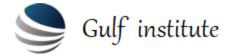# GULF INSTITUTE

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Advanced Data Analysis Techniques

INTRODUCTION

- The Statistical Analysis of Numerical Information is proven to be a powerful tool, providing everyday insight into matters like corporate finance, production processes and quality control.
- However, the advent of the Internet of Things, the consequential growth in Big Data, and the ever-increasing requirements to model and predict, mean that many of the analytical opportunities and needs of a modern, high performing company cannot be met using conventional statistical methods alone.
- More and more companies are wrestling with complex modelling and simulation problems, addressing matters like trying to optimise production systems, to maximise performance efficiency, to minimise operating costs, to combat risk, to detect fraud and to predict future behaviour and outcomes.

Pre-requisite

- This training course on Advanced Data Analysis Techniques is intended for delegates who have already attended the Data Analysis Techniques training course (this is a necessary prerequisite for this training) and hence, who already have a solid understanding of conventional data analysis methods.
- This training course shows by example how to build on the method learned in the Data Analysis Techniques training course and to create a variety of powerful modelling, simulation and predictive analytical methods.
- The methods introduced include Bayesian models, Newtonian and genetic optimisation methods, Monte Carlo simulation, Markov models, advanced What If analysis, Time Series models, Linear Programming, and more.
- This training course on Advanced Data Analysis Techniques uses advanced features of Microsoft Excel throughout, and it is important that all delegates are fully competent in both Excel and the statistical analysis of data.

OBJECTIVES

- This training course on Advanced Data Analysis Techniques aims to provide those involved in analysing numerical data with the understanding and practical capabilities needed to convert data into meaningful information via the use of a range of very powerful modelling, simulation and predictive analytical methods. The specific objectives are as follows:
- To teach delegates how to solve a wide range of business problems which require modelling, simulation and predictive analytical approaches
- To show delegates how to implement a wide range of the more common modelling, simulation and predictive analytical methods using Microsoft Excel 2010 (or higher) and in particular the Solver tool
- To provide delegates with both a conceptual understanding and practical experience of a range of the more common modelling, simulation and predictive analytical techniques, including Bayesian models, conventional and genetic optimisation methods, Monte Carlo models, Markov models, What If analysis, Time Series models, Linear Programming, and more
- To give delegates the ability to recognize which modelling, simulation and predictive analysis methods are best suited to which types of problems
- To provide a clear understanding of why the best companies in the world see modelling, simulation and predictive analytics as being essential to delivering the right quality products and optimised services at the lowest possible costs

TRAINING METHODOLOGY

- This training course on Advanced Data Analysis Techniques adopts a problem-based learning approach, in which delegates are presented with a series of real problems drawn from the widest possible range of applications – they range from insurance to supply chain logistics, from chemistry to engineering, and from production optimisation to financial risk assessment. Each problem presents and exemplifies the need for a different modelling or analytical approach.
- This training course is entirely applications-oriented, minimising the time spent on the theory and mathematics of analysis and maximising the time spent on the use of practical methods from within Excel, along with the understanding of how and why such methods work.
- Delegates will spend almost all of their time exploring the use of modelling and simulation methods using Microsoft Excel, to develop solutions to the totally realistic problems that are presented.

ORGANISATIONAL IMPACT

- Organisations which are able to make optimum decisions, and which can reliably predict future trends and behaviours, are able to enhance substantially their ability to compete on the global stage; as a result of sending their employees on this training course, organisations can expect to benefit from:
- A shift from intuition-based to information-based decision making
- The provision of accurate solutions to complex problems
- Enhanced forecasting and future behaviour prediction
- Advanced modelling and simulation of business processes
- More capable risk assessment and risk-informed decision making
- Improved capitalisation on the wealth of information contained in Big Data

PERSONAL IMPACT
WHO SHOULD ATTEND?

- This training course on Advanced Data Analysis Techniques has been designed for professionals whose jobs involve the manipulation, representation, interpretation and/or analysis of data. This training course involves extensive modelling and analysis using Excel 2010 (or higher) and therefore delegates must not only be numerate, but must enjoy detailed working with numerical data to solve complex problems.
- Full familiarity with Microsoft Excel (version 2007 or higher), and the ability to analyse data using common statistical methods, are fundamental prerequisites for attendance on this Advanced Data Analysis Techniques training course. Only delegates who have attended the Data Analysis Techniques training will be eligible to attend this training course with the reason of, without mastery of the capabilities taught in the aforementioned training, a delegate will not be able to succeed on this training course.

Course Outline
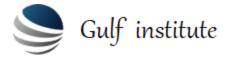
Linear Programming

- Introduction to Optimisation; Multi-variate Optimisation Problems; Determining the Objective Function; Constraints to Problems; Sign Restrictions; The 'feasibility region'; Graphical Representation; Implementation using Solver in Excel
- Using Linear Programming to Solve Production and Supply Chain / Logistics Problems, such as optimising the products from a refinery, and minimising the manufacturing and delivery costs for a complex supply chain (with and without batch manufacturing, and with and without warehousing)

Newtonian and Genetic Optimisation Methods

- Linear and Non-linear Optimisation Problems; Stochastic Search Strategies; Introduction to Genetic Algorithms; Biological Origins; Shortcomings of Newton-type optimisers; How to Apply Genetic Algorithms; Encoding; Selection; Recombination; Mutation; How to Parallelise; Implementation using Solver in Excel

Markov Models

- Understanding Risk; Introduction to Markov Models; 5 Steps for Developing Markov Models; Manipulating Arrays and Matrices inside Excel; Constructing the Markov Model; Analysing the Model; Roll Back and Sensitivity Analysis; First-order Monte Carlo; Second-order Monte Carlo
- Decision Trees and Markov Models; Simplifying Tree Structures; Explicitly Accounting for Timing of Events
- Using Markov Chains to simulate an insurance no claims discount scheme, and Modelling the Outcomes of a Healthcare System

Monte Carlo Simulation

- Introduction to Monte Carlo Simulation; Monte Carlo building blocks in Excel; Using the RAND() function; Learning to model the problem; Building worksheet-based simulations; Simple problems; How many iterations are enough?; Defining complex problems; Modelling the variables; Analysing the data; Freezing the model; Manual recalculation; "Paste Values" function; Basic statistical functions; PERCENTILE() function
- Monte Carlo Simulation solutions to problems of traffic flow in a city, dealing with uncertainty in the sale of product, predicting market growth and assessing risk in currency exchange

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