Research Methods and Professional Practice

Seminar 4

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Module Overview

- Unit 1: Introduction to Research Methods. The Scientific Investigation and Ethics in Computing
- Unit 2: Research Questions, the Literature Review and the Research Proposal
- Unit 3: Methodology and Research Methods
- Unit 4: Case Studies, Focus Groups and Observations
- Unit 5: Interviews, Survey Methods, and Questionnaire Design
- Unit 6: Quantitative Methods - Descriptive and Inferential Statistics
- Unit 7: Inferential Statistics and Hypothesis Testing
- Unit 8: Data Analysis and Visualisation
- Unit 9: Validity and Generalisability in Research
- Unit 10: Research Writing
- Unit 11: Going Forward: Professional Development and Your e-Portfolio
- Unit 12: Project Management and Managing Risk

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Unit	Seminar Title
1.	Introduction
3.	Peer Review Activity
4.	Case Study on Privacy
7.	Inferential Statistics Workshop
8.	Workshop on Presenting Results
11.	e-Portfolio Preparation

e-portfolio and formative activities COMPLETED and EMBEDDED in e-portfolio

Unit(s)	Component	Deadline	e-Portfolio/Formative
1 - 3	Collaborative Discussion 1	End of unit 3	e-Portfolio
1	Reasoning Quiz	End of unit 1	Formative
1	Reflective Activity 1: Ethics in Computing	End of unit 1	e-Portfolio/Formative
2	e-Portfolio Activity: Literature Review and Research Proposal Outlines	End of unit 4	e-Portfolio/Formative
3	e-Portfolio Activity: Research Proposal Review	End of unit 3	e-Portfolio/Formative
3	Seminar 2: Peer Review Activity	End of unit 3	Formative
4	Seminar 3: Case Study on Privacy	End of unit 4	Formative
4	Literature Review Outline Submission	End of unit 4	Formative
5	Reflective Activity 2: Case Study: Inappropriate Use of Surveys	End of unit 5	Formative
5	Wiki Activity: Questionnaires	End of unit 5	Formative

Formative activity/E-Portfolio

THIS MODULE
Research Methods and Professional Practice (All programmes)

1. Appraise the professional, legal, social, cultural and ethical issues that affect computing professionals
2. Appraise the principles of academic investigation, applying them to a research topic in the applicable computing field
3. Evaluate critically existing literature, research design and methodology for the chosen topic, including data analysis processes
4. Produce and evaluate critically the resulting research proposal for the chosen topic.

2 Collaborative Discussion Forum Summaries (These will cover learning outcomes 1, 2, and 3).

Reflective Piece This covers a key aim for this module.

The Portfolio should also include the following, as part of professional development aspect of the module:

- Feedback from peers and tutors
- Professional Skills Matrix and action plan (PDP)

Other artefacts developed during the module should be included in the portfolio. xxx You will need to describe/show how those artefacts relate to the module learning outcomes.

Skills to be gained here are:

- Time management
- Commercial Awareness
- Critical thinking and analysis
- Decision-making
- Problem-solving
- Initiative
- Entrepreneurial
- Communication and Literacy skills
- Numeracy
- IT and Digital
- Interpersonal
- Critical Reflection
- Research

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Assessment

Assessment	Length/duration	Submission	Weighting
Literature Review	2,000 words	By end of Unit 7	30%
Research Proposal Presentation	15 Minute presentation and transcript	By end of Unit 10	30%
End of Module Assignment: e-Portfolio	2,500 words equivalent including 1,000 word reflective piece	By end of Unit 12	40%

Unit 7: Inferential Statistics and Hypothesis Testing

e-Portfolio Assessment | 10 hrs

Compulsory e-Portfolio Component (Hypothesis Testing and Summary Measures Worksheet): Review the additional notes on Inference and then complete the Hypothesis Testing and Summary Measures worksheet in Excel or LibreOffice. The completed worksheets from units 7 and 8 should be included in your e-Portfolio. You will need to provide your interpretation of the results, based on the questions asked and from your analysis of the data. You can complete the worksheets before or after this week's workshop.

Prepare for next week's seminar session by attempting the worksheets on hypothesis testing and summary measures, available in Unit 8.

Remember to record your results, ideas and feedback in your e-Portfolio.If you have not already done so, you should share a link to your e-Portfolio in the **forum** provided in unit 1 for formative feedback.

e-Portfolio Activity: Hypothesis Testing Worksheet — Mark as done

Collaborative Learning Discussion 2 — 31 unread posts — Mark as done

e-Portfolio Activity: Summary Measures Worksheet — Mark as done

Unit 7 Examples - Workbooks

Collaborative Learning Discussion 2

Discussion Topic - Case Study: Accuracy of information

Abi is a researcher at an institute and also a statistical programmer. Abi has received a project from a manufacturer to review the nutritional value of a new cereal, Whizzz. Having collected the necessary data, he now needs to perform the appropriate analyses and print the reports for him to send to the manufacturer. Unfortunately, the data Abi has collected seems to refute the claim that Whizzz is nutritious, and, in fact, they may indicate that Whizzz is harmful.

Abi also realises that some other correlations could be performed that would cast Whizzz in a more favourable light. "After all," he thinks, "I can use statistics to support either side of any issue."

Ethical Concerns

•Clearly, if Abi changed data values in this study he would be acting unethically. But is it any more ethical for him to suggest analysing correct data in a way that supports two or more different conclusions?

•Is Abi obligated to present both the positive and the negative analyses?

•Is Abi responsible for the use to which others put his program results?

•If Abi does put forward both sets of results to the manufacturer, he suspects that they will publicise only the positive ones. What other courses of action has he?

You should also highlight legal, social and professional impacts of any choices made. Please note that there are no right or wrong answers here and you may introduce local, as well as international, legislature in your responses. You should demonstrate that you understand the topic covered and ensure you use references to academic literature (including journals, books, and reports). *This activity will provide evidence of your personal growth and your summary post is required in your e-portfolio.*

Your initial posting should respond to the question and be at least 200 words long. Your initial post should be labelled "initial post".

Unit 7: Inferential Statistics and Hypothesis Testing

Welcome to Week 7 where we will continue to explore quantitative methods and focus more specifically on inferential statistics and hypothesis testing. In a nutshell, 'The goal of inferential statistics is to discover some property or general pattern about a large group by studying a smaller group of people in the hopes that the results will generalize to the larger group.' (Purdue U, 2023).

The reason is called inference is because as we are making inferences about a population from a sample of data. Inference is the process of extracting meaningful and useful business information from raw data. This process is known as **statistical inference**, because it involves using the data to make valid inferences about the underlying population. As data is inherently variable, all such inferences will necessarily be subject to uncertainty. This uncertainty is quantified using probability.

Instead of estimating some population value of interest that underlies the data, an alternative form of inference is to use the data to provide evidence about whether some assumption of interest regarding that population value is likely to be true. Such a form of inference is known as **hypothesis testing** and is usually preferred to the estimation approach when interest lies in comparing the relevant values underlying two or more different populations.

These are all techniques we can employ to find patterns and meaning from our data.

In this unit we shall:

- Understand inferential statistics.

- Introduce the basic principle of probability.

- Introduce hypothesis testing.

On completion of this unit you will be able to:

- Apply inferential statistics to data analysis.

- Identify the correct probability distributions.

- Perform appropriate hypothesis tests.

Hypothesis testing

Step 1

State the Hypotheses

To begin, we identify a hypothesis or claim that we feel should be tested.

Step 2

Set the Criteria for a Decision

We select a criterion upon which we decide that the claim being tested is true or not. Most samples we select should have a mean close to or equal to our hypothesised mean if the claim is true. However, how do we define 'close to'? How far away does it have to be before we say it isn't 'close to'?

Step 3

Compute the Test Statistic

Select a random sample from the population and calculate the sample mean (or whatever it is we are testing).

Step 4

Make a Decision

Compare what we observe in the sample to what we expect to observe if the claim is to be upheld.
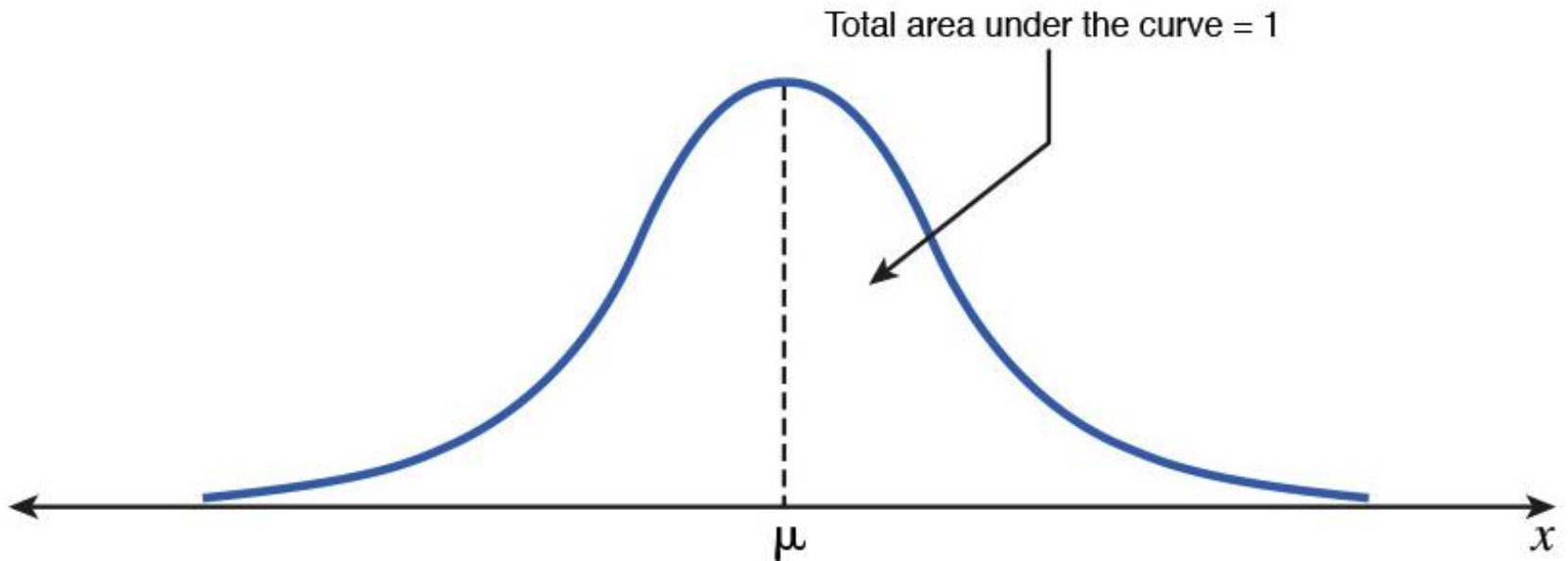
The normal distribution

Figure 4.2 Normal Distribution

Statistical Fundamentals a very brief overview

Correlation

Relationship between two random variables.

Types
- Linear correlation
  - Negative linear correlation
  - Positive linear correlation
- No correlation
- Nonlinear correlation

Correlation coefficient measures the strength and the direction of a linear correlation.

If two random variables are strongly correlated, it does not automatically mean that there is a cause-and-effect relationship between them.
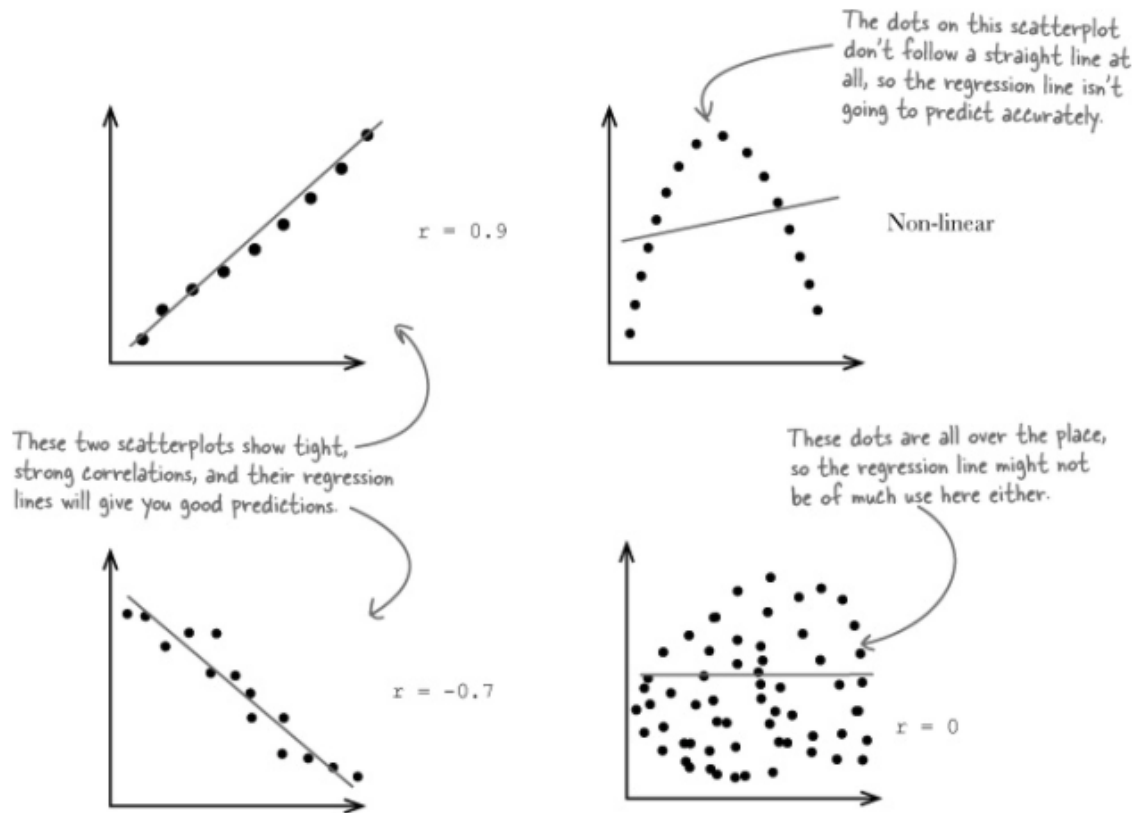
Linear and Multiple Regression

Linear regression is the process of finding a best-fitting straight line, called a *regression line*, through the points in a scatter plot.

The equation of a regression line: $\hat{y} = mx + c$

In multiple regression, the dependent variable gets decided based on multiple independent variables for better prediction.

The regression line

The dots on this scatterplot don't follow a straight line at all, so the regression line isn't going to predict accurately.

r = 0.9

Non-linear

These two scatterplots show tight, strong correlations, and their regression lines will give you good predictions.

These dots are all over the place, so the regression line might not be of much use here either.

r = -0.7

r = 0

https://learning.oreilly.com/library/view/head-first-data/9780596806224/ch10.html

Main e-portfolio and formative activities

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5	Wiki Activity: Questionnaires	End of unit 5	Formative
7 - 9	Collaborative Discussion 2: Case Study on Accuracy of Information	End of unit 9	e-Portfolio
7	Seminar 4: Inferential Statistics Workshop and Statistics Worksheet	End of unit 7	Formative/e-Portfolio (worksheets)
8	e-Portfolio Activity: Research Proposal Outline	End of unit 8	e-Portfolio/Formative
8 - 9	Statistical Worksheet Submissions	End of unit 10	e-Portfolio (compulsory)
9	e-Portfolio Activity: Charts Example Worksheet	End of unit 9	e-Portfolio/Formative
11	Seminar 6: e-Portfolio Preparation	End of unit 11	e-Portfolio/Formative
12	Self Test Quiz	End of unit 12	Formative

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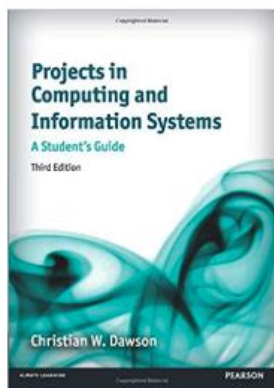
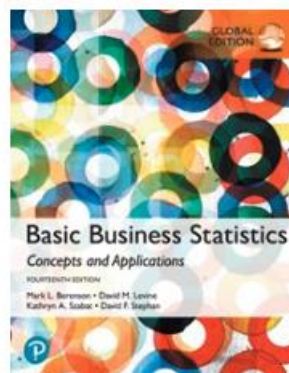**Projects in Computing and Information Systems: A Students Guide**

Edition: 3rd

Author(s): Dawson, C.

Date of Publication: 2015

Publisher: Pearson

Place of Publication: Harlow

Access My eBook

Basic Business Statistics: Concepts and Applications

Edition: 14th

Author(s): Berenson, L., Levine, D., Szabat, K. & Stephan, D.F.

Date of Publication: 2020

Publisher: Pearson

Place of Publication: Harlow

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Thank you

Any questions?

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