Executive Program in Business Analytics & Business Intelligence (EPBABI)

Course Curriculum
EPBABI is a three-month executive program. Classes will be conducted twice a week, on the weekends (Sat and Sun). The course consists of 12 modules, including hands-on project experience. In some of the modules, the instructors will demonstrate the use of relevant softwares. In module XII, there will be hands-on experience in various useful softwares. Various modules of EPBABI will be taught by experts from industry and by eminent faculty members from IIM Ranchi and other reputed institutes. We always update the program structure based on the suggestions from the experts in industry and academia. Based on their suggestions, program structure can always be upgraded in the interest of the participants to meet the requirements of industry.

Various modules (sequence may be different) are as given below.
Module-1: Data Mining and Business Analytics
Module-2: Statistics for Business
Module-3: Advanced Statistics
Module-4: Time Series Analysis
Module-5: Random Analytic Processes
Module-6: Descriptive Analytics with Data Warehousing
Module-7: Optimization Analytics
Module-8: Predictive Analytics
Module-9: Soft Computing Techniques
Module-10: Business Process Analytics
Module-11: Business Analytics Applications
Module-12: Hands-on experience with various softwares, like,
   (i) IBM-Cognos 8 (BI Tool), (ii) SPSS, (iii) SAS, (iv) R
   and other softwares as suggested by the concerned faculty members.

Module-wise course contents

Module 1: Data Mining and Business Analytics
☐ *Introduction to Business Analytics*: What is data mining? KDD vs Data Mining (DM), DM Tasks, DM Application Areas
☐ *Association Rule (AR)*: Market Basket Analysis, Representation of an AR, Strength of AR, Support, Confidence, and Lift, Generalized Association Rule (numeric, categoric, temporal, spatial etc.), Case study on use of association rules in Market Basket Analysis and Inventory Management
☐ *Clustering and Classification*: Difference between clustering & classification, Discussion on clustering techniques, Case discussion on the application of clustering, Classification using Decision Tree, Classification using Artificial Neural Network (ANN),
Module 2: Statistics for Business

Descriptive Statistics
Types of Data: Concepts of population and sample, quantitative and qualitative data, cross-sectional and time-series data, discrete and continuous data, different types of scales. Presentation of data: Construction of tables with one or more factors of classification, diagrammatic representations, frequency distributions and cumulative frequency distributions, relative frequency distributions.
Univariate data – different measures of location, dispersion, relative dispersion: mean absolute deviation (MAD), range, quartile deviation, interquartile range, standard deviation, basic concepts of moments, central and noncentral moments; skewness and kurtosis, Lorenz curve.

Curve-Fitting and Method of Least Squares:
Basic ideas of curve-fitting; straight line, parabola, least-squares curve fitting; fitting exponential and geometric curves.

Correlation and Regression Analysis:
Basic ideas of correlation, scatter diagrams, bivariate data, meaning of covariance, correlation coefficient, variance of the sum (difference) of two series; concept of simple linear regression, meaning of rank correlation, calculation of Spearman’s Rank Correlation Coefficient; applications of correlation in business, particularly financial applications.

Multivariate Analysis & Techniques:
Characteristics of multi-variate data, elementary ideas of multi-variate distributions;; introduction to multiple regression and multiple correlation; some results relating to multiple regression and multiple correlation; partial correlation; relations linking partial regression and partial correlation.

Module 3: Advanced Statistics

Probability and Sampling
Concepts of probability-classical and empirical approaches; theorems of probability; statistical independence of events; Central Limit Theorem; axiomatic approach to probability; random variables; conditional probabilities-Bayes’ Theorem; probability mass functions and probability density functions; probability distributions-Binomial, Poisson and Normal Distributions; other distributions such as Student’s t-distribution and Snecedor’s F-distribution.

Hypothesis Testing and Statistical Inference:
Introduction to hypothesis testing; Concepts of null and alternate hypotheses; concept of test of significance; confidence intervals - critical value method and
- p-value method; point and interval estimates; maximum likelihood estimation (MLE); tests for goodness of fit; Type I and Type II errors; power of a test; applications of hypothesis testing in business decision-making

- Non-parametric methods:
  - Introduction; non-parametric estimation of location and dispersion; tolerance intervals; non-parametric tests for location: one-sample sign, one-sample Wilcoxon signed-rank, paired-sample sign, paired-sample Wilcoxon signed-rank tests

**Module 4: Time Series analysis**

- Introduction to time series; organizing data for analysis
  - Examples, simple descriptive techniques, trend, seasonality, the correlogram.

- Probability models for time series
  - Moving average (MA), Autoregression (AR), ARMA(Autoregressive Moving Average) and ARIMA (Autoregressive Integrated Moving Average) models. Estimating the autocorrelation function and fitting ARIMA models.

- Forecasting:
  - Exponential smoothing. Forecasting from ARIMA models.

- Stationary processes in the frequency domain:
  - The spectral density function, the periodogram, spectral analysis

- State-space models:
  - Dynamic linear models and the Kalman filter technique

**Module 5: Random Analytical Processes**

- Random variables:
  - Probability spaces, probability measures etc. Random variables, conditional expectation, characteristic functions, limits theorems.

- Stochastic processes
  - Basic definitions. Brownian motion. Stationary processes. Other examples of stationary processes; Brownian motion in the stock market

- Markov processes

- Stochastic Differential Equations
  - Basic properties of SDEs. Itô’s Lemma; Numerical solution of SDEs.

- Monte-Carlo Simulation & Sensitivity Analysis

**Module 6: Descriptive Analytics with Data Warehousing**

- Introduction to descriptive analysis:
  - Data Warehousing. What is a data warehouse? Elements of a Data Warehouse. Data Warehouse (DW) vs. Database. Commercial Importance of data warehouse. Fundamentals of Multidimensional data model, Fact/measure, what is dimension? DW Architecture, Data Marts, Virtual Data Warehouse, Metadata, Multidimensional
Representation of data: Dimension Modeling & Hierarchy, Lattice of Cuboids, Summary Measures

**OLAP operations:**
Slicing & Dicing, Drill-up & Drill-down, Drill within & Drill Across, Pivot

**Warehouse Schema:**
Normalization vs Dimensional Modeling, Star Schema, Snowflake Schema and Fact Constellation

**Data Warehouse Implementation:**
Efficient Computation of Data Cubes, Indexing OLAP Data, Backend Processes of ETL

**DW issues in Retail sale:**
Promotion Dimension, Degenerate Dimension, Retail Schema Extensibility DW issues in Inventory Management: Inventory Periodic snapshot, Inventory Transactions, Inventory Accumulating Snapshot

**DW issues in Procurement:**
How to handle Slowly Changing Dimensions (SCD)

**DW issues in CRM:**
How to handle Large Changing Dimensions (LCD), Discussion on DW in Banking, Insurance, Healthcare, Education etc.

**Module7: Optimization Analytics**

**Introduction to Mathematical Programming & Operations Research (OR), Linear Programming Problems (LPP):**
Formulating a Linear Programming Problem; Graphical and Algorithmic Approaches; feasible solutions; concept of Basic Feasible Solution (BFS); duality theorems; Simplex Algorithm for solving LPPs; application of LPP to decision-problems; sensitivity analysis;

**Transportation Problem:**
Formulating Linear Programming to problems in transportation Applications of Linear Programming to problems in transportation; Solution algorithms such as North-West Corner Rule and Vogel’s Approximation Method (VAM); MODI.

**Assignment Problem:**
Defining Assignment Problem in OR; Solution Technique for Assignment Problem; Assignment scheduling and task planning; basic ideas of network models

**Integer Programming:**
Zero-one and mixed-integer problems-applications in financial decision-making, such as capital budgeting problems

**Introduction to Non-Linear Programming:**
Optimization in the presence of inequality constraints and non-linear objective functions; constrained maxima and minima- the techniques of Lagrange multipliers; optimization with inequality constraints (Kuhn-Tucker conditions for constrained optimization)

**Dynamic Programming:**
Mathematical Formulation of Dynamic Programming; Bellman’s Principle of Optimality; Algorithm to Solve

**Queueing Theory**
Different Classes of Queueing Problems; Average Waiting Time; Average Service Time; Average System Response Time; Average Queue Length; Average Utilization of the Servers/counters.

**Module 8: Predictive Analytics**
Advanced Topics in Time Series Modelling & Forecasting

Least-Squares Prediction:
Forecasting with i) Classical Linear Regression Model (CLRM), ii) Autocorrelation iii) Lagged Dependent Variables

Covariance Stationarity, Trend in Time Series, Unit Root Problems

Forecasting with ARIMA models

ARCH and GARCH Models

Module 9: Soft Computing Techniques
- Fuzzy Set and Fuzzy Logic
- Fuzzy Rule induction
- Neural Network as classifier
- Neuro-Fuzzy Technique as classifier
- Genetic Algorithm for optimization

Module 10: Business Process Analytics
- Business Process
- Process Capability
- Statistical Process Control
- Six Sigma

Module 11: Business Analytics Applications
Business analytics applications in:
- Marketing
- Operations
- Service
- Banking & Finance

Module 12: Hands-on-experience
- Statistics
- BI Tool
- Data Mining
- Soft Computing
Softwares to be used: (i) IBM-Cognos 8 (BI Tool), (ii) SPSS, (iii) SAS, (iv) R and other softwares as suggested by the concerned faculty members.