MACHINE LEARNING, PREDICTIVE ANALYTICS AND DATA-DRIVEN DECISION-MAKING COURSE

Introduction

This programme introduces participants to machine learning, predictive analytics and the use of data to support strategic and operational decisions. It explores how organizations can use historical data to identify patterns, estimate future outcomes, classify events, detect anomalies and improve resource allocation. Participants examine data preparation, exploratory analysis, feature selection, supervised and unsupervised learning, regression, classification, clustering, model evaluation and forecasting. The programme also covers the interpretation of analytical results, the communication of uncertainty, data quality, model bias and the responsible application of predictive systems. Practical case studies address customer behaviour, sales forecasting, financial planning, workforce analytics, operational performance and risk management. The course is designed to develop analytical understanding and practical decision-making capabilities, with introductory coding or low-code tools selected according to participants' backgrounds.

Course Objectives

- Explain machine learning concepts and predictive analytics applications.

Course Modules

> Module 1: • Reactive rather than forward-looking planning: Introduces forecasting and predictive techniques to support proactive decisions. • Difficulty identifying patterns in large datasets: Develops skills in exploratory analysis, clustering and pattern recognition. • Unreliable analytical conclusions: Strengthens model evaluation, data quality assessment and interpretation of uncertainty. • Weak translation of data into action: Connects predictive results with operational planning, resource

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allocation and strategic decision-making.

- Artificial intelligence, machine learning and predictive analytics concepts.
- Applications of predictive modelling in business and public organizations.
- Types of analytical problems and model selection considerations.
- Analytical workflows, project objectives and success criteria.

> Module 2: Data Preparation and Exploratory Analysis

- Data collection, integration and quality assessment.
- Missing values, duplicates, outliers and inconsistent observations.
- Descriptive statistics, distributions and exploratory visualization.
- Data splitting, leakage prevention and preparation for modelling.

> Module 3: Statistics and Analytical Foundations

- Descriptive statistics and probability concepts.
- Correlation, relationships and limitations of causal interpretation.
- Sampling, variation and uncertainty in analytical results.
- Statistical significance, confidence intervals and practical interpretation.

> Module 4: Data Features and Model Preparation

- Feature selection and identifying relevant predictors.
- Encoding categorical variables and scaling numerical features.
- Feature engineering and transformation techniques.
- Training datasets, validation datasets and test datasets

> Module 5: Regression and Numerical Prediction

- Linear regression principles and practical applications.
- Multiple regression and interpreting predictor relationships.
- Regression assumptions, residual analysis and diagnostic checks.
- Evaluating predictions using MAE, RMSE and related metrics.

> Module 6: Classification and Predictive Risk Analysis

- Classification problems and logistic regression fundamentals.
- Decision trees and introductory classification algorithms.
- Confusion matrices, precision, recall and F1-score.
- Classification thresholds, class imbalance and decision trade-offs.

> Module 7: Clustering and Pattern Discovery

- Unsupervised learning concepts and business applications.

- K-means clustering and segment identification.
- Hierarchical clustering and alternative grouping approaches.
- Interpreting clusters and applying segmentation results.

> Module 8: Forecasting and Time-Series Analysis
- Time-series data, trends, seasonality and cyclical patterns.
- Moving averages and introductory forecasting techniques.
- Forecast accuracy, validation and error measurement.
- Applying forecasts to sales, budgeting, demand and resource planning.

> Module 9: Model Evaluation, Ethics and Decision Support
- Overfitting, underfitting and model generalization.
- Cross-validation, baseline comparisons and model selection.
- Bias, fairness, explainability and responsible model use.
- Communicating predictions, uncertainty and decision implications.

> Module 10: Predictive Analytics and Decision-Making Project
- Defining a business problem and selecting an appropriate dataset.
- Preparing data and developing a suitable predictive model.
- Evaluating model performance and interpreting analytical findings.
- Presenting recommendations, implementation considerations and monitoring measures

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