

# Biostatistics 890 Syllabus

## Winter 2004

**Instructor:** Dr. Anant Kshirsagar  
Email: kay@umich.edu  
Office: M4063, SPH II  
Phone: 936-1008

### 1. Regression and Correlation Among Several Variables

- 1.1 Multivariate Analysis
- 1.2 Multivariate Distributions
- 1.3 Regression, Partial and Multiple Correlation
- 1.4 The Multinomial Distributions

### 2. Multivariate Normal Distributions

- 2.1 Multivariate Normal Distributions
- 2.2 A Random Sample from  $N_p(\underline{x} \mid \underline{\mu} \mid \Sigma)$
- 2.3 Orthogonal Transformations
- 2.4 Conditional Distributions
- 2.5 Quadratic Forms in Normal Variables

### 3. The Wishart Distribution

- 3.1 Maximum Likelihood Estimates of the Mean Vector and the Variance Covariance Matrix
- 3.2 The Wishart Distribution in the Canonical Case
- 3.3 The Wishart Distribution in the General Case
- 3.4 Distributions of the Maximum Likelihood Estimates of  $\underline{\mu}$  and  $\Sigma$
- 3.5 Miscellaneous Results Associated with the Wishart Distribution
- 3.6 The Characteristic Function of the Wishart Distribution
- 3.7 Distribution of  $XAX'$
- 3.8 The Non-Central Wishart Distribution

### 4. Distributions Associate with Regression

- 4.1 Distribution of Correlation Coefficient
- 4.2 Distribution of the Multiple Correlation Coefficient
- 4.3 Distribution of the Matrix of Correlation Coefficients
- 4.4 Distributions of the Matrix of Regression Coefficients and the Residual s.s. and s.p. Matrix
- 4.5 Multiple Regression of  $x_p$  on  $x_1, \dots, x_{p-1}$
- 4.6 Distribution of the Partial Correlation Coefficient
- 4.7 Determination of  $d(2, n, p)$

### 5. Hotelling's $T^2$ and Its Applications

- 5.1 Hotelling's  $T^2$  and Its Distribution
- 5.2 Application of the Union-Intersection Principle to Obtain Hotelling's  $T^2$

- 5.3 Distribution of Roa's U Statistic
- 5.4 Applications of Hotelling's  $T^2$
- 5.5 Applications of Hotelling's  $T^2$  in Problems Involving Linear Hypotheses
- 5.6 Optimum Properties of Hotelling's  $T^2$  Test

## **6. Discriminant Analysis**

- 6.1 Procedure for Discrimination
- 6.2 The Sample Discriminant Function
- 6.3 Tests Associated with Discriminant Functions
- 6.4 Analogy of Discriminant Analysis with Regression Analysis
- 6.5 Standard Errors of Discriminant Function Coefficients
- 6.6 Chance of Misclassification When Anderson's Statistics is Used
- 6.7 Penrose's Size and Shape Function
- 6.8 Discriminant Analysis in the Case of Unequal Variance-Covariance Matrices
- 6.9 Discrimination in the Case of Zero Mean Differences
- 6.10 Discrimination in the Case of Qualitative Data

## **7. Canonical Variables and Canonical Correlations**

- 7.1 Singular Decomposition of a Matrix
- 7.2 Canonical Variables and Canonical Correlations
- 7.3 Sample Canonical Correlations and Canonical Variables
- 7.4 Representation of an Orthogonal Matrix in Terms of Rotation Angles
- 7.5 Distribution of the Sample Canonical Correlation Coefficients
- 7.6 Distribution of the Canonical Vectors
- 7.7 Some Miscellaneous Results about Canonical Correlations
- 7.8 Canonical Analysis

## **8. Wilks's $\Lambda$ Criterion**

- 8.1 Wilks's  $\Lambda$  Criterion
- 8.2 The Distribution of Wilks's  $\Lambda$
- 8.3 Bartlett's Approximation to Wilks's  $\Lambda$
- 8.4 Independence of Two Vectors
- 8.5 Test for a Subhypothesis Associated with  $\beta$
- 8.6 Factors of Wilks's  $\Lambda$
- 8.7 Tests of Significance of the Residual Roots
- 8.8 Alternatives to Wilks's  $\Lambda$  Criterion

## **9. Multivariate Analysis of Variance and Discrimination in the Case of Several Groups**

- 9.1 Multivariate Analysis of Variance: One-Way Classification
- 9.2 Discrimination in Case of Several Groups
- 9.3 Subdivision of the "Between Groups" s.s. and s.p. Matrix
- 9.4 Goodness of Fit of a Single Hypothetical Discriminant Function in the Case of Several Groups
- 9.5 An Alternative Method of Discrimination

- 9.6 Use of Canonical Analysis in Contingency Tables
- 9.7 The General Theory of Multivariate Analysis of Variance and Covariance
- 9.8 A General Incomplete Block Design

## **10. Likelihood Ratio Tests**

- 10.1 Likelihood Ratio Criteria for Certain Hypotheses
- 10.2 Moments of  $\lambda_a, \lambda_b, \lambda_c$
- 10.3 Independence of  $k$  Sets in Variates
- 10.4 The Sphericity Test

## **11. Principal Components**

- 11.1 Principal Components of a Random Vector
- 11.2 Optimality Properties of Principal Components
- 11.3 Singular Normal Distribution
- 11.4 Sample Principal Components
- 11.5 Distributions Associated with the Sample Principal Components (Null Case)
- 11.6 Asymptotic Distributions
- 11.7 Tests of Certain Hypotheses About Principal Components
- 11.8 Correlation Matrix
- 11.9 Geometrical Interpretation of Principal Components
- 11.10 Principal Component Analysis