

Multivariate statistics topics and exam questions (2019)

A. Theory: multivariate distributions

1. Definition and properties of the multivariate normal distribution (m.n.d.), deriving its p.d.f., level surfaces. Equivalent characterization of the m.n.d. via distribution of linear combinations of its components (with proof).
2. Multivariate CLT (without proof) and asymptotic distribution of the χ^2 -statistic (with proof).
3. Wishart distribution (definition, application). Multivariate extension of the Lukács theorem (with proof). Sufficient and complete statistics, information matrix in multidimensional parameter spaces. Multidimensional Cramér–Rao inequality (without proof).
4. ML estimation of the parameters of the m.n.d. and the distribution of the estimators. Deriving the ML estimates.
5. Testing hypotheses about the mean vector of the m.d.n. with known and unknown covariance matrix, one- and two-sample cases. Hotelling T^2 distribution. Deriving the test statistics.
6. Fisher–Cochran theorem (with proof) and consequences.

B. Methods and models

1. Principal component and factor analysis.
2. Multivariate regression and the linear model (when the predictors are deterministic). Gauss normal equations, Gauss–Markov theorem (without proof).
3. ANOVA (one- and two-way).
4. Canonical correlation analysis and correspondence analysis.
5. Discriminant analysis.
6. Cluster analysis and multidimensional scaling.

C. Applications

Interpreting BMDP outputs: identifying notions, formulas, explaining the results.

References:

1. Bolla M., Krámlí A., Statisztikai következtetések elmélete, Typotex, Budapest (2005), Chapters 5-8 (in Hungarian)
2. Mardia, K. V., Kent, J. T., Bibby, J. M., Multivariate Analysis, Academic Press, Elsevier Science (1979, 2003)
3. Rao, C. R., Linear Statistical Inference and Its Applications, Wiley (1965, 1978)
4. Lecture notes and BMDP outputs on the homepage of this course and that of the Multivar. stat. with economic applications.