Final Year Project Titles for DMAS (Feb 2026)

Contents

1 Puan Azimah Binti Mohd

Lecturer:	Puan Azimah Binti Mohd (azimah@utar.edu.my)
Areas of Interest:	Fuzzy TOPICS& K-Prototype Algorithm
Project Title 1:	Fuzzy TOPSIS for Transportation Problem.
Supplement Knowledge:	Mathematics (matrix operations, linear algebra), fuzzy logic (fuzzy sets, membership functions, and triangular fuzzy numbers), and statistics (descriptive statistics, data normalization, and weighting techniques).
Outline:	This research aims to apply Fuzzy TOPSIS, a multi-criteria decision-making technique, to transportation problems in logistics and urban planning. It will develop a framework, identify key criteria, and validate the methodology through case studies or simulations. The study will support basic statistical analysis and Microsoft Excel coding, identifying optimal solutions under uncertainty.
Preparation:	Basic Microsoft Excel coding
Project Title 2:	K-Prototype Algorithm for Clustering Transportation Problem
Supplement Knowledge:	Mathematics (clustering methods, similarity measures), statistics (descriptive analysis, cluster validation), and programming (Python or R, libraries like Scikit-learn or ClustMixType).
Outline:	This research applies the K-Prototype algorithm to cluster transportation data with mixed types (numerical and categorical). It involves data preparation, clustering process optimization, and validation using metrics like silhouette scores. The study aims to identify patterns or groups within transportation data, validated through case studies or simulations.
Preparation:	Proficiency in Python or R and data visualization techniques for interpreting clustering results.

2 Dr Chen Huey Voon

Lecturer:	Dr Chen Huey Voon(chenhv@utar.edu.my)
Areas of Interest:	Algebra and Combinatorics
Project Title 1:	Complete decomposition of subsets of finite groups
Supplement Knowledge:	Algebra and Combinatorics
Outline:	In pursuit of advancing our understanding of finite groups, our primary goal is to generate numerical data that adheres to the specific conditions necessary for the complete decomposition of subsets within these groups. This meticulous process will provide us with valuable insights into the intricate structures and relationships inherent in finite group theory. Following the comprehensive generation of numerical data, our focus shifts towards the critical phase of substantiating these empirical findings. This involves undertaking a rigorous exploration of theoretical frameworks, delving into the intricate mathematical underpinnings that govern the complete decomposition of subsets within finite groups. Through this analytical journey, we aim to unveil the underlying principles, patterns, and implications associated with the observed numerical data.
Preparation:	Some background in algebra and programming skill
Project Title 2:	Anti-magic Labelling of graphs
Supplement Knowledge:	Graph Theory, Discrete Mathematics and Combinatorics
Outline:	Our research endeavours involve a systematic approach to the generation of numerical data, meticulously designed to meet the stringent criteria required for the anti-magic labelling of specific graph types. This intricate process aims to shed light on the elusive properties and structures inherent in these graphs, paving the way for a deeper understanding of anti-magic labelling phenomena within the realm of graph theory. Following the methodical generation of numerical data, our overarching objective is to embark on a rigorous journey of exploration and validation. Through a combination of mathematical analysis and theoretical frameworks, we strive to establish and prove key results that elucidate the fundamental principles underlying anti-magic labelling in the targeted graph types. This phase is crucial in unveiling the inherent patterns, prope
Preparation:	Some background in graph theory and programming skill

3 Dr Denis Wong Chee Keong

Lecturer:	Dr Denis Wong Chee Keong (deniswong@utar.edu.my)
Areas of Interest:	Cryptography , Modern Algebra
Project Title 1:	Investigations of integers over the ring of algebraic integers
Supplement Knowledge:	UECM3363 Modern Algebra
Outline:	In this project, the student will investigate the properties for the ring of algebraic integers including the arithmetic in the field of Gaussian numbers, Quadratic number fields and Cyclotomic fields. At the end of this project, student should able to identify an arbitrary integer together with it required properties – unit, factorization, norm or discriminant
Preparation:	Algebraic integers
Project Title 2:	Investigations of Lattice-based algebraic structures
Supplement Knowledge:	UECM3363 Modern Algebra
Outline:	In this project, the student will investigate the relationships between various hard problems define over lattices which including the LWE, Ring-LWE, Module-LWE, SVP and GapSVP. At the end of this project, student will construct an IND-CPA secure lattice-based PKE
Preparation:	Lattice
Project Title 3:	Discrete Logarithm problem in non-abelian groups
Supplement Knowledge:	UECM3363 Modern Algebra UECM3383 Cryptology
Outline:	In this project, the student will investigate the usage of variant of DLP in various non-abelian groups in connection to hidden subgroup problem. The main problem is to prove whether DLP is harder in non-abelian group compare to abelian group. Student will also investigate the effect of non-commutative to the efficiency of real-world implementation.
Preparation:	Discrete Logarithm
Project Title 4:	Investigations of Group-based hard problem
Supplement Knowledge:	UECM3363 Modern Algebra UECM3383 Cryptology
Outline:	In this project, group-based hard problems such as the Word problem, Conjugacy decision problem, Decomposition search problem and Factorization problem are investigated. At the end of the project, student will construct a non-commutative cryptographic primitive based on a selected group-based hard problem.

Preparation:	Groups
Project Title 5:	Tower of Code-based Public-Key Encryption Scheme
Supplement Knowledge:	UECM3383 Cryptology
Outline:	The tower of code – a proposed patent PI2024001494 – is a new code-based hard problem using a finite chain ring of linear codes. In this project, student will construct a PKE from Classical McEliece based on tower of code which is IND-CCA secure
Preparation:	UECM3373 Introduction to Coding Theory
Project Title 6	Tower of Code-based Digital Signature Scheme
Supplement Knowledge:	UECM3383 Cryptology
Outline:	IThe tower of code – a proposed patent PI2024001494 – is a new code-based hard problem using a finite chain ring of linear codes. In this project, student will construct a DSS from CROSS based on tower of code which is EUF-CMA secure.
Preparation:	UECM3373 Introduction to Coding Theory
Project Title 7:	Tower of Code-based Key Encapsulation Mechanism
Supplement Knowledge:	UECM3383 Cryptology
Outline:	The tower of code – a proposed patent PI2024001494 – is a new code-based hard problem using a finite chain ring of linear codes. In this project, student will construct a KEM from FIPS2023 based on tower of code which is IND-CPA secure.
Preparation:	UECM3373 Introduction to Coding Theory
Project Title 8:	Tower of Code-based Key Agreement
Supplement Knowledge:	UECM3383 Cryptology
Outline:	The tower of code – a proposed patent PI2024001494 – is a new code-based hard problem using a finite chain ring of linear codes. In this project, student will construct a KA from DHKE based on tower of code that resists man-in-the middle attack, replay attacks and DoS attack.
Preparation:	UECM3373 Introduction to Coding Theory

4 Ms. Gillian Woo Yi Han

Lecturer:	Ms. Gillian Woo Yi Han (wooyh@utar.edu.my)
Areas of Interest:	Optimisation
Project Title 1:	Efficiency Analysis of Gradient-Based Optimization Methods for Linear System Solutions
Background Knowledge:	Fundamental of linear algebra
Outline:	This study conducts a comparative analysis of gradient-based optimization methods for solving linear systems. It focuses on evaluating their efficiency, convergence rate, and applicability. Through empirical experimentation and theoretical examination, this research aims to provide insights into their performance in terms of computational efficiency and solution accuracy. The findings offer valuable guidance for selecting the most suitable optimization approach for linear system problems, contributing to the advancement of computational techniques in engineering and scientific fields.
Preparation:	Python
Project Title 2:	Investigating Proximal Gradient Method for Sparse Optimization
Background Knowledge:	Fundamental of linear algebra
Outline:	This project explores the utilization of the proximal gradient method for solving sparse optimization problems. By delving into theoretical principles and conducting empirical evaluations, the study aims to assess the method's efficacy and applicability across various optimization scenarios. Through comprehensive analysis, the project seeks to provide insights into the performance and potential limitations of the proximal gradient method in sparse optimization settings, contributing to the broader understanding of optimization techniques.
Preparation:	Python

5 Dr Goh Yong Kheng

Lecturer:	Dr Goh Yong Kheng (gohyk@utar.edu.my)
Areas of Interest:	Statistical mechanics, computational finance, bioinformatics
Project Title 1:	Numerical simulation of Swift-Hohenberg equation
Supplement Knowledge:	Numerical analysis, partial differential equations, Python
Outline:	The Swift-Hohenberg is a 2D partial differential equation that exhibit patterns formation under different parameters. In this project, student are expected to review the equation and solve it numerically by using psedo-spectral method. Student then could explore different patterns formed by changing different parameters and nonlinear noise.
Preparation:	Try out some Python tutorials, find and read information on Swift-Hohenberg equations.

6 Dr Goh Yann Ling

Lecturer:	Dr Goh Yann Ling (gohyl@utar.edu.my)
Areas of Interest:	Applied Statistics, Applied Mathematics
Project Title 1:	Statistical and Computational Modeling for Evaluating Healthcare Performance
Supplement Knowledge:	probability and statistics
Outline:	This project focuses on applying statistical and computational modeling techniques to evaluate healthcare performance and patient outcomes. The goal is to compare the accuracy and effectiveness of various models while identifying their respective strengths and limitations. It involves data preprocessing, model development, performance assessment using standard evaluation metrics, and comprehensive analysis of the results. The findings aim to provide meaningful insights into how different modeling approaches can support more informed decision-making in healthcare settings.
Preparation:	Good programming skill.
Project Title 2:	Evaluating Predictive Models to Improve Business Decisions
Supplement Knowledge:	probability and statistics
Outline:	This project explores the use of predictive models, including statistical methods and machine learning techniques. The aim is to compare their performance, understand their strengths and limitations, and determine how they can help improve business decision making.
Preparation:	Good programming skill

7 Dr Kuang Kee Seng

Lecturer:	Dr Kuang Kee Seng (kuangks@utar.edu.my)
Areas of Interest:	Mathematical Theory of Investment, Universal Portfolio
Project Title 1:	Universal Portfolio generated by some positive definite matrices
Supplement Knowledge:	None
Outline:	The student will be introduce with basic theory of universal portfolio and some basic stock trading investment strategies. Meet supervisor for more detail.
Preparation:	Basic Microsoft Excel coding. Matlab would be helpful.
Project Title 2:	Universal Portfolio generated by some probability distribution functions
Supplement Knowledge:	None
Outline:	The student will be introduce with basic theory of universal portfolio and some basic stock trading investment strategies. Meet supervisor for more detail.Meet supervisor for more detail.
Preparation:	Basic Microsoft Excel coding. Matlab would be helpful.

8 Dr Lee Yap Jia

Lecturer:	Dr Lee Yap Jia (yjlee@utar.edu.my)
Areas of Interest:	Universal Portfolio
Project Title 1:	Experiment on Online Portfolio Selection Strategy Using Real Market Data
Supplement Knowledge:	Information Theory and Portfolio Theory
Outline:	This project studies how online portfolio selection (OPS) strategies work using real stock market data. It starts with a short review of key ideas in portfolio theory and explains some OPS methods like Exponential Gradient. The project uses RStudio to get real stock market data, then tests how these strategies perform over time. Results are compared using measures like return and risk. The project concludes with a discussion of findings, practical implications, limitations, and suggestions for future extensions
Preparation:	RStudio
Project Title 2:	Exponential Gradient Strategy for Online Portfolio Selection
Supplement Knowledge:	Information Theory and Portfolio Theory
Outline:	This project focuses on implementing and analysing the Exponential Gradient (EG) strategy for online portfolio selection using real financial market data. It begins with a brief overview of online portfolio theory and the motivation for using adaptive, data-driven strategies. The core of the project involves coding the EG algorithm in RStudio, applying it to historical stock data, and evaluating its performance using metrics such as cumulative wealth. The strategy's behaviour is tested across different market periods and compared with simple benchmarks like buy-and-hold strategy. The project concludes with an assessment of the EG strategy's strengths, limitations, and possible enhancements.
Preparation:	RStudio

9 Dr Liew How Hui

Lecturer:	Dr Liew How Hui (liewhh@utar.edu.my)
Areas of Interest:	Applied Mathematics
Project Title 1:	Database Query with Predicate Logic
Supplement Knowledge:	UECM1304 Discrete Mathematics

Outline:	This project will explore how predicate logic (one famous implementation is Prolog programming language) is used for database queries systematically. In fact if one constrains Prolog programs to use only atoms, integers and reals (no lists or complex terms) and disallows recursive definitions, one gets a database language that is equivalent to a powerful subset of SQL.
Preparation:	Study books on mathematical logic, relevant resources (e.g. `https://www3.cs.stonybrook.edu/~warren/xsbbook/node11.html`) and software (e.g. `https://www.swi-prolog.org/pldoc/man?section=db`)

Project Title 2:	Discrete Mathematics in a Smalltalk Programming Environment
Background Knowledge:	Object-orientied programming knowledge
Outline:	Discrete mathematics is the study of discrete data structures such as logic, sets, counting with numbers, trees and graphs. In this project, the possibility of learning and working with discrete mathematics in a rather well establish object-oriented programming language called the smalltalk will be explored. The literature review should cover (1) Discrete Mathematics in Mathematics Education (covering covering syllabus from universities around the world, textbooks and journal papers); (2) Discrete Mathematics in Computer Science Education (covering syllabus from universities around the world, textbooks and journal papers); (3) Smalltalk Programming Environments (including Squeak, Cuis Smalltalk and Pharo). The methodology should cover the common discrete data structures and operations in discrete mathematics (logic, sets, natural numbers, integers, trees, graphs, etc.) and then fix a smalltalk programming environment (e.g. Pharo?) and investigate how the common discrete data structures are encoded. The results should cover the pedagogies of illustring the discrete data structures and their operations like Boolean algebra, integers, trees, etc. in the Programming environment using Transcript and/or Morph.
Preparation:	Downloading relevant Smalltalk software which are freely available from Internet

Project Title 3	Undergraduate Mathematics for 3D Modelling
Supplement Knowledge:	Linear Algebra
Outline:	3D Modelling is a well-developed subject. However, many of the techniques in 3D Modelling are not included in UTAR's undergraduate mathematics courses. This research is to gather gather information(https://metalbyexample.com/linear-algebra/, https://iquilezles.org/articles/, etc.) related to mathematics and proposed suggestions to enhance undergraduate mathematical courses such as Linear Algebra, Numerical Methods, etc. with 3D modelling.

Preparation:	Try out JavaScript with WebGL, Python, C++ with OpenGL to work with various mathematics and 3D Modelling(https://en.wikipedia.org/wiki/3D modeling).

Project Title 4:	Formal Proving for Logic
Supplement Knowledge:	Discrete Mathematics, C Programming, Real Analysis
Outline:	Logic is the foundation of mathematics. Logic is supposed to be coded in symbols. In this project, we will investigate how to encode logic using formal provers (e.g. Coq, Lean, Isabelle).
Preparation:	Study books and papers related to formal proving. E.g. https://cs.uwaterloo.ca/ plragde/cs245old/, https://leanprover-community.github.io/logic and proof/natural deduction for first order logic.html, etc.

10 Dr Loh Wing Son

Lecturer:	Dr Loh Wing Son (lohws@utar.edu.my)
Areas of Interest:	Applicable Neural Networks Theory, Statistical Machine Learning, Hydrology, Earth Science

Project Title 1:	Application of Statistical Machine Learning Approaches in Extreme Sediment Flux Data Modelling
Background Knowledge:	Statistics, Predictive Modelling
Outline:	Sediments play an important role in the hydrological processes and are an absolute necessity for a wide range of organisms. In spite of that, the temporal variations in sediment transportations should be monitored as sediment overload will cause a drastic change in sediment flux and could potentially lead to flood events. In this project, models will be developed for the sediment flux data by applying statistical methods derived from Extreme Value Theory (EVT), and the incorporation of machine learning approaches.
Preparation:	Programming knowledge (R / Python / MATLAB)

Project Title 2:	Data-Driven Estimation of Urban Heat Island Intensity Using Hybrid Machine Learning and Multi-Source Geospatial Data
Background Knowledge:	Statistics, Predictive Modelling

Outline:	Urban Heat Island (UHI) intensity varies significantly within cities due to heterogeneous land cover, building density, and anthropogenic heat. Traditional remote sensing (e.g., Landsat) offers limited temporal resolution, while ground-based sensors are sparse. There is a need for accurate, low-cost, high-frequency UHI estimation using accessible data. This project develops predictive models to estimate UHI intensity at neighbourhood scale using machine learning techniques
Preparation:	Programming knowledge (R / Python / MATLAB)
Project Title 3:	Adaptive Flood Alert Thresholds Using Machine Learning and CMIP6 Climate Projections for Malaysian River Basins
Background Knowledge:	Statistics, Predictive Modelling
Outline:	Flood forecasting in Malaysia often relies on static rainfall thresholds that ignore future climate variability. With climate change intensifying extreme rainfall, these thresholds become obsolete. There is a need for adaptive, data-driven flood triggers that incorporate future climate scenarios from CMIP6. This project develops a hybrid early warning model that combines historical streamflow/rainfall data with CMIP6 future scenarios to dynamically calibrate flood alert levels.
Preparation:	Programming knowledge (R / Python / MATLAB)
Project Title 4:	Interpretable Machine Learning for Urban Heat Island Driver Attribution in Tropical Urban Environments
Background Knowledge:	Statistics, Predictive Modelling
Outline:	While machine learning models predict Urban Heat Island (UHI) well, they are often "black boxes". Urban planners require interpretable insights into which factors most influence UHI (e.g., green space v.s. building height v.s. traffic). This project develops machine learning models for UHI estimation and uses explainable AI (XAI) techniques to rank the contribution of urban, climatic, and socioeconomic variables to heat intensity.
Preparation:	Programming knowledge (R / Python / MATLAB)
Project Title 5:	Urban Flood Vulnerability Prediction Using Machine Learning and Socio-Hydrological Indicators
Background Knowledge:	Statistics, Predictive Modelling

Outline:	Urban flooding in Malaysia is intensifying due to climate change (increased rainfall intensity), rapid urbanisation (impervious surfaces), and aging drainage infrastructure. Traditional flood models focus on physical variables (e.g., rainfall, topography) but ignore social vulnerability such as income, housing density, and access to emergency services which determines actual flood impact. There is a notable gap in integrating socio-economic data with hydrological data to predict community-level flood risk, not just inundation. This project addresses this gap by developing a socio-hydrological vulnerability index using machine learning approaches.
Preparation:	Programming knowledge (R / Python / MATLAB)

11 Dr Ng Kooi Huat

Lecturer:	Dr Ng Kooi Huat (khng@utar.edu.my)
Areas of Interest:	Statistical Process Control, Applied Statistical Modelling, Data Analysis etc.
Project Title 1:	Uncovering Changes in Statistical Analysis
Supplement Knowledge:	Elementary Statistics, Time Series Analysis, Applied Statistical Model etc.
Outline:	Change point analysis helps avoid the exclusion of pertinent data and mitigates the risk of forecasting based on irrelevant data. The project illustrates that employing change point techniques can enhance forecast accuracy.
Preparation:	Knowledge of R Programming.
Software:	R Programming or Other Statistical Softwares.
Project Title 2:	Monitoring Data Contamination with the Aid of Robust Control Charts
Supplement Knowledge:	Elementary Statistics, Statistical Process Control etc.
Outline:	In this project, we explore the benefits of employing control charts grounded in robust statistics. Utilizing Monte Carlo simulations, we assess and compare the robustness and performance of these charts.
Preparation:	Knowledge of R Programming.
Software:	R Programming or Other Statistical Softwares.

12 Dr Ng Wei Shean

Lecturer:	Dr Ng Wei Shean (ngws@utar.edu.my)
Areas of Interest:	Linear Algebra
Project Title 1:	A study on the immanant of a matrix
Supplement Knowledge:	Linear Algebra
Outline:	Study types of immanant (https://en.wikipedia.org/wiki/Immanant) and the properties of the immanants of a matrix. Explore preserver problems on the immanent of a matrix.
Preparation:	Strengthening the understanding of Linear Algebra through extensive reading
Project Title 2:	Compound commuting mapping on alternate matrices
Background Knowledge:	Linear Algebra
Outline:	Study properties of alternate matrices and compound a matrix. Explore compound commuting mappings on alternate matrices.
Preparation:	Strengthening the understanding of Linear Algebra through extensive reading

13 Dr Ong Poh Hwa

Lecturer:	Dr Ong Poh Hwa (ongph@utar.edu.my)
Areas of Interest:	Graph Theory
Project Title 1:	Self-clique Graphs
Supplement Knowledge:	Discrete Mathematics, Graph Theory
Outline:	This project will study the characterization of all connected self-clique graphs with given clique sizes. After that, we need to find some graphs with certain clique sizes.
Preparation:	None.
Project Title 2:	Antimagic Labeling of Forests
Supplement Knowledge:	Discrete Mathematics, Graph Theory
Outline:	This research explores the antimagic labeling of forests, a class of graphs composed of disjoint trees. The study focuses on identifying and proving antimagic labeling properties within various forest structures. Through systematic analysis and mathematical validation, the research aims to establish new labeling techniques and derive theoretical results. These findings will contribute to the broader understanding of antimagic labeling and its applications in graph theory and related fields such as cryptography and network design.
Preparation:	Some background in graph theory and programming skills.

14 Dr Pang Sook Theng

Lecturer:	Dr Pang Sook Theng (pangst@utar.edu.my)
Areas of Interest:	Universal Portfolio, Mathematics Education
Project Title 1:	Study the performances of the parameters of universal portfolios using some countries stock markets
Supplement Knowledge:	Have knowledge in investment strategy
Outline:	Study the performances of stock markets of some countries by varying parameters of universal portfolio strategies and compare the returns.
Preparation:	knowledge in Excel and Python.
Project Title 2:	Comparative analysis of Student's live online learning readiness during the COVID-19 pandemic in the higher education sector in Malaysia
Supplement Knowledge:	Knowledge in statistics.
Outline:	Differential the method in analyzing the data.
Preparation:	knowledge in any statistical software

15 Dr Pan Wei Yeing

Lecturer:	Dr Pan Wei Yeing (panwy@utar.edu.my)
Areas of Interest:	Investment Performance
Project Title 1:	Utilizing Sharpe Ratio for Analyzing Investment Performance: A Risk-Adjusted Measure Approach
Supplement Knowledge:	Probability and Statistics
Outline:	The proposed title is to analyze the return on an investment portfolio. The investment performance is analyzed by using the risk-adjusted performance measures over a specific period of time.
Preparation:	Knowledge in programming, i.e. R, Python or Java
Project Title 2:	Modelling Auto Claim Severity using machine learning models
Background Knowledge:	Probability and Statistics
Outline:	This study aims to model auto claim severity by employing machine learning techniques. Basic statistical measures and graphical representations will be utilized to observe variable relationships. Multiple machine learning models will be tested to propose the most effective model for predicting auto claim severity.
Preparation:	Knowledge in programming, i.e., R, Python or Java

16 Mr. Phoon Sheong Wei

Lecturer:	Mr. Phoon Sheong Wei (swphoon@utar.edu.my)
Areas of Interest:	Universal Portfolio, basic Knowledge related to statistical analysis, regression analysis, Stock market analysis, dependence modelling, risk management,Rainfall analysis
Project Title 1:	Enhancing Universal Portfolio Performance Using Mahalanobis Distance and Copula-Based Dependency Modeling
Background Knowledge:	Basic portfolio theory and financial mathematics knowledge, regression and statistical modelling, and correlation measures.
Outline:	This project investigates whether integrating Mahalanobis distance and copula-based dependency modelling into a universal portfolio framework can improve risk-adjusted returns and manage tail risks more effectively than traditional methods. The Mahalanobis universal portfolio method typically leverages the covariance structure of returns to dynamically adjust portfolio weights, aiming to emulate the best retrospectively constant-rebalanced portfolio performance. However, it often assumes linear relationships and may not fully capture complex or non-linear dependencies between assets. By incorporating copulas (Most likely R-vine Copulas), this project intends to: 1. Model Non-linear and Tail Dependencies. 2. Refine asset clustering and weight allocation with Mahalanobis distance. 3. Optimize the dynamic portfolio and its performance evaluation with benchmark strategies. 4. Model selection and parameter estimation. Please contact the supervisor for further details
Preparation:	Microsoft Excel + R-studio or Python
Project Title 2:	Regime-Switching Dependence Between Malaysian Stocks Using Copula-Based Hidden Markov Models
Background Knowledge:	Basic Knowledge related to basic probability and statistics, time series/regression

Outline:	This project studies how the dependence between major Malaysian stocks changes across hidden market regimes (E.g., calm vs crisis periods). Instead of modelling only each stock separately, the focus is on the joint behaviour of returns. Comparison between simple models with constant correlation to more advanced models that allow the dependence between stocks to change over time, especially during high-volatility and crisis periods. A copula-based hidden Markov model will be used to represent different hidden market regimes. The fitted models will be used to study how joint extreme losses and portfolio risk change across regimes and how this differs from what is obtained under a simple constant correlation assumption. This project intends: 1. To fit and assess baseline joint models with constant dependence or static copula models for the selected stock returns. 2. To compare the performance of the regime-switching copula HMM with the simpler baseline models in terms of the ability to capture joint extreme losses and tail dependence between stocks. 3. To evaluate the impact of regime-dependent dependence on simple portfolio risk measures, such as variance, VaR, TVaR, and discuss the implications for risk management. Please contact the supervisor for further information.
Preparation:	Microsoft Excel + R-studio or Python

Project Title 3:	Modelling Joint Extreme Rainfall at Neighbouring Stations in Malaysia using Copula Models
Background Knowledge:	Basic Knowledge related to basic probability and statistics, time series/regression
Outline:	This project focuses on extreme rainfall events and how they occur together at nearby stations. Instead of modelling only one station or only monthly totals, the idea is to study the joint behaviour of rainfall between two or three rainfall stations that are close to each other. This project intends: 1. To fit and assess suitable marginal extreme-value distributions for the extreme rainfall at each station. 2. To construct and compare several bivariate copula models for the joint distribution of extreme rainfall between neighbouring stations, including an assessment of tail dependence. 3. To estimate the joint exceedance probabilities and joint return periods for high rainfall thresholds at multiple stations. Please contact the supervisor for further information.
Preparation:	Microsoft Excel + R-studio or Python

17 Dr Sim Hong Seng

Lecturer:	Dr Sim Hong Seng (simhs@utar.edu.my)
Areas of Interest:	Optimization Techniques and Applications
Project Title 1:	Spectral Gradient Method with Modified Weak Secant Relation for solving inverse image problem
Supplement Knowledge:	Calculus I and II, Linear Algebra, Numerical Methods.
Outline:	This project introduces a method called the spectral gradient method with modified secant relation to solve inverse image problems, which are common in areas like medical and satellite imaging. These problems are hard to solve because the original image is not directly available. The spectral gradient method is improved by using modified weak secant relation to speed up the process. The efficiency of the modified method will be compared with some existing methods in terms of number of iterations and computational time.
Preparation:	MATLAB / Python
Project Title 2:	Accelerated Proximal Gradient Method in solving compress sensing problem
Background Knowledge:	Calculus I and II, Linear Algebra, Numerical Methods
Outline:	This project introduces a method called the Accelerated Proximal Gradient Method (APGM) to solve Compressed Sensing (CS) problem, which is common in areas like high-dimensional data processing and advanced sparse imaging (e.g., MRI reconstruction). These problems are hard to solve because they involve recovering a large, detailed signal from a dramatically reduced number of measurements, requiring the minimization of a complex optimization function that is non-smooth. The efficiency of the accelerated method will be compared with existing, non-accelerated techniques in terms of the number of iterations required to achieve stable recovery and the overall computational time.
Preparation:	Python / MATLAB

18 Dr Tan Wei Lun

Lecturer:	Dr Tan Wei Lun(tanwl@utar.edu.my)
Areas of Interest:	Applied Statistics
Project Title 1:	Deep Learning Techniques for Cryptocurrency Price Forecasting: A Comparative Modelling Approach
Background Knowledge:	Probability and Statistics II

Outline:	This project uses deep learning to predict cryptocurrency prices and compare how different models perform. The student will work with real cryptocurrency data, such as Bitcoin or Ethereum, and prepare the data for analysis. Several deep learning models will be tested, such as LSTM, GRU, CNN, or other neural network approaches. The goal is to understand which model works better for forecasting and why. The student will train the models, test their accuracy, and compare the results using standard evaluation metrics. Basic programming skills and some knowledge of machine learning are helpful, but the project is designed to guide the student step by step. This study provides valuable experience in data analysis, model building, and understanding real financial patterns. Challenges include handling noisy crypto data, tuning the models, and choosing features that improve prediction performance.
Preparation:	R/Python

Project Title 2:	Machine Learning Approaches for Predicting Code-Switching in Multilingual Malaysia
Background Knowledge:	Probability and Statistics II
Outline:	This project applies machine learning to understand code-switching patterns in Malaysia, where people often switch between languages such as Bahasa Malaysia, English, Mandarin, and local dialects during conversations. The goal is to build a model that can learn from these language-switching patterns and predict the next language used. The student will work with multilingual data, use basic natural language processing (NLP) techniques to prepare the data, and train machine learning models to analyze code-switching behavior. The project includes evaluating the model's performance and identifying key factors that influence language choice. This project will help the student build practical skills in machine learning, data analysis, and applying technology to study real-world language use.
Preparation:	R/Python

Project Title 3:	A Stochastic Modelling Approach to Rainfall Anomalies Using the Ornstein–Uhlenbeck Process
Background Knowledge:	Probability and Statistics II

Outline:	This project studies how rainfall changes over time using mathematical and computer-based methods. You will work with rainfall anomalies, which show how rainfall goes above or below what is normally expected. To model these changes, the project uses the Ornstein Uhlenbeck (OU) process that describes how rainfall tends to move back toward normal levels after a wet or dry period, while still allowing random climate fluctuations. The work involves preparing rainfall data, calculating the anomalies, fitting the OU model using Python or R, and checking how well the model explains the patterns in the data. Students only need basic programming and some understanding of probability and statistics. This project gives useful experience in time-series modelling, data analysis, and stochastic simulation, and shows how mathematical tools can help us understand real environmental data. Possible challenges include noisy data, getting a good model fit, and making clear and correct interpretations of the results.
Preparation:	R/Python

Project Title 4:	Model Selection in Hidden Markov Models: A Simulation Study
Background Knowledge:	Probability and Statistics II
Outline:	This project studies how to choose the correct number of hidden states in a Hidden Markov Model (HMM). The student will create simulated datasets from HMMs and then fit models with different assumed numbers of states. Model selection methods such as AIC, BIC, and ICL will be used to see which one identifies the true model correctly. The study will test different conditions, such as varying sample sizes and noise levels. This project helps the student learn how HMMs work, how to simulate them, and how model selection criteria behave in practice
Preparation:	R/Python

19 Mr Tan Zong Ming

Lecturer:	Mr Tan Zong Ming (tanzm@utar.edu.my)
Areas of Interest:	Applied Statistics, Financial Mathematics
Project Title 1:	Hybrid Technical Analysis Techniques in Financial Markets
Supplement Knowledge:	Technical Analysis Techniques, Programming Language
Outline:	Integrates well-known technical analysis indicators like RSI, MACD, Bollinger Bands Fibonacci etc.and construct model that are able to provide entry and exit price. Back test and real time monitoring to examine the performance of the model.
Preparation:	R- programming software
Project Title 2:	Automated Candlestick Pattern Recognition
Supplement Knowledge:	Candlesticks Chart and Pattern, Statistics and R-Programming Language
Outline:	Develop an automated system to detect candlestick patterns.Validate the model using historical price data.Insights into model performance.Expanding to recognize complex patterns or integrating with trading signals.
Preparation:	R-programming software

20 Dr Teoh Lay Eng

Lecturer:	Dr Teoh Lay Eng (teohle@utar.edu.my)
Areas of Interest:	Applied Mathematics
Project Title 1:	A Multi-criteria Priority Assessment of Pre-disaster Preparedness Mitigation Strategies for Flood Management
Background Knowledge:	Mathematics/Statistics/Operations Research

Outline:	Nowadays, the increasing frequency and severity of flood occurrences pose crucial challenges to many countries worldwide due to their adverse threats not only to the safety and well-being of populations, but also to enormous damage and economic losses. Correspondingly, numerous mitigation strategies have been planned and implemented by the relevant authorities to solve the disaster problems. Notably, the applicability and effectiveness of the implemented strategies may vary greatly for different contexts and/or countries. Thus, it is important to identify the most desirable mitigation strategies for effective flood management. Focusing on the pre-disaster preparedness stage, this study aims to propose a multi-criteria decision-making tool to prioritize the relevant mitigation strategies (e.g., flood early warning system, urban green infrastructure, vegetation forms/nature-based solutions, etc.) by considering numerous significant influential criteria (e.g., operational cost, complexity, sustainability, etc.). The proposed approach should be able to determine an insightful priority order for the respective mitigation strategy for viable long-term implementation. Concisely, it is anticipated that this study will provide useful insights to relevant stakeholders, especially emergency officials and policy makers, in mitigating flood occurrences in a better manner.
Preparation:	This project may require numerous skills related to mathematical/statistical analysis, machine learning, and simulation

Project Title 2:	Unveiling Evacuation Behavior and Decision of Vulnerable Elderly People for Diverse Flooding Scenarios
Background Knowledge:	Mathematics/Statistics/Operations Research

Outline:	Flood emerges as one of the concerning challenges to many countries due to their threat to considerable lives, properties, and economic losses. Notably, one of the most important flood evacuation tasks is the capacity to save affected victims (including vulnerable elderly people) swiftly from disaster areas. Particularly, the reaction of victims toward the flood evacuation is found to be dynamic under uncertainty. Furthermore, unique behavior and specific concerns of the elderly victims complicate the flood evacuation strategy. Correspondingly, this study aims to model the flood victim behavior and evacuation decision by focusing on vulnerable elderly people. To do this, a feasible quantitative approach that comprises machine learning and statistical techniques will be applied suitably to model the flood evacuation behavior and decision of vulnerable elderly people by performing the relevant data modeling/analysis for diverse probable flooding scenarios. In particular, the associated flood evacuation tendency (likelihood) of the victims will be quantified accordingly for feasible evacuation planning. It is anticipated that this study will provide useful insights to the relevant stakeholders, e.g., emergency planners and rescue teams, in operating flood evacuation strategies effectively.
Preparation:	This project may require numerous skills related to mathematical/statistical analysis, machine learning, and simulation.

Project Title 3:	A Multi-criteria Analysis of Situational Volunteerism for Flood Evacuation Planning
Background Knowledge:	Mathematics/Statistics/Operations Research

Outline:	Globally, the increasing frequency and severity of flood occurrences, which pose adverse consequences to many countries, are worrying. Correspondingly, effective flood evacuation planning is of utmost importance to evacuate flood victims promptly from disaster areas. However, emergency authorities and/or rescue teams may encounter issues of manpower and resource shortages, which may impede the evacuation operations. Thus, the active participation of volunteers is vital to ensure that the planned evacuation operations can be implemented effectively. Thus, this study aims to explore situational volunteerism for flood evacuation planning by using a multi-criteria analytical approach. The proposed study would be able to identify numerous influential factors, challenges, as well as opportunities to improve situational volunteerism for disaster management. Besides, the identification of diverse groups of volunteers as well as the tendency of individuals to actively participate in voluntary flood evacuation operations will be beneficial in solving disaster problems. Concisely, it is anticipated that this study will provide useful insights to relevant stakeholders, particularly emergency officials, rescue teams, and policy makers, in implementing smart flood evacuation operations, by closely engaging volunteers' participation.
Preparation:	This project may require numerous skills related to mathematical/statistical analysis, machine learning, and simulation.

21 Dr Wong Kuan Wai

Lecturer:	Dr Wong Kuan Wai (wongkw@utar.edu.my)
Areas of Interest:	Cryptography, information security, risk management
Project Title 1:	Securing Image Data on Social Media: A Study on Image Encryption and Risk Mitigation
Supplement Knowledge:	None
Outline:	The student will study the importance of securing images and the growing risks such as unauthorized access, identity theft, and misuse of image data. Student will explore to the current risk measures and review encryption methods. Student will develop a scheme for encrypting images before they are uploaded to social media platforms.
Preparation:	None
Project Title 2:	Studying Cascading Chaotic Systems and Their Applications
Supplement Knowledge:	None
Outline:	Chaotic systems are known for their sensitivity to initial conditions, as small changes can result in dramatically different outcomes. This project focuses on cascading chaotic systems, where multiple chaotic systems are connected, resulting in even more complex dynamics. The student will explore the mathematical behavior of these systems, understand how they are modeled, and examine their potential applications in cryptography.
Preparation:	None

22 Dr Wong Wai Kuan

Lecturer:	Dr Wong Wai Kuan (wongwk@utar.edu.my)
Areas of Interest:	Applied Statistics, Statistical Quality Control
Project Title 1:	Modeling Insurance Claim Frequency Using Count Data Distributions. (Co-supervisor: Dr.Sim Shin Zhu (shinzhusim@gmail.com))
Supplement Knowledge:	Mathematical Statistics
Outline:	The objective of this project is to explore various statistical models to understand and represent the distribution of insurance claims, which often exhibit characteristics such as over-dispersion and long tails. Students will examine different count data models, including the Poisson and Negative Binomial distributions, and potentially other appropriate models, to evaluate their effectiveness in capturing the frequency of insurance claims. The project will involve a comparative analysis of these models using goodness-of-fit measures and statistical criteria, such as the Akaike Information Criterion (AIC). A central focus of the study will be on estimating the parameters of the selected models. Maximum Likelihood Estimation (MLE) will be used as the primary method for parameter estimation. Students will investigate how MLE can be applied to estimate the best-fitting parameters for each model, and how well each model performs in terms of accurately representing the insurance claim frequency.
Preparation:	Statistical Software (R, Python), Maximum Likelihood Estimation (MLE), Basic Probability Theory, Data Handling and Analysis Techniques
Project Title 2:	$\overline{X}$-chart Construction Without the Normality Assumption
Supplement Knowledge:	Probability and Statistics II
Outline:	The construction of control charts is based on the assumption that the data is normally distributed. This project will study the construction of $\overline{X}$- chart when the data is not normally distributed.
Preparation:	Knowledge in programming.

23 Dr Wong Voon Hee

Lecturer:	Dr Wong Voon Hee (wongvh@utar.edu.my)
Areas of Interest:	Artificial Intelligence, Risk Analysis, Probability and Statistics
Project Title 1:	AI-Powered Traffic Accident Analysis System for Determining Fault under Malaysian Road Transport Law
Supplement Knowledge:	Deep Learning, Computer Vision Tools, Video Analytics, Signal Processing, Python Programming
Outline:	Road accidents in Malaysia remain a significant public safety and economic issue, with thousands of cases investigated annually by the police, insurance companies, and the Road Transport Department (JPJ). Determining fault in an accident is often complex, relying on eyewitness testimony, manual inspection of dashcam or CCTV footage, and interpretation of the Road Transport Act 1987 and subsidiary regulations. However, manual analysis is prone to human error, bias, and delays. With the advancement of computer vision and artificial intelligence, there is an opportunity to build a system that can automatically analyse accident videos, reconstruct vehicle trajectories, detect possible violations of traffic laws, and generate preliminary reports. This project aims to design an AI-based decision-support tool that integrates video analytics, mathematical modelling of vehicle motion, and rule-based legal reasoning to provide structured insights on accident causation in Malaysia.
Preparation:	UECS2053 Artificial Intelligence or UEMH4623 Applications of Artificial Intelligence
Project Title 2:	AI-Based Prediction and Analysis of Student Stress Levels Based on Daily Life Activities
Supplement Knowledge:	Deep Learning, Python Programming (Pandas, Scikit-learn, Matplotlib)
Outline:	Stress among university students is a growing concern. While tools like DASS-21 can measure stress levels, they don't analyse behavioural causes such as time spent on study, sleep, sports, or entertainment. This project aims to build an AI model that predicts a student's stress level based on their daily life activities, using data collected through structured self-reporting and DASS-21 scoring
Preparation:	UECS2053 Artificial Intelligence or UEMH4623 Applications of Artificial Intelligence

24 Dr Yap Hong Keat

Lecturer:	Dr Yap Hong Keat (yaphk@utar.edu.my)
Areas of Interest:	Number Theory
Project Title 1:	Gaussian Integer Solutions of the Diophantine Equation $x^3+y^4 = z^3$
Background Knowledge:	Number Theory and Complex Number
Outline:	Diophantine equation involving only sums, products and powers in which all the constants are integers and the only solutions of interest are integers. In this problem, we consider the Diophantine equation $x^3+y^4 = z^3$ and determine the solutions over the Gaussian integer ring.
Preparation:	Diophantine Equation and Complex Number.
Project Title 2:	On the Exponential Diophantine Equation $3^x + 23^y = z^2$
Background Knowledge:	Number Theory and C Programming
Outline:	An exponential Diophantine equation is an equation in which the bases are (given or unknown) integers; the exponents are unknown integers. An exponential Diophantine equation is a special kind of Diophantine equations and the study of Diophantine equations becomes important when researchers found out that Diophantine equations can be applied in the authentication protocol in Cryptography. In this problem, we consider the Exponential Diophantine equation $3^x + 23^y = z^2$ where x, y and z are non-negative integers that are less than 5000. The study begins with the construction of a programming to determine the existence of solution(s) to the equation considered. Subsequently, the general form of the solution(s) will be categorized and proven using mathematical approaches for unique solution or infinitely many solutions.
Preparation:	Diophantine Equation and basic knowledge in C programming.

25 Dr Yap Lee Ken

Lecturer:	Ms Yap Lee Ken (lkyap@utar.edu.my)
Areas of Interest:	Numerical Analysis,Artificial Intelligence
Project Title 1:	A Study on Prompt Design and Model Response Characteristics in Large Language Models
Supplement Knowledge:	Familiarity with Large Language Models, basic knowledge of Python programming, understanding of data processing
Outline:	This project investigates how different types of prompts influence the behaviour and responses of Large Language Models (LLMs). The study begins by reviewing existing prompt styles and developing a simple prompt taxonomy based on linguistic and task features. Selected LLMs will then be compared to determine a suitable model for analysis. The project further defines basic activation or response-related metrics to describe how the model processes different prompt categories. Based on these findings, a conceptual framework is proposed to explain the relationship between prompt structure and model behaviour. The outcome of the project provides clearer insight into how LLMs interpret prompts, which can support future work in prompt engineering, interpretability, and model evaluation.
Preparation:	Python
Project Title 2:	An Improved Block Hybrid Collocation Techniques for Third-Order ODEs
Supplement Knowledge:	Numerical methods, C Programming, Matematica
Outline:	We shall derive numerical methods for solving third order ordinary differential equations. The derivation involves interpolation and collocation of basic polynomial. The programming code will be compiled to test the efficiency of the numerical methods.
Preparation:	Strong background in numerical analysis and good programming skill.

26 Dr Yeo Heng Giap Ivan

Lecturer:	Dr Yeo Heng Giap Ivan (yeohg@utar.edu.my)
Areas of Interest:	Inventory Management
Project Title 1:	An inventory model with remanufacturing and carbon emission control in a circular economy
Background Knowledge:	Calculus I and II
Outline:	In this project, an economic order quantity (EOQ) inventory model that incorporates remanufacturing and carbon emission control policies such as carbon tax, carbon cap, and cap-and-trade will be mathematically formulated. One key assumption is that the model operates in a circular economy where its circular economy activities is measured by a single indicator. This indicator affects various parameters in the model such as demand rate, costs, and return rate. A profit maximization problem will be defined and a numerical solution procedure will be proposed to solve the said problem. Finally, business insights will be derived from the model.
Preparation:	Python
Project Title 2:	A manufacturing-remanufacturing inventory model with circularity indicator
Background Knowledge:	Calculus, Operations Research
Outline:	In this project, an inventory model of a manufacturing system that manufactures new items and remanufactures returned items will be proposed. The demand for the manufactured item and the profits earned are dependent on the circularity level of the inventory system. The circularity level roughly measures how sustainable are the operations of the inventory system. Hence, an important question to be answered is " can running sustainable operations be profitable for manufacturers, and if not, what can be done to make it so?" Once the model is developed, it will be solved to find the optimal inventory policy and analyzed to derive managerial insights, one of which will answer the question posed above.
Preparation:	Python

27 Dr Yong Chin Khian

Lecturer:	Dr Yong Chin Khian (yongck@utar.edu.my)
Areas of Interest:	Applied Statistics and Financial Economics
Project Title 1:	Analyzing PCFCCE using Bayesian Network
Supplement Knowledge:	Probability and Statistics I & II or Statistical Inference, Design of Experiments
Outline:	This project will analyze Partially Confounded Factorial Conjoint Choice Experiments using Baysian Network.

Project Title 2:	Assessing Consumers' Behavior Using PCFCCE
Supplement Knowledge:	Probability and Statistics I & II or Statistical Inference, Design of Experiments
Outline:	This project will use Partially Confounded Factorial Conjoint Choice Experiments to asses consumers' behavior toward certain products.
Project Title 3:	Valuing Equity-Linked death benefits
Supplement Knowledge:	Financial Economics II or Derivative Security and Life Contingencies
Outline:	This project use the Option Pricing and Actuarial Present Value to price equity-linked death benefits.
Project Title 4:	Parameters Estimation for CIR Model
Supplement Knowledge:	Probability and Statistics I & II, Financial Economics II or Derivative Security
Outline:	This project will use Kalman Filter to estimate the parameters in CIR Model.
Project Title 5:	Estimating Limited Fluctuation Credibility Using Exact Distribution
Supplement Knowledge:	Probability and Statistics I & II, Credibility Theory
Outline:	This project will use certain non-normal distribution to estimated the expected number of claims for full credibility.
Project Title 6:	Modelling Claims Using MCMC
Supplement Knowledge:	Probability and Statistics I & II, Credibility Theory and Stochastic Processes.
Outline:	This project will use Markov Chain Monte Carlo simulation to estimated claims premiums.
Project Title 7:	Using GARCH Models to Estimate CTE
Supplement Knowledge:	Probability and Statistics I & II, Applied Stat Models, Loss Models
Outline:	This project will evaluate the performance of GARCH (genralized Auto Regressive Conditional Hetrocedastic) models in modelling daily Conditional Tail Expectation(CTE)of certain portfolios.
Project Title 8:	Interval Estimate of Credibility
Supplement Knowledge:	Probability and Statistics I & II, Credibility
Outline:	This project will find the confidence interval of the variance hypothetical means of the Buhlmann models.