On the basis of above data, can it be concluded that there is a significant difference in the effect of the drug and sugar pills. (Given: value of χ^2 at 5% level of significance and 2 degree of freedom is 5.99)

OR iii. Two independent samples drawn from the two Normal populations have the following values: **6**

Sample I	9	11	13	11	15	9	12	14
Sample II	10	12	10	14	9	8	10	

Test whether the two populations have the same variance at the 5% level of significance. (Given F= 4.20 at 5% level for $n_1 = 7$ and $n_2 = 6$.)

Q.6. i. Explain the steps involved in decision making process. **4**

ii. The following payoff matrix shows the payoff of different course of action E1, E2, E3, E4 against state of nature A1, A2, A3, A4 **6**

	A1	A2	A3	A4
E1	10	15	24	38
E2	48	14	36	59
E3	20	34	47	68
E4	6	19	8	22

Find the optimum decision with the help of Laplace rule, Max-min rule.

OR iii. Distinguish between the following **6**

(a) Expected Opportunity Loss (EOL) and Expected Value of Perfect Information (EVPI).

(b) Maximin and minimax decision criterion.

******

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

Enrollment No.....

Faculty of Management Studies

End Sem Examination Dec-2023

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. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. The additive model of the time series is- **1**

(a) T*S*C*I (b) T + S + C + I

(c) Y = a + bX (d) None of these

ii. Factors responsible for Seasonal variations are- **1**

(a) Weather (b) Social Customs

(c) Festivals (d) All of these

iii. Which of the following are the major characteristics of index numbers? **1**

(a) It is expressed in percentages

(b) It measures the net or relative changes in variables

(c) It measures changes over a period of time

(d) All of these

iv. Which of the following statements is/are correct about average prices if the price index is 110? **1**

(a) The prices have increased by 10 percent

(b) The prices have increased by 110 percent

(c) The prices have decreased by 10 percent

(d) None of these

v. In a Binomial Distribution, if p, q and n are probability of success, failure and number of trials respectively then variance is given by- **1**

(a) np (b) npq (c) np^2q (d) npq^2

vi. A card is drawn from the set of 52 cards. Find the probability of getting a queen card- **1**

(a) 1/26 (b) 1/13

(c) 4/53 (d) 4/13

vii. A statement about a population developed for the purpose of testing is called- **1**

(a) Hypothesis
(b) Hypothesis Testing
(c) Level of Significance
(d) Test-Statistic

viii. When using the chi-square test for differences in two proportions with a contingency table that has r rows and c columns, the degrees of freedom for the test statistic will be- **1**

(a) n-1 (b) (r-1)(c-1)
(c) (r-1)+(c-1) (d) None of these

ix. Decision theory is concerned with- **1**

(a) Methods of arriving at an optimal decision
(b) Selecting optimal decision in a sequential manner
(c) Analysis of information that is available
(d) All of these

x. A pessimistic decision-making criterion- **1**

(a) Maximax (b) Equally likely
(c) Maximin (d) None of these

Q.2 i. Explain the various components of time series by giving suitable examples. **4**

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

Year	1979	1980	1981	1982	1983	1984	1985	1986
Earning	80	90	70	60	110	50	40	30

OR iii. Given below are the figures of production of a sugar factory: **6**

Year	1995	1996	1997	1998	1999	2000	2001
Production (in '000 tons)	40	45	46	42	47	49	46

Fit a straight-line trend by method of least square and estimate its value for 2004.

Q.3 i. Define index numbers. Write important characteristics of index numbers. **4**

ii. From the following data construct price index numbers for the years 2004 and 2007 by simple aggregative method taking 2000 as the base year: **6**

Commodities	Price in 2000	Price in 2004	Price in 2007
Wheat	630	710	765
Rice	25	34	41
Sugar	12	15	18
Milk	16	17	19
Clothing	38	40	43

OR iii. Calculate price index numbers by Fisher's Ideal Method, Laspeyres's Method and Pssache Method from the following data: **6**

	1994		1995	
Commodity	Price	Quantity	Price	Quantity
A	20	8	40	6
B	50	10	60	5
C	40	15	50	15
D	20	20	20	25

Q.4 i. State the addition theorem of probability for two events: **4**

(a) When they are mutually exclusive
(b) When they are not mutually exclusive.

ii. The probability that a contractor will get a plumbing contract is 2/3 and the probability that he will not get an electric contract is 5/9. If the probability of getting at least one contract is 4/5, what is the probability that he will get both? **6**

OR iii. The incidence of a certain disease is that on an average 20% of workers suffer from it. If 10 workers are selected at random, find the probability that: **6**

(a) Exactly two workers suffer from the disease.
(b) Not more than two workers suffer from the disease.

Q.5 i. Write difference between parametric and non-parametric tests. **4**

ii. A certain drug is claimed to be effective in curing cold. In an experiment on 500 persons with cold, half of them were given the drug and half of them were given sugar pills. The patients reactions to the treatment are recorded in the following table: **6**

Treatment	Helped	Reaction	No effect	Total
Drug	150	30	70	250
Sugar Pills	130	40	80	250
Total	280	70	150	500

Faculty of Management

MS3 C010

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Quantitative Techniques

BBA - IIIrd Sem.

Objectives Q.1.

i) b ii) d iii) d iv) a

v) a vi) b vii) a (Hypothesis)

viii) b : (r-1)·(c-1) ix) d x) Maximin

i) b) : T + S + C + I 1

ii) d) : All of these 1

iii) d) : All of these 1

iv) a) : The prices have increased by 10%. 1

v) a) : np 1

vi) b) : 1/13 1

vii) a) Hypothesis 1

ix) d) : All of Three 1

x) c) : Maximin 1

Q:2

i) Time Series is a Sequence of data points that are recorded over a period of Time. The components of time series are the different patterns that can be observed in the data, these patterns can be used to understand the various forces affecting the values of a phenomenon in a time. Series may be broadly classified into the following four categories, commonly known as the components of a time series. 1

i) Secular trend :
(Long - term smooth, regular movement) 1

ii) ⇒ it is the matter of common sense that there might be violent variations in a time series during a short of time. however in a long run by span. This tendency or trend of variation may be either upward or downward set on over a long time period. This known as Secular Trend
Ex Technological process medical facilities production prices etc.)
Broadly the trends are divided under two heads
i) Linear Trends ii) Non-Linear trends

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ii) Seasonal Variations:-

As we heared Seasonal variations like that the first things come in over mind is spring, Summer, autumn and Winter. The Seasonal variations are occur due to changes in weather condition, customers, traditions, fashion etc.

Ex: i) Sale of Woolens go up in Winter

ii) Sale of raincoat and Umbralla go up in rainy season.

iii) Cyclical Variations:-

Most of the business activities are often characterized by reccurence of periods of prosperity and slump constituting a buisness cycle Cyclical Variation are another type of periodic movement. One complete period is called a cycle, cyclic Variation are not as regular as Seasonal Variation. but the sequence of change

iv) Irregular or Random Variation:-

Irregular or random Variation are such Variation which are Completely Unpredictable in character. These are caused by factors which are either wholly Unaccountable like flood, drough famines, epidemic etc.

Q: 2 (ii) Calculate 3-year moving Average. — 6

Year	Farming	3-year moving total	3-yearly moving Averages	Central year trend.
1979	80	—	—	
1980	90	240	$\frac{240}{3} = 80$	(1980, 80)
1981	70	220	$\frac{220}{3} = 73.3$	(1981, 73.3)
1982	60	240	$\frac{240}{3} = 80$	(1982, 80)
1983	110	220	$\frac{220}{3} = 73.3$	(1983, 73.3)
1984	50	200	$\frac{200}{3} = 66.6$	(1984, 66.6)
1985	40	120	$\frac{120}{3} = 60$	(1985, 60)
1986	30	—	—	

Q. 2 (iii) Fit a straight line trend — for estimate for 2004-

Here The central year 1998 and estimated for the year 2004 with the production in '000 tons

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Solving by least Square method

$$y = a + bx \quad \text{---(1)}$$

to be determine the Unknown 'a' and 'b'

The Normal Equations

$$\Sigma y = ma + b\Sigma x \quad \text{---(2)}$$

$$\Sigma xy = a\Sigma x + b\Sigma x^2 \quad \text{---(3)}$$

Where $m = 7$ (No of present value)

Year y	production y	$x = y - 1998$	xy	x^2
1995	40	-3	-120	9
1996	45	-2	-90	4
1997	46	-1	-46	1
(1998)	42	0	0	0
1999	47	1	47	1
2000	49	2	98	4
2001	46	3	138	9
	$\Sigma y = 315$	$\Sigma x = 0$	$\Sigma xy = 27$	$\Sigma x^2 = 28$

By Normal Equations -

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

$$315 = 7a + b \times 0$$

$$\Rightarrow 315 = 7a$$

$$\Rightarrow a = \frac{315}{7} = 45$$

$$\boxed{a = 45}$$

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

$$\Rightarrow 27 = a \times 0 + b \times 28$$

$$\Rightarrow 27 = 28b$$

$$\Rightarrow b = \frac{27}{28} = 0.964$$

$$\Rightarrow \boxed{b = 0.97} \text{ (Approx)}$$

The fit of Straight line

$$y = a + bx$$

$$\boxed{y = 45 + 0.97x} \quad \text{— (A)}$$

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The Estimated value

$$x = 2004 - 1998$$

$$x = 6 \quad (1000 \text{ ton production})$$

So that least Square trend will be.

$$y = 45 + 0.97x$$

put $x = 6$

$$y = 45 + 0.97 \times 6$$

$$\boxed{y = 50.82} \approx y = 51 \text{ (Approx)}$$

2

Q:3 (i) Index number:

It is a numerical value characterising the change in complex economic phenomena over a period

(Maslow) 2

Index number is a single ratio which measures the combined change of several variables b/w two different times, places or situations.

(A.M Tuttle)

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Characteristics of Index numbers.

i) **Specialised averages** - It is a special type of average because whereas in a simple average the data trend are homogeneous having the same unit of measurment index numbers average variables having different units of measurment 1

ii) **Expressed in percentages**:

Index number are expressed in terms of percentages (%) to show the extent of relative change 1

iii) Measure changes not capable of direct measurment. 2

The technique of index number is utilised in measuring changes in magnitudes which are not capable of direct measurment due to composite and complex.

iv) Index number are for comparison - 1

The index numbers by their very nature are comparative. They compare changes taking place

Q13 (i) Simple aggregative method —

Given 2000 is an base year.

i.e p_0 for the years

p_1 & p_2 i.e

$p_0 = 2000$ $p_1 = 2004$ $p_2 = 2007$

Commodities	2000 (p_0)	2004 (p_1)	2007 (p_2)
Wheat	630	710	765
Rice	25	34	41
Sugar	12	15	18
Milk	16	17	19
clothing	38	40	43
Total	$\Sigma p_0 = 721$	$\Sigma p_1 = 816$	$\Sigma p_2 = 886$

- 3

Index number of prices for 2004 and 2007

$$P_{01} = \frac{\Sigma p_1}{\Sigma p_0} \times 100 = \frac{816}{721} \times 100$$

$$\boxed{P_{01} = 113.176}$$

$$\Rightarrow P_{02} = \frac{\Sigma p_2}{\Sigma p_0} \times 100$$

$$= \frac{886}{721} \times 100$$

$$\boxed{P_{02} = 122.884}$$

Q:3 (iii) Calculate price index number.

Commodity	Base year price p_0	Base year quantity q_0	Current year price p_1	Current year quantity q_1	p_0q_0	p_1q_0	p_0q_1	p_1q_1
	p_0	q_0	p_1	q_1	p_0q_0	p_1q_0	p_0q_1	p_1q_1
A	20	8	40	6	160	320	120	240
B	50	10	60	5	500	600	250	300
C	40	15	50	15	600	700	600	750
D	20	20	20	25	400	400	500	500
					Σp_0q_0 = 1660	Σp_1q_0 = 2070	Σp_0q_1 = 1470	Σp_1q_1 = 1790

2

(1) Laspeyre's Method.

$$P_{01}^{Lq} = \frac{\Sigma p_1q_0}{\Sigma p_0q_0} \times 100 = \frac{2070}{1660} \times 100$$ 2

$$P_{01}^{Lq} = 124.70$$

ii) Paasche's method :-

$$P_{01}^{Pa} = \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1} \times 100$$

$$P_{01}^{Pa} = \frac{1790}{1470} \times 100$$

$$P_{01}^{Pa} = 121.77$$

(iii) Fisher's Ideal method -

$$P_{01}^{F} = \sqrt{L \times P} = \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}} \times 100$$

$$P_{01}^{F} = \sqrt{\frac{2070}{1660} \times \frac{1790}{1470}} \times 100$$

$$= \sqrt{1.2469 \times 1.2176} \times 100$$

$$= 1.3596 \times 100$$

$$P_{01}^{F} = 125.97$$

Q:4(i) Mutually exclusive and not mutually exclusive with Addition Theorem

if A and B are two events then addition law of the probability that

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$ 2

if A and B are exclusive then

$$P(A \cap B) = 0$$ 1

if A and B are not exclusive

$$P(A \cap B) \neq 0$$ 1

Q:4(ii) The probability of plumbing contract is 2/3

The probability that he will not get an electric contract 5/9 2

at least one contract 4/5

Find the probability that will get both.

Let $P(A) = 2/3$

$P(B) = 5/9$

$P(\bar{A}) = 1 - \frac{2}{3} = \frac{1}{3}$

The probability of getting does not both contract - 2

$= P(\bar{A}) \times P(\bar{B})$

$= \frac{1}{3} \times \frac{5}{9} = \frac{5}{27}$

The probability of getting both contract. 2

$1 - \frac{5}{27} = \frac{22}{27}$ Ans

Q: 4 (iii) We consider The probability of certain disease of suffer of worker $p = \frac{20}{100} = 0.2$ (small) 1

Apply poisson dist^n. with $n = 10$ workers are selected at random.

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$$m = np = 10 \times 0.2 = 2$$

$$p(r) = \frac{e^{-m} m^r}{\lfloor r}$$ 1

(a) $$p(r) = \frac{e^{-2} 2^r}{\lfloor r}$$ (1)

(1) Exactly two workers suffer from the disease.

$$p(r=2) = \frac{e^{-2} \cdot 2^2}{\lfloor 2} = \boxed{2e^{-2}}$$ 2

(2) Not more than two workers suffer from the disease.

$$1 - \left[p(r=0) + p(r=1) + p(r=2) \right]$$ 2

$$1 - \left[\frac{e^{-2} 2^0}{\lfloor 0} + \frac{e^{-2} 2}{\lfloor 1} \right]$$

$$1 - e^{-2}(1+2) = \boxed{1 - 3e^{-2}}$$ 4

Q1 5 (i) difference b/w parametic and non-paramitic test-

In statistics a parametic test is a kind of hypothesis test which gives generalizations for generating records regarding the mean of the primary population. The t-Test is carried out based on the student t-statistic, which is often used in that value.

parametic test relies on statistical distribution in data whereas non parametic do not depend on any distribution. non-parametic does not makes any assumptions and measures. central tendency include in parametic test and sign, run test kruskal test include in non paramitic test.

	parametic test	Non-parametic test
1.	Lower statistical power	Greater statistical power
2.	Applied for Large samples	Applied for small samples
3.	makes a lot of assumptions.	Don't make any assumptions.
4.	The calculations are exists	The calculation are not exists.

Q: 5 (ii) The Null and Alternative hypothesis

H_0: There is a significant difference in the effect of the drug and sugar pills

H_1: There is no significant ------

χ^2 tabulated value at 5% Level of significance 5.99

The expected Frequency calculate by the following contingency table

Treatment	Helped	Reaction	No effect	Total
Drug	150 (A)	30 (B)	70 (C)	250
Sugar pills	130 (D)	40 (E)	80 (F)	250
Total	280	70	150	500 → grand Total

The expected Frequency (E) of the Cells A, B, C, D & E

$$A = \frac{250 \times 280}{500} = 140$$

$$B = \frac{250 \times 70}{500} = 35$$

2

$$C = \frac{250 \times 150}{500} = 75$$

$$D = \frac{250 \times 280}{500} = 140$$

$$E = \frac{250 \times 70}{500} = 35$$

$$F = \frac{250 \times 150}{500} = 75$$

Computation of χ^2

Cells	Observed Frequency O	Expected Frequency E	O-E	$(O-E)^2$	$(O-E)^2/E$
A	150	140	10	100	0.71
B	30	35	-5	25	0.714
C	70	75	-5	25	0.333
D	130	140	-10	100	0.714
E	40	35	-5	25	0.714
F	80	75	-5	25	0.312
total	500	500			3.185

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

$\chi^2 = 3.185$ (calculated value)

$\chi^2 = 5.99$ (tabulated value)

$\therefore \chi^2_{cal} < \chi^2_{tab}$

In this condition that the Null hypothesis are accepted.

Q: 5 (iii) It is given that

$n_1 = 7, \quad n_2 = 6$

Null Hypothesis $H_0 : \sigma_1^2 = \sigma_2^2$ 1/2

Alternative Hypothesis $H_1 : \sigma_1^2 \neq \sigma_2^2$ 1/2

The test statistic is

$$F = \frac{s_1^2}{s_2^2} \text{ or } \frac{s_2^2}{s_1^2}$$ 1

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

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

Calculations for sample variance

Sample 1			Sample 2		
x_1	$x_1 - \bar{x}_1$	$(x_1 - \bar{x}_1)^2$	x_2	$x_2 - \bar{x}_2$	$(x_2 - \bar{x}_2)^2$
9	-3	9	10	-2	4
11	-1	1	12	0	0
13	1	1	10	-2	4
15	3	9	14	2	4
9	-3	9	9	-3	9
12	0	0	8	-4	16
14	2	4	10	-2	4
		33			41

2

$$\bar{x}_1 = \frac{\Sigma x_1}{n_1} = 11.8 \approx 12$$

$$\bar{x}_2 = \frac{\Sigma x_2}{n_2} = 11.16 \approx 12$$

$$s_1^2 = \frac{\Sigma (x_1 - \bar{x}_1)^2}{n_1 - 1} = \frac{33}{7-1} = \frac{33}{6} \quad 1$$

$$\boxed{s_1^2 = 5.5}$$

$$s_2^2 = \frac{\Sigma (x_2 - \bar{x}_2)^2}{n_2 - 1} = \frac{41}{6-1} = \frac{41}{5}$$

$$\boxed{s_2^2 = 8.2} \quad 1$$

Where $s_2^2 > s_1^2$

The test of statistic

$$F = \frac{s_2^2}{s_1^2} = \frac{8.2}{5.5}$$

$$\boxed{F = 1.49}$$

at 5% level of significance The tabulated value of F Test

$F_{0.5} = 4.20$

And calculated value are

$F_{cal} = 1.49$

clearly

$F_{cal} < F_{tab}$

So that at 5% Level with $n_1 = 7$ and $n_2 = 6$ We accept the null hypothesis and conclude that the two populations variance are same.

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Q.6(i) Decision making process -

The decision making process of the following steps. 1

1.) Identification and defining of the decision problem. 1

2. Finding all possible outcomes, known as the states of nature Ei for the decision problem. These outcomes are out of control of the decision maker. 1

3. Finding all course of action Aj

4. Finding the pay-offs which are results of combinations of stats of nature and course of action. 1

5. Finding the optimal pay-off matrix

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Q16(ii)

	A_1	A_2	A_3	A_4
E_1	10	15	24	38
E_2	48	14	36	59
E_3	20	34	47	68
E_4	6	19	8	22

2

Laplace Rule: In this rule E_1, E_2, E_3 & E_4 are equally likely so that the probabilities are given to each E_i $(i = 1,2,3,4)$ is $1/n = \frac{1}{4}$

Thus, the mean pay off values for each course of action are

$E(A_1) = (10+48+20+6)/4 = 21$

$E(A_2) = (15+14+34+19)/4 = 20.5$ 1

$E(A_3) = (24+36+47+8)/4 = 28.75$

$E(A_4) = (38+59+68+22)/4 = 46.5$

Since A_4 is maximum (optimum)

Max-min Rule:

According to the max-min rule first of all find the minimum pay-off value for each course of action.

States of Nature	Course of action.			
	A_1	A_2	A_3	A_4
E_1	10	15	24	38
E_2	48	14	36	59
E_3	20	34	47	68
E_4	6	19	8	22
Minimum	6	14	8	22
	A_1	A_2	A_3	A_4

↓

max

Now out of these minimum pay off values the maximum is 22

A_4 is optimum action.

Q: 6 (iii) EOL Rule:

The Expected monetary value (EMV) is to minimize the expected loss value or expected regret value. The expected opportunity loss may be defined as the difference b/w the highest pay-off for a state of nature and the actual pay-off obtained for the particular course of action

If m be the number of states of nature p_i is probability assigned to state of nature S_{ij} and l_{ij} is the conditional loss

$$EOL(E_i) = \sum_{(i=1)}^{m} l_{ij} \times p_i \quad \text{1}$$

$$j = 1, 2, 3 \ldots$$

EVPI Rule:- It is discussed earlier that in decision making under the risk the probabilities of occurrences of each state of nature were assigned. The expected profit with perfect information (EPPI), is the expected return in long run.

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The expected value of perfect information (EVPI) show that amount of money which is paid by the decision maker to get the additional information in comparison of the information given by due to expected monetary value (EMV)

$$EVPI = EPPI - EMV$$

$$= \sum_{i=1}^{n} q_i P_i - EMV$$

Q.6 (iii) Maximin and minimax decision criterion.

i) Maximin rule:
This rule is basis on the concept of pessimism.

The following steps get involved in this rule—

Step-I :- Compute the minimum for each course of action

Step-II : Adopt that course of action for which the payoff is maximum.

Maximin Rule :-

This rule is based on the concept of optimism. Using this concept decision maker adopts that course of action for which the pay-off is maximum out of maximum pay-off for each course of action.

The following steps get involved in this rule -

Step-I Compute the maximum pay-off for each course of action

Step-II Adopt that course of action for which the pay-off is maximum.