

**MQM Comprehensive Examination  
Statistics Major General Questions**

**Day 3**

Answer two of the following four questions. Begin each response on a new page, and clearly number the item to which you are responding.

1. Explain in detail the important role that latent roots and vectors (eigenvalues and eigenvectors) play in multivariate hypothesis testing theory.
  
2. Inferential procedures
  - A. Differentiate between inferential procedures based on hypothesis testing and those based on estimation procedures.
  - B. Explain the role of the sampling distribution in each of the two types of inferential procedures.
  - C. Indicate whether and how each of the following concepts function in each of these two approaches to inference.
    - i. Type I and Type II errors
    - ii. standard errors
    - iii. the null hypothesis
    - iv. confidence intervals
  
3. In using the general linear model, programs such as SAS and SPSS allow the user to specify categorical variables as independent variables in the analysis. For example, the CLASS statement is used for declaring categorical variables in SAS.
  - A. Explain in detail why such programs produce estimates for multiple estimators ( $\beta$ s) for each categorical variable.
  - B. How would each estimator be interpreted? (You may want to outline a simple model here to use in answering this question.)
  
4. Consider the independent, identically distributed random variables  $X_1$  through  $X_n$ , with density  $f(x)$ . Often the transformation  $g(X_i)$  is of interest.

- A. Describe two situations (e.g., give examples) in which one might be interested in a transformation of the original random variables  $X_1$  through  $X_n$ . Why would the original variables  $X_1$  through  $X_n$  not be of interest in these situations?
- B. Suppose you wanted to obtain a density for the new variables  $g(X_1)$  through  $g(X_n)$ . Describe two different methods you might use to obtain such a distribution. What restrictions apply to the use of each approach (e.g., can it be used for any function  $g(x)$ , are there conditions on  $X$  or  $f(x)$ , etc.)?