Frequency
Only this year

Remarque
Next time : From 17.02.2020 to 27.03.2020

Summary
The course focuses on probabilistic reasoning and its applications in data analysis in order to infer model parameters (e.g. 'fits') to compare models and to make probabilistic predictions. Probabilistic computation is covered, including methods based on Markov chain Monte-Carlo.

Content
Abstract:
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The course will focus on probabilistic reasoning and its applications in data analysis in order to infer model parameters (e.g. 'fits'), to compare models and to make probabilistic predictions. Extensive use of graphical models will be made, i.e. of models which describe the network of causes and effects. Practical aspects of probabilistic computation will be covered, including methods based on Markov chain Monte-Carlo. Many examples will be made, using the R language as the 'lingua franca' of the course, although the use of some free (or demo version of) packages for special purposes will be illustrated.

Syllabus:
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Uncertainty and probability in the Sciences.
ISO Guide on Uncertainty (GUM).
Basic rules of probability for discrete and continuous variables.
Summaries of distributions and general theorems.
Multivariate distributions, in particular normal multivariate, including conditioning in many dimensions.
Marginals, correlations and covariance matrix.
Propagation of uncertainties: from exact to approximate methods, including correlations (covariance matrix propagation).
Probabilistic inference.
Parametric inference applied to basic models.
Beta and Gamma distributions and their use in inference.
Treatment of uncertainties due to systematics.
Bayesian Networks as conceptual and practical tools.
Fits and unfolding.
Direct sampling with Montecarlo methods.
Computational issues in probabilistic inference overcome by Montecarlo sampling: importance sampling;
Metropolis(-Hasting) algorithm; Gibbs sampler; simulated annealing; nested sampler. Recovery of 'standard formulae' (like those derived from "likelihood methods") as special cases of the general probabilistic approach under well stated conditions. Linear models: design matrix and parameter 'estimation'.

Hosts: Prof. A. Bay (EPFL) & Dr. A. Bravar (UNIGE)

**Note**

February 17, 19, 21, 24, 26, 28 & March 16, 18, 20, 23, 25, 27, 2020
February@Geneva & March@Lausanne

**Expected student activities**

to apply advanced probabilistic methods to data analysis