UNIVERSITY OF EXETER

MODULE TITLE	Statistical Modelling and Inference	CREDIT VALUE	30
MODULE CODE	MTH2006	MODULE CONVENER	Prof David B. Stephenson (Coordinator)

DURATION: TERM	1	2	3
DURATION: WEEKS	11	11	0

Number of Students Taking Module (anticipated)	128

DESCRIPTION - summary of the module content

Statistical modelling lies at the heart of modern data analysis, helping us to describe and predict the real world. Statistical inference is the way that we use data and other information to learn about and apply statistical models. In this module, you will learn the theory underpinning modern statistical methods such as fitting normal linear models, evaluating how well they fit the data and taking inferences from it. You will apply the theory using statistical software such as R to analyse and draw conclusions from a range of real-world data sets. Topics covered in the module range from estimators, confidence intervals, design of experiments and hypothesis testing to statistical modelling, regression, inference and comparison of models. Skills developed in the module are taken further in modules such as MTH3012 Advanced Statistical Modelling.

Prerequisite module: MTH1004 or equivalent.

AIMS - intentions of the module

This module aims to develop understanding and competence in statistical modelling by introducing you to the Normal linear model from a modern perspective. It will provide you with the ability to formulate and apply these models in a range of practical settings, to carry out associated inference appreciating how this relates to the general likelihood inferential framework, and to perform appropriate model selection and model checking procedures. Use will be made of a suitable statistical computer language for practical work.

INTENDED LEARNING OUTCOMES (ILOs) (see assessment section below for how ILOs will be assessed)

On successful completion of this module, **you should be able to**:

Module Specific Skills and Knowledge:

1 demonstrate knowledge and understanding of inferential procedures, including point estimation, interval estimation and hypothesis testing;

2 apply these inferential procedures to draw correct inferences from data;

3 derive properties of basic inferential procedures;

4 formulate simple and multiple regression models and analyse their properties, including polynomial regression and models which involve categorical explanatory variables (i.e. factors) and understand how the latter relate to classical analysis of variance techniques;

5 demonstrate an awareness of the range of practical situations where it is, and is not, appropriate to employ Normal linear models;

6 demonstrate understanding of the theory and practice of estimation and inference for the Normal linear model and be able to apply this to fit models and carry out model selection and checking procedures in a range of practical situations;

7 carry out data analysis using multiple regression and related models in conjunction with a suitable computer language.

Discipline Specific Skills and Knowledge:

8 demonstrate understanding and appreciation of the mathematical modelling of stochastic phenomena and its usefulness;

9 demonstrate sufficient knowledge of fundamental ideas central to modern model-based statistics which are necessary to be able to progress to, and succeed in, further studies in statistical inference, statistical modelling of data and of stochastic modelling more generally.

Personal and Key Transferable/ Employment Skills and Knowledge:

10 demonstrate general data analysis skills and communicate associated reasoning and interpretations effectively in writing;

11 use relevant computer software competently;

12 demonstrate appropriate use of learning resources;

13 demonstrate self management and time management skills.

SYLLABUS PLAN - summary of the structure and academic content of the module

1 Introduction and revision

2 Likelihood inference
-The likelihood function
-Maximum likelihood estimates
-Numerical optimization in R
-Properties of estimators
-Properties of maximum likelihood estimators
-Likelihood ratio test

3 Normal Linear Model
-Model specification
-Parameter estimation and inference
-Model evaluation and selection
-ANOVA models
-Further topics: Gauss-Markov theorem, collinearity, variance stabilisation
-Out-of-sample predictive performance

4 Design of experiments
-Experimental designs
-Interactions

-Quantitative explanatory variables
-Simultaneous inference
-Robust or resistant statistical methods
-Sample size
-Manipulating levels
-Missing data

5 Nonparametric statistics
-Kernel density estimation
-Nonparametric tests
-Permuation and randomisation tests

LEARNING AND TEACHING

LEARNING ACTIVITIES AND TEACHING METHODS (given in hours of study time)

Scheduled Learning & Teaching Activities	70.00	Guided Independent Study	230.00	Placement / Study Abroad	0.00

DETAILS OF LEARNING ACTIVITIES AND TEACHING METHODS

Category	Hours of study time	Description
Scheduled learning and teaching activities	48	Lectures including examples classes and guest real-world application lectures
Scheduled learning and teaching activities	11	Practicals in a computer lab
Scheduled learning and teaching activities	11	Tutorials
Guided independent study	230	Private study

ASSESSMENT

FORMATIVE ASSESSMENT - for feedback and development purposes; does not count towards module grade

Form of Assessment	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Example sheets	5 x 10 hours	1-10	Oral feedback in weekly tutorial classes

SUMMATIVE ASSESSMENT (% of credit)

Coursework	30	Written Exams	70	Practical Exams	0

DETAILS OF SUMMATIVE ASSESSMENT

Form of Assessment	% of Credit	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Written exam – closed book	70	2 hours (Summer)	1-10	Via SRS
Coursework 1	15	3000 words or equivalent	1-3	Written feedback on script and oral feedback in office hour
Coursework 2	15	3000 words or equivalent	4-8	Written feedback on script and oral feedback in office hour

DETAILS OF RE-ASSESSMENT (where required by referral or deferral)

Original Form of Assessment	Form of Re-assessment	ILOs Re-assessed	Time Scale for Re-reassessment
Written Exam *	Written exam (2 hours) (70%)	All	August Ref/Def period
Coursework 1 *	Coursework 1 (15%)	1-3	August Ref/Def period
Coursework 2 *	Coursework 2 (15%)	4-8	August Ref/Def period

*Please refer to reassessment notes for details on deferral vs. Referral reassessment

RE-ASSESSMENT NOTES

Deferrals: Reassessment will be by coursework and/or exam in the deferred element only. For deferred candidates, the module mark will be uncapped.

Referrals: Reassessment will be by a single written exam worth 100% of the module only. As it is a referral, the mark will be capped at 40%.

RESOURCES

INDICATIVE LEARNING RESOURCES - The following list is offered as an indication of the type & level of information that you are expected to consult. Further guidance will be provided by the Module Convener

ELE – http://vle.exeter.ac.uk
Reading list for this module:

Type	Author	Title	Edition	Publisher	Year	ISBN	Search
Set	Krzanowski W.J.	An Introduction to Statistical Modelling		Arnold	1998	000-0-340-69185-9	[Library]
Set	Draper N.R. & Smith H.	Applied Regression Analysis	3rd edition	John Wiley & Sons	1998	9780471170822	[Library]
Set	Faraway, J.J.	Linear Models with R		Chapman and Hall/CRC (Texts in Statistical Science)	2004	978-1584884255	[Library]
Extended	Rice, J A	Mathematical Statistics and Data Analysis	3rd	Brooks Cole	2007	978-0495118688	[Library]

CREDIT VALUE	30	ECTS VALUE	15

PRE-REQUISITE MODULES	MTH1004
CO-REQUISITE MODULES	

NQF LEVEL (FHEQ)	5	AVAILABLE AS DISTANCE LEARNING	No
ORIGIN DATE	Tuesday 10 July 2018	LAST REVISION DATE	Thursday 26 January 2023

KEY WORDS SEARCH	Normal linear model; regression; statistical inference.