



WEEK 1: UNIVERSITY OF WARWICK
11th–15th December 2023

Welcome to Warwick!

Getting here: <https://warwick.ac.uk/fac/sci/mathsgeneral/gethere>

Workshop registration: Registration on Monday will take place in the main atrium of the Zeeman Building (see the campus map on the next pages or on the link above), **between 11.30 and 12.30**.

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.

Lunches and refreshment. All lunches and refreshments will be provided in the main atrium of the Mathematics building (Zeeman). The Mathematics Undergraduate Student work area (accessible from the atrium) will be open to provide seating during these breaks.

IT: You are expected to bring a laptop that supports wireless networking. Wireless access to basic Internet services is also available (eduroam is supported across most of the Warwick campus).

Messages: The telephone number for colleagues or family to leave an urgent message for you during office hours is 02476 574812. For emergency messages outside these times, please call the main University Switchboard on 02476 523523.

Bars: Both Radcliffe and Scarman have bars. The central campus has three main bars, “The Terrace Bar” situated in Rootes Social Building, “The Dirty Ducks”, right behind the Plaza, and “Benugo” in the Arts Centre. All serve a wide selection of draught and bottled beers, spirits and soft drinks. There are also bars situated within the Students’ Union.

Other Campus Facilities: Facilities at the University include a pharmacy, Post Office, supermarket (Rootes), hairdresser, and cinemas. There are also cash dispensers. These can be found in the mall area around Rootes Social Building.

There are various places to eat and drink.

Sport facilities All participants have full use of the extensive and well maintained 750 acre campus, with Warwickshire walks. There are comprehensive sports and wellbeing facilities including swimming, squash and tennis. **Sports facilities are available to participants (staying at Scarman) free of charge.**

Accommodation information

Your room: Workshop participants with accommodation have been booked in to en suite single study bedrooms in Scarman (G3/4 on the campus map, next page), see also the interactive campus map.

Breakfasts and Dinners: All breakfasts (Tuesday-Friday) and dinners (Monday-Thursday) at the the Lakeview Restaurant in Scarmann.

Checking in/out: Delegates are welcome to check in from 3pm. Please vacate your bedroom by 10am on your day of departure.

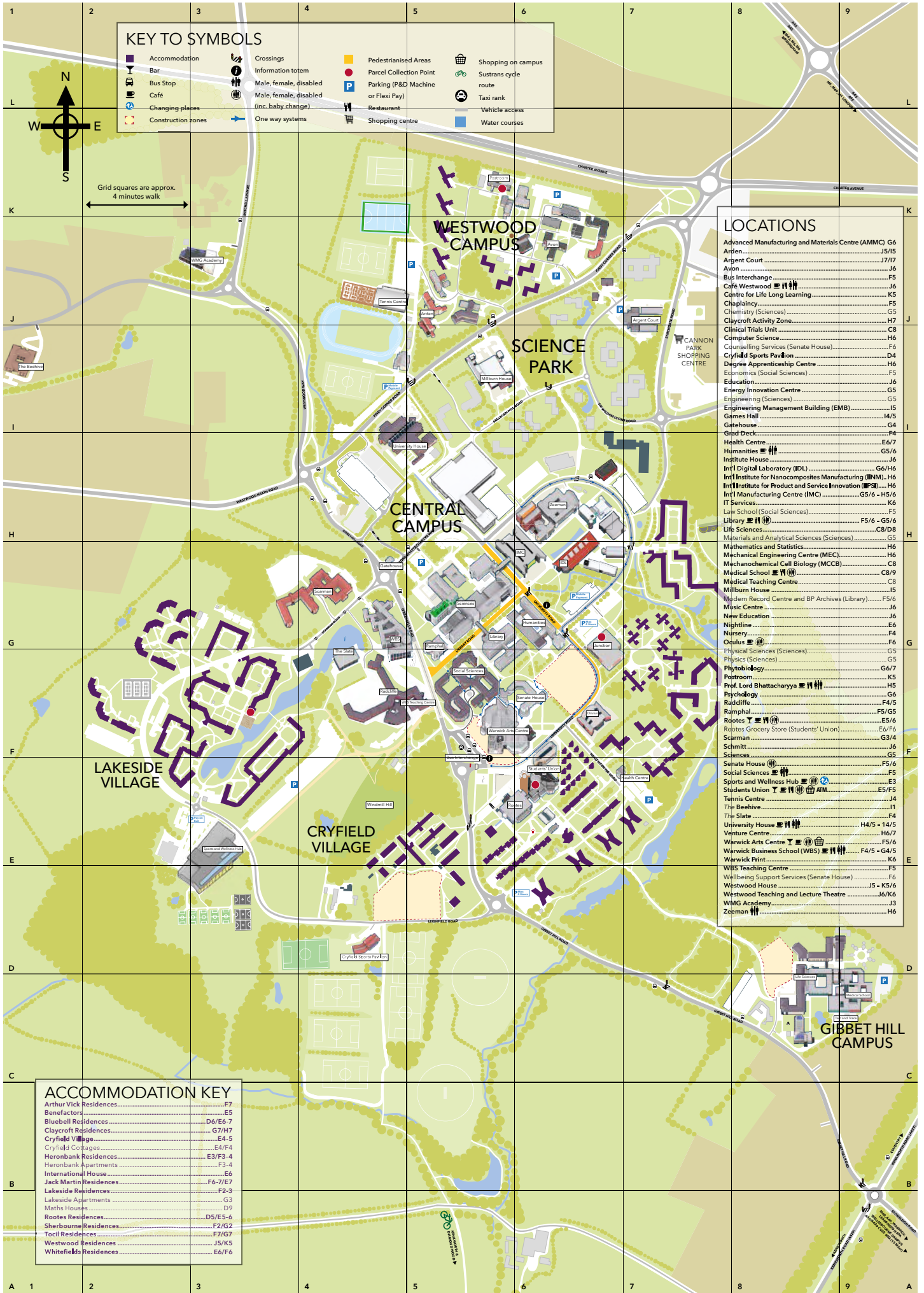
Luggage: The Reception team at Scarman will be happy to store your luggage in their storage facilities.

Internet access: All bedrooms on campus are networked for free. The Wi-Fi can easily be accessed via the Warwick Guest network. Please check the details online via this link or contact Reception.

Car Parking: Car parking is available at Scarman and it is included in the booking for delegates attending meetings or staying overnight. Disabled parking spaces are available close to the entrance of main buildings. It is required to pre-register your vehicle ahead of your arrival via the link below. This will guarantee complimentary parking via the below steps:

1. Click on the following link: Car Parking Conferences
2. Fill in "Personal Details", check the "Booking Summary" is correct.
3. Add the promotional code: JSFTB (this promotional code will then reduce the price to £0.00) - Click "Book now"

Contact Details: Phone: +44 (0) 24 7622 1111. Email: scarman@warwick.ac.uk.



KEY TO SYMBOLS

	Accommodation		Crossings		Pedestrianised Areas		Shopping on campus
	Bar		Information totem		Parcel Collection Point		Sustrans cycle route
	Bus Stop		Male, female, disabled		Parking (P&D) Machine or Flexi Pay		Taxi rank
	Café		Male, female, disabled (inc. baby change)		Restaurant		Vehicle access
	Changing places		One way systems		Shopping centre		Water courses
	Construction zones						

LOCATIONS

Advanced Manufacturing and Materials Centre (AMMC)	G6
Ardlen	J5/I5
Argent Court	J7/I7
Avon	J6
Bus Interchange	F5
Café Westwood	J6
Centre for Life Long Learning	K5
Chaplaincy	F5
Chemistry (Sciences)	G5
Claycroft Activity Zone	H7
Clinical Trials Unit	C8
Computer Science	H6
Counselling Services (Senate House)	F6
Cryfield Sports Pavilion	D4
Degree Apprenticeship Centre	H6
Economics (Social Sciences)	F5
Education	J6
Energy Innovation Centre	G5
Engineering (Sciences)	G5
Engineering Management Building (EMB)	I5
Games Hall	I4/5
Gatehouse	G4
Grid Deck	E4
Health Centre	E6/7
Humanities	G5/6
Institute House	J6
Int'l Digital Laboratory (IDL)	G6/H6
Int'l Institute for Nanocomposites Manufacturing (IINM)	H6
Int'l Institute for Product and Service Innovation (IPSI)	H6
Int'l Manufacturing Centre (IMC)	G5/6 - H5/6
IT Services	K6
Law School (Social Sciences)	F5
Library	F5/6 - G5/6
Life Sciences	C8/D8
Materials and Analytical Sciences (Sciences)	G5
Mathematics and Statistics	H6
Mechanical Engineering Centre (MEC)	H6
Mechanochemical Cell Biology (MCCB)	C8
Medical School	C8/9
Medical Teaching Centre	C8
Milburn House	I5
Modern Record Centre and BP Archives (Library)	F5/6
Music Centre	J6
New Education	J6
Nightline	E6
Nursery	F4
Oculus	F6
Physical Sciences (Sciences)	G5
Physics (Sciences)	G5
Physiology	G6/7
Postroom	K5
Prof. Lord Bhattacharyya	H5
Psychology	G6
Radcliffe	F4/5
Ramphal	F5/G5
Rootes	E5/6
Rootes Grocery Store (Students' Union)	E6/7
Scarma	G3/4
Schmitt	J6
Sciences	G5
Senate House	F5/6
Social Sciences	F5
Sports and Wellness Hub	E3
Students Union	E5/F5
Tennis Centre	J4
The Beehive	I1
The Slate	F4
University House	H4/5 - I4/5
Venture Centre	H6/7
Warwick Arts Centre	F5/6
Warwick Business School (WBS)	F4/5 - G4/5
Warwick Print	K6
WBS Teaching Centre	F5
Wellbeing Support Services (Senate House)	F6
Westwood House	J5 - K5/6
Westwood Teaching and Lecture Theatre	J6/K6
WMG Academy	J3
Zeeman	H6

ACCOMMODATION KEY

Arthur Vick Residences	F7
Benefactors	E5
Bluebell Residences	D6/E6-7
Claycroft Residences	G7/H7
Cryfield Cottages	E4-5
Heronbank Residences	E3/F3-4
Heronbank Apartments	F3-4
International House	E6
Jack Martin Residences	F6-7/E7
Lakeside Residences	F2-3
Lakeside Apartments	G3
Maths Houses	D9
Rootes Residences	D5/E5-6
Sherbourne Residences	F2/G2
Tocil Residences	F7/G7
Westwood Residences	J5/K5
Whitefields Residences	E6/F6

APTS timetable

All lectures/practical sessions are in MS01 in the Zeeman Building (H6).

	Monday 11th Dec	Tuesday 12th Dec	Wednesday 13th Dec	Thursday 14th Dec	Friday 15th Dec
09.00 – 10.30		Statistical Inference	Statistical Inference	Statistical Inference	Statistical Inference
10.30 – 11.00		Tea and Coffee			
11.00 – 12.30	Registration from 11.30 (atrium of Zeeman)	Statistical Computing	Statistical Computing	Statistical Computing	Statistical Computing
12.30 – 1.30pm	Lunch (in the Zeeman Atrium)				End
1.30 – 3pm	Welcome Statistical Inference	Statistical Inference	Free Afternoon	Statistical Inference	
3 - 3.30pm	Tea and Coffee			Tea and Coffee	
3.30 – 5pm	Statistical Computing	Statistical Computing (Practical session)		Statistical Computing (Practical session)	
5.15 – 6.30pm	Drinks Reception in Zeeman Atrium				
From 7pm	Dinner - in Scarman Restaurant				
Evening		Pub Quiz from 8.30pm (venue TBC)	Free evening	Academy dinner Scarman Restaurant	

Local information

Locations: All the lectures, practical sessions and the first evening reception will take place in the Zeeman Building (Mathematics). Lectures will be held in MS.01, which is accessible from the main atrium called “The Street”.

Laboratory sessions: You are expected to bring your own laptop to work on during these sessions. Please charge your laptop over night. Some charging points will be available in MS.01, The Street and the Maths Undergraduate Common room.

Tuesday evening: After dinner on Tuesday’s evening, there will be a pub quiz organised by local students and post-docs, at The Dirt Duck Quiz (E6 in the map) to commence at 8:30 pm.

Emergency details

Medical Assistance: The University Health Centre is open Monday-Friday 09.00-13.00 and 14.00-17.00. Visitors in need of emergency assistance should contact Security on internal extension 22222.

Emergency Services and Fire Procedures: For help in an emergency dial 22222 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 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 Service or University Security Staff.

Reporting Incidents: In the unlikely event of an accident or other serious incident occurring on University premises (fire, police, ambulance), call Security 024 7652 2222 (external line) or x22222 (Internal extension). If you dial 999 first, please then inform Security. The 24 hour number for general enquiries is 024 7652 2083, internal extension 22083. Other incidents should be reported immediately to the local staff if you are at a session, or to the reception of your accommodation. You can also make an online report.

Module details

Statistical Computing

MODULE LEADER: SIMON WOOD

Aim: To introduce, in a practical way, the fundamentals of numerical computation for statistics, in order to help students to write stable, fast and numerically accurate statistical programs.

Learning outcomes: After taking this module students will

- understand the importance of stability, efficiency and accuracy in numerical computations, and how these may be promoted in practical statistical computation;
- understand the main difficulties and other issues that arise in the topics given below;
- be aware of standard computational libraries and other resources.

Prerequisites: In preparation for this module, students should obtain an elementary knowledge of the use of R. (Knowledge also of a lower level language such as C, Pascal or Fortran would be an advantage but will not be presumed.) Preparation for this module should also (re-)establish familiarity with Taylor's theorem and with basic matrix algebra—e.g., notion of an inverse and eigenvalues, manipulation of matrix expressions, the numerical unsuitability of Cramer's rule for computation of an inverse.

Further reading:

- Lange, K. (2010). Numerical Analysis for Statisticians, second edition, Springer.

Topics:

- Finite-precision arithmetic; related types of error and stability (probably mostly covered, in context, as part of other topics).
- Numerical linear algebra (with statistical applications): basic computational efficiency, Choleski, QR, stability (e.g. Normal/Choleski vs QR for LS), eigen and singular value decompositions. Standard libraries.
- Optimization: Newton-type methods; other deterministic methods; stochastic methods; using methods effectively in practice; what to use when.
- Differentiation and integration by computer: finite differencing (interval choice, cancellation and truncation errors); automatic differentiation; quadrature methods; stochastic integration.
- Basics of stochastic simulation.
- Other types of problem (e.g. sorting and matching); the pervasiveness of efficiency and stability issues; where to find out more.

Assessment: A short project bringing together several of the topics covered. For example writing a routine to estimate a linear mixed model by (RE)ML.

Statistical Inference

MODULE LEADER: MICHAEL GOLDSTEIN

Aims: To explore a number of statistical principles, such as the likelihood principle and sufficiency principle, and their logical implications for statistical inference. To consider the nature of statistical parameters, the different viewpoints of Bayesian and Frequentist approaches and their relationship with the given statistical principles. To introduce the idea of inference as a statistical decision problem. To understand the meaning and value of ubiquitous constructs such as p-values, confidence sets, and hypothesis tests.

Learning outcomes: An appreciation for the complexity of statistical inference, recognition of its inherent subjectivity and the role of expert judgement, the ability to critique familiar inference methods, knowledge of the key choices that must be made, and scepticism about apparently simple answers to difficult questions.

Preliminaries. Students should have done at least one course in probability and one in statistics. Students should be familiar with: the idea of a statistical model, statistical parameters, the likelihood function, estimators, the maximum likelihood estimator, confidence intervals and hypothesis tests, p-values, Bayesian inference, prior and posterior distributions.

Further information on all of these topics can be found in standard undergraduate statistics textbooks, for example

- J.A. Rice, 1999, *Mathematical Statistics and Data Analysis*, 2nd edn, Duxbury Press (more recent edition available); or
- Morris H, DeGroot, and Mark J Schervish, 2002, *Probability & Statistics*, Addison Wesley, 3rd edn. Prof. Schervish maintains a list of *errata* at <http://www.stat.cmu.edu/~mark/degroot/index.html>.

More advanced treatments can be found in

- G.A. Young and R.L. Smith, 2005, *Essential of Statistical Inference*, Cambridge University Press.
- A.C. Davison, 2003, *Statistical Models*, Cambridge University Press. This book also contains a wealth of applications. Prof. Davison maintains a list of *errata* at <http://statwww.epfl.ch/davison/SM/>.

Topics:

0. What is statistics? Statistical models, prediction and inference, Frequentist and Bayesian approaches.
1. Principles of inference: the Likelihood Principle, Birnbaum's Theorem, the Stopping Rule Principle, implications for different approaches.
2. Decision theory: Utility, Bayes Rules, admissibility, and the Complete Class Theorems. Implications for point and set estimation, and for hypothesis testing.
3. Likelihood based estimators and their large sample properties. Confidence sets, hypothesis testing, and P-values. Relationships between Bayesian and frequentist intervals.
4. Limitations of models of statistical inference. Exchangeability representations. Lessons from Uncertainty Quantification.

Assessment: General questions on the implementation of different approaches in particular types of inference, possibly involving additional reading.

