FP041-15 Scientific Programming and Mathematical Modelling

21/22

Department
Warwick Foundation Studies
Level
Foundation
Module leader
Credit value
15
Module duration
10 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

FP041-15 Scientific Programming and Mathematical Modelling

Module web page

Module aims

To develop an understanding of the basic principles of mathematical models and demonstrate basic competence in computer programming.

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.

1. Introduction to data science and scientific programming in Python
   What is data science?
   Introduction to Python
   The use of Python for data scientist

Variables and data types
Operation and function
Python data science libraries: numpy, panda, matplotlib

2. Introduction to Mathematical Modelling
   Different types of model
   Mathematical model
   Applications and classifications of mathematical model
   Limitations of mathematical model
   4 stages of mathematical modelling
   Applying mathematical modelling to provide insights and predictions to real world problems

3. Modelling using functions and structured data
   Mathematical expression, equations, and functions
   Understanding the difference between equations and functions
   Recognizing functions from relations, graph, structured data, and word problem
   Constructing a linear function from structured data and word problem
   System of linear model

4. Basics of descriptive and inferential analysis
   Empirical data and statistics
   Using measures of central tendency and measures of spread to summarize and describe data
   Population and samples
   Using interval estimates and hypothesis testing to make inferences about the population from which the sample is drawn
   P-value and confidence interval
   Limitations of descriptive and inferential statistics

5. Statistics fundamentals with Python
   Importing data sets to analyse in Python (datasets, csv files, and excel spreadsheet)
   Using describe and summarize function in python to do descriptive analysis
   Illustrate data using data visualization tools
   Using statistical functions in Python for measures of central tendency and spread
   Measures of correlations between pairs of data

6. Modelling with linear regression
   Introduction to simple linear regression
   Dependent and independent variables
   Coefficient estimate
   Using Ordinary Least Square method to estimate the values of the coefficients
   Making predictions with simple linear regression

7. Big data analytics with python
   What is big data?
   Importing and analysing large data sets in Python
   Model development
   Preparing data for linear regression in Python
   Using python to build a linear regression model from large data sets.

Making predictions based on the model developed.

Learning outcomes

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

- Critically observe a real-world problem and applying the 4-stages of mathematical modelling (building, analysing, validating, and applying) to provide insights and predictions.
- Demonstrate understanding of basic mathematical concepts in data science, relating to linear function, descriptive analysis, inferential analysis, and linear regression.
- Utilize Python to prepare data for analysis, perform simple data analysis, create meaningful data visualization, and make prediction from data.
- Produce a rigorous analytical report which considers a broad range of mathematical and statistical methods to describe, analyse, extrapolate, and apply big data.

Indicative reading list

Bender, E.A., 2012. An introduction to mathematical modeling. Courier Corporation.

Hill, C., 2016. Learning scientific programming with Python. Cambridge University Press.

Langtangen, H.P. and Langtangen, H.P., 2009. A primer on scientific programming with Python (Vol. 2). Berlin, Germany: Springer.

View reading list on Talis Aspire

Subject specific skills

Mathematical Skills

Analytical Skills

Problem-solving skills

Investigative Skills

IT Skills

Transferable skills

Mathematical Skills

Analytical Skills

Problem-solving skills

Communication Skills

Investigative Skills

Study

Study time

Type	Required
Lectures	10 sessions of 1 hour (6%)
Seminars	10 sessions of 1 hour (6%)
Practical classes	10 sessions of 2 hours (11%)
Private study	110 hours (61%)
Assessment	30 hours (17%)
Total	180 hours

Private study description

Private Study.

Costs

No further costs have been identified for this module.

Assessment

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

Assessment group A2

Assessment component	Weighting	Study time	Eligible for self-certification
Questions set 1	30%	7 hours	Yes (extension)

Series of questions incorporating programming related to Mathematical Modules (approximately 800 words)

Reassessment component is the same

	Weighting	Study time	Eligible for self-certification
Assessment component			
Questions set 2	30%	7 hours	Yes (extension)
Series of questions incorporating programming related to Mathematical Modules (approximately 800 words)			
Reassessment component is the same			
Assessment component			
Case Study	40%	16 hours	No
Analyse a data set using a board range of mathematical and Statistical Methods, producing an analytical report. (Approximately 1.5 pages)			
Reassessment component is the same			

Feedback on assessment

Written feedback provided on Tabula

Availability

Courses

This module is Core for:

- Year 1 of FIOE Warwick International Foundation Programme