

Probability and Statistics Course Outline

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QEM ERASMUS MUNDUS MASTER. FALL 2016

1. Descriptive Statistics

Frequency distributions. Summary statistics. Bivariate frequency distributions. Conditional sample means. Sample covariance and correlation.

2. Random Variables and Probability Distributions

Preliminaries: an introduction to set theory. Statistical inference, random experiments, and probabilities. Finite sample spaces and combinatorial analysis. Definition of random variable and cumulative density function. Continuous and discrete random variables. Commonly used univariate distributions. Transformations of random variables. Expectation and moments. Quantiles, the median, and the mode.

3. Multivariate Random Variables

Joint, marginal, and conditional distributions. Independence. Functions of random variables. Multivariate normal distribution. Covariance, correlation, and conditional expectation. Linear prediction.

4. Sample Theory and Sample Distributions

Random samples. Sample mean and variance. Sampling from a normal population: χ^2 , t , and F distributions. Bivariate and multivariate random samples. Heterogeneous and correlated samples.

5. Estimation

Analogy principle. Desirable properties of an estimator. Moments and likelihood problems. Maximum likelihood estimation. The Cramer-Rao lower bound. Bayesian inference.

6. Regression

Classical regression model. Statistical results and interpretation. Nonparametric regression.

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7. Hypothesis Testing and Confidence Intervals

Hypothesis testing. Type I and type II errors. The power function. Likelihood ratio test. Confidence intervals. Hypothesis testing in a normal linear regression model.

8. Asymptotic Theory

The concept of stochastic convergence. Laws of large numbers and central limit theorems. Delta method. Consistency and asymptotic normality of ordinary least squares and maximum likelihood estimators. Asymptotic efficiency. Bootstrap.

References

Main references:

Mood, Alexander M., Franklin A. Graybill, and Duane C. Boes (1974), *Introduction to the Theory of Statistics*, McGraw-Hill, Third Edition, 1974.

Lindgren, Bernard W. (1998), *Statistical Theory*, Fourth Edition, Chapman & Hall/CRC, 1993.

Goldberger, Arthur S. (1991), *A Course in Econometrics*, Harvard University Press, 1991.

Additional reference:

Greene, William E. (2003), *Econometric Analysis*, Prentice-Hall, Fifth Edition, 2003.