

**apts**.ac.uk  
Academy for PhD Training in Statistics

WEEK 4: UNIVERSITY OF GLASGOW  
03–07 September 2012

**EPSRC**

Engineering and Physical Sciences  
Research Council



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# Welcome to Glasgow!

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**Workshop registration:** Registration on Monday 3rd September will take place at the University of Glasgow, in the main foyer of the Mathematics Building, (D4 on the map), between 11.30am and 12.30pm.

You will receive your badge from the registration desk. Please wear your badge at all times. This will help with security and also help you identify fellow participants.

**IT:** You will be issued with a log in and password from the registration desk. Please keep a note of this for use throughout the week within the Labs in the Mathematics Building and for Wifi access in the Mathematics Building Common Room

There will also be Wifi access in The Campus Village accommodation area especially around the Lord Todd Building, for further information please speak to the Village Office at your accommodation complex. (see map)

**Messages:** The telephone number for colleagues or family to leave an urgent message for you during office hours is 0141 330 5176.

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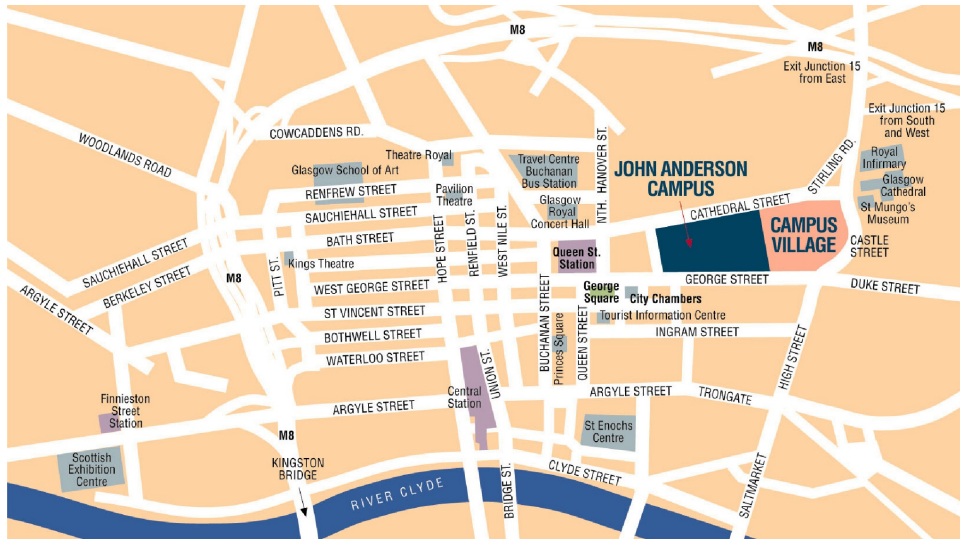
# Accommodation

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Your accommodation is based in the Campus Village at the University of Strathclyde. The address is:

The Campus Village, John Anderson Campus, Weaver Street, Glasgow G4 0NP

Weaver Street is situated just off Cathedral Street and opposite Glasgow Cathedral.



## Travel information:

**By Road** From Edinburgh and the north of England take Exit 15 off the M8 motorway. At the second set of traffic lights turn left, then first right into Collins Street. The Campus Village is on the right.

**Parking** There are two pay and display car parks situated in Collins Street adjacent to the Campus Village – charges apply to all visitors.

**By Rail** Arrivals from the west and most Intercity services arrive at Glasgow Central Station from where a 10 minute taxi ride will take you to the Campus Village. Arrivals from Edinburgh and the east come into Queen Street Station. This is a 5 minute walk from the Campus Village.

**By Bus** Buchanan Bus Station is a 10 minute walk or 5 minute taxi ride to the Campus village

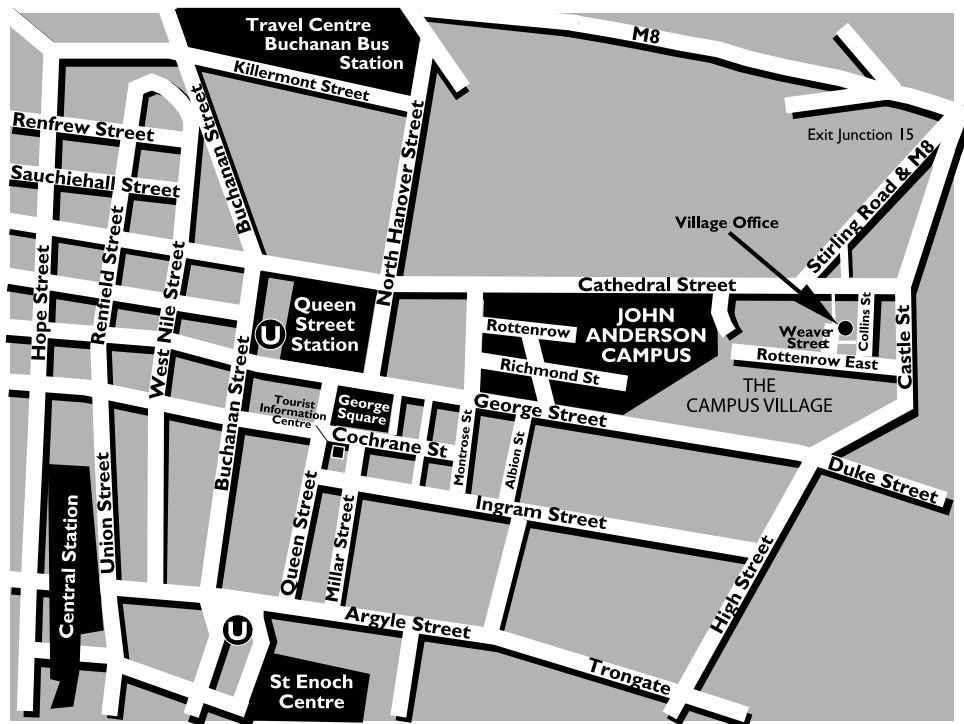
**By Air** The Campus Village is about a 20 minute drive from the airport. A frequent bus service will take guests from Glasgow Airport to Buchanan Bus Station, ten minutes walk from the Campus Village.

## Facilities:

All rooms single en-suite with linens, towels and toiletries provided Laundry facilities are available on the Campus Village site Wifi access in the Campus accommodation area especially around the Lord Todd area.

Other facilities include: Communal Lounge/Social Area with television; Sports facilities — please ask at Village office for further information and a fully-licensed bar in the Lord Todd Building.

### The Campus Village:



- Check-in for accommodation is at the Village Office on Weaver Street, in the ground floor of the Lord Todd complex, this is located in the middle of the Campus Village.
- The reception desk is manned 24 hours a day, so there is no restriction as to when you must check in by. However if you expect to arrive very late in the evening, please contact Susan Christie — [susan.christie@glasgow.ac.uk](mailto:susan.christie@glasgow.ac.uk) before Wednesday 29th August 2012 with your expected arrival time.
- Bedrooms are available from 2pm onwards and rooms should be vacated by 10am on the day of departure.
- There are no facilities at this accommodation for luggage storage however we will provide a room in the Mathematics Building, University of Glasgow on Monday 3rd and Friday 7th September to store your luggage. Further details will be given at Registration.
- Your accommodation includes breakfast each day which is served in the Lord Todd Restaurant in the Campus Village from 7.30am 9.00am Monday- Friday.

### Travel to APTS Course Venue — The University of Glasgow (campus map on page 8)

The University of Glasgow is a short journey from your accommodation at The Campus Village. The following link: <http://www.gla.ac.uk/about/maps/transport/> shows travel options within the city of Glasgow.

The most easily accessible for the Mathematics Building, University Gardens being the Subway (underground train system) from Buchanan Street to Hillhead stations, or the bus route from the city centre (Bath Street) to University Avenue (11 or 44/44a).

# APTS Timetable

	Monday 3rd Sep	Tuesday 4th Sep	Wednesday 5th Sep	Thursday 6th Sep	Friday 7th Sep
09.30 – 11.00		<b>Spatial and Longitudinal Data Analysis</b>	<b>Spatial and Longitudinal Data Analysis</b>	<b>Nonparametric Smoothing</b>	<b>Nonparametric Smoothing</b>
11.00 – 11.30		Tea and Coffee			
11.30 – 12.30	Registration	<b>Spatial and Longitudinal Data Analysis</b>	<b>Spatial and Longitudinal Data Analysis</b>	<b>Nonparametric Smoothing (Lab)</b>	<b>Nonparametric Smoothing</b>
12.45 – 13.45	Lunch				
13.45 – 14.00	Welcome				
14.00 – 15.30	<b>Spatial and Longitudinal Data Analysis</b>	<b>Spatial and Longitudinal Data Analysis</b>	<b>Nonparametric Smoothing</b>	<b>Nonparametric Smoothing</b>	
15.30 – 16.00	Tea and Coffee				
16.00 – 17.00	<b>Spatial and Longitudinal Data Analysis</b>	<b>Spatial and Longitudinal Data Analysis</b>	<b>Nonparametric Smoothing</b>	<b>Nonparametric Smoothing (Lab)</b>	
17.00 – 17.30	(16.00 – 17.30)		(16.00 – 17.30)		
17.30 – 18.30	RSS Reception				
18.30 – 19.30	Dinner				
Evening	Free Evening	Pub Quiz (19.30 – 21.00)	Free evening	Ceilidh (20.00 – 23.30)	

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## Local / Timetable Details

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**Lecture rooms:** All the lectures and computer labs will take place in the Mathematics Building. Lectures during the day will take place in Room 516, Level 5, Mathematics Building. Computer labs will take place in Room 110, Level 1, Mathematics Building and Room 215, Level 2, Mathematics Building.

**Breakfast:** Your accommodation includes breakfast each day which is served in the Lord Todd Restaurant in the Campus Village from 7.30am – 9.00am Tuesday – Friday.

**Tea and Coffee breaks:** will be held in the Common Room, Mathematics Building.

**Lunch and dinner:** Lunches and dinners will be served in the Queen Margaret Union, which is very close to the Mathematics Building in University Gardens.

**Evening events:** These will take place either in the Mathematics Building or in the adjacent Queen Margaret Union.

**RSS Reception:** The Royal Statistical Society is kindly sponsoring a wine reception on the evening of Monday 3rd September. This will take place in the Common Room of the Mathematics Building *before Dinner* in the Queen Margaret Union.

**Pub Quiz:** This will take place in the Queen Margaret Union after Dinner on Tuesday 4th September.

**Ceilidh:** This will take place in the Queen Margaret Union after Dinner on Thursday 6th September.

**Visitor attractions and buildings opened to the public**

- Visitor Centre** (A11)
- Hunterian Museum** (A15)
- Hunterian Art Gallery** (D12)
- The Mackintosh House** (D13)
- Zoology Museum** (B3)

**Facilities:**

- Catering Facilities** (Pink circle)
- Underground** (U)
- Information** (I)
- Telephones** (T)
- Toilets** (Toilet icon)

**Transportation:**

- Footpaths** (Yellow line)
- Bus Stop** (Bus icon)
- Car Parking** (P)
- One Way Traffic** (Arrow)



<b>Accommodation Services</b> D14-73 Great George St A16 - Main Building D8 E10-66 Oakfield Ave E14 - St Andrew's Building, 11 Elton St South Building A12 - Main Building D5-16 University Gdns A3 - Thomson Building C1 C2 - Gregory Building C3 - Glasgow C25 - East Quadrangle D7 George Service House German Gimmorehill Centre Glasgow International College & C2 - Robertson Building Glasgow University Sports Association Glasgow University Union Glasgow Veterinary School HATI - College of Arts Hetherington Building Hetherington House Hispanic Studies History History (Medical) History (Modern) History (Scottish) History of Art Hospitality Services Housing Humanities, School of (Students & Staff Support) Humanities, School of (Classics & Philosophy) Human Resources Hunter Halls Hunterian Museum Hunterian Museum & Inflammation, Institute of Infection, Immunity & Inflammation, Institute of Italian James Watt North Building James Watt South Building Joseph Black Building John McInyre Building Kelvin Gallery Kelvin Building Language Centre & EFL Unit Law School of Learning & Teaching Centre Life Sciences, School of (Main Office) Life Sciences, School of (Support) Lilypark House Mackintosh House McMillan Reading Room Mail Room Main Gatehouse (Security) Main Gate, University of Management Information Services Mathematics & Statistics, School of Mechanical Engineering Medical, Veterinary & Life Sciences, College of (Admin) Medical, Veterinary & Life Sciences, Wolfson Medical College of (Graduate School) Medicine, School of Modern Languages & Culture, School of Molecular, Cell & Systems Biology, Institute of MRC Social & Public Health Sciences Unit	<b>Finance Office</b> Florentine House Fore Hall Forensic Medicine & Science (School of Medicine) Building Fraser Building French Language & Literature Gardiner Institute UCU Geographical & Earth Sciences George Service House German Gimmorehill Centre Glasgow International College & C2 - Robertson Building Glasgow University Sports Association Glasgow University Union Glasgow Veterinary School HATI - College of Arts Hetherington Building Hetherington House Hispanic Studies History History (Medical) History (Modern) History (Scottish) History of Art Hospitality Services Housing Humanities, School of (Students & Staff Support) Humanities, School of (Classics & Philosophy) Human Resources Hunter Halls Hunterian Museum Hunterian Museum & Inflammation, Institute of Infection, Immunity & Inflammation, Institute of Italian James Watt North Building James Watt South Building Joseph Black Building John McInyre Building Kelvin Gallery Kelvin Building Language Centre & EFL Unit Law School of Learning & Teaching Centre Life Sciences, School of (Main Office) Life Sciences, School of (Support) Lilypark House Mackintosh House McMillan Reading Room Mail Room Main Gatehouse (Security) Main Gate, University of Management Information Services Mathematics & Statistics, School of Mechanical Engineering Medical, Veterinary & Life Sciences, College of (Admin) Medical, Veterinary & Life Sciences, Wolfson Medical College of (Graduate School) Medicine, School of Modern Languages & Culture, School of Molecular, Cell & Systems Biology, Institute of MRC Social & Public Health Sciences Unit	<b>Music</b> Neuroscience & Psychology, Institute of Nursery Occupational Health Officer Training Corps One A The Square Photography Physics & Astronomy, School of Planning Office Politics Pontonovo Buildings Principals' Lodgings Print Unit (Gimmorehill) Psychology, School of Public Health Purchasing Office Queen Margaret Union Recruitment Office Recruitment & International Office Receptor's Office Research & Enterprise Residential Services Robert Clark Centre for Technological Education Robinson Building Robbing Room Safety & Environmental Protection Services Science & Engineering, College of Scottish Literature Security (Central Services) Senate Office Senior Researcher's Office Sir Charles Gairdner Sivonics Studies Sociology Sociology (Scottish Centre for Cultural & Justice Research) Southpark House Social & Political Sciences, School of Social Sciences, College of (Admin) Sport & Recreation Service Staff Development Service Star Building Statistics Student Counselling & Advisory Service Student Services Enquiries Desk Students' Representative Council (SRC) Telephone Exchange TGWU Theatre Firm & TV Studies Theology & Religious Studies Transport Services Tumult Room UNISON Urban Studies Visitor Centre Western Clinical Research & Education Centre Western Infirmary Lecture Theatre Wildlife Garden Wolfson Building Wolfson Medical School Building Zoology Museum	<b>Music</b> Neuroscience & Psychology, Institute of Nursery Occupational Health Officer Training Corps One A The Square Photography Physics & Astronomy, School of Planning Office Politics Pontonovo Buildings Principals' Lodgings Print Unit (Gimmorehill) Psychology, School of Public Health Purchasing Office Queen Margaret Union Recruitment Office Recruitment & International Office Receptor's Office Research & Enterprise Residential Services Robert Clark Centre for Technological Education Robinson Building Robbing Room Safety & Environmental Protection Services Science & Engineering, College of Scottish Literature Security (Central Services) Senate Office Senior Researcher's Office Sir Charles Gairdner Sivonics Studies Sociology Sociology (Scottish Centre for Cultural & Justice Research) Southpark House Social & Political Sciences, School of Social Sciences, College of (Admin) Sport & Recreation Service Staff Development Service Star Building Statistics Student Counselling & Advisory Service Student Services Enquiries Desk Students' Representative Council (SRC) Telephone Exchange TGWU Theatre Firm & TV Studies Theology & Religious Studies Transport Services Tumult Room UNISON Urban Studies Visitor Centre Western Clinical Research & Education Centre Western Infirmary Lecture Theatre Wildlife Garden Wolfson Building Wolfson Medical School Building Zoology Museum
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## Emergency Details

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**Medical Assistance:** The University Health Centre is open Monday-Friday 09.00–17.00.

**Messages:** The number for colleagues or family to leave an urgent message for you during office hours is 0141 330 5024. This is the General Office in the Department of Statistics.

**Emergency Services and Fire Procedures:** For help in an emergency dial 4444 from any internal telephone and your call will be directed appropriately. Visitors are asked to familiarise themselves with the University's fire procedures which are displayed in each bedroom.

*On discovering a fire in other buildings:* Raise the alarm by breaking the glass in the nearest Break Glass Point.

*On hearing the continuous ringing of the fire bells:*

- Stop what you are doing.
- Leave by the nearest Fire Exit.
- Walk calmly do not run.
- 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.

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# Module Details

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## Nonparametric Smoothing

MODULE LEADER: R. SAMWORTH

Aim: In nonparametric statistics, it is not assumed that data come from a distribution belonging to a finite-dimensional class. This module will introduce students to the theory and methods associated with the idea of smoothing, which is one of the key concepts in modern nonparametric techniques of statistical analysis.

Learning outcomes: By the end of the module, students will understand the technique of kernel density estimation and its advantages over histograms. They will appreciate the central role played by the smoothing parameter, or bandwidth, and understand how this can be determined in practice. Students will also understand how both kernel- and spline-based smoothing methods can be used to estimate a nonparametric regression function.

Prerequisites: Preparation for this module should include a rapid review of basic probabilistic limit theory (including modes of convergence, laws of large numbers, ‘o’ and ‘O’ notation and the delta method), and basic understanding of asymptotic expansions to at least the level of the earlier APTS module ‘Statistical Asymptotics’.

Topics:

- Kernel and spline approaches to smoothing;
- Principles and practice of model selection;
- Random-effects/hierarchical/mixed models;
- Nonparametric regression;
- Applications, e.g., covariate measurement error, generalized additive models.
- Connections with wavelets and other nonparametric estimators.

Assessment: A set of exercises assigned by the module leader, or a data-analysis exercise involving practical use of some of the methods covered.

# Spatial and Longitudinal Data Analysis

MODULE LEADER: P.J. DIGGLE

Aim: This module will introduce students to the statistical concepts and tools involved in modelling data which are correlated in time and/or space. The content will include models which are well established in statistical practice, although not usually well represented in the undergraduate curriculum, as well as examples of models which are central to current research in the area.

Learning outcomes: By the end of the module, students should have achieved:

- a clear understanding of the meaning of temporal and spatial correlation;
- a good working knowledge of standard models to describe both the systematic and the random parts of an appropriate model;
- the ability to implement and interpret these models in standard applications;
- an understanding of some of the key concepts which lie at the heart of current research in this area;
- appreciation of at least one substantial case study.

Prerequisites: Preparation for this module should establish familiarity with:

- standard models and tools for time series data, at the level of a typical undergraduate course on time series;
- standard models and tools for spatial data at its simplest level;
- inferential methods, including classical and Bayesian likelihood-based methods, to at least the level of the earlier APTS modules 'Statistical Inference' and 'Statistical Modelling'.

This module's preliminary web-lectures will cover the first two of the above pre-requisites.

Topics:

- Introduction: motivating examples; the fundamental problem analysing dependent data.
- Longitudinal data: linear Gaussian models; conditional and marginal models; why longitudinal and time series data are not the same thing.
- Continuous spatial variation: stationary Gaussian processes; variogram estimation what not to do and how to do it; likelihood-based estimation; spatial prediction.
- Discrete spatial variation: Markov random field models.
- Spatial point patterns: exploratory analysis; Cox processes and the link to continuous spatial variation; pairwise interaction processes and the link to discrete spatial variation.
- Spatio-temporal modelling: spatial time series; spatio-temporal point processes.
- Conclusion: review of available software (as preparation for mini-project); connections between spatial and longitudinal data analysis as two sides of the same coin.

Assessment: One of

- A critique, in essay form, of a specified research paper, including both modelling and application aspects;
- A mini-project involving the analysis of a data-set, selected by the student from several on offer (to allow students to focus on topics within the course which they find particularly interesting).

