Q.6 i. Discuss the essential elements of decision-making problem. **4**

ii. Following is a payoff table in terms of cost: **6**

Acts	State of nature			
	S_1	S_2	S_3	S_4
A_1	16	20	25	19
A_2	11	15	16	12
A_3	8	11	11	7
A_4	9	13	22	15

Find the optimal action using Minimax criterion and Laplace criterion.

OR iii. Explain following rules under the condition of risk- **6**

(a) Expected Monetary Values (EMV)

(b) Expected Opportunity Loss (EOL)

(c) Expected Value of Perfect Information (EVPI)

******

Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Management Studies

End Sem (Odd) Examination Dec-2022

MS3CO10 Quantitative Techniques

Programme: BBA Branch/Specialisation: Management

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. The method of moving average is used to find- **1**

(a) Secular trend (b) Seasonal variance

(c) Cycle variance (d) Irregular variance

ii. In a straight-line equation Y = a + bX; a is the- **1**

(a) X-intercept (b) Slope

(c) Y-intercept (d) None of these

iii. Index number is also called- **1**

(a) Economic barometer (b) Economic parameter

(c) Constant (d) None of these

iv. Which index number is called as ideal index number? **1**

(a) Lasperys (b) Paasches (c) Fisher (d) None of these

v. In a single throw of two dice, the probability of getting a total of 2 or 4 is- **1**

(a) 2/9 (b) 2/3 (c) 1/9 (d) 1/3

vi. A table with all possible value of a random variable and its corresponding probabilities is called- **1**

(a) Probability mass function

(b) Probability density function

(c) Cumulative distribution function

(d) Probability distribution

vii. If the assumed hypothesis is tested for rejection considering it to be true is called- **1**

(a) Null hypothesis (b) Statistical hypothesis

(c) Simple hypothesis (d) Composite hypothesis

P.T.O.

viii. A hypothesis which defines the population distribution is called- **1**

(a) Null hypothesis (b) Statistical hypothesis
(c) Simple hypothesis (d) Composite hypothesis

ix. The minimum expected opportunity loss (EOL) is- **1**

(a) Equal to EVPI (b) Minimum regret
(c) Both (a) and (b) (d) Equal to EMV

x. Which of the following criterion is not applicable to decision-making under risk? **1**

(a) Maximize expected return
(b) Maximize return
(c) Minimize expect regret
(d) Knowledge of likelihood occurrence of each state of nature

Q.2 i. What is trend? How would you find out the trend value by the method of least squares? **4**

ii. Calculate trend by using 3 yearly moving average in the following time series- **6**

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Price	11	12	9	8	14	15	18	16	17	19	21	24	28	30

OR iii. Fit a straight-line trend by method of least square and calculate the expected demand for the year 2024: **6**

Year	2011	2012	2013	2014	2015	2016
Demand	200	250	275	340	410	500

Q.3 i. What is index number? Write important characteristics of index numbers. **4**

ii. From the following data compute price index number for the year 2014 taking 2013 as the base year using simple aggregative method: **6**

Commodity	Prices (Rs) in the year 2013	Prices (Rs) in the year 2014
A	1	5
B	2	4
C	3	3
D	4	2

OR iii. Construct the consumer price index number for the year 2012 on the basis of 2010 from the following data: **6**

Commodities	Rice	Wheat	Pulses	Butter	Oil
Weights	40	20	15	20	5
Price (per unit in Rs) 2010	16	40	0.5	5.12	2
Price (per unit in Rs) 2012	20	60	0.5	6.25	1.5

Q.4 Attempt any two:

i. A bag contains 10 white and 6 black balls, 4 balls are drawn out successively and not replaced. What is the probability that they are alternately of different colours? **5**

ii. If on an average, out of 10 ships, one is drowned, then what is the probability that out of 25 ships at least 4 reach safely? **5**

iii. Find the probability that at most 5 defective fuses will be found in a box of 200 fuses. If experience shows that 2 percent of such fuses are defective. (Given $e^{-4} = 0.0183$) **5**

Q.5 i. What is the difference between population and sample? **4**

ii. Two random samples were drawn from two normal populations and their values are: **6**

A	65	66	73	80	82	84	88	90	92		
B	64	66	74	78	82	85	87	92	93	95	97

Test whether the two populations have the same variance at the 5% level of significance. (Given F=3.36 at 5% level for $\nu_1=10$ and $\nu_2=8$.)

OR iii. To test the significance of variation in the retail prices of a commodity in three principal cities, Mumbai, Kolkata, and Delhi, four shops were chosen at random in each city and the prices who lack confidence in their mathematical ability observed in rupees were as follows: **6**

Kanpur	15	7	11	13
Lucknow	14	10	10	6
Delhi	4	10	8	8

Do the data indicate that the price in the three cities are significantly different?

End Sem Exam 2022 Solution | Marks

Course Name - Quantitative Techniques

Course Code - MS3C010

Q.1 MCQ

Ans(i)	(a)	Secular Trend	+1
Ans(ii)	(c)	Y- intercept	+1
Ans(iii)	(a)	Economic barometer	+1
Ans(iv)	(c)	Fisher	+1
Ans(v)	(c)	1/9	+1
Ans(vi)	(d)	Probability Distribution	+1
Ans(vii)	(a)	Null Hypothesis	+1
Ans(viii)	(c)	Simple hypothesis	+1
Ans(ix)	(d)	Both (a) and (b)	+1
Ans(X)	(b)	Maximize Return	+1

Q.2 (i) Trend is a pattern in data that shows the movement of a series to relatively higher or lower values over a long period of time. +2

Using normal eqns, we can find out the unknown ~~constants~~ parameter 'a' ~~and 'b'~~ basid on these parameters we can set trend and putting values of independent variable, we get the corresponding value of dependent variable which are called trend value or predictable values. +2

Ans (ii)

Marks

Year	Price	3 year moving total	3 Yearly moving average
1	11		
2	12	→ 32	32 ÷ 3 = 10.67
3	9	29	29 ÷ 3 = 9.67
4	8	31	31 ÷ 3 = 10.33
5	14	37	37 ÷ 3 = 12.33
6	15	47	47 ÷ 3 = 15.67
7	18	49	49 ÷ 3 = 16.33
8	16	51	51 ÷ 3 = 17
9	17	52	52 ÷ 3 = 17.33
10	19	57	57 ÷ 3 = 19
11	21	64	64 ÷ 3 = 21.33
12	24	73	73 ÷ 3 = 24.33
13	28	82	82 ÷ 3 = 27.33
14	30		

+6

Ans (iii)

Year	Demand	Deviation $t - 2013\frac{1}{2}$	(x) Deviation multiply by 2	x^2	xy
2011	200	-2.5	-5	25	-1000
2012	250	-1.5	-3	9	-750
2013	275	-0.5	-1	1	-275
2014	340	0.5	1	1	340
2015	410	1.5	3	9	1230
2016	500	2.5	5	25	2500
	$\Sigma y = 1975$		$\Sigma x = 0$		

+2

$\Sigma x^2 = 70$

$\Sigma xy = 2045$

Marks

Here n = no. of year = 6, (even)

Thus mid point of 2013 and 2014 i.e. 1st July of 2013 is taken as origin.

Now, let the linear trend be given by — $y = a + bx$

Using standard equations to get the value of a and b.

$$\Sigma y = na + b\Sigma x$$

$$\Rightarrow 1975 = 6a + 0$$

$$\Rightarrow \boxed{a = 329.17}$$

$$\Sigma xy = a\Sigma x + b\Sigma x^2$$

$$\Rightarrow 2045 = a \times 0 + b \times 70$$

$$\Rightarrow \boxed{b = 29.21}$$

∴ eqn of straight line trend is given by —

$$\boxed{y = 329.17 + 29.21x}$$ +2

Estimation for 2024 :

$$\text{deviation} = 2024 - 2013\frac{1}{2} = 10.5$$

Marks

$\therefore \quad x = 2\sigma \text{ deviation}$

$= 2 \times 10.5$

$\boxed{x = 21}$

$\therefore \quad y = 329.17 + 29.21 \times 21$

$\boxed{y = 942.58 \text{ units}}$ +2

Ans(3) (i) Index no. is a method of valuating variations in a variables or group of variables in regards to geographical locations, time and other feature. +1

Characteristics of Index no. —

1) Average — they predict or represent the changes that take place in terms of averages

2) Quantitative : they offer the accurate measurement of quantitative change.

3) Measure of relative change —

they measure relative change over time +3

Marks

Ans (3) (ii)

Commodity	Price (Rs) in year 2013 (p_0)	Price (Rs) in year 2014 (p_1)
A	1	5
B	2	4
C	3	3
D	4	2
Total	$\Sigma p_0 = 10$	$\Sigma p_1 = 14$

+3

Index no. using Simple aggregative method is given by -

$$I_{01} = \frac{\Sigma p_1}{\Sigma p_0} \times 100$$

$$= \frac{14}{10} \times 100$$

$$I_{01} = 140$$

+3

Ans (3) (iii)

Commodities	Weights (w)	Price (per unit) Rs. 2010 (p_0)	Price (per unit) Rs 2012 (p_1)	$p_0 w$	$p_1 w$	
Rice	40	16	20	640	800	
wheat	20	40	60	800	1200	
Pulses	15	0.5	0.5	7.5	7.5	
Butter	20	5.12	6.25	102.4	125	+3
Oil	5	5	1.5	25	7.5	

Marks

here $\Sigma p_0 w = 1574.9$

$\Sigma p_1 w = 2140$

Now, Consumer price Index no. is given by

$$I_{01} = \frac{\Sigma p_1 w}{\Sigma p_0 w} \times 100$$

$$= \frac{2140}{1574.9} \times 100$$

$$= 135.89 \quad +3$$

—x—

Ans (4) (i)

Balls can be drawn alternately in the following order

(i) White, Black, White, Black

(ii) Black, White, Black, White

Case I: if white ball is drawn first

, Then the probability of drawing balls alternatively is

Marks

$$P(WBWNB) = \frac{10}{16} \times \frac{6}{15} \times \frac{9}{14} \times \frac{5}{13}$$ — 1

{∵ balls are not replaced, the events are dependent}

$$\therefore \quad P(WBWB) = \frac{45}{728}$$ +2

Case II : if Black ball is drawn first

Then the probability of drawing the balls alternatively is

$$P(BWBW) = \frac{6}{16} \times \frac{10}{15} \times \frac{5}{14} \times \frac{9}{13}$$

$$= \frac{45}{728}$$ +2

∵ Both case can be accepted

∴ required probability is given by -

$$P(WBWB) \text{ or } P(BWBW) = \frac{45}{728} + \frac{45}{728}$$

$$= \frac{90}{728} \text{ (or) } \frac{45}{364}$$ +1

Ans(4) (ii)

Marks

Let p be the probability that the ship reaches safely

Then $p = \frac{9}{10}$

and $q = 1 - \frac{9}{10} = \frac{1}{10}$ (ship does not reaches safely) +1

Let X be the random variable, showing the ship reaches safely

Then,

~~P(~~ probability that atleast 4 ship reaches safely is —

$P(X = 4 \text{ or more}) = 1 - P(X = 0, 1, 2, 3)$ +1

Now, $P(X = 0, 1, 2, 3) = P(X=0) + P(X=1) + P(X=2) + P(X=3)$

$= {}^{25}C_0 \left(\frac{9}{10}\right)^0 \left(\frac{1}{10}\right)^{25-0} + {}^{25}C_1 \left(\frac{9}{10}\right)^1 \left(\frac{1}{10}\right)^{25-1}$

$+ {}^{25}C_2 \left(\frac{9}{10}\right)^2 \left(\frac{1}{10}\right)^{25-2} + {}^{25}C_3 \left(\frac{9}{10}\right)^3 \left(\frac{1}{10}\right)^{25-3}$ +1

Marks

$$= \left(\frac{1}{10}\right)^{22} \left\{ {}^{25}C_0 \times \frac{1}{} \times \left(\frac{1}{10}\right)^3 + {}^{25}C_1 \times 0.9 \times \left(\frac{1}{10}\right)^2 \right.$$

$$\left. + {}^{25}C_2 \times 0.81 \times \frac{1}{10} + {}^{25}C_3 \times 0.729 \times 1 \right\}$$

$$= \left(\frac{1}{10}\right)^{22} \left\{ \frac{1 \times 1 \times 1}{1000} + \frac{25 \times 0.9}{100} + \frac{300 \times 0.81}{10} \right.$$

$$\left. + 2300 \times 0.729 \right\}$$

$$= \left(\frac{1}{10}\right)^{22} \left\{ 0.001 + 0.225 + 24.3 + 1676.7 \right\}$$

$$= \frac{1701.226}{10^{22}}$$

$\therefore$ P (X = 4 or more) $= 1 - \frac{1701.226}{10^{22}}$

$$= \frac{10^{22} - 1701.226}{10^{22}} \quad +2$$

Ans (4) (iii)

here $n = 200$

The probability that fuse ~~to~~ are defective $= 2\% = 0.02$

Marks

as n is large and $p \to 0$

poisson distribution will be used.

average no. of defective $(m) = np$

$= 200 \times 0.02$

$= 4$ +1

$\therefore e^{-m} = e^{-4} = 0.0183$ (given)

Let r denotes the no. of defective fuses in a box of 200

$\therefore$ required probability is given by

$$P(X=r) = \frac{e^{-m} m^r}{r!}$$ +1

probability of atmost 5 defective i.e.

$P(r=5$ or less $) = P(r=0) + P(r=1) + P(r=2)$

$+ P(r=3) + P(r=4) + P(r=5)$ +1

$$= \frac{e^{-4} 4^0}{0!} + \frac{e^{-4} 4^1}{1!} + \frac{e^{-4} 4^2}{2!} + \frac{e^{-4} 4^3}{3!} + \frac{e^{-4} 4^4}{4!}$$

$$+ \frac{e^{-4} 4^5}{5!}$$ +1

$$= e^{-4} \left[1 + 4 + 8 + \frac{32}{3} + \frac{32}{3} + \frac{128}{15} \right]$$

Marks

$$= 0.0183 \times \frac{643}{15}$$

$$= 0.784$$ +1

Ans (5) (i)

Population : Population is the entire set of items from which you draw data for statistical study. It can be a group of individual, set of items, etc. +1

Eg: An example of population would be the entire student body at some institute who study in that institute at the time of data collection. +1

Sample : A sample is defined as a smaller and more manageable representation of a larger group, which contains characteristics of that population. +1

Eg:- An example of sample would be the part of entire student body at some institute who study in that institute at the time of data collection. +1

Marks

Ans (5) (ii)

Let the Null hypothesis be $H_0 : \sigma_1^2 = \sigma_2^2$

where σ_1^2 and σ_2^2 are variances of two populations.

The alternate hypothesis is $H_1 : \sigma_1^2 \neq \sigma_2^2$

We have, $s_1^2 = \frac{\Sigma (x_1 - \bar{x}_1)^2}{n_1 - 1}$

and $s_2^2 = \frac{\Sigma (x_2 - \bar{x}_2)^2}{n_2 - 1}$ +1

where n_1 and n_2 are sample size

Table: Calculation for sample variance

Sample 1			Sample 2		
x_1	$x_1 - \bar{x}_1$	$(x_1 - \bar{x}_1)^2$	x_2	$(x_2 - \bar{x}_2)$	$(x_2 - \bar{x}_2)^2$
65	-15	225	64	-19	381
66	-14	196	66	-17	289
73	-7	49	74	-9	81
80	0	0	78	-5	25
82	2	4	82	-1	1
84	4	16	85	2	4
88	8	64	87	4	16
90	10	100	92	9	81
92	12	144	93	10	100
			95	12	144
			97	14	196

+2

Marks

$$\bar{x}_1 = \frac{\Sigma x_1}{n_1} = \frac{720}{9} = 80$$

$$\bar{x}_2 = \frac{\Sigma x_2}{n_2} = \frac{913}{11} = 83$$

we have, $\Sigma (x_1 - \bar{x}_1)^2 = 798$

$$\Sigma (x_2 - \bar{x}_2)^2 = 1298$$

$$\therefore s_1^2 = \frac{\Sigma (x_1 - \bar{x}_1)^2}{n_1 - 1} = \frac{798}{9-1} = 99.75$$

$$s_2^2 = \frac{\Sigma (x_2 - \bar{x}_2)^2}{n_2 - 1} = \frac{1298}{11-1} = 129.8$$

since $s_2^2 > s_1^2$ $\therefore$ $F = \frac{s_2^2}{s_1^2}$

$$= \frac{129.8}{99.75}$$

$$= 1.30$$

The tabulated value for 10 and 8 d.o.f at 5% level is 3.36

as $F_{calculated} < F_{tabulated}$

i.e. $1.30 < 3.36$

Marks

we accept the null hypothesis and conclude that the variance of the two population is the same. +3

Ans (5) (iii)

Let the Null hypothesis be H_0

~~Table~~:

H_0: there is no significant difference b/w the prices in the three cities

Let the alternate hypothesis H_1 be

H_1: there is a significant difference b/w the prices in the cities.

Table: Calculation using Short-cut method

Sample 1		Sample 2		Sample 3	
X_1	X_1^2	X_2	X_2^2	X_3	X_3^2
15	225	14	196	4	16
7	49	10	100	10	100
11	121	10	100	8	64
13	169	6	36	8	64
$\Sigma X_1 = 46$	$\Sigma X_1^2 = 564$	$\Sigma X_2 = 40$	$\Sigma X_2^2 = 432$	$\Sigma X_3 = 30$	$\Sigma X_3^2 = 244$

+1

T = Grand total

$= \Sigma X_1 + \Sigma X_2 + \Sigma X_3$

$= 46 + 40 + 30$

$T = 116$

Marks

Correction factor $= \frac{T^2}{N}$ $(N = 12)$ — 1

$= \frac{(116)^2}{12} = 1121.33$ +1

SST = Total sum of square

$= \Sigma X_1^2 + \Sigma X_2^2 + \Sigma X_3^2 - \frac{T^2}{N}$

$= 564 + 432 + 244 - 1121.33$

$= 148.67$

SSB = Sum of square b/w samples

$= \frac{(\Sigma X_1)^2}{n_1} + \frac{(\Sigma X_2)^2}{n_2} + \frac{(\Sigma X_3)^2}{n_3} - \frac{T^2}{N}$

$= \frac{(46)^2}{4} + \frac{(40)^2}{4} + \frac{(30)^2}{4} - 1121.33$

$= 529 + 400 + 225 - 1121.33$

$= 32.67$ +1

and v_1 = degree of freedom $= k - 1$

$= 3 - 1$

$= 2$

$\therefore$ MSB = Mean square b/w sample

$= \frac{SSB}{v_1}$

$= \frac{32.67}{2} = 16.33$

Marks

SSW = Sum of square within sample

= SST − SSB

= 148·67 − 32·67

= 116

MSW = mean square within sample

$= \frac{SSW}{\nu_2} = \frac{116}{N-k} = \frac{116}{12-3} = 12.89$ +1

ANOVA Table :

Source of variation	Sum of square	d.o.f	Mean square	Test statistic
B/W Samples	32·67	2	16·33	$F = \frac{16.33}{12.89} = 1.266$
Within Samples	116	9	12·89	
Total	148·67	N−1 = 11		

Since the tabulated value for $\nu_1 = 2$ and $\nu_2 = 9$ d.o.f at 5% level is 4·26, which is greater that calculated value of F +2

i.e. $F_{calculated} < F_{tabulated}$

Marks

or $1.266 < 4.26$

hence we ~~of~~ accept the null hypothesis and conclude that there is no significant difference in the price of commodity in three diffrent cities

Ans (6) (i)

Elements of Decision making problem

1.) Define the problem :

In this step, a decision maker must clearly define his/her problem and should make sure that the problem could be only be solved through a decision that establishes a rule or principle

2) Gather the data :

After defining the problem, the decision maker should find out the way to collect the data which regards the problem

3) Identify Alternatives :

Marks

After collecting the data from the sources, pick the no. of alternatives that can be used for decision making.

4) Establish Solution Criteria :

After selecting the no. of alternatives establish your solution criteria that which qualities or things should possess your alternatives.

5) Evaluate Alternatives :

When the solution criteria has been established then evaluate your selected alternatives one by one according to the solution criteria.

6) Select the best Alternative :

Once you have done evaluating the selected alternative, find out the alternative which best fits to your desired solution criteria and finally ~~&~~ select that alternative for the decision. +4

—X—

Marks

Ans (6) (ii)

(a) Minimax Criterion:

Maximum cost for action $A_1 = 25$
Maximum cost for action $A_2 = 16$
Maximum cost for action $A_3 = 11$
Maximum cost for action $A_4 = 22$

as the minimum cost among the maximum cost is for A_3 i.e. 11 hence, According to Minimax criterion Action A_3 is optimum decision. +3

(b) Laplace Criterion:

According to laplace criterion, the probability of occurence of each event is equal. Thus the probability of occurence of S_1, S_2, S_3 and S_4 is $\frac{1}{4}$

$\therefore$ Expected cost for $A_1 = \frac{16+20+25+19}{4}$

$= 20$

Similarly Expected Cost for $A_2 = \frac{11+15+16+12}{4}$

$= 13.5$

Marks

Expected Cost for $A_3 = \frac{8+11+11+7}{4} = 9.25$ —1

Expected Cost for $A_4 = \frac{9+13+22+15}{4} = 14.75$

Since minimum expected cost is for A_3 . Hence according to Laplace criterion, Optimum decision is A_3. +3

—x—

Ans (6) (iii)

(a) Expected Monetary Value (EMV):

EMV is calculated for each act by multiplying the payoff with the associated probabilities and add up these values for each course of action, Then determine the best course of action or strategy on the basis of these expected values. +2

(b) Expected Opportunity Loss (EOL):

Under this criterion the expected Opportunity loss or expected value of regret is minimized. Expected opportunity loss for any course of action is calculated by multiplying the conditional opportunity loss by its

Marks

probability of occurence. According to EOL criterion the decision maker would choose the strategy with the minimum expected opportunity loss +2

(c) Expected value of Perfect Information:

Under this, it is assumed that the decision maker has authentic and perfect information available. This improves the quality of decision.

In order to calculate EVPI, we choose the best alternatives for each state of nature and multiply its payoff with the probability of occurence of the state of nature

ie. EVPI = EPPI − EMV
= Minimum EOL

where EPPI = expected profit with perfect information. +2