

MODULE TITLE	Statistical Inference: Theory and Practice		CREDIT VALUE	15
MODULE CODE	MTH3028		MODULE CONVENER	Dr Christopher Ferro (Coordinator)
DURATION: TERM	1	2	3	
DURATION: WEEKS	11 weeks	0	0	
Number of Students Taking Module (anticipated)		80		

DESCRIPTION - summary of the module content

Statistical models help us to describe and predict the real world, and are used in sectors as diverse as finance, insurance, economics, marketing, pharmaceuticals, sport, environment and government to name only a few. Statistical inference is the way that we use data and other information to learn about and apply our models. This module introduces you to some of the main approaches to statistical inference and explains their associated procedures. It is designed for students who want to understand the ideas and mathematical theory that lie behind many modern statistical methods. The module establishes key theoretical concepts and results alongside explanations of their practical purpose and application. We will use computer simulations to illustrate basic concepts and as a tool for comparing procedures. You will gain practical experience with the methods through a series of worked examples and exercises.

Prerequisite module: MTH2006 Statistical Modelling and Inference or equivalent

AIMS - intentions of the module

This module aims to help you to develop a thorough understanding of statistical inference from a frequentist perspective. This includes understanding the underlying concepts, the mathematical theory, and how to apply the inferential methods to a range of statistical models. Such understanding is important for any job that involves conducting statistical investigations.

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 an understanding of the purpose of statistical inference, different approaches to statistical inference, and the key theoretical results and inferential procedures associated with these approaches;
- 2 apply these procedures to draw inferences about parametric statistical models, and compare different procedures critically.

Discipline Specific Skills and Knowledge:

- 3 demonstrate an understanding of the ways in which statistical inferential procedures and their performances may differ;
- 4 demonstrate an understanding of inferential concepts integral to statistical science;
- 5 progress to study a wider range of statistical inferential approaches in more detail.

Personal and Key Transferable/ Employment Skills and Knowledge:

- 6 demonstrate an understanding of key mathematical arguments, statistical concepts and practical issues important for advanced study, application and development of statistical science;
- 7 use the statistical programming environment 'R' to implement generic inferential procedures and to conduct simulation studies.

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

1. Classical Inference:
 - The principles and methods of classical frequentist inference are explained. These include point estimators, bias and efficiency; hypothesis tests, the Neyman-Pearson Theorem and uniformly most powerful tests; confidence sets and their construction from hypothesis tests; prediction intervals and their construction from ancillary statistics.
2. Likelihood Inference:
 - Inferential approaches based on the likelihood are introduced. These include maximum likelihood estimators and their asymptotic properties; likelihood-based hypothesis tests and confidence sets; and pseudo-likelihoods.
3. Computational Inference:
 - Inferential approaches based on resampling are introduced. These include Monte Carlo and bootstrap tests; the jackknife and bootstrap estimates of bias and variance; bootstrap confidence sets; and bootstrap prediction intervals.

LEARNING AND TEACHING

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

Scheduled Learning & Teaching Activities	33.00	Guided Independent Study	117.00	Placement / Study Abroad
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DETAILS OF LEARNING ACTIVITIES AND TEACHING METHODS

Category	Hours of study time	Description
Scheduled learning and teaching activities	33	Lectures/example classes
Guided independent study	20	Study of lecture notes
Guided independent study	50	Unassessed and formative exercises
Guided independent study	27	Revision
Guided independent study	20	Summative Assessment

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
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Form of Assessment	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Coursework - set questions	10 hours (1 hour each week)	All	Oral feedback in tutorial and office hour.

SUMMATIVE ASSESSMENT (% of credit)

Coursework	20	Written Exams	80	Practical Exams
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DETAILS OF SUMMATIVE ASSESSMENT

Form of Assessment	% of Credit	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Written exam – closed book	80	2 hours (summer)	All	Written/verbal on request
Coursework – set questions	20	20 hours	All	Written/verbal on request

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) (80%)	All	August Ref/Def period
Coursework*	Coursework (20%)	All	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 written 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	Garthwaite, Ph; Jolliffe, IT; Jones, B	Statistical Inference	2nd	Oxford University Press	2002	978-0198572268	[Library]
Set	Azzalini, A	Statistical Inference - Based on the Likelihood		Chapman and Hall	1996	978-0412606502	[Library]
Set	Cox, D.R.; Hinkley, D.V.	Theoretical Statistics		Chapman and Hall	1974	978-0412161605	[Library]
Set	Davison, A.C.; Hinkley, D.V.	Bootstrap Methods and their Application		Cambridge University Press	1997	978-0521574716	[Library]
Set	Efron, B; Tibshirani, R.J.	Introduction to the Bootstrap		Chapman and Hall/CRC	1994	978-0412042317	[Library]
Set	Pawitan Y	In All Likelihood: Statistical Modelling and Inference Using Likelihood		Oxford University Press	2001	978-0198507659	[Library]
Set	Silvey, S.D.	Statistical Inference		Chapman and Hall	1975	978-0412138201	[Library]

CREDIT VALUE	15	ECTS VALUE	7.5
PRE-REQUISITE MODULES	MTH2006		
CO-REQUISITE MODULES			
NQF LEVEL (FHEQ)	6	AVAILABLE AS DISTANCE LEARNING	No
ORIGIN DATE	Tuesday 10 July 2018	LAST REVISION DATE	Thursday 26 January 2023
KEY WORDS SEARCH	Statistics; mathematics; probability; data; analysis; modelling; inference.		