# Course Outline (Higher Education)

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|---|---|
| **Institute / School:** | Institute of Innovation, Science & Sustainability |
| **Course Title:** | COMPUTATIONAL METHODS FOR DATA ANALYSIS |
| **Course ID:** | MATHS7002 |
| **Credit Points:** | 15.00 |
| **Prerequisite(s):** | (STATS5000) |
| **Co-requisite(s):** | Nil |
| **Exclusion(s):** | Nil |
| **ASCED:** | 010199 |

**Description of the Course:**

This course is aimed at students who are interested in the application of computational methods to solve various problems in data analysis and in particular, to solve cluster analysis, supervised data classification, regression analysis and prediction problems. In this course you will be provided with a comprehensive introduction to numerical methods of linear algebra, optimisation and to numerical methods applied to model and solve problems in data mining. It would be particularly valuable to prospective data analysts in improving their understanding of basic computational approaches and techniques in data mining. This course can be used by students interested in pursuing more advanced mathematical courses, particularly in the areas of Computing, Information Technology and Applied Science.

**Grade Scheme:** Graded (HD, D, C, P, MF, F, XF)

**Work Experience:**

No work experience: Student is not undertaking work experience in industry.

**Does Recognition of Prior Learning apply to this course?** No

**Placement Component:** No

**Supplementary Assessment:** Yes

Where supplementary assessment is available a student must have failed overall in the course but gained a final mark of 45 per cent or above and submitted all major assessment tasks.

**Program Level:**

| Level of course in Program | AQF Level of Program | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 6 | 7 | 8 | 9 | 10 |
| Introductory | | | | | | |
| Intermediate | | | | | ✔ | |
| Advanced | | | | | | |

**Learning Outcomes:**

At the end of this course you will be able to:

**Knowledge:**

**K1.** Describe various optimisation models and methods used in data mining.
**K2.** Explain optimisation methods for solving cluster analysis and supervised data classification problems.
**K3.** Compare basic optimisation approaches for solving regression analysis problems.
**K4.** Discuss optimisation based regression methods for prediction.
**K5.** Examine methods of numerical linear algebra in data mining
**K6.** Demonstrate graph theory and decision trees for solving data mining problems

**Skills:**

**S1.** Implement optimisation methods to solve various data analysis problems.
**S2.** Use basic optimisation approaches to design and implement data analysis algorithms.
**S3.** Evaluate and analyse optimisation techniques in solving Big Data Analytics problems.
**S4.** Apply numerical linear algebra techniques for solving various data mining problems
**S5.** Apply graph theory and decision trees for solving data mining problems

**Application of knowledge and skills:**

**A1.** Design and implement numerical algorithms to solve variety of problems in data mining.
**A2.** Model various data mining problems using optimisation and numerical linear algebra techniques.

**Course Content:**

This unit introduces a broad range of numerical analysis and mathematical optimisation approaches and methods to solve various data mining problems. It contains material which will be of interest and relevant to computing and information technology students who seek an understanding of the role of mathematical modelling and solution methods in data mining. The unit provides valuable enrichment material for those students intending to become data analysts.

Topics may include:

1. Multivariate calculus, derivatives, Hessians, Jacobians; chain rules; approximations of functions
2. Methods of numerical linear algebra
3. Graph theory, decision trees, Markov chians
4. Elements of optimisation theory, the design of optimisation algorithms.
5. Necessary and sufficient optimality conditions.
6. Linear programming, simplex method.
7. Unconstrained optimisation, gradient methods.

8. Conjugate gradient, Newton and quasi-Newton methods.
9. Numerical methods for constrained optimisation.
10. Optimisation models of clustering problems and algorithms for their solution.
11. Optimisation models and methods in the supervised data classification and regression analysis.
12. Methods of Evolutionary optimisation

### Graduate Attributes

The Federation University Federation graduate attributes (GA) are entrenched in the Higher Education Graduate Attributes Policy (LT1228). FedUni graduates develop these graduate attributes through their engagement in explicit learning and teaching and assessment tasks that are embedded in all FedUni programs. Graduate attribute attainment typically follows an incremental development process mapped through program progression. **One or more graduate attributes must be evident in the specified learning outcomes and assessment for each FedUni course, and all attributes must be directly assessed in each program**

| Graduate attribute and descriptor | | Development and acquisition of GAs in the course | |
|---|---|---|---|
| | | Learning Outcomes (KSA) | Assessment task (AT#) |
| GA 1 Thinkers | Our graduates are curious, reflective and critical. Able to analyse the world in a way that generates valued insights, they are change makers seeking and creating new solutions. | K1, K2, A2 | AT1 |
| GA 2 Innovators | Our graduates have ideas and are able to realise their dreams. They think and act creatively to achieve and inspire positive change. | K2, A1 | AT1, AT3 |
| GA 3 Citizens | Our graduates engage in socially and culturally appropriate ways to advance individual, community and global well-being. They are socially and environmentally aware, acting ethically, equitably and compassionately. | V2 | N/A |
| GA 4 Communicators | Our graduates create, exchange, impart and convey information, ideas, and concepts effectively. They are respectful, inclusive and empathetic towards their audience, and express thoughts, feelings and information in ways that help others to understand. | V1 | N/A |
| GA 5 Leaders | Our graduates display and promote positive behaviours, and aspire to make a difference. They act with integrity, are receptive to alternatives and foster sustainable and resilient practices. | N/A | N/A |

### Learning Task and Assessment:

| Learning Outcomes Assessed | Assessment Tasks | Assessment Type | Weighting |
|---|---|---|---|
| K1-6, S1-5, A1 | Computational methods for data analysis | Online assignments | 10-20% |
| A1,A2 | Application of computational methods for solving data analysis problems. | Presentation, Analysis Report | 20% - 30% |
| K1-6, S1-5, A1, A2 | Computational methods for clustering, supervised data classification and regression analysis | Final test | 50% - 60% |

### Alignment to the Minimum Co-Operative Standards (MiCS)

The Minimum Co-Operative Standards (MiCS) are an integral part of the Co-Operative University Model. Seven

criteria inform the MiCS alignment at a program level. Although courses must undertake MiCS mapping, there is NO expectation that courses will meet all seven criteria. The criteria are as follows:

1. Co-design with industry and students
2. Co-develop with industry and students
3. Co-deliver with industry
4. FedTASK alignment
5. Workplace learning and career preparation
6. Authentic assessment
7. Industry-link/Industry facing experience

MiCS program level reporting highlights how each program embraces the principals and practices associated with the Co-Operative Model. Evidence of program alignment with the MiCS, can be captured in the Program Modification Form.

**MICS Mapping has been undertaken for this course** No

Date:

**Adopted Reference Style:**

APA

Refer to the library website for more information

Fed Cite - referencing tool