Multivariate statistics
Lecture 02:
Multivariate normal distribution (MVN)

Literature and Problems: See course schedule

Agenda (preliminary):

Review of 1D normal distribution and moments

pD (multivariate) normal distribution

- **simultaneous pdf**
- **parameters (moments)**
- **notation**
- **special case of independent variables**
- **marginal pdf's**
- **constant density contours (ellipsoids)**
- **statistical (Mahalanobis) distance from μ and chi-square distribution**
- **confidence region (ellipsoide)**
- **DEMO: bivariate normal distribution and geometry, examples**

General MVN <----> standard MVN

- **(DEMO: generation of general MVN from standard 1D normal distribution)**

Reproductivity and linear combinations

Estimation of MVN parameters

- **ML estimator for μ and its distribution and properties**
- **ML estimator for ∑ and its properties --> estimator S**
- **estimator S, the Wishart distribution and its properties**

Multivariate CLT, Central Limit Theorem

- **(DEMO: illustration of bivariate CLT)**

Modelcheck for MVN

- **p=1: histogram and QQ-plot**
- **p=2: scatter plots, marginal histograms and Mahalanobis QQ-plot**
- **p>2: scatter matrix plots, marginal histograms and Mahalanobis QQ-plot**
- **DEMO: model check for p = 1, 2 and 3 for fitting/non-fitting models**

Outlier detection in 1D, 2D and pD

Transformation of data (variables) for improved normality