24.3.4. QUANTITATIVE METHODS

24.3.4.01: INTRODUCTION

This course unit is intended to provide the trainee with the necessary computing skills to enable him/her to use numerical methods to quantify and process data.

24.3.4.02: GENERAL OBJECTIVES
By the end of this course unit, the trainee should be able to:
a) use forecasting tools to analyse systems
b) apply approximation methods in systems design
c) appreciate financial, network planning and simulation techniques in systems design

24.3.4.03: SUBJECT SUMMARY AND TIME ALLOCATION

CODE	TOPIC	SUB-TOPIC	HOURS
24.3.4.1	DATA COLLECTION AND PRESENTATION	• basic for data collection • data classification • data tabulation • diagrammatic and graphical presentation	10
24.3.4.2	MEASURES OF CENTRAL TENDENCY	• definition of measures • properties • calculation and interpretation • data presentation	10
24.3.4.3	MEASURE OF DISPERSION	• characteristics • relative and absolute measures • calculation of measures	12
24.3.4.4	CORRELATION AND REGRESSION	• scatter diagram • correlation • correlation coefficient • coefficient of determination • linear regression models	14
24.3.4.5	TIME SERIES ANALYSIS	• components of time series • time series models • measurement methods • application of time series	20
24.3.4.6	INDEX NUMBERS	• definition of index numbers • types of construction problems • application of index numbers • limitations	12
24.3.4.7	PROBABILITY DISTRIBUTION	• concepts of discrete and continuous variables • discrete distributions • continuous distribution	18
24.3.4.8	NETWORK PLANNING	• introduction • network construction • critical construction • applications	18
24.3.4.9	LINEAR PROGRAMMING (LP)	• models • types of models • LP models requirement • LP models • solutions methods	20

CODE	TOPIC	SUB-TOPIC	HOURS
24.3.4.10	ESTIMATION AND TEST OF HYPOTHESIS	• estimation • types of estimators • sampling distributions • confidence interval and interpretation • hypothesis • types of errors • test statistics and the test	16
24.3.4.11	THE ORYDECISION	• mathematical expectation • expectation and decision	16
24.3.4.12	SIMULATION	• definition • techniques of simulation	18
24.3.4.13	SAMPLING	• introduction • sampling and census • types of sampling and limitations	16
24.3.4.14	FINANCIAL MATHEMATICS	• simple and compound interest • sinking fund • annuities and perpetuities • cash flow generation • mortgages • project appraisal methods • inventory control systems • economic order quantity models • safety stock and re-order level	20

24.3.4.1T DATA COLLECTION AND PRESENTATION

THEORY
24.3.4.1.T0   Specific Objectives
By the end of this topic, the trainee should be able to:
a)   discuss the basic consideration for data collection
b)   classify collected data into various categories
c)   tabulate collected data
d)   diagrammatically and graphically present data

CONTENT
24.3.4.1.T1   Basis for data collection

objective and scope

statistical units

data sources and types

collection methods and their limitations

24.3.4.1.T2   Data classification

classification functions

rule of classification

types of classification

24.3.4.1.T3   Data tabulation

definitions and parts of table

types of tabulations

applications

24.3.4.1.T4   Diagrammatic and graphic presentation

types of construction diagrams

types of construction graphs

interpretation of diagrams and graphs

24.3.4.2T   MEASURES OF CENTRAL TENDENCY

THEORY

24.3.4.2.T0   23.3.2.T0   Specific Objectives

By the end of this topic, the trainee should be able to:

a)   define measures of central tendency

b)   state the properties of the measures of central tendency

c)   determine the measures of central tendency

CONTENT

24.3.4.2.T1   Definition of measures of central tendency

24.3.4.2.T2   Properties of the measures of the central tendency

24.3.4.2.T3   Calculation and interpretation

mean

mode

medium

24.3.4.3T   MEASURES OF DISPERSION

THEORY

24.3.4.3.T0   Specific Objectives

By the end of this topic, the trainee should be able to:

a)   state the characteristics of a good measure of dispersion

b)   differentiate between the absolute and relative measures

c) calculate and interpret the measures of dispersion

CONTENT

24.3.4.3.T1 Characteristic

24.3.4.3.T2 Relative and absolute measures

 definition

 merits and demerits

24.3.4.3.T3 Calculation of measures of dispersion

 range

 mean deviation

 quartile, decile, percentiles, etc

 standard deviation

 skewness and curtosis

24.3.4.4T   CORRELATION AND REGRESSION

THEORY

24.3.4.4.T0   **Specific Objectives**

By the end of this topic, the trainee should be able to:

a) define terms related to correlation

b) compute parameters related to correlation

c) compute coefficient to determinants

d) explain independent and dependent variables

e) draw scatter diagrams

f) draw the line of beat fit by free hand method

g) explain the term regression line

h) differentiate between mathematical model and regression model

CONTENT

24.3.4.4.T1   Computation of parameters related to correlation

 product moment

 rank correlation

 coefficient of determination

24.3.4.4.T2   Interpretation of values of correlation coefficient

24.3.4.4.T3   Explanation of terms

 independent variables

 dependent variables

24.3.4.4.T4   Drawing scatter diagrams

24.3.4.4.T5   Drawing line of best fir

24.3.4.4.T6   Explanation of regression line

24.3.4.4.T7   Distinction between mathematical model and regression model

24.3.4.4.T8   Principles of least square method

24.3.4.4.T9   Determining normal equations

24.3.4.4.T10   Solving normal equations to obtain the regression equation

24.3.4.4.T11   Using regression equation of forest

24.3.4.4.T12   Assumptions made in linear regression
> linearity between x and y
> standard deviation of error term is constant and same for all values of x
> distribution of error is normal

24.3.4.5T   TIME SERIES

THEORY

24.3.4.5.T0   **Specific Objectives**
By the end of this topic, the trainee should be able to:
a) describe the characteristic of time series
b) describe the components of a time series
c) distinguish between the two different models
d) decompose the time series into its components
e) extrapolate past the future values using the trend
f) interpolate values using trend

CONTENT

24.3.4.5.T1   Description of time series
> definition
> characteristics
> time period

24.3.4.5.T2   Description of components
> trend
> cyclic variations
> seasonal variations
> random variations

24.3.4.5.T3   Models
> trends

-   semi average
-   centered moving average
-   mathematical model (least squares method)
-   free hand fitting

Seasonal – moving averages

$(R-Y) = -(T+C+S)$

24.3.4.5.T4 Extrapolation of past and future values

24.3.4.5.T5 Interpolation of values

24.3.4.6T   INDEX NUMBERS

THEORY

24.3.4.6.T0   Specific Objectives

By the end of this topic, the trainee should be able to:

a) define index numbers

b) explain advantages and disadvantages of different types of index numbers

c) state the uses of index numbers

d) choose a representative base period

e) explain how weighting are calculated

f) construct index numbers

CONTENT

24.3.4.6.T1 Definition of index numbers

24.3.4.6.T2 Definition of basic terms

price index

quantity index

paasche index number

laspayres index numbers

weighted index numbers

base period

current period

weights

time reversal and chaining

24.3.4.6.T3 Advantages and disadvantages of different types of index numbers

paasche

laspayres

weighted index numbers

24.3.4.6.T4   Uses of index numbers

24.3.4.6.T5   Choice of base period

24.3.4.6.T6   Calculation of weightings

> weightings of price
> weightings for individual commodities
> weightings for quantities

24.3.4.6.T7   Construction of indices

24.3.4.7T   PROBABILITY DISTRIBUTIONS

THEORY

24.3.4.7.T0   Specific Objectives

By the end of the topic, the trainee should be able to
a)   differentiate between discrete and continuous variables
b)   explain discrete probability distributions
c)   apply discrete probability distributions to problems
d)   explain continuous variables
e)   apply continuous probability distributions to problems

CONTENT

24.3.4.7.T1   Discrete and continuous variables

24.3.4.7.T2   Discrete probability distributions

24.3.4.7.T3   Application of discrete probability distribution to solve problems

> binomial
> poisson

24.3.4.7.T4   Continuous probability distribution to solve problems

> normal probability
> analysing measurements that follow natural laws
> binomial probability approximation
> problems involving confidence level and interval

24.3.4.8T   NETWORK PLANNING

THEORY

24.3.4.8.T0   Specific Objectives

By the end of this topic, the trainee should be able to:

a)   explain network planning
b)   explain importance of network planning
c)   explain the uses of network planning
d)   explain terms associated with network planning
e)   state the rules of drawing network
f)   draw a network
g)   identify critical path]
h)   find the minimum time required to complete project.

CONTENT

24.3.4.8.T1   Network planning

24.3.4.8.T2   Importance of network planning

24.3.4.8.T3   Uses of network planning

24.3.4.8.T4   Terms associated with network planning
      node
      activity
      preceding time
      succeeding time
      PERT
      most likely time
      optimistic time
      pessimistic time

24.3.4.8.T5   Rules of drawing a network
      dangling
      looping
      dummy variables

24.3.4.8.T6   Drawing a network
      node
      activity
      starting point
      ending point

24.3.4.8.T7   Critical path
      forward pass
      backward pass
      optimistic time
      pessimistic time
      most likely time

24.3.4.8.T8   Minimum time required to complete a project

   mean time required to complete a project

   standard deviation of the time required to complete the project

24.3.4.9T   LINEAR PROGRAMMING

THEORY
24.3.4.9.T0   **23.3.9.T0**   **Specific Objectives**

By the end of this topic, the trainee should be able to:

a)   explain linear programming

b)   explain the constraints in linear programming

c)   state linear programming assumption

d)   explain limitations of linear programming

e)   outline the objectives of linear programming

f)   use simplex method to solve linear programming problems

g)   state when to use graphical methods

h)   apply graphical methods to solve problems

CONTENT

24.3.4.9.T1   Constraints which limit the achievement of objectives

   policy

   finance

   market

   availability of resources

24.3.4.9.T2   Statement of linear programming assumptions

   linearity

   divisibility

   additivity

   single objectives

   simple cost function

   external cost function

   certainty

24.3.4.9.T3   Limitations of linear programming

24.3.4.9.T4   Objectives of linear programming

   maximization of profit

   minimization of costs

make optimal use of resources

24.3.4.9.T5   Using simplex method to solve linear programming problems

24.3.4.9.T6   When to use graphical method

only w variables are involved

2 or more constraints operating

24.3.4.9.T7   Use graphical method to solve problems

24.3.4.10T ESTIMATION AND TEST OF HYPOTHESIS

THEORY
24.3.4.10.T0   Specific Objectives

By the end of this topic, the trainee should be able to:

a)   define estimation

b)   differentiate between the two types of estimation

c)   determine the sampling distribution of a statistic

d)   determine the confidence interval for a parameter

e)   design a simple hypothesis testing

f)   define errors in hypothesis testing

g)   test various hypothesis

CONTENT

24.3.4.10.T1   Estimation

definition

need for estimation

24.3.4.10.T2   Types of estimators

point estimators

interval estimators

24.3.4.10.T3   Sampling distribution

central limit problems

x and 6 distribution

distribution of difference between means (x) and between proportions (A/P)

24.3.4.10.T4   Confidence interval and interpretations

24.3.4.10.T5   Hypothesis

definitions

design and rules

types

24.3.4.10.T6 Types of errors

type I errors

type II errors

24.3.4.10.T7 Test statistics and the test

24.3.4.11T DECISION

THEORY

24.3.4.11.T0 Specific Objectives

By the end of this topic, the trainee should be able to:

a) define mathematical expectation

b) calculate mathematical expectation

c) state bayer's rule

d) construct pay-off table

e) state maxima rule

f) solve decision-tree problems

CONTENT

24.3.4.11.T1 Definition of mathematical expectation

24.3.4.11.T2 Calculation of mathematical expectation

24.3.4.11.T3 Statement of Bayer's rule

24.3.4.11.T4 Construction of pay-off table

24.3.4.11.T5 Statement of maxima rule

24.3.4.11.T6 Solution of decision tree problem

24.3.4.12T SIMULATION

THEORY

24.3.4.12.T0 Specific Objectives

By the end of this topic, the trainee should be able to:

a) explain simulation

b) explain types of simulation

c) solve problems using simulation techniques

CONTENT

24.3.4.12.T1 Meaning of simulation

24.3.4.12.T2 Types of simulation

physical

mathematical

deterministic

probabilistic

Monte Carlo

24.3.4.12.T3   Problems solving using simulation

random numbers

generation of random numbers

Monte-Carlo simulation technique

24.3.4.13T SAMPLING

THEORY

24.3.4.13.T0 Specific Objectives

By the end of this topic, the trainee should be able to:

a)   define the terms used in sampling

b)   explain the concept of sampling distribution

c)   calculate standard error

d)   relate the mean and SD of sampling distribution of mean t mean and SD of the parent distribution

e)   determine the unbiased estimate of the population mean and variance from the sample data

CONTENT

24.3.4.13.T1   Definition of terms

random sampling

sampling with replacement

population

samples

sampling distributions

24.3.4.13.T2   Explanation of the concepts of sampling distribution

24.3.4.13.T3   Calculation of standard errors

24.3.4.13.T4   Relationship between mean and SD of the sampling distribution of the mean and the SD of the parent distribution.

24.3.4.13.T5   Recognition that the distributions of the sample mean of normal distribution is normal distribution.

24.3.4.13.T6   Determination of population mean and SD from sample data

when sample size is large

when sample size is small

24.3.4.14T FINANCIAL MATHEMATICS

THEORY

24.3.4.14.T0 Specific Objectives

By the end of this topic, the trainee should be able to:

a) Explain simple and compound interest

b) explain the concepts of sinking fund

c) calculate the value of annuity

d) use annuity table

e) define terms used in relation with present values

f) use discount factor table

g) calculate present value

h) explain terms used in relation with annuities

i) calculate present value of annuity

j) use present value of annuity table for calculation

k) define inventory

l) describe the control system

m) calculate economic order quantity (EOQ)

n) determine safety stock (SS) and re-order level

CONTENT

24.3.4.14.T1   Simple and compound interest

24.3.4.14.T2   Concepts of sinking fund

24.3.4.14.T3   Future value of annuity

24.3.4.14.T4   Use of annuity table

24.3.4.14.T5   Terms used in relation with present value

Present value

discounting

discount tree

discount rate

discounting factor

24.3.4.14.T6   Cash flow generation using discounting factor table

24.3.4.14.T7   Calculation of present value

24.3.4.14.T8   Inventory and control systems

re-order control systems

periodic systems

ABC systems

MRP

24.3.4.14.T9   Economic order quantity (E)Q) model
         without discount
         with discount
         limitations

24.3.4.14.T10   Safety stock and re-order level

TEACHING/LEARNING RESOURCES
     Whiteboard
     Relevant text books and free e-books
     Content from www
     Resource person
     charts

ASSESSMENT MODE
     Written Tests
     Oral test