

# IP110-15 Quantitative Methods for Undergraduate Research

**20/21**

**Department**

Liberal Arts

**Level**

Undergraduate Level 1

**Module leader**

Lauren Bird

**Credit value**

15

**Module duration**

11 weeks

**Assessment**

60% coursework, 40% exam

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

In our capacity as learners, researchers, and members of society, we are continually exposed to statistics and data which, while it can shed light on the nature of the world around us, also has the capacity to confound and mislead. As such, it is vital that we understand both how to interpret the data which surrounds us, and also understand how to use this data to our advantage.

[Module web page](#)

### Module aims

This module will empower learners by providing a problem-based framework which promotes self-directed and reflective learning. Through tackling multifaceted and complex social issues, students will begin to generate, appreciate and understand broader, underlying, conceptual problems around why quantitative approaches are relevant, and to uncover the appropriate methodologies. In addition to improved learning outcomes, this approach also aligns learning activities with the processes of independent research —effectively preparing students for independent project work or modules which encourage individual enquiry.

Through group discussion and research around the provided cases, students will begin building

their knowledge and confidence in producing and interpreting descriptive statistics, generating meaningful and appropriate data visualisations, and will acquire an introductory understanding of the linked issues of probability and distribution.

As part of the assessment and weekly Problem-Based Learning activities, the course will build on these introductory skills with case studies which will see students engaging in the more involved task of using measurable data from samples to inform inferences about the broader population, and gaining an understanding of key questions of appropriateness and limitations.

The combination of PBL discussion classes, and practical workshops will build students' confidence at using statistical computer packages to put into practice the concepts they uncover through their research, and to take their first steps in statistically modelling data.

Quantitative Methods for Undergraduate Research is complementary to its sister module Qualitative Methods for Undergraduate Research, both of which aim to prepare students to take their first steps in independent research.

This module offers a unique and innovative approach to the teaching of introductory statistics for research, which is not provided by any other modules at the University of Warwick.

## **Outline syllabus**

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

The following section outlines the approach of the module and the core knowledge and competency gain associated with the course activities.

In order to facilitate the acquisition of knowledge and competency, the course is delivered via Problem-Based Learning which emphasises student knowledge acquisition via efforts to understand the parameters of, and solutions to, complex real-world situations. Such case studies will involve engaging and contemporary challenges around themes such as education, deprivation and social exclusion, social justice, climate and environment, and health and wellbeing.

In practical accounts of PBL approaches to quantitative methods, complex case studies are presented, accompanied by data, which encourage students to engage with deeper conceptual problems around the use and method of quantitative enquiry. For each study students will need to engage with the data, potentially identifying and learning techniques for statistical or quantitative which will allow them to understand and address the case study and the deeper underlying problem. As such it is customary for students to be expected to consult a well-chosen and accessible text relating to statistical methods as a source for technical background material.

This approach, when applied to the teaching of quantitative research methods is very innovative, though earlier studies (e.g. Karpiak (2011)) suggest that learning outcomes are improved for students who study the subject in this fashion. Moreover, the PBL approach more closely aligns the mode of learning with the research process such that students will first encounter the scenario, generate the problem, before working to acquire the skills and knowledge required to address said problem.

The use of complex and involved case studies allows multiple learning outcomes to be associated with a single problem; as students develop their knowledge they are able to iteratively explore the problem in greater depth over several weeks. The course will be based around case studies which address four key conceptual problems in quantitative research:

1. Why do we use quantitative methods?

Which will allow students to develop knowledge and understanding around:

- Numbers in society
- Advantages and disadvantages of quantitative approaches
- Key principles of quantitative research

1. How can we convey complex information?

Which will allow students to develop knowledge and understanding around:

- Key descriptive statistics, their meaning and significance, and how they are calculated
- Different data types, how we present data

1. How certain of our results can we be when we use data?

Which will allow students to develop knowledge and understanding around:

- Introduction to data distributions, sampling distributions, and their implications for understanding data
- The principle of probability and its calculation
- The relationship between probability and distribution

1. How should data be collected, and what impacts can poor practice have? Which will allow students to develop knowledge and understanding around:

- Data sources, collecting data, challenges, and pitfalls
- The relationship between sample and population
- Using samples to make inferences about the population
- Confidence intervals and hypothesis testing

The methods of teaching, and the emphasis on student understanding through self-directed inquiry, differentiates this module from other thematically similar modules at this level taught at the university (and more widely).

References:

Karpiak, C.P. (2011) Assessment of Problem-Based Learning in the Undergraduate Statistics Course. *Teaching of Psychology*, 38(4): 251-254

## Learning outcomes

By the end of the module, students should be able to:

- Articulate the usefulness of quantitative analysis as a mode of research within the broader portfolio of research techniques —demonstrating an understanding of its strengths and advantages, but also understanding weaknesses, and where alternative complementary approaches may be more appropriate
- Demonstrate an understanding of key descriptive statistics used to describe a sample, their meaning, and how they are calculated
- Demonstrate an understanding of different data types, sources, methods of collection, issues to be considered in data collection, and to undertake collection and analysis of primary data
- Read and understand basic data descriptions and analysis in published academic literature such as journals or textbooks

- Use computer software to analyse data, produce descriptive statistics, and present data in an appropriate and intuitive way
- Demonstrate understanding of the relationship between sample and population data, challenges associated with bias and non-representative data, and how we use sample data to make inferences about the entire population
- Demonstrate an awareness of data distributions, the way key variables are distributed, and their implications for the analysis of data
- Demonstrate an understanding and calculation of simple, compound, and conditional probabilities, and understand the relationship between probability and data distribution

## **Indicative reading list**

The case study structure of the course means that each problem will be associated with in-depth news articles, data, academic journal articles, and other source materials relating to a contemporary issue (possible themes include the study of issues in education, deprivation and social exclusion, social justice, climate and environment, and health and wellbeing).

It is essential to the course that students have access to a well-chosen technical reference in order to assist in the technical side of their learning. Such technical sources might include (or be similar to):

Lomax, R.G., Hans-Vaughn, D.L. (2012) An introduction to statistical concepts (3e). Routledge, New York

### **22. Learning outcomes**

Successful completion of the module leads to the learning outcomes. The learning outcomes identify the

knowledge, skills and attributes developed by the module.

Learning Outcomes should be presented in the format "By the end of the module students should be able to..." using the table at the end of the module approval form:

## **Research element**

This is a core module on the Liberal Arts course which aims to facilitate the acquisition by students of a range of methods of enquiry from various disciplines and equip them to deploy those skills in research. Research skills are embedded into the teaching strategy of all of the course's modules which, collaboratively, seek to develop and enhance students' capacity to conduct independently original research into a current problem.

## **Interdisciplinary**

This is a core module on the Liberal Arts course which adopts an interdisciplinary approach spanning the arts, humanities, social and natural sciences fields in order to engage with debates on topical, local national and international issues.

## **Subject specific skills**

Students will learn to understand different data types, sources, methods of collection, issues to be considered in data collection, and be able to undertake collection and analysis of primary data. They will acquire an understanding of the relationship between sample and population data,

challenges associated with bias and non-representative data, and how we use sample data to make inferences about the entire population.

They will have an awareness of data distributions, the way key variables are distributed, and their implications for the analysis of data.

They will be able to demonstrate an understanding and calculation of simple, compound, and conditional probabilities, and understand the relationship between probability and data distribution

They will learn to read and understand basic data descriptions and analysis in published academic literature such as journals or textbooks

## **Transferable skills**

As a module delivered with a problem-based learning approach, this module will develop enhanced skills of problem identification, articulation and analysis as well as highly developed skills of data analysis. They will be able to articulate the usefulness of quantitative analysis as a mode of research within the broader portfolio of research techniques — demonstrating an understanding of its strengths and advantages, but also understanding weaknesses, and where alternative complementary approaches may be more appropriate

Other skills supported by this module are:

Oral and written communication

Digital literacy

Professional communication

Working with others

Information technology

Numeracy

Research across various disciplines and using a variety of methods

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## **Study**

### **Study time**

| <b>Type</b>       | <b>Required</b>              |
|-------------------|------------------------------|
| Lectures          | 10 sessions of 2 hours (13%) |
| Practical classes | 9 sessions of 1 hour (6%)    |
| Other activity    | 18 hours (12%)               |
| Private study     | 103 hours (69%)              |
| Total             | 150 hours                    |

### **Private study description**

Reading and research in preparation for workshops

### **Other activity description**

Computer workshop

## Costs

No further costs have been identified for this module.

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## Assessment

You do not need to pass all assessment components to pass the module.

### Assessment group D1

|   | Weighting | Study time |
|---|-----------|------------|
| Group Presentation<br>1 x 15-minute in-class                  | 15%       |            |
| Technical report<br>1 x 1,250-words.                          | 30%       |            |
| Group technical report based on presentation                  | 15%       |            |
| Computer-based exam<br>Questions seen 7 days before the test. | 40%       |            |

### Feedback on assessment

- Written feedback for written assignments (individual and group) will be provided via Tabula  
Written feedback will be provided for presentations via Tabula in addition to feedback and discussion in class at time of presentation  
Feedback on the course test will be provided individually with written comments via Tabula.

[Past exam papers for IP110](#)

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## Availability

### Courses

This module is Core optional for:

- Year 1 of UVCA-LA99 Undergraduate Liberal Arts