

# apts.ac.uk

Academy for PhD Training in Statistics

Week 3: University of Lancaster  
4-8 July 2016

**EPSRC**

Engineering and Physical Sciences  
Research Council

---

## Welcome to Lancaster!

---

We at Lancaster University take great pleasure in welcoming you for the APTS Week 3 course during 4-8<sup>th</sup> July, 2016. Located on a beautiful campus in the North West of England, we are one of the leading UK research universities.

**Travel information:** A taxi stand and a bus stand are located at the Lancaster Railway Station near the exit by Platform 3. A taxi to the University costs around £10. Please ask the driver to be taken to the Library Avenue Car Park (opposite the Pre-School Centre) from which the registration desk at the Furness Foyer is a minute's walk. Bus number X1 from the train station comes directly to the University Underpass from which the Furness Foyer is a 5 minute walk.

Also, regular bus service into Lancaster City Centre operates from the University Underpass, beneath Alexandra Square. The main buses that go to the City Centre are numbered X1, 2A, 2, 3 and 4 and bus times are posted at all bus stops.

**Campus Map:** This will be provided during the registration and it is also available from

<http://www.lancaster.ac.uk/media/lancaster-university/content-assets/documents/maps/campus.pdf>

**APTS registration:** Registration for the APTS week will take place from 11:15am to 12:45pm on Monday 4<sup>th</sup> July inside the Furness Foyer (**Building Number 42/ref D7**).

You will receive your badge from the registration desk. Please wear your badge at all times. This will help with security and also help participants to identify one another. You will also receive the key for your en suite room accommodation at that time. If you bring your car, ask for a visitor's parking permit which can be issued free of charge for the APTS week.

**IT:** Login and password details for logging into the computer labs on the campus will be included in your information pack at the APTS registration. For the wireless internet access on the campus, you can either use guest internet access (valid for 24 hours each time you register) or the eduroam account of your university; see ( <http://www.lancaster.ac.uk/iss/services/wi-fi/> ) for details.

**Accommodation location, check in/out your room:** Your accommodation is in County College John Creed Building (number 19 on the campus map) which is a 5 minute walk from the Furness Foyer. When you check out on Friday morning, you can either leave your key at the accommodation office of the CETAD building (number 13) where luggage storage facilities are available or simply leave it in a tray the organisers will bring at the Biology Lecture Theatre before the start of the Friday Lecture. Please note that any lost key will result in a charge of £50. A convenient point for taxi pick-up near the Biology Lecture Theatre is the Library Avenue Car Park.

**Your room, breakfast, dinner:** Most of the rooms will be ready by 1pm and in fact all rooms will be ready by 2pm on 4th July. Please vacate your room by 10.00am on the day of departure.

APTS Participants have been booked in single-bed, en-suite rooms. Bath towels and bed linen will be provided and there are shared kitchen facilities. Furthermore, internet access is available in each room. Breakfast will be served at the County South Private Dining Room between 8am and 9am from Tuesday 5<sup>th</sup> July to Friday 8<sup>th</sup> July. Dinner (for Monday, Tuesday and Wednesday only) will be served at the same place also.

**Lecture Theatre and Lab:** All lectures will take place at the Biology Lecture Theatre 1 (number 43a). Students with laptop may do their lab work at the same place. Students without laptop can work at the Postgraduate Statistics Centre Lab (number 48)

**Academy dinner:** This will take place on 7<sup>th</sup> July at the Greaves Park Bar and Dining ( <http://www.greavespark.co.uk/> ). This is a grade II listed building surrounded by beautiful parklands and is a 10 minute walk from the town centre. Bus number 2A, 2, 3 and 4 from the Campus stops at Greaves Park Bus stop at the end of the Bowerham Road (Address: Greaves Park, Bowerham Road, Lancaster, LA1 3AH).

Please note that on the last day of the conference, lunch will not be provided. However, there are plenty of places nearby if you want to grab a sandwich.

**Other campus facilities:** The Lancaster University campus has a wide range of facilities; a bakery, bookshop, newsagents, Students' Union shop, hairdresser, a post office, banks, a charity shop and a small supermarket (Spar) are all located in or near to Alexandra Square, shown on the campus map. Also on campus are a pharmacy, a health centre and a sports centre. There are dozens of places to eat and drink across the campus, with cafes, restaurants and nine college bars as well as an ice cream parlour, some of which will be open during the conference week.

The university Sports Centre has a swimming pool, sports hall, squash and badminton courts, table tennis room, sauna and solarium, a climbing and a bouldering wall and various outdoor facilities. The centre will be open from 8am to 10pm during the conference, except the swimming pool whose opening times can be found in ( <http://sportscentre.lancs.ac.uk/opening-times/> ).

---

## Emergency details

---

**Fire Procedures:** If the fire alarm sounds for more than five seconds and there has been no warning of a prolonged test, you must leave the building by the nearest emergency exit. All exits are well signposted. Do not stop to collect personal belongings. Make your way to the nearest evacuation point, standing well clear of the building. Do not re-enter the building until told to do so by the Fire Services or the University security staff.

**Emergency and Medical Assistance Numbers:**

University Security: 01524 594541

**Medical Assistance:** Please contact a local member of staff who will alert the appropriate services. Please note if you need to dial 999 from a mobile, please also call security on 01524 594541 to inform them your location as the campus is complex and escorts by the security team are required for emergency service vehicles arriving onto campus to prevent any delays reaching you.

**Transport:**

A to B Taxis : 01524 60000

A1 Taxis: 01524 32090 or 35666

848848 Radio Taxis: 01524 848848

Bus information: 08712 002233

National Rail Enquiries: 08457 484950

# LANCASTER UNIVERSITY CAMPUS MAP

- KEY**
- Accessible Route
  - Roads
  - Walkways
  - The Spine
  - Footpath / cycle route
  - Woodland Trail
  - Bridleways
  - Visitor car parks A - L
  - Closed during development
  - Open during development
  - Pay & Display machines
  - Motorcycle Parking
  - Accessible Parking
  - Electrical charging point
  - Refreshments
  - Visitor Toilet
  - Baby Change
  - Cycle Parking
  - One way system
  - Bus Stops
  - Taxi Rank



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16



0 100m 200m  
0 100ft 200ft

A6 South (to M6 Junction 33) →

← A6 North (to Lancaster City Centre)



## APTS Timetable

	Monday	Tuesday	Wednesday	Thursday	Friday
09:30-11:00	Registration (11:15-12:45) Furness Foyer	Applied Stochastic Processes	Applied Stochastic Processes	Applied Stochastic Processes	Applied Stochastic Processes
11:00-11:30		Coffee (Furness Foyer)			
11:30-13:00		Computer Intensive Statistics	Computer Intensive Statistics	Computer Intensive Statistics	Computer Intensive Statistics
13:00-14:00	Lunch (13:00-13:45) Furness Foyer	Lunch Furness Foyer			(End)
	Welcome (13:45-14:00)				
14:30-15:30	Applied Stochastic Processes (14:00-15:30)	Applied Stochastic Processes	Applied Stochastic Processes	Applied Stochastic Processes	
15:30-16:00	Coffee (Furness Foyer)				
16:00-17:15	Computer Intensive Statistics	Computer Intensive Statistics (lab)	Computer Intensive Statistics (lab)	Computer Intensive Statistics (lab)	
18:30-19:30	Dinner (County South Private Dining Room)			Academy Dinner (Greaves Park)	
Evening	Free Evening	RSS reception (Postgraduate Statistics Centre)	Free Evening		

You are encouraged to bring your own laptop for the computer sessions.

---

## Computer Intensive Statistics

---

**Module leader:** Dr Adam M. Johansen (Warwick)

**Aims:** This module will introduce various computationally-intensive methods and their background theory, including material on simulation-based approaches such as Markov-chain Monte Carlo (MCMC) and the bootstrap, and on strategies for handling large datasets. The different methods will be illustrated by applications.

**Learning outcomes:** After taking this module, students will have a working appreciation of MCMC, the bootstrap and other simulation-based methods and of their limitations, and have some experience of implementing them for simple examples. Students will also have gained an appreciation of the difficulties of handling very large datasets and of some approaches to overcoming them.

**Prerequisites:** Preparation for this module should include a review of the following topics:

- familiarity with basic types of convergence of random variables: in probability, almost sure and in distribution;
- relevant basic material on statistical modelling (for which the earlier APTS module 'Statistical Modelling' would be advantageous);
- basic Markov chains (as for the 'Applied Stochastic Processes' module);
- basic knowledge of programming in a high-level language such as R will be assumed, and R will be used for case studies and exercises.

**Topics:**

- Overview of simulation-based inference; Monte Carlo testing.
- Basic theory of bootstrap methods; practical considerations; limitations.
- Basic theory of MCMC; types of MCMC samplers; assessment of convergence/mixing; other practical considerations; case studies.

**Assessment:** Exercises set by the module leader, which will include some practical simulation.

---

# Applied Stochastic Processes

---

**Module leader:** Dr Stephen B. Connor (York) and Dr Amanda G. Turner (Lancaster)

**Aims:** This module will introduce students to two important notions in stochastic processes --- reversibility and martingales, --- identifying the basic ideas, outlining the main results and giving a flavour of some of the important ways in which these notions are used in statistics.

**Learning outcomes:** Students successfully completing this module will be able to:

- describe and calculate with the notion of a reversible Markov chain, both in discrete and continuous time;
- describe the basic properties of discrete-parameter martingales and check whether the martingale property holds;
- recall and apply significant concepts from martingale theory (indicative list: optional stopping, martingale convergence);
- explain how to use Foster-Lyapunov criteria to establish recurrence and speed of convergence to equilibrium for Markov chains.

**Prerequisites:** Preparation for this module should include a review of the basic theory and concepts of Markov chains as examples of simple stochastic processes (transition and rate matrices, irreducibility and aperiodicity, equilibrium equations and results on convergence to equilibrium), and with the definition and basic properties of the Poisson process (as an example of a simple counting process).

**Topics:**

- Reversibility of Markov chains in both discrete and continuous time, computation of equilibrium distributions, application to important examples.
- Discrete time martingales, examples, application, super- and sub-martingales.
- Stopping times, statements and applications of optional stopping theorem, martingale convergence theorem.
- Recurrence and rates of convergence for Markov chains, application to important examples.
- Statements and applications of Foster--Lyapunov criteria, viewed using the language of martingales.
- Statistical applications and relevance (highlighted where appropriate).

**Assessment:** One of the following:

- Read an appropriately chosen paper (either specified or from a specified list), and identify some of the main stochastic process models and results referred to in the paper, describe their significance and use in the paper, and relate them to the material covered in the module.
- Complete appropriate exercises that are simple developments or extensions of aspects of the results in the module (that may be related in some way to models and results arising in the paper).