ARCLG117
Spatial Statistics, Network Analysis and Human History
(15 credits)

2017–2018

Co-ordinator: Mark Lake
mark.lake@ucl.ac.uk
Room 115, Tel. 020 7679 1535
Turnitin Course ID: 3545515
Contents

1 Overview .......................................................... 3
  1.1 Short description .................................................. 3
  1.2 Week-by-week summary ............................................ 3
  1.3 Basic and more advanced texts ..................................... 3
  1.4 Methods of assessment ............................................. 4
  1.5 Teaching methods ................................................ 4
  1.6 Workload .......................................................... 4
  1.7 Prerequisites ..................................................... 4

2 Aims, objectives and assessment ................................. 4
  2.1 Aims ..................................................................... 4
  2.2 Objectives .......................................................... 5
  2.3 Learning outcomes ................................................ 5
  2.4 Coursework ........................................................ 5
  2.5 Word count and submission procedure ....................... 6

3 Schedule and syllabus .................................................. 6
  3.1 Teaching schedule ................................................ 6
  3.2 Detailed week-by-week syllabus ................................ 6

4 Online resources ....................................................... 11

5 Additional information ................................................ 11
  5.1 Libraries and other resources .................................... 11
  5.2 Attendance ........................................................ 11
  5.3 Information for intercollegiate and interdepartmental students ........................................... 12
  5.4 Dyslexia ............................................................. 12
  5.5 Feedback ........................................................... 12
  5.6 Health and safety .................................................. 12

6 Tutor ..................................................................... 12
  6.1 General Matters ................................................... 13
  6.2 Coursework ........................................................ 13
  6.3 Resources .......................................................... 16

This document and other resources are available from the course website:
http://moodle.ucl.ac.uk/course/view.php?id=335
1 Overview

1.1 Short description

This course provides a working knowledge of the statistical theory and methods used to comprehend spatial patterns, whether the latter be distributions of settlements across a landscape, densities of artefacts across a site or region, or different kinds of archaeological sampling procedure. Students learn the fundamental differences between spatial and non-spatial statistics, the design of appropriate sampling strategies for fieldwork, geostatistical methods (e.g. kriging), predictive modelling through logistic regression and more spatially-sensitive versions (e.g. geographically-weighted regression) as well as the multi-scalar analysis of point patterns or processes (e.g. K functions and related methods). They develop practical familiarity with the R statistical package, which is perhaps the premier open source software environment for statistical analysis. The course is suitable for all those interested in more formal methods of spatial analysis, and hence assume a willingness to grapple with computational and quantitative methods. However, there are no pre-requisites and the course is open to those with no prior training in statistics or GIS.

It is taught using a combination of lectures, practical sessions and tutorials in the Institute’s AGIS laboratory and is assessed via a portfolio of analytical work and one essay. It would particularly benefit those who have an interest in statistically-supported approaches to spatial phenomena.

1.2 Week-by-week summary

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Session</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>08 Jan</td>
<td>1</td>
<td>A rough guide to spatial analysis</td>
</tr>
<tr>
<td>2</td>
<td>15 Jan</td>
<td>2</td>
<td>Archaeological sampling and spatial inference</td>
</tr>
<tr>
<td>3</td>
<td>22 Jan</td>
<td>3</td>
<td>Regression models</td>
</tr>
<tr>
<td>4</td>
<td>29 Jan</td>
<td>4</td>
<td>Multivariate predictive models</td>
</tr>
<tr>
<td>5</td>
<td>05 Feb</td>
<td>5</td>
<td>Point pattern analysis</td>
</tr>
<tr>
<td>6</td>
<td>12 Feb</td>
<td>–</td>
<td>Reading week</td>
</tr>
<tr>
<td>7</td>
<td>19 Feb</td>
<td>6</td>
<td>Point process models</td>
</tr>
<tr>
<td>8</td>
<td>26 Feb</td>
<td>7</td>
<td>Kriging and local spatial statistics</td>
</tr>
<tr>
<td>9</td>
<td>05 Mar</td>
<td>8</td>
<td>Network analysis</td>
</tr>
<tr>
<td>10</td>
<td>12 Mar</td>
<td>9</td>
<td>Spatial networks</td>
</tr>
<tr>
<td>11</td>
<td>19 Mar</td>
<td>10</td>
<td>Uncertainty in spatial analysis</td>
</tr>
</tbody>
</table>

1.3 Basic and more advanced texts

In addition to the sessional readings below, some useful basic texts for this course are:


1.4 Methods of assessment

This course is assessed on the basis of two pieces of coursework: (i) a project, consisting of three individual practical assessments, the sum of which contribute 50% to your final grade; (ii) a written essay, no more than 3000 words in length, also worth 50% of your final mark. The topics and deadlines for each assessment are specified below. If you are unclear about the nature of an assignment, you should contact me. I will be willing to discuss an outline of your approach to the assessment, provided this is planned suitably in advance of the submission date.

1.5 Teaching methods

The course is taught by a mixture of lectures, practical sessions and group discussion. Students will be expected to have done the necessary tutorial revision in order to continue to follow the practical session in class and to contribute actively to discussion.

N.B. Participation in practical exercises is limited by the availability of suitably equipped computers, and is guaranteed only for those who are taking this course as an examined module for a Masters degree.

1.6 Workload

There will be 20 hours of dedicated lectures and practicals for this course, and students are expected to undertake around 70 hours of tutorial revision and further reading for the course, plus 60 hours preparing for and producing the assessed work. This adds up to a total workload of approximately 150 hours.

1.7 Prerequisites

There are no formal prerequisites for this course, but it is strongly recommended that students have at least some prior experience of GIS.

2 Aims, objectives and assessment

2.1 Aims

The course aims to provide:

- A working knowledge of non-spatial statistical methods that are widely used in conjunction with GIS;
- An understanding of the role of spatial sampling in archaeology
- A working knowledge of both basic and more advanced spatial statistics;
- A basic knowledge of grounded network analysis.
2.2 Objectives

The course objectives are that you will be able to:

- Evaluate the limitations of existing spatial data and devise appropriate spatial sampling strategies for the acquisition of additional data;
- Make statistically sound inferences as part of spatial analysis;
- Use spatial statistics to model the properties of spatial data;

2.3 Learning outcomes

In meeting these objectives you will also be able to demonstrate the following generic learning outcomes:

- An understanding of the differences between scientific and other forms of reasoning;
- The ability to use quantitative data to support an argument;
- The application of acquired knowledge.

2.4 Coursework

2.4.1 Assessment tasks

This course is assessed entirely by coursework consisting of the two assignments described here.

1. One 2,850-3,150 word essay (50%) giving you an opportunity to demonstrate your theoretical understanding of an important issue in archaeological spatial analysis. You should choose one of the following questions:

   - What factors can cause archaeological data to be inadequate to support a spatial analysis, and what steps might be taken to overcome them?
   - What are the potential pitfalls when testing a hypothesis about the reasons for site location? Illustrate your answer using one or more published examples.
   - What are the strengths and weaknesses of network analysis when used to model or understand archaeological data? Are the challenges and potential of networks similar or different when documentary historical data is available?

2. One written account of laboratory work (50%), comprising three practical assignments (assigned approximately every fortnight). This will provide an opportunity for you to demonstrate technical competence in a range of spatial analytic methods. You will be provided with further information about the exact form that the practical exercises should take. They will require you to include illustrations, such as maps and graphs. Please ensure that these are carefully presented. General guidance is available at: https://moodle.ucl.ac.uk/pluginfile.php/3837989/mod_folder/content/0/Illustration%20Guidelines.pdf?forcedownload=1. All illustrations should have informative captions. Where appropriate, maps should include indicators of scale and orientation, as well as a legend (key) based on sensible ranges of data values. Graphs should include informative labels for the X- and Y-axes.
Students are not permitted to re-write and re-submit essays in order to try to improve their marks. However, students may be permitted, in advance of the deadline, to submit for comment a brief outline of the assignment. The Course co-ordinator is willing to discuss an outline of the student’s approach to the assignment, provided this is planned suitably in advance of the submission date.

2.5 Word count and submission procedure

Please be sure to observe the following specifications:

<table>
<thead>
<tr>
<th></th>
<th>Word count</th>
<th>Submission deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical 1</td>
<td>See separate instructions</td>
<td>12th Feb. 2018</td>
</tr>
<tr>
<td>Practical 2</td>
<td>See separate instructions</td>
<td>12th Mar. 2018</td>
</tr>
<tr>
<td>Practical 3</td>
<td>See separate instructions</td>
<td>23rd Apr. 2018</td>
</tr>
<tr>
<td>Essay</td>
<td>2850–3150</td>
<td>23rd Apr. 2018</td>
</tr>
</tbody>
</table>

All work should be submitted to Turnitin (http://www.turnitinuk.com/en_gb/login). The relevant ‘class ID’ is 3545515 and the ‘enrolment password’ is IoA1718.

UCL has strict regulations with regard to word-length, late submission and plagiarism. You should note that these regulations could result in you failing a course and thus potentially failing the whole degree. Please see the MA/MSc Handbook for further information (available at https://moodle.ucl.ac.uk/course/view.php?id=40867), or ask!

3 Schedule and syllabus

3.1 Teaching schedule

The course will be taught in Term 2. Classes will be held on Mondays, commencing at 14:00 lasting until 17:00. All practicals will be held in room 322C (the AGIS lab). There will be no taught class in Reading Week. Except in the case of illness, the 70% minimum attendance requirement applies to all classes.

3.2 Detailed week-by-week syllabus

The following is an outline for the course as a whole, and identifies essential and supplementary readings relevant to each session. Information is provided as to where in the UCL library system individual readings are available; their location and status (whether out on loan) can also be accessed on the eUCLid computer catalogue system. Copies of individual articles and chapters identified as essential reading are in the Teaching Collection in the Institute Library (where permitted by copyright).

Session 1: A Rough Guide to Spatial Analysis

A brief introduction to the course followed by familiarisation with the principal software package that will be used throughout the course.
Practical  You will be introduced to the R statistical programming language. You will learn how to start R, load libraries, import data, conduct basic exploratory data analysis and produce plots.

Essential reading


Session 2: Archaeological Sampling and Spatial Inference

The role of sampling is fundamental to archaeological practice, at scales from the regional to the microscopic. Archaeologists either sample in a deliberate way or they do so by accident, but in either case, these sampling decisions have important implications for what we can and cannot then infer from the recovered archaeological record. In this session, we both introduce the general idea of sampling and use case studies to focus on the specific issues raises by spatial samples.

Practical  Types of sampling regime. Use of R to perform t-tests, Kolmogorov-Smirnov tests and Monte Carlo simulation.

Essential reading


Session 3: Regression Models

This week we begin a series of more analytical sessions by reviewing the use of linear regression to explore the relation between two variables, including measures of correlation and the distribution of residuals. We then introduce linear logistic regression, which is widely used for the construction of GIS-based predictive models.

Practical  Use of R for linear regression analysis, including the study of residuals.
Essential reading


Session 4: Multivariate Predictive Models

This week is entirely devoted to a practical exercise in which you will use multivariate logistic regression to build a predictive model of archaeological site location.

Practical Use of R and GRASS GIS to build a predictive model.

Essential reading


Session 5: Point Pattern Analysis

This week, we consider a variety of methods for analysing data comprising the point locations, a common kind of evidence best-known to archaeologists in the form of ‘distribution maps’. The simplest, nearest-neighbour and quadrat-based methods have been around in archaeology for nearly 50 years, while more complicated, multi-scalar methods such as K functions have only been introduced into archaeology more recently. We also consider the analysis of point distributions where there are likely to be directional patterns present, as well as the treatment of point distributions of multiple types or involving cases-and-controls.

Practical Use of R to analyse point patterns.

Essential reading


Bevan, A., Crema, E., Li, X. and Palmisano, A. 2013. Intensities, interactions and uncer-
tainties: some new approaches to archaeological distributions, in Bevan, A. and Lake, M.  
(eds.), *Computational Approaches to Archaeological Spaces*: 27-51. Walnut Creek: Left 
Coast Press [UCL Discovery].

Rosenberg, M.S. 2004. Wavelet analysis for detecting anisotropy in point patterns, *Journal of 

**Session 6: Point Process Models**

Modern approaches to point distributions do not just consider whether and how a pattern 
departs from a null hypothesis of complete spatial randomness. Instead, there is increasing 
emphasis on fitting different kinds of model to observed point patterns with a view to understand 
when external variables might affect the overall density of points across a study area, as well as 
what kinds of interaction between points might be involved. Joint models of 'first-order' and 
'second-order' characteristics are now possible and of great use in archaeology.

**Practical** Use of R to build an inhomogeneous point process model.

**Essential reading**

Bevan, A., Crema, E., Li, X. and Palmisano, A. 2013. Intensities, interactions and uncer-
tainties: some new approaches to archaeological distributions, in Bevan, A. and Lake, M.  
(eds.), *Computational Approaches to Archaeological Spaces*: 27-51. Walnut Creek: Left 
Coast Press [UCL Discovery].

Vanzetti, A., Vidale, M., Gallinaro, M., Frayer, D.W. and Bondioli, L. 2010. The iceman as a 

Baddeley, A. Rubak, E., and R. Turner *Spatial Point Patterns: Methodology and Applications 
with R*, New York: Chapman and Hall/CRC [AGIS Lab bookshelf]

**Session 7: Kriging and local spatial statistics**

In many cases, we are not dealing with a pattern of unmarked points (i.e. without attributes), 
but instead wish to analyse a spatial relationship between one continuously-measured variable 
and a range of others across a study area. Some of the simple forms of regression analysis 
introduced earlier in this course assume that the relations between independent variables are 
constant throughout space, but this is not always—perhaps not even usually—the case. This 
week we explore (a) ways to measure the degree of autocorrelation between point attributes in 
space, (b) ways to explore how statistical parameters can vary across a study area.

**Practical** Use of local statistics and kriging to understand patterns of spatial autocorrelation.

**Essential reading**

Premo, L. 2004. Local spatial autocorrelation statistics quantify multi-scale patterns in distrib-
butional data: An example from the Maya Lowlands. *Journal of Archaeological Science*  
31, 855–866. [UCL eJournals]
Session 8: Network Analysis

Network analysis has become increasingly popular across many different disciplines over the last decade or so. For archaeologists, networks have provided a useful, if rather loose, metaphor for thinking about human interaction in the past as well as, for some, an opportunity to try out more formal graph theoretic models. The simplifying assumptions that network structure typically imposes also bring an elegance to our analysis of social and natural phenomena that is very attractive.

Practical  Construction of a network model based on cultural similarity in R.

Essential reading


Session 9: Spatial Networks

If abstract networks are sometimes good to think with in archaeology, where does that leave our modelling of more complex spatial networks such as those physical grounded in the actual landscape? Past and present transport systems, for example, potentially involve a bewildering array of directed, weighted, time-sensitive and/or multi-modal links that support an equally bewildering array of routine, officially regulated and/or effectively random interaction events by the humans and animals that use them.

Practical  Simulation modelling of transport networks and site hierarchies.

Essential reading


Session 10: Uncertainty in Spatial Analysis

This session looks at the kinds of classificatory, temporal and/or positional uncertainties inherent in most archaeological analyses. In particular, it address the issue of how we manage the very fuzzy spatial and chronological evidence with which archaeologists regularly work.

Practical Handling temporal uncertainty via R scripting

Essential reading


4 Online resources

The full UCL Institute of Archaeology coursework guidelines are given here: https://moodle.ucl.ac.uk/course/view.php?id=40867.

The full text of this handbook is available at http://www.ucl.ac.uk/archaeology/studying/masters/courses/ARCLG117.

The Moodle pages for this course are available at https://moodle.ucl.ac.uk/course/view.php?id=335.

5 Additional information

5.1 Libraries and other resources

In addition to the Library of the Institute of Archaeology (5th floor), other libraries in UCL with holdings of particular relevance to this course are the Science Library (D.M.S. Watson building on the central UCL site) and the Environmental Studies Library in Wates House on Gordon Street. A full list of UCL libraries and their opening hours is provided at http://www.ucl.ac.uk/library/.

The University of London Senate House Library (http://www.ull.ac.uk/) also has holdings which may be relevant to this course.

5.2 Attendance

A register will be taken at each class. If you are unable to attend a class, please notify the lecturer by email. Departments are required to report each student’s attendance to UCL Registry at frequent intervals throughout each term. Students are expected to attend at least 70% of classes.
5.3 Information for intercollegiate and interdepartmental students

Information for intercollegiate and interdepartmental students Students enrolled in Departments outside the Institute should obtain the Institutes coursework guidelines from Judy Medrington (mailto:j.medrington@ucl.ac.uk), which will also be available on Moodle.

5.4 Dyslexia

If you have dyslexia or any other disability, please make your lecturers aware of this. Please discuss with your lecturers whether there is any way in which they can help you. Students with dyslexia are reminded to indicate this on each piece of coursework.

5.5 Feedback

In trying to make this course as effective as possible, we welcome feedback from students during the course of the year. All students are asked to give their views on the course in an anonymous questionnaire which will be circulated at one of the last sessions of the course. These questionnaires are taken seriously and help the Course Co-ordinator to develop the course. The summarised responses are considered by the Institute’s Staff-Student Consultative Committee, Teaching Committee, and by the Faculty Teaching Committee.

If you are concerned about any aspect of this course we hope you will feel able to talk to the Course Co-ordinator, but if you feel this is not appropriate, you should consult your degree coordinator/personal tutor, the Academic Administrator (Judy Medrington), or the Chair of Teaching Committee (Dr. Bill Sillar).

5.6 Health and safety

Students enrolled on this course are particularly reminded of the measures that should be taken to reduce possible discomfort arising from the extended use of computer workstations. UCL’s occupational health centre provides some information at: http://www.ucl.ac.uk/hr/occ_health/health_advice/office_guide.php.

6 Tutor

The course tutor is:

Dr Mark Lake (ML), who is available for consultation in room 115 at the times posted on his door, or by appointment.

Tel: 020 7679 1535
Ext: 21535
Email: mark.lake@ucl.ac.uk

Appendix A: Policies and Procedures 2017-18
(please read carefully)

This appendix provides a short précis of policies and procedures relating to courses. It is not a substitute for the full documentation, with which all students should become familiar. For full information on Institute policies and procedures, see the IoA Student Administration section

6.1 General Matters

6.1.1 Attendance

A minimum attendance of 70% is required, except in case of illness or other adverse circumstances which are supported by medical certificates or other documentation. A register will be taken at each class. **If you are unable to attend a class, please notify the lecturer by email.**

6.1.2 Dyslexia

If you have dyslexia or any other disability, please discuss with your lecturers whether there is any way in which they can help you. Students with dyslexia should indicate it on each coursework cover sheet.

6.2 Coursework

6.2.1 Word Length

Essay word-lengths are normally expressed in terms of a recommended range. Penalties will only be imposed if you exceed the upper figure in the range. There is no penalty for using fewer words than the lower figure in the range: the lower figure is simply for your guidance to indicate the sort of length that is expected. Not included in the word count are the bibliography, appendices, tables, graphs, captions to figures, tables, graphs. You must indicate word length (minus exclusions) on the cover sheet. Exceeding the maximum word-length expressed for the essay will be penalized in accordance with UCL penalties for over-length work. In the 2017-18 session penalties for over-length work will be as follows:

- For work that exceeds the specified maximum length by less than 10% the mark will be reduced by five percentage marks, but the penalised mark will not be reduced below the pass mark, assuming the work merited a Pass;
- For work that exceeds the specified maximum length by 10% or more the mark will be reduced by ten percentage marks, but the penalised mark will not be reduced below the pass mark, assuming the work merited a Pass.

6.2.2 Citing of Sources and Avoiding Plagiarism

Coursework must be expressed in your own words, citing the exact source (author, date and page number; website address if applicable) of any ideas, information, diagrams, etc., that are taken from the work of others. This applies to all media (books, articles, websites, images, figures, etc.). **Any direct quotations from the work of others must be indicated as such by being placed between quotation marks.** Plagiarism is a very serious irregularity, which can carry heavy penalties. It is your responsibility to abide by requirements for presentation, referencing and avoidance of plagiarism. Make sure you understand definitions of plagiarism and the procedures and penalties as detailed in UCL regulations: http://www.ucl.ac.uk/current-students/guidelines/plagiarism.
6.2.3 Submission Procedures

All coursework must normally be submitted both as hard copy and electronically. (The only exceptions are bulky portfolios and lab books which are normally submitted as hard copy only.). The procedures are as follows:

- You should staple the appropriate colour-coded IoA coversheet (available in the IoA library and outside room 411a) to the front of each piece of work and submit it to the red box at the Reception Desk (or room 411a in the case of Year 1 undergraduate work)

- All coursework should be uploaded to Turnitin by midnight on the day of the deadline. This will date-stamp your work. It is essential to upload all parts of your work as this is sometimes the version that will be marked. Instructions for the use of Turnitin follow.

6.2.4 How to Use Turnitin

Note that Turnitin uses the term ‘class’ for what we normally call a ‘course’.

1. Ensure that your essay or other item of coursework has been saved as a Word doc., docx. or PDF document, and that you have the Class ID for the course (available from the course handbook) and enrolment password (this is ‘IoA1718’ for all courses this session - note that this is capital letter ‘I’, lower case letter ‘o’, upper case ‘A’, followed by the current academic year).


3. Click on ‘Create account’.

4. Select your category as ‘Student’.

5. Create an account using your UCL email address. Note that you will be asked to specify a new password for your account—do not use your UCL password or the enrolment password, but invent one of your own (Turnitin will permanently associate this with your account, so you will not have to change it every 6 months, unlike your UCL password). In addition, you will be asked for a “Class ID” and a “Class enrolment password” (see point 1 above).

6. Once you have created an account you can just log in at http://www.turnitinuk.com/en_gb/login and enrol for your other classes without going through the new user process again. Simply click on ‘Enrol in a class’. Make sure you have all the relevant “class IDs” at hand.

7. Click on the course to which you wish to submit your work.

8. Click on the correct assignment (e.g. Essay 1).

9. Double-check that you are in the correct course and assignment and then click ‘Submit’.

10. Attach document as a “Single file upload”.

11. Enter your name (the examiner will not be able to see this).

12. Fill in the “Submission title” field with the right details: It is essential that the first word in the title is your examination candidate number (e.g. “YGBR8 In what sense can culture be said to evolve?”).
13. Click “Upload”. When the upload is finished, you will be able to see a text-only version of your submission.

14. Click on “Submit”.

If you have problems, please email the IoA Turnitin Advisers on ioa-turnitin@ucl.ac.uk, explaining the nature of the problem and the exact course and assignment involved.

One of the Turnitin Advisers will normally respond within 24 hours, Monday-Friday during term. Please be sure to email the Turnitin Advisers if technical problems prevent you from uploading work in time to meet a submission deadline - even if you do not obtain an immediate response from one of the Advisers they will be able to notify the relevant Course Coordinator that you had attempted to submit the work before the deadline.

6.2.5 Late Submission

Late submission is penalised in accordance with UCL regulations, unless formal permission for late submission has been granted. Please note that these regulations have changed for the 2016–17 session. The UCL penalties are as follows:

1. The marks for coursework received up to two working days after the published date and time will incur a 10 percentage point deduction in marks (but no lower than the pass mark);

2. The marks for coursework received more than two working days and up to five working days after the published date and time will receive no more than the pass mark (40% for UG modules, 50% for PGT modules);

3. Work submitted more than five working days after the published date and time, but before the second week of the third term will receive a mark of zero but will be considered complete.

6.2.6 Granting of Extensions

Please note that there are strict UCL-wide regulations with regard to the granting of extensions for coursework. You are reminded that Course Coordinators are not permitted to grant extensions. All requests for extensions must be submitted on the appropriate UCL form, together with supporting documentation, via Judy Medrington’s office and will then be referred on for consideration. Please be aware that the grounds that are acceptable are limited. Those with long-term difficulties should contact UCL Student Disability Services to make special arrangements. Please see the IoA website for further information. Additional information is given here: http://www.ucl.ac.uk/srs/academic-manual/c4/extenuating-circumstances/.

6.2.7 Return of Coursework and Resubmission

You should receive your marked coursework within one month of the submission deadline. If you do not receive your work within this period, or a written explanation, notify the Academic Administrator. When your marked essay is returned to you, return it to the Course Co-ordinator within two weeks. You must retain a copy of all coursework submitted.
6.3 Resources

6.3.1 MOODLE

Please ensure you are signed up to the course on Moodle. For help with Moodle, please contact Charlotte Frearson (mailto:c.frearson@ucl.ac.uk).