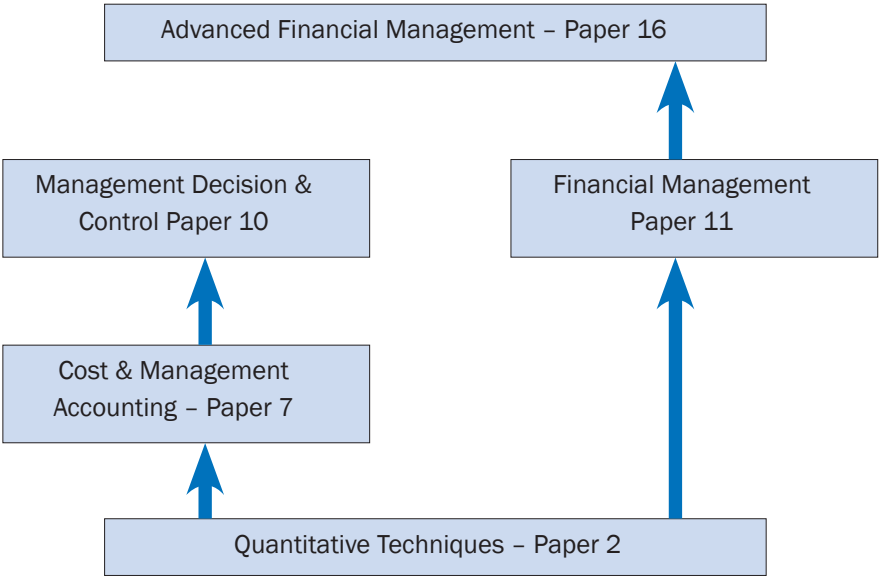
QUANTITATIVE TECHNIQUES - PAPER 2
SYLLABUS CHART



OVERALL AIM

To develop an understanding of the mathematical principles and concepts which are useful in problem solving and decision making

LEARNING OUTCOMES

On completion of this course, the learner should be able to:

1. Demonstrate an understanding of statistical methods used in decision-making
2. Demonstrate an understanding and application of statistical and mathematical models for estimation and forecasting
3. Demonstrate an understanding and application of techniques used in solving optimisation problems in management

LEVEL OF ASSESSMENT

The syllabus is assessed for knowledge, comprehension and application.

EXAMINATIONS STRUCTURE

There will be a three hour examination comprising of six questions of 20 marks each, of which the candidate will be required to attempt any five

DETAILED SYLLABUS

A. INTRODUCTION

1. Meaning of statistics
   (a) Functions and limitations of statistics
   (b) Types of statistics: descriptive and inference statistics

B. STATISTICAL DATA, PRESENTATION AND MEASURES

1. Statistical data
   (a) Primary and secondary
      (i) Sample and population
      (ii) Discrete and continuous
      (iii) Quantitative and qualitative
      (iv) Variable and attribute
   (b) Sources of data
   (c) Methods of data collection: interview, questionnaire, direct observation, census and sample survey
   (d) Merits and demerits of each method of data collection
   (e) Response errors
   (f) Sample frame
   (g) Sampling techniques: random sampling (simple random and stratified), quasi random sampling (systematic and multistage sampling), non- random sampling (cluster and quota sampling)
   (h) Advantages and disadvantages of each technique of sampling
   (i) Methods of data presentation:
      (i) Tables (row and column, two way, frequency and percentage distribution tables)
      (ii) Basic principles of table design
      (iii) Interpretation of data presented in each type of table
      (iv) Limitations of each type of table
      (v) Pictograms, charts (simple and compound bar charts, and pie charts)
      (vi) Methods of construction of each type of chart; type of data suitable for each type of chart; limitations of each type of chart
      (vii) Graphs (line graph, histogram, frequency polygon and curves, including

o-give, Lorenz and Z charts)

(viii) Basic principles of drawing each type of graph; interpretation and limitations of graphs

2. Measures of location / central tendency

   (a) Measures of averages: arithmetic mean, weighted mean, mode, median, harmonic and geometric means
   (b) Characteristics, merits and demerits of each type of average
   (c) Computation of the mean using actual values and /or working mean
   (d) Determination of the mode and median using both computational and graphical methods
   (e) Interpretation of calculated values of each measure
   (f) Computation of weighted mean, harmonic mean and geometric mean
   (g) Relationship between mean, mode and median
   Note: Knowledge of logarithms either from mathematical tables or calculator is assumed.

3. Measures of dispersion

   (a) Meaning of dispersion and variation
   (b) Measures of dispersion: range, quartile deviation (interquartile range), semi-quartile deviation (semi-interquartile range), decile and percentile range, mean deviation, quartile coefficient of dispersion, standard deviation and variance
   (c) Characteristics, merits and demerits of each measure of dispersion
   (d) Determination of quartile, decile and percentile by computation and graphically
   (e) Computation of quartile coefficient of dispersion
   (f) Computation of mean deviation, standard deviation and variance using the working mean method
   (g) Properties of standard deviation and coefficient of variation
   (h) Interpretation of calculated values of each measure

4. Measures of skewness

   (a) Positive, symmetric and negative skewness
   (b) Relationship among mean, mode and median in a skewed distribution: 3 (mean – median) = (mean – mode)
   (c) Computation of measures of skewness using Karl Pearson's and Bowley's formulae
   (d) Graphical illustration of the concept of skewness and kurtosis
   (e) Comparison of skewness with measures of central tendency and dispersion
   (f) Interpretation of skewness and degree of skewness

C. PROBABILITY AND DISTRIBUTIONS

1. Probability theory

   (a) Basic concepts of probability: event, outcome, sample, sample space and equiprobable
   (b) Classical definition of probability
   (c) Properties of probability theory: (probability limits, total probability and

complimentary probability); types of events (independent, dependent, and mutually exclusive events)

(d) Rules used in probability theory that is addition and multiplication

(e) Conditional probabilities (prior and posterior, including use of probability trees and Bayes' theorem) as methods of computation

(f) Probability frequency distribution and the computation of expected values (expectation)

Note: Application of the knowledge of set theory in probability is assumed.

2. Permutations and combinations

   (a) The factorial notation

   (b) Application of permutations and combinations in probability

3. Probability distribution

   (a) The concept of probability distribution

   (b) Normal distribution – properties and standardisation

   (c) Computation of probabilities using normal distribution tables

   (d) Binomial distribution probability properties and use of binomial formula

   (e) Computation of the mean, variance and standard deviation of a binomial distribution

   (f) Use of binomial distribution tables to find probabilities

   (g) Approximating a binomial distribution to a normal distribution

   (h) Properties and computation of probabilities using poisson distribution

D. ESTIMATION AND HYPOTHESIS TESTING

1. Estimation

   (a) Definition of concepts: estimation, estimator (point estimator and interval estimator), standard error of the mean, and population and sample means

   (b) Confidence limits and intervals

   (c) Estimation of the population mean from a large sample using normal distribution

   (d) Estimation of the mean from a small sample using Student's t distribution

   (e) Use of contingency tables for chi-square distribution

   (f) Estimation of the population proportion from a large sample

2. Hypothesis and significance tests

   (a) Definition of basic concepts used in hypothesis testing: null (Ho) and the alternative (Ha) hypotheses, errors in hypothesis testing (type (I) and type (II) errors), critical (acceptance and rejection) regions, and level of significance

   (b) Methods of testing (normal Z score, Student's t and chi-square)

   (c) Reading values from tables (one tailed and two tailed)

   (d) Computation of the statistic and determination of the level of significance at a particular percentage

   (e) Testing of population mean and population proportion

   (f) Testing goodness of fit, use of contingency tables, and computation of expected values for chi-square test

3. Control charts

   (a) Definition of the concept 'control chart'
   (b) Advantages and disadvantages of control charts
   (c) Drawing control charts
   (d) Interpretation and making conclusions from control charts

E. INDEX NUMBERS

1. Meaning, uses, importance and limitations of index numbers
2. Price and quantity relatives
3. Considerations in the construction of index numbers
4. Types of index numbers: simple and weighted (price and quantity)
5. Computation, comparison and interpretation of Laspeyres and Paasche price and quantity indices
6. Time series relatives: fixed base and chain relatives
7. Published indices: cost of living, consumer, stock and retail indices

F. REGRESSION AND CORRELATION

1. Correlation

   (a) Definition and importance of correlation analysis
   (b) Types of correlation: linear or non-linear, positive, negative, zero and no correlation
   (c) Scatter diagrams
   (d) Methods of calculating coefficient of correlation: product moment (Karl Pearson's) and rank correlation (Spearman's formula).
   (e) Interpretation of correlation co-efficient
   (f) Merits and demerits of each method
   (g) Link between correlation and causation

2. Regression

   (a) Definition of terms: regression, regression equation, regression coefficients
   (b) Distinction between correlation and regression
   (c) Uses of regression line
   (d) Definition of dependent and independent variables
   (e) Regression equation: y on x and x on y
   (f) Calculation of regression equation using least squares method
   (g) Interpretation of regression line and prediction of other values using the line
   Note: This excludes non-linear regression and non-linear correlation.

G. TIME SERIES AND FORECASTING

1. Time series

   (a) Definition of terms: forecasting, time series
   (b) Examples of time series and their uses / importance

(c) Components of time series: secular trend, seasonal variation, cyclic variation and irregular variation
(d) Seasonal adjustment and deflating time series

2. Methods of computing trend

(a) Moving average method and exponential smoothing
(b) Computation of trend by least squares method
(c) Graphical representation of data
(d) Estimation of production or output using a trend line
(e) Limitations and merits of moving averages and least squares methods

3. Forecasting

(a) Steps involved in forecasting
(b) Methods of forecasting: quantitative and qualitative, regression analysis and deseasonalisation method, exponential smoothing, interpolation and extrapolation and their interpretation
(c) Construction and uses of the Z chart

H. LINEAR ALGEBRA AND CALCULUS

1. Algebra

(a) Linear, quadratic and simultaneous equations in 2 or 3 variables
(b) Methods of solving quadratic equations by factorisation, completing the square and use of the quadratic formula
(c) Methods of solving simultaneous equations by elimination, substitution and matrix methods
(d) Formulating equations involving quadratic and simultaneous equations in 2 variables or 3 variables

2. Functions and graphs

(a) Explicit functions in one variable of polynomial nature up to the third degree (i.e. $f(x) = a + bx + cx2+ dx3 +.....$)
(b) Graphical representation of functions

3. Calculus

(a) Geometric interpretation of differentiation
(b) Basic rule of differentiation: $y = x^n$, $\frac{dy}{dx} = nx^{n-1}$
(c) Differentiation methods: sum, difference, chain rule (substitution), product and quotient rule of the functions (including differentiation of fractional and negative indices)
(d) Finding a second derivative
(e) Application of differentiation (or derivatives) in determining maxima and minima values of functions
(f) Definition of terms: cost and marginal cost, revenue and marginal revenue, and profit functions
(g) Application of differentiation in maximization and minimization of revenue, cost

and profit functions in production functions including determination of their values at any given level

Note: This excludes logarithmic differentiation, exponential differentiation, derivatives of parameters, implicit functions and partial differentiation.

I. DECISION THEORY

1. Types of decision making
2. Decision rules and decision trees
3. Computation of expectation or expected values
4. Construction and interpretation of results from decision trees
5. Advantages and disadvantages of decision trees
6. Determination of redundancy

J. LINEAR PROGRAMMING

1. Definition of terms: linear programming problem, objective function, constraints, feasible solution and optimum solution
2. Assumptions applied in linear programming
3. Advantages and limitations of linear programming
4. Formulation of linear programming model
5. Graphical and simplex methods of solving linear programming problems
6. Advantages and disadvantages of graphical and simplex methods
7. Optimisation (maximisation and minimisation) in linear programming
8. Terms associated with simplex method: slack, surplus, shadow prices, primal, dual and tableau
9. Solving primal and dual linear programming problems
10. Interpretation of primal and dual solutions
11. Advantages of the dual method

Note:

(i) This excludes non- linear programming, transportation, assignment and non-linear dynamic programming.

(ii) Basic knowledge of solving simple linear inequalities and interpretation of matrix representation is assumed.

K. NETWORK ANALYSIS

1. Definition of terms: network, activity, event, dummy variable, critical path, float, cost slopes, dangler and lead time
2. Drawing of networks and Gantt charts and their interpretation
3. Advantages and limitations of network analysis
4. Determination of earliest start time (EST), latest start time (LST), and total cost
5. Techniques of network analysis: PERT (program evaluation and review technique) and CPM (critical path method)
6. Crashing of projects, cost analysis
7. Resource and cost scheduling

8. Use of computers in network analysis

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