

## Statistical Modelling and Design of Experiments

### Objectives

Statistical experimental design allows experimenters to get the maximum of relevant information with a minimum experimental effort. Most often the problems that practitioners face can be framed by the two questions: which are the most important factors of the system (model identification) and what is the best settings of the factors (prediction). Students will learn the fundamental concepts of factor, bias, interaction, confounding, how to construct fractional factorial designs and how to optimize a response surface. The methodology of robust engineering design (Taguchi method) used in modern quality improvement will also be taught. Although this course is an applied statistics course with many real examples, it provides insights in fundamental statistical modelling issues.

### Contents

1. What is statistical experimental design
2. Full Factorial Designs with Factors at Two-Level  
Factors, interaction  
Analysis with normal and half-normal plot
3. Fractional Factorial Designs with Factors at Two-Level  
Construction  
Confounding of effects  
Analysis
4. Special Issues  
Design resolution  
Blocking  
Other screening designs
5. Modelling  
Advantage of orthogonal designs  
Model comparison  
Test of lack-of-fit
6. Optimization techniques  
Simplex  
Evop  
Steepest ascent
7. Response Surface Analysis  
Central composite designs  
Other designs  
Canonical analysis
8. Special Issues  
Simultaneous optimization of many responses  
Analysis of transformation
9. Robust Engineering Design  
Control and noise factors  
Taguchi method  
Parameter design optimization

### Evaluation

According curriculum 2010-2011 :

- E : 2-hour final written test during the end-of-semester examination session
- *Reexamination session (September) : 2h written test*

## Textbooks

- Box G.E.P., Hunter W. and Hunter S.J., *Statistics for Experimenters: Design, Innovation, and Discovery*, 2nd Edition, Wiley (2005).
- Myers R.H. and Montgomery D.C., *Response Surface Methodology: Process and Product Optimization Using Designed Experiments*, Wiley (1995).
- Wu C.F.J, Hamada M., *Experiments: Planning, Analysis, and Parameter Design Optimization*, Wiley (2000).

## Characteristics

- 3 ECTS credits
- Compulsory course for master in statistics
- Spring Semester
- Course : 2 hours
- Prerequisite : Linear Regression

## Teaching team

- *Dr. Yves-Laurent Grize*  
Assurances La Baloise,  
Aeschengraben 21  
CH-4002 Bâle, Suisse  
✉ email: [yves-laurent.grize@baloise.ch](mailto:yves-laurent.grize@baloise.ch)

## Exercises