



FACULTY OF APPLIED SCIENCES
BACHELOR OF SCIENCE IN ARTIFICIAL INTELLIGENCE
LEARNING MODULE OUTLINE

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|-----------------------|----------------------------|---------------|---------------------|
| Academic Year | 2025/2026 | Semester | 1 |
| Module Code | CSAI2121 | | |
| Learning Module | Probability and Statistics | | |
| Pre-requisite(s) | Nil | | |
| Medium of Instruction | English | | |
| Credits | 3 | Contact Hours | 45 hrs |
| Instructor | Dr. Chi-Kin Lam | Email | cklamsta@mpu.edu.mo |
| Office | Rm. N46B, Wui Chi Building | Office Phone | 8599-6823 |

MODULE DESCRIPTION

This learning module aims to provide the probabilistic and statistical skills which are essential for AI. This module will cover descriptive statistics and probability theory basics. To develop a broad understanding of random variables, popular probability distributions, correlation and regression analyses. A gentle introduction to MAP and MLE for Machine Learning will also be covered.

MODULE INTENDED LEARNING OUTCOMES (ILOS)

On completion of this learning module, students will be able to:

| | |
|-----|---|
| M1. | Explain the basic concepts of statistics; (C1) |
| M2. | Summarize numeric data by computing descriptive statistics; (C2) |
| M3. | Define basic probability theory; (C1) |
| M4. | Explain the differences among various statistical techniques and identify an appropriate technique for a given set of variables; (C1) |
| M5. | Estimate parameters using MAP and MLE. (C2) |

These ILOs aims to enable students to attain the following Programme Intended Learning Outcomes (PILOs):

| PILOs | M1 | M2 | M3 | M4 | M5 |
|--|----|----|----|----|----|
| P1. Select and apply proven methods, tools and techniques to the effective and efficient implementation of information systems on common platforms, including the Internet platform; | | | | | |
| P2. Acquire essential knowledge in specific fields of artificial intelligence, including machine learning, computer vision and natural language processing; | | | | | |



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|------|--|---|---|---|---|---|
| P3. | Apply necessary mathematical techniques to model, analyse and devise solutions to complex problems; | ✓ | ✓ | ✓ | ✓ | ✓ |
| P4. | Work independently to develop an understanding of, and the knowledge and skills associated with the general support and mitigation of security risks of computer systems and networks; | | | | | |
| P5. | Design and implement both relational and non-relational data stores, with an emphasis on how to organise, maintain, retrieve and analyse information; | | | | | |
| P6. | Distinguish the fundamental and operational issues of computer systems and artificial intelligence applications, with considerations of user, business, ethical, societal and environmental needs; | | | | | |
| P7. | Evaluate, prepare and communicate effectively on technical information to both technical and non-technical audience; | | | | | |
| P8. | Work as an effective member of a team in the analysis, design and development of software systems, with recognition of requirement to support equality, diversity and inclusion; | | | | | |
| P9. | Use project planning, risk management and quality management techniques in solutions to complex problems; | | | | | |
| P10. | Build the capacity and desire for lifelong learning and to learn advanced and emerging technologies on one's own. | | | | | |

MODULE SCHEDULE, COVERAGE AND STUDY LOAD

| Week | Content Coverage | Contact Hours |
|------|--|---------------|
| 1 | 1. Introduction to Statistics | 3 |
| | 1.1 Overview of statistics | |
| | 1.2 Data classification | |
| 2—3 | 2. Probability | 6 |
| | 2.1 Probability Models | |
| | 2.2 Properties of Probability Models | |
| | 2.3 Conditional Probability and Independence | |
| 4—6 | 3. Probability Distributions | 9 |
| | 3.1 Random Variables | |
| | 3.2 Distributions of Random Variables | |
| | 3.3 Cumulative Distribution Functions | |
| 7—8 | 4. Measures of Central Tendency and Dispersion | 6 |



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|--------|---|---|
| | 4.1 Expectation | |
| | 4.2 Variance, Covariance, and Correlation | |
| 9 – 11 | 5. Parameter Estimation | 9 |
| | 5.1 Likelihood Inference | |
| | 5.2 The Likelihood Function | |
| | 5.3 Maximum Likelihood Estimation | |
| | 5.4 Inferences Based on the MLE and MAP | |
| 12 –13 | 6. Simple Correlation and Regression Analysis | 6 |
| | 6.1 The Pearson correlation | |
| | 6.2 Fitting regression lines | |
| | 6.3 The method of least squares | |
| 14—15 | *7. Sampling Distributions and Limits | 6 |
| | *7.1 Sampling Distributions | |
| | *7.2 Notions of Convergence of Random Variables | |
| | *7.3 Monte Carlo Approximations | |

* Advanced Topics.

TEACHING AND LEARNING ACTIVITIES

In this learning module, students will work towards attaining the ILOs through the following teaching and learning activities:

| Teaching and Learning Activities | M1 | M2 | M3 | M4 | M5 |
|----------------------------------|----|----|----|----|----|
| T1. Lectures | ✓ | ✓ | ✓ | ✓ | ✓ |
| T2. In-class exercises | ✓ | ✓ | ✓ | ✓ | ✓ |

ATTENDANCE

Attendance requirements are governed by the Academic Regulations Governing Bachelor's Degree Programmes of the Macao Polytechnic University. Students who do not meet the attendance requirements for the learning module shall be awarded an 'F' grade.



ASSESSMENT

In this learning module, students are required to complete the following assessment activities:

| Assessment Activities | Weighting (%) | AHEP4 LOs | ILOs to be Assessed |
|----------------------------|---------------|-----------|---------------------|
| A1. Assignment / Classwork | 25% | C1, C2 | M1, M2, M3, M4, M5 |
| A2. Tests | 25% | C1, C2 | M1, M2, M3, M4, M5 |
| A3. Examination | 50% | C1, C2 | M1, M2, M3, M4, M5 |

The assessment will be conducted following the University's Assessment Strategy (see www.mpu.edu.mo/teaching_learning/en/assessment_strategy.php). Passing this learning module indicates that students will have attained the ILOs of this learning module and thus acquired its credits.

Students with an overall score of less than 35 in the coursework must take the re-sit examination even if the overall score for the module is 50 or above.

Students with a score of less than 35 in the final examination must take the re-sit examination even if the overall score for the module is 50 or above.

Students with an overall final grade of less than 35 are NOT allowed to take the re-sit examination.

REQUIRED READINGS

1. Deisenroth, M.P. (2020). Mathematics for Machine Learning (1st ed.). UK: Cambridge University Press.

REFERENCES

1. Michael J. Evans, Jeffrey S. Rosenthal. (2009). Probability and Statistics: The Science of Uncertainty. W. H. Freeman.
2. Sheldon Ross. (2019). A First Course in Probability. Pearson.
3. George Casella, Roger Berger. (2024). Statistical Inference. Chapman & Hall/CRC.

STUDENT FEEDBACK

At the end of every semester, students are invited to provide feedback on the learning module and the teaching arrangement through questionnaires. Your feedback is valuable for instructors to enhance the module and its delivery for future students. The instructor and programme coordinators will consider all feedback and respond with actions formally in the annual programme review.

ACADEMIC INTEGRITY

The Macao Polytechnic University requires students to have full commitment to academic integrity when engaging in research and academic activities. Violations of academic integrity, which include but are not limited to plagiarism, collusion, fabrication or falsification, repeated use of assignments and cheating in examinations, are considered as serious academic offenses and may lead to disciplinary actions. Students should read the relevant regulations and guidelines in the Student Handbook which is distributed upon the admission into the University, a copy of which can also be found at www.mpu.edu.mo/student_handbook/.