



WEEK 1: UNIVERSITY OF WARWICK
13th–17th December 2021

Welcome to Warwick!

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

Workshop registration: Registration on Monday will take place in the main atrium of the Zeeman Building (see the campus map below in grid square H6), between 11.15 and 12.45.

You will receive your badge and a 2-page sheet with key information. Those who asked for it will receive a copy of the lecture notes. Please wear your badge at all times. This will help with security and also help you identify fellow participants.

Car Parking: All participants with booked accommodation are staying in Radcliffe accommodation. For those arriving by car and staying in Radcliffe there is **free parking** available in the car park immediately in front of the main entrance. On the map (later in this booklet) this is located in the square with coordinates F4 and you access it from Scarman Road (G4 on the map). When you park you will need to inform the reception desk (just inside the entrance) that you have arrived by car, and provide your car's registration details. If it is too early to check in, you can leave your luggage in secure storage.

There are a number of other car parks around campus but these are all either "permit only" (do not park in these) or "pay as you go" with daily rates of £7.00. If you do park in a "pay as you go" car park then you will need to purchase a ticket (daily) for the appropriate car park from <https://carparking.warwick.ac.uk/tickets>. Information for this is displayed in the car parks themselves.

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.

COVID guidelines: In addition to the government guidelines, we politely (strongly) encourage that:

- Attendees wear a face covering during all classes and in indoor spaces.
- Attendees take a lateral flow test before attending, and in line with Warwick University's advice. We further strongly encourage participants to take (at least 2) lateral flow tests throughout the week as a further precaution.

Thank you. More information at <https://warwick.ac.uk/coronavirus/safety-tests-vaccinations-isolation>

Accommodation information

Your room: Workshop participants with accommodation have been booked in to en-suite single study/bedrooms in Radcliffe (F4 on the campus map).

Reception: The Radcliffe Reception staff will be pleased to answer your queries. You can call them on a personal phone at 024 7622 1111.

Checking in/out: Check-in will be available from 15:00 to 23:00 at The Radcliffe Reception (just inside the main entrance to the building). Please **check-out by 10am** on your day of departure. Please inform Radcliffe Reception on arrival of any difficulties you may have in the unlikely event of an evacuation (e.g. hearing or walking difficulties).

Luggage: If you require storage for your luggage, please ask at Radcliffe Reception. They can provide a secure area for luggage storage. This may be particularly useful on the check-in and check-out day if you require storage of your luggage on Monday morning or after checking out while you attend the final sessions of the programme.

Internet access: All bedrooms in Radcliffe have Wi-Fi available using either a “Warwick Guest” account or using “Eduroam”.

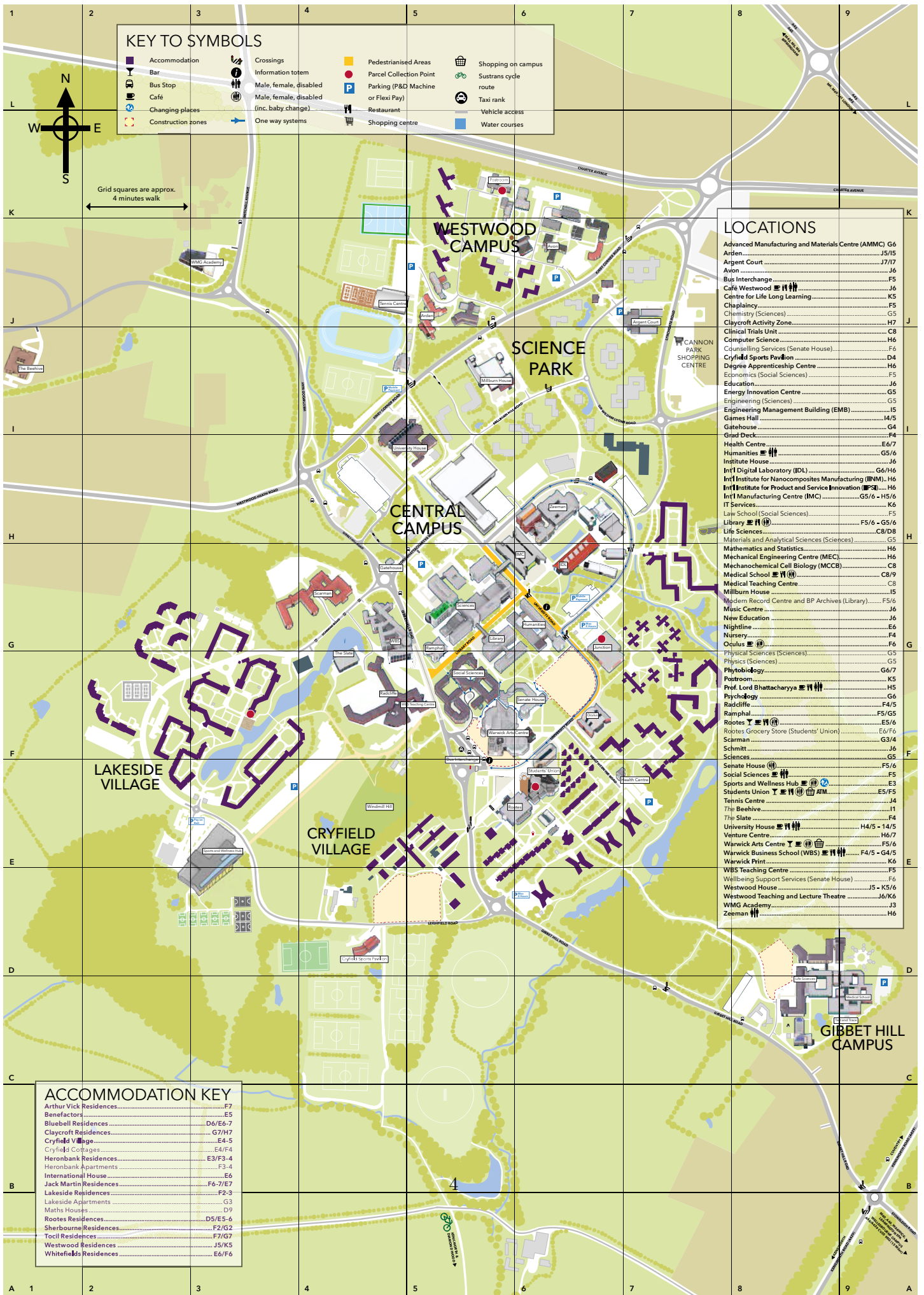
Meals: Those with accommodation in Radcliffe have both breakfast and dinner served in the accommodation area during their stay.

- Breakfast is served between 7am and 9am (Tues-Fri) in the Radcliffe Restaurant.
- Dinners (buffet meal) on Mon-Wed are served at 7pm at the Radcliffe Restaurant.
- On Thursday the **academy conference dinner** is a 3-course meal, again in the Radcliffe Restaurant. Please arrive at 6:30pm.

Lunches and refreshment: will be provided in the main atrium of the Zeeman building throughout the week. **Please bring your own water bottle and if possible your own mug to save on wastage.**

Extra nights accommodation: There may be bedrooms available in Radcliffe on Sunday 12th and Friday 17th December, and they can be booked online if you need extra nights accommodation and would like to stay in the same venue. Please note that APTS **can’t cover the cost** of extra accommodation. The relevant contact should be here <https://warwick.ac.uk/services/conferences/contact>.

Alternatively, there are local hotels such as the Village hotel - <https://www.village-hotels.co.uk/hotels/Coventry>. Another possibility may be looking for a room via AirBnB.



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
Grad 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
Scarmas	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/labs are in MS01/MS02 (allocated at registration) in the Zeeman Building (H6).

	Monday 13th Dec	Tuesday 14th Dec	Wednesday 15th Dec	Thursday 16th Dec	Friday 17th Dec
09.15 – 10.45		Statistical Inference	Statistical Computing	Statistical Inference	09.00 – 10.15 Statistical Computing
10.45 – 11.15		Tea and Coffee			10.15 – 10.45
11.15 – 12.45	Registration (atrium of Zeeman)	Statistical Computing	Statistical Inference	Statistical Computing	10.45 – 12.00 Statistical Inference
12.45 – 13.45	Lunch				End
13.45 – 15.15	Welcome Statistical Inference	Statistical Inference	Free Afternoon	Statistical Inference	
15.15 – 15.45	Tea and Coffee			Tea and Coffee	
15.45 – 17.15	Statistical Computing	Statistical Computing (Practical session)		Statistical Computing (Practical session)	
17:30 – 18:30	Wine Reception in Zeeman Atrium				
19.00	Dinner - In Radcliffe Restaurant				
Evening	Quiz in Radcliffe Restaurant (20.00-)	Social Event in Radcliffe Restaurant (20.00 –)	Free evening	Academy dinner (18.30–) Radcliffe Restaurant	

Local information

Bring your own mugs: Please bring your water bottle (and if possible your own mug to save on wastage). Compostable cups will be provided with teas/coffees but even better to bring your own.

Locations: All the lectures, computer labs and the wine reception will take place in the Zeeman Building (H6 on the map). All sessions will take place in the lecture theatres MS01 or MS02. You will be allocated a room on arrival.

Laboratory sessions: Please bring your own laptop to work on during these sessions. Due to the pandemic it has proven impossible to find computer labs that can be booked and so the labs will be in the lecture rooms where there are very few power sockets. Please try to ensure your laptop is fully charged for the labs.

Monday evening: TWO EVENTS:

- Wine Reception in the Zeeman atrium from 5:30pm-6:30pm.
- Quiz 8pm-9:30pm in Radcliffe Restaurant (kindly led by Warwick PhD students).

Tuesday evening: Discussion on “Statistical Ethics” organised and led by Prof Jane Hutton (8pm-9:30pm) in Radcliffe Restaurant. You will be provided with information upon registration.

Thursday Academy dinner: this will take place in the Radcliffe Restaurant from 6:30pm. Please arrive in good time. Smart casual dress is recommended.

Campus Facilities:

- **Bars:** The central campus has a few main bars, “The Bar” situated in Rootes Social Building; “The Dirty Duck” situated in the student union; and “The Terrace Bar” again situated in the student union. They all serve a wide selection of draught and bottled beers, spirits and soft drinks.
- **Basic Services:** Facilities at the University include a pharmacy, newsagent, cinema, bookshop, Post Office, grocery store and a launderette. These are all located in the student union and Arts centre buildings. Just north of campus (8 min walk from Maths building) there is a retail park with many shops including a large Tesco, an Aldi and much more.
- **Banks:** There are Santander and Barclays banks on campus with cash dispensers. These can be found by the student union building.
- **Sports Facilities:** All participants have full use of the extensive campus grounds and details of routes for walking (or running) can be found at <https://warwick.ac.uk/services/estates/campus/walks/>
Also there is a new sports centre (open between 6am and 11pm on weekdays) with excellent facilities including superb climbing, swimming, squash and tennis facilities. Details and opening times are available at <https://warwick.ac.uk/services/sport/active/>.

Emergency details

Medical Assistance: The University Health Centre is open Monday-Friday 09.00-17.00 outside term time (09.00-18.00 in term time). Visitors in need of emergency assistance should contact Security on internal extension 22222.

Emergency Services and Fire Procedures: For help in an emergency (fire, police, ambulance) dial 22222 from any internal telephone or from a personal phone dial 024 7652 2222 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.

Report and support: Everyone at the University of Warwick, whether studying, working, or visiting, has the right to feel safe. The University of Warwick has a legal duty to promote freedom of expression. Harassment of any kind is not acceptable.

In the event of an emergency where you feel in immediate danger please contact the emergency services (described above). Otherwise, if you have witnessed or been the victim of inappropriate behaviour at the event then please contact one of the organisers: Prof Jane Hutton (J.L.Hutton@warwick.ac.uk); Dr Massimiliano Tamborrino (Massimiliano.Tamborrino@warwick.ac.uk); Dr Nicholas Tawn (n.tawn.1@warwick.ac.uk); and Paula Matthews (Paula.Matthews@warwick.ac.uk).

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Module details

Statistical Computing

MODULE LEADER: D. WILKINSON

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: S. SHAW

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. Preliminary reading will cover the necessary material on probability. For 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: Bayes Rules, admissibility, and the Complete Class Theorems. Implications for point and set estimation, and for hypothesis testing.
3. Confidence sets, hypothesis testing, and P-values. Good and not-so-good choices. Level error, and adjusting for it. Interpretation of small and large P-values.

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