MANCHESTER 1824
The University of Manchester

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MATH48082

Design and Analysis of Experiments

Unit code:	MATH48082
Credit Rating:	15
Unit level:	Level 4
Teaching period(s):	Semester 2
Offered by	School of Mathematics
Available as a free choice unit?:	N

Requisites

Prerequisite

- MATH20701 - Probability 2 (Compulsory)
- MATH20802 - Statistical Methods (Compulsory)
- MATH38141 - Regression Analysis (Compulsory)

Additional Requirements

MATH48082 pre-requisites

This course is suitable for any Year 3 student with average Year 2 marks of 55%.

Students are not permitted to take, for credit, MATH48082 in an undergraduate programme and then MATH68082 in a postgraduate programme at the University of Manchester, as the courses are identical.

Aims

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

Overview

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 main principles for designing and analyzing experiments will be introduced. Various standard experimental designs and the analysis of data obtained using them are covered. Criteria for optimality of experimental designs will be introduced. Methods for constructing nonstandard designs when the model is linear or nonlinear in the parameters will be presented.

Assessment methods

- Other - 7%
- Written exam - 93%

Assessment Further Information

- Coursework: weighting 7%
- End of semester examination: Three hours, weighting 93%

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
- response surface designs.

Future topics requiring this course unit

None.

Syllabus

1. Basic concepts; Definitions. Treatment, factors, plots, blocks, precision, efficiency, replication, randomisation and design. [2]
2. Completely randomised design. Fixed and random effects, contrasts, ANOVA table. [4]
3. Factorial designs. General factorial experiment; fixed and random effects; interactions. [3]
4. Nested designs. [2]
5. Blocking. Orthogonal designs: Randomised complete block designs; Latin square designs; extensions of the Latin square design. Non-orthogonal designs: Balanced incomplete block designs. [6]
6. 2m Factorial experiments; Confounding; fractional replication; aliasing. [4]
7. Response surface designs [1]
8. Criteria for design optimality [3]
9. The General Equivalence Theorem and its applications; construction of D-optimal experimental designs. [5]
10. Designs for nonlinear models. [3]

Recommended reading

- A. C. Atkinson, A. N. Donev, R. D. Tobias (2007). Optimum Experimental Designs, With SAS. Oxford University Press.
- G. Cassela (2008). Statistical Design. Springer.
- Lawson, J. (2015). Design and Analysis of Experiments with R. CHapman and Hall/CRC.
- D. C. Montgomery (1997). Design and Analysis in the Design of Experiments, (eight edition). Wiley.

Feedback methods

Tutorials will provide an opportunity for students' work to be discussed and provide feedback on their understanding.

Study hours

- Lectures - 33 hours

- Tutorials - 11 hours
- Independent study hours - 106 hours

Teaching staff

Alexander Donev - Unit coordinator