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Structure

This module consists of three parts: first three lectures on matrices, then two lectures on probability, and finally two lectures on statistics. Each lecture is concluded with a training exercise to get hands-on training. You can check your understanding by doing these exercises and by checking your answers with the fully worked-out webcast solutions that are available on the website.

Three lectures on matrices

- Matrix summation, matrix multiplication
- Square matrix, diagonal matrix, identity matrix, unit vector
- Transpose, trace, rank, inverse
- Positive and negative (semi)definite matrix
- Gradient vector, Hessian matrix
- First and Second Order Conditions for optimization of vector functions

Two lectures on probability

- Univariate and multivariate random variables
- Probability density function (pdf)
- Cumulative density function (cdf)
- Expectation, expectation of functions
- Mean, variance, standard deviation
- Covariance, correlation
- Mean, variance, and covariance of linear transformations
- Independence
- Higher order moments, skewness, kurtosis
- Normal distribution, standard normal distribution
- Multivariate normal distribution

- Multivariate normal distribution
- Linear transformations of normally distributed random variables
- Chi-squared distribution, Student t-distribution, F-distribution

Two lectures on statistics

- Statistic, estimator, estimate
- Standard error
- Confidence interval
- Unbiasedness
- Efficiency
- Consistency
- Sample mean, sample variance
- Hypothesis, null and alternative hypothesis
- Test statistic
- Type I and Type II error
- Size and power of a statistical test
- Significance level
- Critical value, critical region
- P-value
- T-statistic, Chi-squared statistic, F-statistic