each analysis.
2. Power
 - A. Describe the four key variables that influence power and explain the relationship between power and each of the key variables.
 - B. Discuss Cohen's rule of thumb for the interpretation of standardized mean difference, d .
 - C. Suppose you were to conduct an independent samples t-test and want to maximize the power of your test. Suggest some *reasonable* strategies that you might employ to maximize power.

Part II. Answer two of the following four items.

3. Analysis of Covariance
 - A. Explain how ANCOVA adjusts group differences for a covariate.

- B. Explain how the covariate is adjusted for group differences.
4. Sampling Distributions
- A. Derive the variance for the random sampling distribution of a mean.
 - B. Clearly state the assumptions of the derivation.
5. Survey sampling
- A. Explain the effects of clusters on the estimate of means and total in a survey sample.
 - B. Explain the effects of strata on the estimate of means and total in a survey sample.
6. Multicollinearity is one of the key problems that a researcher may encounter when using regression analysis.
- A. What is multicollinearity?
 - B. What are the consequences of multicollinearity for conclusions about regression slopes? For conclusions about the overall performance of a regression model?
 - C. Describe two ways to diagnose whether multicollinearity is a problem in a regression model.
 - D. Support or refute the following statement: The more predictors you include in a regression model, the more likely the model is to suffer from multicollinearity.