# 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

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## 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

IT 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.

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# Assessment

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

### Assessment group A2

| | Weighting | Study time |
|---|---|---|
| Questions set 1 | 30% | 7 hours |

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

| | Weighting | Study time |
|---|---|---|
| Questions set 2 | 30% | 7 hours |

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

| | Weighting | Study time |
|---|---|---|
| Case Study | 40% | 16 hours |

Analyse a data set using a board range of mathematical and Statistical Methods, producing an analytical report.
(Approximately 1.5 pages)

### Feedback on assessment

Written feedback provided on Tabula

## Availability

## Courses

This module is Core for:

- Year 1 of FIOE Warwick International Foundation Programme