MATH48082 - 2008/2009

General Information

- Title: Design and Analysis of Experiments
- Unit code: MATH48082
- Credits: 15
- **MATH48082 unit may not be taken as well as MATH38082.**
- Prerequisites: MATH20701, Knowledge of MATH38011, *Linear Statistical Models,* is helpful but not essential.
- Co-requisite units: None
- School responsible: Mathematics
- Members of staff responsible: Dr. Alex Donev

Specification

Aims

To introduce the student to the principles and methods of statistical analysis of designed experiments.

Brief Description of the unit

Experiments are carried out by researchers in many fields including biology, medicine, chemistry, physics, engineering and agriculture. In such experiments the results are affected both by the choice of factors to study and experimental error (such as measurement error or inherent randomness between experimental units). Choosing a good experimental design ensures that the aim of the study where it is used is achieved. Moreover, the statistical analysis of data collected from such designed experiments is simple, easier to interpret and the experimental resources are spent most efficiently. The unit introduces various criteria for design optimality, as well as the General Equivalent Theorem and its applications.

Learning Outcomes

On successful completion of this course unit students will

- given the description of how a set of data were collected, be able to:
  - recognise what design was followed,
  - comment on the shortfalls of the design used,
  - decide what assumptions are appropriate in modelling the data,
  - perform the appropriate analysis;
- be familiar with the principles of:
  - randomisation and replication,
  - nested designs,
  - block designs,
  - factorial designs and fractional layouts.
- be familiar with:
  - criteria for design optimality,
  - principles of constructing optimal experimental designs,
  - the General Equivalent Theorem and its applications.

Future topics requiring this course unit

None.

Syllabus

1. Basic concepts; Definitions. [2]
   Treatment, factors, plots, blocks, precision, efficiency, replication, randomisation and design.
2. Completely randomised design. [4]
   Fixed and random effects, contrasts, ANOVA table.

3. Factorial designs. [4]
   General factorial experiment; fixed and random effects; interactions.
4. Nested designs. [2]
5. Blocking. [6]
   Orthogonal designs: Randomised complete block designs; Latin square designs; extensions of the Latin square design.
   Non-orthogonal designs: Balanced incomplete block designs.
6. 2^m Factorial experiments; Confounding; fractional replication; aliasing. [4]
7. Response surface designs [3]
8. Criteria for design optimality [3]
9. The General Equivalence Theorem and its applications; construction of D-optimal experimental designs. [5]

Textbooks

- W. G. Cochran and G. M. Cox, *Experimental Designs*, Wiley 1957.
- C. R. Hicks, *Fundamental Concepts in the Design of Experiments*, (4th edition), OUP 1973.
- D. C. Montgomery, *Design and Analysis in the Design of Experiments*, (4th edition), Wiley 1997.

Teaching and learning methods

Three lectures and one examples/computing class each week. In addition students should expect to spend at least six hours each week on private study for this course unit.

Assessment

Coursework: weighting 20%
End of semester examination: two and a half hours weighting 80%

Arrangements