Master of Business Administration (First Semester) Examination, 2014
Paper : Second
QUANTITATIVE METHODS
Time Allowed : Three Hours
Maximum Marks : 70
Minimum Pass Marks : 28
Note: Attempt both the sections as directed.

Note: Attempt all the questions. This section contains *Ten* short answer type questions having 2 Marks each.

Section – A

(10x2 = 20 Marks)

1. CONCURRENT DEVIATION METHOD

The method of studying correlation is the simplest of all the methods. The only thing that is required under this method is to find out the direction of change of X variable and Y variable. The formula applicable is:

$r_c = \pm\sqrt{\pm (2C-n)/n}$

Where rc stands for coefficient of correlation by the concurrent deviation method; C stands for the number of concurrent deviations or the number of positive signs obtained after multiplying

Dx with Dy; n = Number of pairs of observations compared.

Steps are as follows:

(i) Find out the direction of change of X variable, i.e., as compared with the first value, whether the second value is increasing or decreasing or is constant. If it is increasing put (+) sign; if it is decreasing put (-) sign (minus) and if it is constant put zero. Similarly, as compared to second value find out whether the third value is increasing, decreasing or constant. Repeat the same process for other values. Denote this column by D_x.

(ii) In the same manner as discussed above find out the direction of change of Y variable and denote this column by D_y

(iii) Multiply D_x with D_y, and determine the value of c, i.e., the number of positive signs.

(iv) Apply the above formula, i.e.,

$r_c = \pm\sqrt{\pm (2C-n)/n}$

2. A graphical representation is a visual display of data and statistical results. It is often more effective than presenting data in tabular form. There are many different types of

graphical representation and which is used depends on the nature of the data and the type of statistical results.

    a. Pie chart: An appropriate graphical representation of category frequencies is a pie chart, where each slice represents a different category and slice angles are proportional to the frequencies of the categories.

    b. Bar chart: Another graphical method used for category frequencies is a bar chart, where each bar represents a different category and the heights of the bars are proportional to the frequencies of the categories.

    c. Histogram and Frequency Polygram: For frequency distribution of continuous quantitative data convenient graphs are a histogram, frequency polygon, and/or. Some other common and suitable graphical representations are Stem-and-leaf plot, Ogive Curve, Lorenz Curve, Line Chart etc.

3. A problem can be realistically represented as a linear program if the following assumptions hold:

    a. The constraints and objective function are linear.

    b. This requires that the value of the objective function and the response of each resource expressed by the constraints is proportional to the level of each activity expressed in the variables.

    c. Linearity also requires that the effects of the value of each variable on the values of the objective function and the constraints are additive. In other words, there can be no interactions between the effects of different activities; i.e., the level of activity X_1 should not affect the costs or benefits associated with the level of activity X_2.

    d. Divisibility -- the values of decision variables can be fractions. Sometimes these values only make sense if they are integers; then we need an extension of linear programming called integer programming.

    e. Certainty -- the model assumes that the responses to the values of the variables are exactly equal to the responses represented by the coefficients.

    f. Data -- formulating a linear program to solve a problem assumes that data are available to specify the problem.

    g. Non-negativity requirements as resources can't hold negative values.

4. Histogram based on data given below

Variable	Frequency
5 --10	15
10--15	25
15-20	30
20-25	35
25-30	50
30-35	40
35-40	10
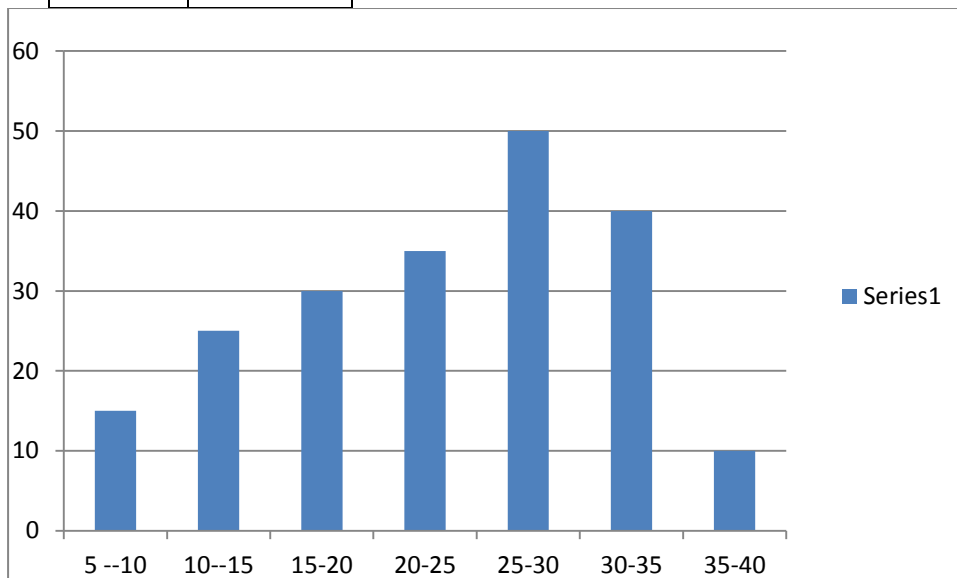
5. A distribution in which the values of mean, median and mode coincide (i.e. mean = median = mode) is known as a symmetrical distribution. Conversely, when values of mean, median and mode are not equal the distribution is known as asymmetrical or skewed distribution. In moderately skewed or asymmetrical distribution a very important relationship exists among these three measures of central tendency. In such distributions the distance between the mean and median is about one-third of the distance between the mean and mode, Karl Pearson expressed this relationship as:

Mode = mean - 3 [mean - median]

Mode = 3 median - 2 mean

6. In linear algebra, the **determinant** is a value associated with a square matrix. It can be computed from the entries of the matrix by a specific arithmetic expression, while other ways to determine its value exist as well. The determinant provides important information about a matrix of coefficients of a system of linear equations, or about a

matrix that corresponds to a linear transformation of a vector space. The determinant of a matrix A is denoted det(A), det A, or $|A|$.[1] In the case where the matrix entries are written out in full, the determinant is denoted by surrounding the matrix entries by vertical bars instead of the brackets or parentheses of the matrix. For instance, the determinant of the matrix

$$\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$$

is written as

$$\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix}$$

and has the value

$$(aei + bfg + cdh) - (ceg + bdi + afh).$$

Properties of determinants:

(i.) A multiple of one row of "A" is added to another row to produce a matrix, "B",
Then: $|\mathbf{A}| = |\mathbf{B}|$.

(ii.) If two rows are interchanged to produce a matrix, "B", then: $|\mathbf{B}| = -|\mathbf{A}|$.

(iii.) If one row is multiplied by "k" to produce a matrix, "B", then: $|\mathbf{B}| = \mathbf{k} \cdot |\mathbf{A}|$.

(iv.) If "A" and "B" are both n x n matrices then: $|\mathbf{A} \cdot \mathbf{B}| = |\mathbf{A}| \cdot |\mathbf{B}|$.

(v.) $|\mathbf{A^T}| = |\mathbf{A}|$.

7. Probability Distribution

A probability distribution is a statistical model that shows the possible outcomes of a particular event or course of action as well as the statistical likelihood of each event. For example, a company might have a probability distribution for the change in sales given a particular marketing campaign. The values on the "tails" or the left and right

end of the distribution are much less likely to occur than those in the middle of the curve.

Importance of Probability distribution

    a. Scenario Analysis: Probability distributions can be used to create scenario analyses. A scenario analysis uses probability distributions to create several, theoretically distinct possibilities for the outcome of a particular course of action or future event. For example, a business might create three scenarios: worst-case, likely and best-case.

    b. Sales Forecasting: One practical use for probability distributions and scenario analysis in business is to predict future levels of sales. It is essentially impossible to predict the precise value of a future sales level; however, businesses still need to be able to plan for future events.

    c. Risk Evaluation: In addition to predicting future sales levels, probability distribution can be a useful tool for evaluating risk.

    d. Replacement Planning : Replacement of machines can be planned through probability distribution

    Similarly many other applications can be sighted by students.

8. To make decisions about everything from hiring to manufacturing volume, businesses must engage in some level of forecasting. The area where most businesses employ forecasting is sales. Forecasts, however, are made in a gray area that lacks certainty. The absence of certainty stems from a number of factors that affect forecasts for which the business cannot account or from problems with the available data.

Two important bases for forecasting are:

    a. Historical data

    b. Suitable mathematical model for forecasting

9. **Periodic function** is a function that repeats its values in regular intervals or periods. The most important examples are the trigonometric functions, which repeat over intervals of 2π radians. Periodic functions are used throughout science to describe oscillations, waves, and other phenomena that exhibit periodicity. In business administration product life cycle, business cycle are common example of periodic functions.

10. 10. Number of ways taking 5 flags out of 8-flags = 8P5

= 8!/(8-5)!

= 8 x 7 x 6 x 5 x 4 = 6720

Note: Attempt any five questions. This section contains *Eight* long- answer type questions carrying 10 marks each. (5x10=50 Marks).

2. **Solution:** Let us start ranking from the lowest value or both the variables, as shown below:

Debenture Price (x)	R_1	Share Price (y)	R_2	$d = R_1 = R_2$	$d^2 = (R_1 = R_2)^2$
97.8	3	73.2	1	2	4
99.2	7	85.8	6	1	1
98.8	6	78.9	4	2	4
98.3	4	75.8	2	2	4
98.4	5	77.2	3	2	4
96.7	1	87.2	7	-6	36
97.1	2	83.8	5	-3	9
					$\sum d^2 = 62$

Applying the formula

$$R = 1 - \frac{6\sum d^2}{n^3 - n} = 1 - \frac{6 \times 62}{(7)^3 - 7}$$

$$= 1 - (372/336)$$

$$= 1 - 1.107 = -0.107$$

3. Regression equation and desires estimations are as follows:

Height of Father(inch) (X)	x =X − 68.25	X^2	Height of Son(inch)	y=Y- 68.5	Y^2	xy
65	-3.25	10.5625	67	-1.5	2.25	4.875
66	-2.25	5.0625	68	-0.5	0.25	1.125
67	-1.25	1.5625	64	-4.5	20.25	5.625
67	-1.25	1.5625	68	-0.5	0.25	0.625
68	-0.25	0.0625	72	3.5	12.25	-0.875
69	0.75	0.5625	70	1.5	2.25	1.125
71	2.75	7.5625	69	0.5	0.25	1.375
73	4.75	22.5625	70	1.5	2.25	7.125
Sum 546	**0**	**49.5**	**548**	**0**	**40**	**21**

Mean X = 68.25 and Mean Y = 68.5

Regression equation of Y on X is

$Y - \bar{Y} = $ byx $(X - \bar{X})$

$b_{yx} = \sum xy/\sum x^2 = 21/49.5 = 0.42$

Y − 68.5 = 0.42X − 28.7

Y = 39.8 + 0.42X

For X (father height) = 67.5 Y (Avg. expected height of son) will be 68.15

Regression equation of X on Y is

$X - \bar{X}) = $ bxy$(Y - \bar{Y})$

$b_{xy} = \sum xy/\sum y^2 = 21/40 = 0.52$

X − 68.25 = 0.52Y − 35.62

X = 32.63 + 0.52Y

For Y (son height) = 73.5 the value of X (Avg. expected height of father) will be 70.85

4. In probability theory and statistics, the **binomial distribution** with parameters n and p is the discrete probability distribution of the number of successes in a sequence of n independent yes/no experiments, each of which yields success with probability p. A success/failure experiment is also called a Bernoulli experiment or Bernoulli trial; when $n =$

1, the binomial distribution is a Bernoulli distribution. The binomial distribution is the basis for the popular binomial test of statistical significance.

The binomial distribution is frequently used to model the number of successes in a sample of size n drawn with replacement from a population of size N. If the sampling is carried out without replacement, the draws are not independent and so the resulting distribution is a hypergeometric distribution, not a binomial one. However, for N much larger than n, the binomial distribution is a good approximation, and widely used.

Hence an example of binomial distribution is as follows

Suppose we have $n = 40$ patients who will be receiving an experimental therapy which is believed to be better than current treatments which historically have had a 5-year survival rate of 20%, i.e. the probability of 5-year survival is $p = .20$. Thus the number of patients out of 40 in our study surviving at least 5 years has a binomial distribution, i.e. $X \sim BIN(40,.20)$.

5. SYSTAT is a powerful statistical analysis and graphics software. Simplify your research and enhance your publications with SYSTAT's comprehensive suite of statistical functions and brilliant 2D and 3D charts and graphs. In 1995 SYSTAT was sold to SPSS Inc., who marketed the product to a scientific audience under the SPSS Science division. By 2002, SPSS had changed its focus to business analytics and decided to sell SYSTAT to Cranes Software in Bangalore, India. Cranes formed Systat Software, Inc. to market and distribute SYSTAT in the US, and a number of other divisions for global distribution. The headquarters are in Chicago, Illinois.

By 2005, SYSTAT was in its eleventh version having a revamped codebase completely changed from Fortran into C++. Version 13 came out in 2009, with improvements in the user interface and several new features.

Major functions of SYSTAT

- ARCH and GARCH for Time Series
- Best Subsets Regression
- Confirmatory Factor Analysis
- New data editor, gives faster computation
- NEW SYSTAT 13 with Exact Tests Product

Major Elements of SYSTAT

File menu, Analysis, Data Sheet, Variable view, Help are major components of SYSTAT.

6. Regression equation of X and Y as per data given below.

X	(deviation from mean)x	x^2	(deviation from mean)Y	y	y^2	xy
1	-2	4	6	4	16	-8
5	2	4	1	-1	1	-2
3	0	0	0	-2	4	0
2	-1	1	0	-2	4	2
1	-2	4	1	-1	1	2
2	-1	1	2	0	0	0
7	4	16	1	-1	1	-4
3	0	0	5	3	9	0
SUM 24	0	30	16	0	36	-10
Mean of X			Mean of Y			
3			2			

.

Mean X = 3 and Mean Y = 2

Regression equation of Y on X is

$Y - \bar{Y} = $ byx $(X - \bar{X})$

$b_{yx} = \sum xy/\sum x^2 $ = -10/30 = -0.33

Y – 2 = -0.33X + 0.99

Y = 2.99 - 0.33X

Regression equation of X on Y is

$X - \bar{X}) = $ bxy$(Y - \bar{Y})$

$b_{xy} = \sum xy/\sum y^2 $ = -10/36 = -0.28

X – 3 = -0.28Y + 0.56

X = 3.56 - 0.28Y

7. Matrix A $\begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$

Inverse of Matrix A = **Solution:-**

$$A = \begin{vmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{vmatrix}$$

$$|A| = \begin{vmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{vmatrix}$$

|A| = 3 (-3+4) + 3(2-0) + 4 (-2+0)

$= 3 + 6 - 8$

|A| = 1

The co-factors of element of various row of |A| are

$$\begin{vmatrix} A_1 & A_2 & A_3 \\ B_1 & B_2 & B_3 \\ C_1 & C_2 & C_3 \end{vmatrix} = \begin{vmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{vmatrix}$$

$A_1 = b_2c_3 - b_3c_2 = -3 + 4 = 1$

$A_2 = -(2-0) = -2$

$A_3 = -2$

$B_1 = -(a_2c_3 - b_3c_2) = -(-3+4) = -1$

$B_2 = (a_1c_3 - a_3c_1) = 3 - 0 = 3$

$B_3 = (a_1c_2 - a_2c_1) = -(-3-0) = 3$

$C_1 = (c_2b_3 - a_3b_2) = (-12 + 12) = 0$

$C_2 = -(a_1b_3 - a_3b_1) = -(12 - 8) = -4$

$C_3 = (a_1b_2 - a_2b_1) = (-9 + 6) = -3$

$$\begin{vmatrix} 1 & -2 & -2 \\ -1 & 3 & 3 \\ 0 & -4 & -3 \end{vmatrix}$$

Therefore the matrix formed by the co- factor of **|A|** is:

$$\begin{vmatrix} 1 & -2 & -2 \\ -1 & 3 & 3 \\ 0 & -4 & -3 \end{vmatrix}, \quad \text{Adj A} = \begin{vmatrix} 1 & -1 & 0 \\ -2 & 3 & -4 \\ -2 & 3 & -3 \end{vmatrix}$$

A^{-1} = 1/ |A| X (Adj. A)

$$= 1 \text{ X} \begin{vmatrix} 1 & -1 & 0 \\ -2 & 3 & -4 \\ -2 & 3 & -4 \end{vmatrix}$$

Inverse A (A^{-1}) = $\begin{vmatrix} 1 & -1 & 0 \\ -2 & 3 & -4 \\ -2 & 3 & -3 \end{vmatrix}$

8. Standard deviation of data given is as follows:

X	f	MV	d=(x-115)/10	d^2	fd	fd^2
70-80	12	75	-4	16	-48	192
80-90	18	85	-3	9	-54	162
90-100	35	95	-2	4	-70	140
100-110	42	105	-1	1	-42	42
110-120	50	115	0	0	0	0
120-130	45	125	1	1	45	45
130-140	20	135	2	4	40	80
140-150	8	145	3	9	24	72
	N =230				$\sum$ fd =-105	$\sum fd^2$= 733

Standard deviation $(\sigma) = \sqrt{\frac{\sum \text{fd}^2}{N} - \left(\frac{\sum fd}{N}\right)^2} \ X \ i$

Standard deviation $(\sigma) = \sqrt{\frac{733}{230} - \left(\frac{-105}{230}\right)^2} \ X \ 10$

$\sigma = \sqrt{3.19 - 0.21} \ X \ 10 \ = 1.73 \ X \ 10 = 17.3$

9. Explain any two of the following:

(i). some managerial applications functions are:

    1. Profit (P) = Revenue - Cost

    2. Revenue (R): The amount a company receives from sales. Revenue = (Price per unit)×(# of units)

    3. Cost (C) such as, fixed cost (FC) - stays constant regardless of the # of units produced. Ex. rent, utilities. Variable cost (VC) - changes depending on the # of units produced. Cost = FC+VC

    4. Marginal profit (MP): the slope of the profit function = rate of change in profit with respect to the number of units produced and sold.

5. Marginal cost (MC): the slope of the cost function.

6. Marginal revenue (MR): the slope of the revenue function.

7. A firm's breakeven point occurs when P (x) = 0, or when R(x) = C(x).

Examples:

1. Total Cost, Revenue, and Profit- The profit a firm makes in a product is the difference between the revenue (amount received in sales) and its costs (amount spent by firm to produce the product). If x units are produced and sold, it is written: P(x) = R(x)-C(x)

Where: P(x) = profit from x sale of units; R(x) = total revenue from sale of x units; C(x) = total cost of production and sale of x units. Examples of fixed costs include depreciation, rent, utilities, and so on. Variable costs, VC, are those directly related to the number of units produced. Thus, the total cost is found by using the equation: C= FC + VC.

(ii) Some illustrations of business applications of forecasting are as follows:

1. A telephone company may use forecast to customers equipment purchase enabling it to cut cost and improve profitability

2. A gas company may use exponential smoothing model to forecast future demand and overcome issues of over or under production eliminating shortage and wastage.

3. Banks may use exponential smoothing to forecast loan demand.

4. Car manufacturing company may forecast demand of various models hence optimizing the resources.

5. A hospital can use forecast to depute pathologist based on forecast of blood tests.

(iii). Utility of Time series in studying managerial problems

1. It helps in understanding the past behavior

2. Helps in planning future behaviors

3. It helps in evaluating current achievements and accomplishments

4. It facilitates comparisons.

(iv) Application of arithmetic and geometric progression:

1. Manage volatility in investment: Geometric progression lowers volatility in investment returns. Arithmetic and geometric averages serve different purposes and only geometric averages will accurately reflect compounded investment returns. Arithmetic averages will always over state investment returns unless there is zero volatility. The greater the volatility the greater the difference will be between arithmetic and geometric averages. When it comes to investment returns and retirement planning it is compounded (geometric) averages that matter.

2. Retirement planning is another important area of application of geometric progression. Following example explains the role of AP and GP

   Arithmetic Average of a firm Total Returns in period 2000 – 2012 is:

   (-9.2) + (-11.9) + (-22.1) + 28.7 + 10.9 + 4.9 +15.8 + 5.5 + (-37.0) + 26.5 + 15.1 + 2.1 + 15.8) / 13 = 4.89%

   Geometric Average Total Returns (2000 – 2012):

   [.908 x .881 x .779 x 1.287 x 1.109 x 1.049 x 1.158 x 1.055 x .63 x 1.265 x 1.151 x 1.021 x 1.158) ^(1/13)] – 1 = 1.64%

   Some problems that could be solved through AP and GP are:

   a. In investigating different job opportunities, you find that firm A will start you at $25,000 per year and guarantee you a raise of $1,200 each year while firm B will start you at $28,000 per year but will guarantee you a raise of only $800 each year. Over a period of 15 years, how much would you receive from each firm?

   b. In investigating different job opportunities, you find that firm A will start you at $25,000 per year and guarantee you a raise of $1,200 each year while firm B will start you at $28,000 per year but will guarantee you a raise of only $800 each year. Over a period of 15 years, how much would you receive from each firm?

   c. In investigating different job opportunities, you find that firm A will start you at $25,000 per year and guarantee you a raise of $1,200 each year while firm B will start you at $28,000 per year but will guarantee you a raise of only $800 each year. Over a period of 15 years, how much would you receive from each firm?