

4. 2065 (II) Q.No. 9 b

It is claimed that both tea and coffee are equally popular in Ilam district. If in a random sample of 1200 persons 650 were regular consumers of tea. Is the claim justified at 5% level of significance?

Ans: 2.91; H_0 is rejected

5. 2064 Q.No. 10 a

In a sample of 400 items produced by a factory, the number of defective items found was 30. However, the company claims that only 5% of their product is defective. Is the company's claim reliable? Test at 5% level of significance. [5]

Ans: $Z = 2.29$, reject H_0

6. 2060 Q.No. 9 a

A manufacturer claims that at least 95% of the machine parts supplied by him confirm to specification. An examination of a sample of 200 parts revealed that 50 parts were defective. Is the claim of the manufacturer valid at 5% level of significance? [5]

Ans: $Z = 12.98$, (reject H_0) significant

7. 2058 Q.No. 9 b

In a metropolitan city it was observed that 500 out of 1500 men are against the "Green Sticker Control Policy", in vehicles. Based on this information can you conclude that majority of the people in the town are in favour of the policy, assuming that people in favour and disfavour are equal. [5]

Ans: $Z = 13.16$ (reject H_0) significant

8. 2057 (II) Q.No. 9 a

In a sample of 625 persons selected at random from a city, 300 were males. Test the hypothesis that males and females were in equal numbers in city at 1% level of significance. [5]

Ans: $z = 1$, (accept H_0) not significant

MBA**1. 2055 Q.No. 2 b**

Before, an increase in excise duty on coffee 800 out of a sample of 1000 persons were known to be taking coffee. After the increase in the duty 800 persons are now found to be taking coffee in a sample of 1200. Do you think that there has been a significant decrease in the consumption of coffee after the increase in the excise duty? [10]

Ans: 6.84, (reject H_0) significant

2. 2054 Q.No. 2 b

A machine puts out 16 imperfect articles in a sample of 500. After machine is overhauled, it puts out 3 imperfect articles in a batch of 100. Has the machine improved? [10]

Ans: 0.104, (accept H_0) not significant

3. 2051 Q.No. 2 b

The owner of a wholesale distributing firm would like to know the proportion of accounts receivable that are more than 60 days past due. The owner estimates that in the past the proportion has remained stable at 15%. A random sample of 200 current accounts receivable revealed that 44 were more than 60 days past due.

Using the 0.05 level of significance, is there evidence that the proportion of accounts receivable that are more than 60 days past due had changed? [10]

Ans: 2.77 (accept H_0) not significant

4. 2048 Q.No. 2 a

A furniture store with a loose credit policy expects that 8% of its credit accounts will default on payments. Looking at 500 accounts sold last year, however, we see that 49 have defaulted. Using a 5% level of significance do you think the store has reason to believe that estimate of 8% is too low? [10]

Ans: 1.48, (accept H_0) not significant

5. 2041 Q.No. 2 b

At a certain date in a large city 400 out of a random sample of 500 men were found to be smokers. After the tax on tobacco has been heavily increased, another random sample of 600 men in the same city included 400 smokers. Was the observed decrease in the proportion of the smokers significant? Test at 5% level of significance. [10]

Ans: 4.84, (reject H_0) significant

6. 2040 Q.No. 5 b

A sample of 600 persons selected randomly from a large city gives the results that males are 53%. Is there reason to doubt the hypothesis that males and females are in equal number in the city? [10]

Ans: 1.47, (accept H_0) not significant

C. t-TEST

MBS

1. 2071 Q.No. 11

The monthly advertising expenditure of a company for two products X and Y were as follows during 6 month period

Month	1	2	3	4	5	6
Product X	120	140	160	140	180	190
Product Y	200	210	150	200	220	240

Is there sufficient evidence to conclude that average expenditure on advertising on product Y is more than on product X. [10]

Ans: $t = -2.944$, reject H_0

2. 2070 Q.No. 10a

A random sample of 27 pairs of observations from a population gives a correlation coefficient of 0.6.

Is it likely that the variables in the population are correlated? [5]

Ans: $t = 3.75$; reject H_0

3. 2070 Old Q.No. 9b

Sale of electronic item in six shops before and after special promotional campaign were observed as follows:

Shops	A	B	C	D	E	F
Sales before	52	33	34	45	50	40
Sales after	55	32	35	50	60	48

Can you judge the special promotional campaign a success? [5]

Ans: $t = 2.54$; reject H_0

4. 2069 Q.No. 10a

A librarian in a campus expects that the average number of books checked out to each students per visit has changed recently. From the past record, it is observed that the average of 4 books were checked out. A recent sample of 25 students averaged 5 books per visit with a s.d. of 2 books. At 0.01 level of significance, test whether the average checkout of books has changed. [5]

Ans: $t = 2.449$, accept H_0 ; not changed

5. 2069 Old Q.No. 9b

Prices of the shares of a company on different days of a month were found to be 168, 164, 163, 170, 171, 169, 170, 169, 165 and 166. Discuss whether the mean price of shares in the month is 165. [5]

Ans: $t = 2.824$, reject H_0

6. 2068 Q.No. 10a

Samples of two types of electric bulbs were tested for length of life and following results were obtained.

	Brand A	Brand B
Sample size	15	12
Mean	1250 hours	1100 hours
Standard deviation	30 hours	40 hours

Test whether the electric bulbs of Brand A is superior to the electric bulbs of Brand B. [5]

Ans: $t = 1.708$; reject H_0 , A is superior

7. 2068 (Old) Q.No. 9b

The sales figure of an item in eight shops before and after promotional campaign are given below: [5]

Before	68	63	46	70	78	90	96	98
After	70	68	51	73	82	93	105	102

Test whether the campaign was successful or not.

Ans: $t = 5.80$; Reject H_0 ; campaign was successful.

8. 2067 (II) Q.No. 9b

Discuss in the light that following information. Throw on the suggestion that sailor are, on average, taller than soldier. [5]

No. of soldier 10	No. of sailor 6
Mean height 167.8 cm	Mean height 168 cm
Sum of the square of deviation 153.60	Sum of the square of deviation 60
$t_{0.05}$ for 15 d.f. = 1.75	
$t_{0.05}$ for 14 d.f. = 1.76	

Ans: Sailors are not taller than soldiers.

9. 2067 (II) (Old) Q.No. 9b

The changes in the score of IQ test of 5 persons before and after they were trained was as follows:

10, -2, 2, 4, -4

Test whether there is any change in IQ after training programme at 5% level of significance. [5]

Ans: $t = 0.816$; No change

10. 2066 Q.No. 9a

A certain stimulus administered to 12 patients resulted average increase in blood pressure by 2.58 with standard deviation 3.09. Can it be concluded that the stimulus will, in general, be accompanied by an increase in blood pressure? [10]

$$\begin{aligned} (t_{0.05} = 1.81 \text{ for } 10 \text{ d.f.}) \\ (t_{0.05} = 1.80 \text{ for } 11 \text{ d.f.}) \\ (t_{0.05} = 1.78 \text{ for } 12 \text{ d.f.}) \end{aligned}$$

Ans: $t = 2.77$; Reject H_0

11. 2066 Partial Q.No. 10

A Company, developing animal fodder that enhances weight is conducting research on two types of fodders A and B. Two groups of animals, one consisting 12 animals were feed on fodder A and other group consisting 10 animals on B for a period of 4 months. The record of weight gained in kilograms after the

Group 1	25	32	30	34	24	20	30	23	28	32	33	25
Group 2	44	34	22	17	45	40	41	30	32	35		

Test if two fodders differ significantly to enhance the weight at 5% level of significance.

Ans: 1.998; Accept H_0

12. 2065 (I) Q.No. 10 a

A random sample of size 16 showed a mean of 52 with a standard deviation 4. Test the hypothesis that the mean of the population is 50. [5]

Ans: 1.935; H_0 is accepted

13. 2065 (II) Q.No. 10

Marks of 8 students before tuition and after tuition is given below:

	1	2	3	4	5	6	7	8
Before tuition	50	54	52	53	48	51	53	54
After tuition	54	57	54	55	52	56	56	55

Can you conclude that tuition has benefited the students?

Ans: 6.48; H_0 is rejected.

14. 2064 Q.No. 8

Two different types of drugs D_1 and D_2 were applied on certain patients for increasing weight at interval of one week time period. From the following observation, can you conclude that the second drug is more effective in increasing weight, use 1% level of significance? [10]

D_1	8	12	13	9	3	8	10	9
D_2	10	8	12	15	6	11	12	12

Ans: $t = 1.208$, accept H_0

15. 2063 Q.No. 9

In a manufacturing company the new modern manager is in a belief that music enhances the productivity of the workers. He made observation on eight workers for a week and recorded the production before and after music was installed. From the data given below can one conclude that productivity has been increased due to music? [10]

Employee	1	2	3	4	5	6	7	8
Without music	220	202	226	190	200	215	208	210
With music	236	190	240	200	220	205	212	215

Ans: $t = 1.418$, (accept H_0) not significant

16. 2062 Q.No. 10

Ten cartoons are taken at random from an automatic filing machine. The mean net weight of the ten cartoons is 15.5 ounces and s.d. is 0.88 ounces. Can we conclude that there is a significant difference in the sample mean from the intended weight of 16 ounces? [$\alpha = 0.05$].

Also obtain 95% and 99% fiducial limits for the population mean. [10]

Ans: $|t| = 1.7045$, (accept H_0) not significant. There is no significant difference between sample mean and population mean (14.84, 16.16)

17. 2061 Q.No. 9

Sale of new electronic item in six stores before and after special promotional program are observed as follows:

Store	1	2	3	4	5	6
Sales before campaign	50	30	31	48	55	42
Sales after campaign	52	29	30	52	56	45

Can you judge the special promotional program a success? ($\alpha = 0.01$) [10]

Ans: $t = 1.58$, (accept H_0) not significant

18. 2059 Q.No. 8 b

A special coaching class on mathematics subject in a group of 10 students yield following changes in score, 8, 10, -2, 0, -5, -1, 9, 12, 6, 5.

Test at 5% level of significance whether the coaching class was effective or not. [10]

Ans: 2.2867, (reject H_0) significant

19. 2058 Q.No. 10

The monthly advertising expenditure of a company for two products A and B are as follows:

Month	Expenditure in Rs.	
	Product A	Product B
January	100	175
February	120	200
March	125	250
April	145	225
May	150	200
June	140	150
July	200	200

Is there sufficient evidence to conclude that the average expenditure on advertising on product B is more than that on product A? [10]

Ans: $t = 3.5204$, (reject H_0) significant

20. 2057 (II) Q.No. 11

The sales figure of an item in eight shops before and after advertisement is given as

Before:	70	65	48	72	80	92	98	100
After:	72	70	53	75	84	95	105	104

Test whether advertisement was effective or not.

[10]

Ans: 7.514, (reject H_0) significant**MBA****1. 2056 Q.No. 2 b**

In a manufacturing company the new modern manager is in a belief that music enhances the productivity of the workers. He made observation on six workers for a week and recorded the production before and after the music was installed. From the data below: Can you conclude that the productivity has indeed changed due to music.

[10]

Employee	1	2	3	4	5	6
Week without music	219	205	226	198	209	216
Week with music	235	186	240	203	221	205

Ans: 0.478, (accept H_0) not significant**2. 2055 Q.No. 2 a**

Two types of drugs were used on 5 and 7 patients for reducing their weight. drug A was imported and drug B indigenous. The decrease in the weight after using the drugs for six months was as follows:

Drug A:	10	12	13	11	14		
Drug B:	8	9	12	14	15	10	9

Is there a significant difference in the efficiency of two drugs? If not, which drug should you buy?

Ans: 0.735, (accept H_0) not significant**3. 2054 Q.No. 2 a**

For a random sample of 10 pigs fed on diet A, the increase in weight (in lbs) in a certain period were 10, 17, 13, 12, 9, 8, 14, 15, 6 are 16. For another random sample of 12 pigs fed on diet B, the increase in weight in the same period were 14, 18, 8, 21, 23, 10, 17, 12, 22, 15, 7 and 13. Test whether diets A and B differ significantly as regards their effect on increase in weight.

[10]

Ans: 1.48; (accept H_0) not significant**4. 2053 Q.No. 5 a**

A random sample of 16 value from a normal population showed a mean of 41.5 inches and the sum of squares of deviations from this mean equal to 135 square inches. Show that the assumption of a mean of 43.5 inches for the population is not reasonable. Obtain 95 and 99 percent fiducial limits from the same.

[10]

Ans: 2.67, (reject H_0) significant; 95 limits for the (39.902, 43.098); 99% limits for the (39.29; 43.71)**5. 2052 Q.No. 2 b**

The manufacturer of Shilpa Electric bulbs claims that have a mean life of 25 months. A random sample of 9 such bulbs gave the following values.

Life in months: 24, 26, 32, 28, 20, 20, 23, 27 and 34

Can you regard the manufacturer's claim to be valid at 5% level of significance?

[10]

Ans: 0.616, (accept H_0) not significant**6. 2051 Q.No. 2 a**

Prices of shares of a company on the different days in a month were found to be 66, 65, 69, 70, 69, 71, 70, 63, 64 and 68. Discuss whether the mean price of the shares in the month is 65.

[10]

Ans: $t = 2.82$, (reject H_0) significant**7. 2050 Q.No. 3 a**

The heights of 6 randomly chosen sailors are in inches. 63, 65, 68, 69, 71 and 72. Those of 9 randomly chosen soldiers are 61, 62, 65, 66, 69, 70, 71, 72 and 73. Discuss in the light that these data throw on the suggestion that sailors are on the average taller than soldiers.

[10]

Ans: 0.083, (accept H_0) not significant

8. 2048 Q.No. 2 b

10 MBA students were selected by a big organization. They were given an I.Q. test immediately after selection and their scores out of 50 were noted. A two-month training as arranged for them and on completion I.Q. test was again given and score recorded.

Students	1	2	3	4	5	6	7	8	9	10
Score (before)	31	35	38	25	40	45	40	38	18	30
Scores (after)	32	30	32	37	38	37	42	40	27	35

On the basis of these results, can it be concluded that the training has benefited the students? [10]
Ans: 0.49, (accept H_0) not significant

9. 2045 Q.No. 2 a

A group of six months old chickens reared on a high protein diet weight 1.2, 1.5, 1.1, 1.6, 1.4, 1.4 and 1.6 kg. A second group of five chickens similarly treated expect that they receive a low protein diet weight 0.8, 1.0, 1.4, 1.0 and 1.3 kg. Test whether there is significant evidence that high protein diet has increased the weight of the chickens. [5]
Ans: 2.39, (reject H_0) significant

10. 2042 Q.No. 2 a

The specimen of copper wires drawn from a large lots have the following breaking strength (in kg wt.): 578, 572, 570, 568, 572, 578, 570, 572, 596, 544
Test whether the mean breaking strength of the lot may be taken to be 578 kg weights. [10]
Ans: 1.49, (accept H_0) not significant

11. 2041 Q.No. 2 a

The sales data of an item in six shops before and after a special promotional campaign are:

Shops	A	B	C	D	E	F
Before	50	28	31	48	50	42
After	58	29	32	55	56	45

Can the campaign be judged to be a success? [10]
Ans: 3.45, (reject H_0) significant

D. F- TEST

MBS

1. 2071 Q.No. 10

The labour productivity index of Nepal were recorded as below:

Sector	Year		
	2000	2005	2010
Agriculture	110	125	140
Manufacturing	120	75	100
Community and social services	100	90	80

Does labour productivity index vary due to ① difference in time period ② difference in sector? [10]

Ans: (1) $F = 0.42$, accept H_0 (2) $F = 2.91$, accept H_0

2. 2070 Q.No. 10b

Sample I

$$n_1 = 10$$

$$\Sigma(X_1 - \bar{X}_1)^2 = 120$$

Test whether two population variances are same or not.

Sample II

$$n_2 = 16$$

$$\Sigma(X_2 - \bar{X}_2)^2 = 324$$

[5]
Ans: $F = 1.62$; accept H_0

3. 2070 Old Q.No. 10

The productivity of the operators were recorded as follows:

Operators	Machines			
	M ₁	M ₂	M ₃	M ₄
A	12	10	16	14
B	14	9	15	14
C	16	13	14	11
D	18	8	19	15

Test whether difference in average productivity is due to the (i) difference in operators
(ii) difference in machines. [10]

Ans: (i) $F = 0.696$; accept H_0 , (ii) $F = 5.37$, reject H_0

4. 2069 Q.No. 10b

Following results are obtained from a study on three products A, B, C taking samples of 25 in total for all the products.

- (i) Set the null and alternate hypothesis.
(ii) Test the hypothesis at 5% level of significance. [5]

Source of variation	Sum of squares
Model	15.68
Error	94.40
Total	110.08

Ans: $F = 1.83$; accept H_0

5. 2069 Old Q.No. 11a

Test whether two populations have same variances or not from the following: [5]

	Sample A	Sample B
Sample size	7	6
Sum of the squares of the deviations from mean	320	350

Ans: $F = 1.3$; accept H_0

6. 2069 Old Q.No. 11b

The following results were obtained in a study of the sales made by 3 sales person in 4 different regions. [5]

Total sum of squares (SST) = 210
Sum of squares between sales person (SSC) = 32
Sum of squares between regions (SSR) = 42

Test whether there is any significant difference in the sales of different salesmen and regions.

Ans: (i) $F = 0.71$, accept H_0 , (ii) $F = 0.62$, accept H_0

7. 2068 Q.No. 10b

Obtain the estimates of population variances and test at 5% level of significance whether two populations have same variances or not from the following: [5]

	Sample I	Sample II
Sample size	10	8
Sum of the squares of deviations from mean	320	350

Ans: $F = 1.406$; accept H_0 ; same variances

8. 2068 (Old) Q.No. 11

A garment company appoints four salesmen P, Q, R and S and observes their sales in three seasons. The sales made by the salesmen (in millions of rupees) is given as follows:

Seasons	Salesmen			
	P	Q	R	S
Summer	40	40	25	39
Winter	32	33	35	36
Monsoon	30	32	33	33

Carry out an analysis of variance and test whether there is any significant difference in the sales of different salesmen and seasons. [10]

Ans: Salesmen: $F_{cal} = 0.62$, accept H_0 , there is no significant different in the average sales due to four salesmen P, Q, R and S; Seasons: $F_{cal} = 0.71$, accept H_0 , there is no significant difference in the average sales in three seasons.

9. 2067 (I) Q.No. 10

A three day survey on production of sweaters per day from three machines in a factory is as follows. Perform one-way ANOVA to test whether the variation in average production is due to the variation in machines. [10]

Machines		
A	B	C
20	30	30
25	25	20
15	35	25

Ans: 3

10. 2067 (II) Q.No. 9a

Four manager were deputed to five different branch of a bank on rotation for a year to study whether the average performance of the managers and the branches are significantly different in terms of productivity. Following information prevailed test the hypothesis at 5% level of significance and discuss the decision. [5]

Sources of variation	D.F	Sums of Squares
Between managers	4 - 1	338.8
Between branches	5 - 1	161.5
Error	(5 - 1)(4 - 1)	73.7
Total	20 - 1	574

$F_{0.05}(3, 12) = 3.49$, $F_{0.05}(12, 3) = 8.74$,
 $F_{0.05}(4, 12) = 3.26$, $F_{0.05}(12, 4) = 5.91$

Ans: (i) Significant different between average performance of the managers in terms of productivity (ii) significant different between the average performance of the branches in terms of productivity.

11. 2067 (II) (Old) Q.No. 11

The following table represents the sales (in lakh rupees) of a certain factory in 5 districts by its four salesmen.

Districts	Salesmen			
	S ₁	S ₂	S ₃	S ₄
D ₁	34	28	37	26
D ₂	36	30	42	33
D ₃	24	26	34	22
D ₄	33	28	36	23
D ₅	28	32	39	29

Find whether differences in average sales is due to the difference in (i) salesmen (ii) districts [10]

Ans: (i) $F = 18.39$, significant difference due to difference in salesmen (ii) $F = 6.58$, significant difference due to difference in districts

12. 2066 Q.No. 10a

Two random samples gave the following results:

Sample	Size	Sample mean	Sum of square of deviation from mean
1	10	15	90
2	12	14	108

Test whether the sample comes from normal population with same variance. [10]

$F_{0.05}$ for (9, 11) d.f. = 2.90

$F_{0.05}$ for (11, 9) d.f. = 3.03

Ans: $F = 1.02$; Accept H_0

13. 2066 Partial Q.No. 11b

Two random samples gave the following results:

Sample	Sample size	Sample mean	Sum of squares of deviation from the mean
1	10	15	90
2	15	20	110

Test whether the samples come from the same normal population with same variance at 5% level of significance.

Ans: 1.27; Accept H_0

14. 2065 (I) Q.No. 11

Four trained operator work in four machines in production of a new product. The productivity of the operators and machine are recorded as below:

Machines → Operators	1	2	3	4	Total
1	10	12	14	16	52
2	12	11	13	16	52
3	14	15	12	11	52
4	16	10	17	17	60
Total	52	48	56	60	216

Test whether difference in average productivity is due to the difference in operators or the machines. [10]

Ans: $F_1 = 1.036$; $F_2 = 0.621$; H_0 is accepted.

15. 2064 Q.No. 11

An investor of stock market is interested in testing whether there is significant differences in rates of return on stocks, bonds and mutual funds. He recorded data as follows:

Rate of return (%)		
Stocks	Bonds	Mutual Fund
2.1	4.0	3.5
6.0	3.1	3.1
2.0	2.2	2.9
2.9	5.7	1.5
Total 13.0	15.0	11.0

Test the hypothesis at 5% level of significance. [10]

Ans: $F = 0.46$, accept H_0

16. 2063 Q.No. 11 a

Obtain the estimates of the population variances and test whether the two populations have same variances or not from the following. [5]

Samples I	$n_1 = 10$	$\sum(X_1 - \bar{X}_2)^2 = 120$ hrs
Sample II	$n_1 = 12$	$\sum(X_2 - \bar{X}_2)^2 = 314$ hrs

Ans: $F = 2.142$, (accept H_0) not significant

17. 2062 Q.No. 12

A research company has designed three different systems to clean up oil spills. The following table contains the results, measured by how much surface area (in sq. m.) is cleared per hour. Are the three systems equally effective? Use 5% level of significance. [10]

System A	System B	System C
55	57	66
60	53	52
63	64	61
56	49	57
59	62	-
55	-	-
Total 348	285	236
Grand Total	869	

Ans: $F = 0.17$; (accept H_0) not significant. Three systems are equally effective.

18. 2061 Q.No. 10

Salesmen in various sectors are assigned to increase the sales. Data are recorded as below:

Region		
1	2	3
20	30	25
80	40	50
50	30	40
60	40	30
70	50	40

At 5% level of significance, test whether there is significant difference in sales due to the regions. [10]

Ans: $F = 2.47$, (accept H_0) not significant

19. 2060 Q.No. 11

The following data represents the number of units of production per day turned out by 5 different workmen using different types of machines.

Machine Type	1	2	3	4	5
A	44	46	34	33	38
B	38	40	36	38	42
C	47	52	44	46	49
D	36	43	32	33	39

Test whether the mean productivity is the same for the four different machine types [10]

Ans: $F = 6.86$, (reject H_0) significant

20. 2059 Q.No. 9

The average rate of return recorded by an investor are as follows:

Financial Sector	Manufacturing Sector	Hotels
6	2	1
5	3	2
7	1	3
10	5	1
12	4	3

Is there any significance difference in the average return due to the sectors? Test the hypothesis at 1% level of significance. [10]

Ans: 12.92, (reject H_0) significant

21. 2058 Q.No. 11

The labour productivity index of Nepal are recorded as below:

Sector	Year		
	1985	1990	1995
Agriculture	100	125	138
Manufacturing	100	60	53
Community and social service	100	89	80

Does the labour productivity index vary due to the

(i) difference in sector; (ii) difference in time period? [5+5]

Ans: (i) 0.164 (ii) 3.7130, (accept H_0) not significant

22. 2057 (I) Q.No. 10

The following table represents the sales of three salesmen in four different districts.

Districts	Sales figures (000)		
	A	B	C
Kathmandu	14	20	16
Lalitpur	12	23	15
Bhaktapur	10	20	10
Palpa	8	18	12

Test whether there is any significance difference in the sales of different districts. [5]

Ans: $F = 0.55$, (accept H_0) not significant

23. 2057 (II) Q.No. 10 b

Test whether two populations have the same variance or not from the following: [5]

Sample I	Sample II
$n_1 = 7; \sum(X_1 - \bar{X}_1)^2 = 320$	$n_2 = 6; \sum(X_2 - \bar{X}_2)^2 = 350$

Ans: 1.31, (accept H_0) not significant

MBA

1. 2056 Q.No. 3 a

A trucking firm has three types of trucks. It wishes to determine the effect of the type of truck on operating cost is Rs. per mile. From the following data can we conclude that all three types of trucks have the same operating cost per mile. [10]

Type A	Type B	Type C
Rs. 73	Rs. 56	Rs. 79
Rs. 83	Rs. 76	Rs. 95
Rs. 76	Rs. 72	Rs. 87
Rs. 68		Rs. 83
Rs. 80		Rs. 84
		Rs. 81

Ans: 7.72, (reject H_0) significant

2. 2055 Q.No. 4 b

Three training methods were compared to see if they led to greater productivity after training. Below are productivity measures for individuals trained by each method.

Method 1	45	40	50	39	53	44
Method 2	59	43	47	51	39	49
Method 3	41	37	43	40	52	37

At the 0.05 level of significance, do the three training methods lead to a different levels of productivity. [10]

Ans: 1.67, (accept H_0) not significant

3. 2054 Q.No. 3 b

The following data show the number of claims processed per day for a group of four insurance company employees observed for a number of days. Test the hypothesis that the employee's main claim per day are all the same. [10]

Use the 0.05 level of significance:

Employee 1	15	17	14	12		
Employee 2	12	10	13	17		
Employee 3	11	14	13	15	12	
Employee 4	13	12	12	14	10	9

Ans: 1.47, (accept H_0) not significant

4. 2053 Q.No. 5 b

Two horses A and B were tested according to the time (in seconds) to run a particular track with the following results. [10]

Horse A	28	30	32	33	33	29	34
Horse B	29	30	30	24	27	29	

Test whether the two horses are equally consistent or not?

Ans: 1.03, (accept H_0) not significant

5. 2052 Q.No. 4 b

Two random samples drawn from populations are:

Sample I	20	16	26	27	23	22	18	24	25	19
Samples II	17	23	34	25	22	26	28	22	37	

Obtain estimates of the variances of the population and test whether the two populations have the same variance. [10]

Ans: $f = 2.93$, (accept H_0) not significant

6. 2051 Q.No. 4 b

Two random samples drawn from the populations are:

Sample I	10	16	22	25	23	20	24	26	27	29
Samples II	17	20	25	25	27	28	30	31	30	

Test whether the two populations have the same variance. [10]

$f = 1.4$, (accept H_0) not significant

7. 2050 Q.No. 2 b

Two random samples drawn from two normal populations are:

	Weights in lbs						
Sample I	28	30	32	33	33	29	34
Sample II	29	30	30	24	27	29	

Obtain the estimates of the variances of the populations and also test whether the population have same variances.

Ans: 1.02, (accept H_0) not significant [10]

8. 2048 Q.No. 4 b

Two independent samples of 7 and 6 items respectively had the following value of variables:

	Weights in lbs						
Sample A	9	11	13	11	15	9	12
Sample B	10	12	10	14	9	8	

Do the two estimates of population variance differ significantly?

[10]

Ans: 1.02, (accept H_0) not significant

9. 2046 Q.No. 3

The following data represents the number of units of production per day turned out by 5 different workmen using 4 different types of machines.

Workmen	Machine Type			
	A	B	C	D
1	44	38	47	36
2	46	40	52	43
3	34	36	44	32
4	33	38	46	33
5	38	42	49	39

a. Test whether the mean productivity is the same for the four different machine types.

b. Test whether the 5 workmen differ with respect to mean productivity.

[10+10]

Ans: (a) 7.81 (reject H_0) significant (b) 2.72 (accept H_0) not significant

10. 2045 Q.No. 4

A tea company appoints four salesmen: A, B, C and D and observes their sales in three seasons summer, winter and monsoon. The figures (in lakh) are given below:

Seasons	Salesmen				Total
	A	B	C	D	
Summer	36	36	21	35	128
Winter	28	29	31	32	120
Monsoon	26	28	29	29	112
	90	93	81	96	360

Find out if there is difference in the sales of different salesmen and seasons.

[20]

Ans: 0.62, (accept H_0), 0.71, (accept H_0) not significant

11. 2041 Q.No. 4

Following table gives the monthly sales (in thousand rupees) of a certain firm in three regions by its four salesman:

Region	Salesmen			
	A	B	C	D
X	5	4	4	7
Y	7	8	5	4
Z	9	6	6	7
Total	21	18	15	18

Test whether the sales are significantly different due to the four salesmen.

[20]

Ans: 0.67, (accept H_0) not significant

E. χ^2 TEST

MBS

WRITE SHORT NOTES ON

1. 2067 (II) Q.No. 12 a)

Application of χ^2 test (chi square)

NUMERICAL PROBLEMS

2. 2071 Q.No. 9

A large corporation is interested in determining whether a relationship exists between the commuting time of its employees and level of stress-related problems observed on the job. A study of 116 assembly-line workers reveals the following

Commuting time	Stress level		
	High	Moderate	Low
Under 15 min.	9	5	18
15 - 45 min.	17	8	28
Over 45 min.	18	6	7

At the 0.01 level of significance, is there evidence of a significant relationship between commuting time and stress level? [10]

Ans: $\chi^2 = 9.292$, accept H_0

3. 2070 Q.No. 11

Manufacturer is bringing out a new product in order to determine whether the new product will appeal most to a particular group or will appeal equally to all age group. The manufacture conducted a sample survey and find following data. [10]

Persons opinion	Age group				Total
	< 15	15 - 24	25 - 34	35 - 44	
Liked the product	300	100	110	200	710
Disliked the product	50	15	70	60	195
Indifferent	25	10	20	40	95
	375	125	200	300	1000

Ans: $\chi^2 = 57.464$; reject H_0

4. 2070 Old Q.No. 11

A company is considering an organizational change by adopting the use of self-managed work teams. To assess the attitude of the employees of the company toward this change, a sample of 400 employees is selected and asked whether they favour the institution of self managed work teams in the organization. Three responses are permitted: favour, natural, or oppose. The result of the survey are summarized as follows:

Type of job	Self Managed Work Teams			Total
	Favour	Neutral	Oppose	
Hourly worker	108	46	71	225
Supervisor	18	12	30	60
Middle management	35	14	26	75
Upper management	24	7	9	40
Total	185	79	136	400

At 5% level of significance, is there evidence of a relationship between attitude toward self-managed work teams and type of job? [10]

Ans: $\chi^2 = 11.8967$; accept H_0

5. 2069 Q.No. 11

The manager of newly opened KFC chain of fast food restaurant in Kathmandu derives to test the likeliness of the food with different age-group. A sample of 100 visitors in the KFC restaurant were asked their opinion and following is the result.

	20-30	30-50	>50	Total
Liked	40	20	10	70
Not liked	10	10	10	30
	50	30	20	100

Test the hypothesis whether liking of KFC food is associated with age group. [10]

Ans: $\chi^2 = 6.3493$, reject H_0 , liking of KFC food and age group is associated

6. 2069 Old Q.No. 10

The following are the mistakes per page observed in a book:

No. of mistakes per page	0	1	2	3	4	5
Frequency	142	156	69	27	5	1

Fit Poisson distribution and test the goodness of fit.

[10]

Ans: 147, 147, 74, 25, 6, 1; $\chi^2 = 1.494$, accept H_0

7. 2068 Q.No. 11

A set of five coins were tossed 3200 times and the number of heads appearing each time was noted as follows:

No. of heads	0	1	2	3	4	5
Frequency	80	570	1100	900	500	50

Test the hypothesis that the coins are unbiased.

[10]

Ans: $\chi^2 = 58.8$; reject H_0 , biased

8. 2068 (Old) Q.No. 10

A set of 5 coins was tossed 3200 times and the number of heads appeared each time was noted

No. of heads	0	1	2	3	4	5
Frequency	80	570	1100	900	500	50

Find expected frequencies and test for goodness of fit.

[10]

Ans: 100, 500, 1000, 500, 100; $\chi^2 = 58.8$; Reject H_0 , biased

9. 2067 (I) Q.No. 9

Pizza Hut wants to open its branches indifferent regions of Nepal and a sample of 3000 persons were surveyed to know whether they like the Pizza or not. The result is as follows:

	East	Centre	West	Far West	Total
Like	250	400	300	950	1900
Do not like	250	100	200	550	1100
	500	500	500	1500	3000

Test whether liking or not liking of Pizza is associated with the region of Nepal.

[10]

Ans: 100.478

10. 2067 (II) (Old) Q.No. 10

Three researchers adopted different sampling techniques while investigating the same group of students to find the number of students failing in different intelligence levels. The results were as follows:

Researcher	No. of students in each level			
	Very low	low	high	very high
R ₁	24	97	62	58
R ₂	22	28	30	41
R ₃	32	10	11	20

Is there any significant differences in the level of students?

[10]

Ans: $\chi^2 = 67.416$; Significant different

11. 2066 Q.No. 10b

Theory predicts that the frequencies of A, B, C and D are in proportion 9:3:3:1. But in experiment frequencies of A, B, C and D are found respectively 315, 101, 108 and 32. Test the correspondence between theory and experiment.

$$\chi^2_{0.05} \text{ for 2 d.f.} = 5.991$$

$$\chi^2_{0.05} \text{ for 3 d.f.} = 7.815$$

$$\chi^2_{0.05} \text{ for 4 d.f.} = 9.488 \quad [5]$$

Ans: $\chi^2 = 0.47$; Accept H_0

12. 2066 Partial Q.No. 11a

Among the 90 offspring of a certain cross between rabbits 46 were red 16 were black and 28 were white. According to the genetic model these numbers should be in the ratio 8:3:4. Are the data consistent with the model at 5% level?

[5]

Ans: 0.972; Accept H_0

13. 2065 (I) Q.No. 12

The number of married, unmarried and widow population in the three cities of Kathmandu Valley is obtained as below. Test whether the city and the marital status of the adult female population are associated. [10]

City \ Marital Status	Married	Unmarried	Widow	
	X	20	15	15
Y	30	20	25	75
Z	50	40	10	100
	100	75	50	225

Ans: 15.994; H_0 is rejected

14. 2065 (II) Q.No. 11

A random sample of 200 students was selected and their grading in ability in mathematics and interest in business administration were as given below:

Interest in Business Administration	Ability in mathematics			Total
	Low	Average	High	
Low	60	15	15	90
Average	15	45	10	70
High	5	10	25	40
Total	80	70	50	200

Test whether there is any relationship between student interest in business administration and ability in mathematics. [10]

Ans: 84.76; H_0 is rejected

15. 2064 Q.No. 9

A 'movie theatre' owner is trying to introduce new strategy of showing only English movie in his theatre. A survey on 200 persons of various age group was conducted and the result is as follows:

	Age group			Total
	Below 20	20-40	above 40	
Liked movie	50	25	25	100
Dislike movie	30	30	40	100

Test at 5% level of significance whether age group is associated with the new strategy. [10]

Ans: $\chi^2 = 8.92$, reject H_0

16. 2063 Q.No. 11 b

A dice was thrown 120 times and the frequencies of various faces are as follows:

Faces No.	1	2	3	4	5	6
Frequency	10	15	20	30	28	17

Test whether the observed data are fitted with the expected data or not? [5]

Ans: $\chi^2 = 14.9$, (reject H_0) significant

17. 2062 Q.No. 9

One thousands students at college level were studied in terms of their CMAT score and the types of schools they came from, and, the data is presented as below:

	CMAT		Total
	High	Low	
Private school	460	140	600
Public school	240	160	400
	700	300	1000

At 5% level of significance, can you conclude that there is association between the types of school and the CMAT scores? [10]

Ans: $\chi^2 = 31.746$; (reject H_0) significant

18. 2061 Q.No. 8 b

From the following data can you conclude that there is association between the purpose of brand and the geographical region?

	Central region	Eastern region	Western region
Purchase brand	40	55	45
Do not purchase brand	60	45	55

Use 5% level of significance.

[5]

Ans: $\chi^2 = 4.687$, (accept H_0) not significant

19. 2060 Q.No. 10

From the adult male population of seven large cities random samples of married and unmarried men as given below were taken, can it be said that there is significant variation among the cities in the tendency of men to marry. [10]

Marital Status	Cities				Total
	A	B	C	D	
Married	40	285	165	106	596
Unmarried	170	125	35	37	367
Total	210	410	200	143	963

Ans: $\chi^2 = 218.6151$, (reject H_0) significant

20. 2059 Q.No. 10

The sales pattern due to trained and fresh salesmen were recorded as follows:

	Sales (Rs.)			
	0 - 500	500-1000	Above 1000	Total
Trained salesman	15	25	30	70
Fresh salesman	15	10	5	30
Total	30	35	35	100

Is there any evidence to conclude that the training of salesman and the sales revenue are associated? [10]

Ans: $\chi^2 = 9.864$, (reject H_0) significant

21. 2058 Q.No. 8

Fit a Poisson distribution to the following data and test the goodness of fit. [10]

X	0	1	2	3	4
f	120	60	15	4	1

Ans: 117.72, 62.39, 16.53, 2.92, 0.44, $\chi^2 = 0.1363$ (accept H_0) not significant

22. 2057 (I) Q.No. 11

From hundred employees of a factory are classified according to their level and decisions. Do you agree with the statement that decisions vary according to the level of employee? [10]

Decisions	Senior Officer	Officer	Jr. Officer	Total
Quick	60	80	70	210
Slow	40	60	90	190
Total	100	140	160	400

Ans: $\chi^2 = 8.377$, (reject H_0) significant

23. 2057 (II) Q.No. 10 a

A sample of 500 workers of a factory according to sex and nature of work is as follows:

Nature of work	Male	Female	Total
Technical	200	100	300
Non-technical	50	150	200
Total	250	250	500

Test at 5% level of significance whether there exists any relationship between sex and nature of work.

Ans: $\chi^2 = 83.334$, (reject H_0) significant [5]

MBA

1. 2056 Q.No. 3 b

Marketing manager of a company is concerned that the Brand's share is unevenly distributed through the country. In a survey of 100 consumers in four geographic regions of the country following result was obtained.

Region	North east	North west	South east	South west	
Purchase the Brand	40	55	45	50	190
Do not purchased the Brand	60	45	55	50	210
	100	100	100	100	400

Is the marketing manager's concern correct?

[10]

Ans: 5.012, (accept H_0) not significant

2. 2055 Q.No. 3 a

A manufacturer of TV sets was trying to find out what variable influenced the purchased of TV set. Level of income was suggested as possible variable influencing the purchase of TV sets. A sample of 500 households was selected and the information obtained is classified as shown below:

	Have TV sets	Do not have TV sets
Low income group	0	250
Middle income group	50	100
High income group	80	20
Total	130	370

Is there evidence from the above data of a relation between ownership of TV sets and level of income?

[10]

Ans: 243.590, (reject H_0) significant

3. 2054 Q.No. 3 a

A financial consultant is interested in the differences in capital structure within different from sizes in a certain industry; the consultant surveys a group of firms with assets of different amount and divides the firms into three groups. Each firm is classified according to whether its total debt is greater than stockholder's equity or whether its total debt is less than stockholder's equity, the results of the survey are:

	Firms assets sized (in thousands)			
	< Rs. 500	Rs. 500-2000	Rs. 2000+	Total
Debt less than equity	7	10	8	25
Debt greater than equity	10	18	9	37
Total	17	28	17	62

Do the three firm sizes have the same capital structure? Use 0.10 significance level.

[10]

Ans: 0.5727, (accept H_0) not significant

4. 2053 Q.No. 2

Fit a binomial distribution to the following data, assuming that the coin is unbiased.

No. of heads (X)	0	1	2	3	4	5
Frequencies (f)	90	560	1000	900	600	50

Test the goodness of fit for above data.

[20]

Ans: 63.2, (reject H_0) significant

5. 2052 Q.No. 4 a

A brand manager is concerned that his brands share may be unevenly distributed throughout the country. In a survey in which the country was divided into 4 geographic regions, a random sampling of 100 consumers in each region was surveyed, with the following results:

	Regions			
	A	B	C	D
Purchase the brand	47	52	43	49
Do not purchase	53	48	57	51

Do the brand share in four regions are evenly distributed?

[10]

Ans: 1.7135, (accept H_0) not significant

6. 2051 Q.No. 4 a)

The department of Business Administration at a university would like to determine whether there is a relationship between student interest in Business Administration and ability in Mathematics.

A random sample of 200 students is selected and they are asked whether their ability in Mathematics and interest in Business Administration are low, average or high. The results were as follows: [10]

Interest in Business Administration	Ability in Mathematics			Total
	Low	Average	High	
Low	60	15	15	90
Average	15	45	10	70
High	5	10	25	40
Total	80	70	50	200

Ans: 84.75, (reject H_0) significant

7. 2050 Q.No. 3 b)

In a set of random number the digits were found to have the following frequencies:

Digits	0	1	2	3	4	5	6	7	8	9
Frequencies	43	32	38	27	38	52	36	31	39	24

Test whether they are significantly different from those expected on the hypothesis of uniform distribution. [10]

Ans: 16.287, (accept H_0) not significant

8. 2046 Q.No. 2 b)

Do the following data provide evidence of the effectiveness of inoculation? [10]

	Attacked	Not attacked	Total
Inoculated	20	300	320
Not inoculated	80	600	680
Total	100	900	1000

Ans: 4.853

9. 2045 Q.No. 2 b)

Among 64 off springs of a certain cross between guinea pigs, 34 were red, 10 were black and 20 were white. According to the genetic model these numbers should be in the ratio 9:3:4. Are the data consistent with the model at 5 percent level? [10]

Ans: 1.444, (accept H_0) not significant

10. 2042 Q.No. 3)

The following information is obtained concerning an investigation of 50 ordinary shops of small size.

	Shops		
	In town	In village	Total
Run by men	17	18	35
Run by women	10	15	25
Total	27	33	60

Can it be inferred that shops run by women are relatively more in village than in town? [10]

Ans: 0.4329, (accept H_0) not significant

11. 2041 Q.No. 3)

The number of automobile accidents per week in a certain community were as follows:

12 8 20 2 14 10 15 6 9 4

Are these frequencies in agreement with the belief that accident conditions were the same during the 10 week periods under considerations? [20]

Ans: 26.6, (reject H_0) significant

12. 2040 Q.No. 7)

Shyam and Co. produces three varieties of products: deluxe, fine and ordinary. In a recent market survey conducted in four cities, the preference was found as stated below:

	Deluxe	Fine	Ordinary	Total
Kathmandu	50	30	20	100
Tansen	18	12	16	46
Nepalgunj	8	25	17	50
Birgunj	20	16	37	73
	96	83	90	269

Is there a significant difference in the preference of products among the customers of different cities? [20]

Ans: 32.86, (reject H_0) significant

13. 2039 Q.No. 6

From the adult male population of seven large cities random samples of married and unmarried men as given below were taken. Can it be said that there is significant variation among the cities in the tendency of men to marry. [Given, χ^2 at 0.05 at 6 d.f. = 12.6] [20]

Marital Status	Cities							Total
	A	B	C	D	E	F	G	
Unmarried	170	285	165	106	153	125	146	1150
Married	40	125	35	37	55	35	33	360
Total	210	410	200	143	208	160	179	1510

Ans: $\chi^2 = 21.3875$, (reject H_0) significant

6. CORRELATION AND REGRESSION ANALYSIS

MBS

THEORETICAL QUESTIONS

1. 2057 (II) Q.No. 7 a

Explain multi-collinearity and autocorrelation and their application in analysis of regression model. [5]

WRITE SHORT NOTES ON

2. 2067 (I) Q.No. 12b

Multicollinearity [5]

NUMERICAL PROBLEMS

3. 2071 Q.No. 12

Fit the best regression line to the following data:

Productivity	Labour	Inputs
25	50	5
28	48	10
26	50	9
30	55	8
34	60	12
37	65	11

i. What will be the productivity if input is 14 and labour is 68?

ii. Compute coefficient of multiple determination. [10]

Ans: (i) $\hat{Y} = -4.935 + 0.542X_1 + 0.577X_2$; 40; where Y = productivity, X_1 = Labour and X_2 = Inputs (ii) $R^2 = 0.9380$

4. 2070 Q.No. 12

The information below has been gathered from a random sample of apartment renters of Kathmandu city.

Rent in Rs.	Number of rooms	Distance from downtown (Km)
360	2	1
1000	6	1
450	3	2
525	4	3
350	2	10
300	1	4

- ① Calculate the least squares equation that best relates these three variables.
 ② If some one is looking for a 2 bedroom apartment two kilometres from downtown, what rent should be expect to pay? [10]

Ans: $Y = \text{Rent in Rs.}; X_1 = \text{Size of apartment (number of rooms)}; X_2 = \text{distance from downtown (in km)}$;

$$\hat{Y} = 96.458 + 136.485X_1 - 2.403X_2 \quad \text{Rs. } 364.622$$

5. 2070 Old Q.No. 12

A household survey in a town obtained following information about income, and expenditure on the basis of family size.

Family size	Expenditure '000'	Income '000'
1	4	8
2	6	10
3	7	12
4	9	14
5	11	15
6	14	16
7	15	18

Find the expenditure on food of a family of size 3 with income Rs. 20,000 by developing the best regression line. [10]

Ans: $Y = \text{expenditure on food (000)}; X_1 = \text{family size}; X_2 = \text{income ('000)}$;

$$\hat{Y} = 8.267 + 3.396X_1 - 0.935X_2 \quad \text{and -Rs. } 245$$

6. 2069 Q.No. 12

The second-hand car is supposed to be affected by the mileage covered and the duration of use. From the data below, find the price of a used car with 10 years used with 12,000 mileages. [10]

Price (lakhs)	3.0	3.25	3.5	4.0	4.5	5.0	6.0
Year use	8	7	6	5	5	6	4
Mileage ('000)	40	35	30	25	20	15	10

$$\text{Ans: } \hat{Y} = 6.402 + 0.06 X_1 - 0.103 X_2; \text{ Rs. } 5.766 \text{ lakhs}$$

7. 2069 Old Q.No. 12

Estimate the relationship between the use of inputs and labour on productivity from the following:

Productivity	17	20	18	22	26	29
Inputs	7	10	9	8	12	11
Labour	45	50	55	60	65	55

- ① Estimate amount of productivity when inputs is 15 and labour 70.
 ② Compute coefficient of multiple determination. [10]

$$\text{Ans: } \hat{Y} = -1.155 + 1.621 X_1 + 0.141 X_2; 33.03 \approx 0.6286$$

8. 2068 Q.No. 12

A researcher wants to determine the sales behaviour of a compact cassette tape recorded. The following table represents the sales behaviour of a shop.

Sales (units sold)	Advertising (No. of ads)	Price ('000 Rs.)
Y	X_1	X_2
33	3	125
61	6	115
70	10	140
82	13	130
17	9	145
24	6	140

Estimate the sales when the number of advertising is 7 units and price is Rs. 132 thousand.

$$\text{Ans: } Y = 219.23 + 6.381 X_1 - 1.671 X_2; 43$$

9. 2068 (Old) Q.No. 12

Family	Annual savings ('000 Rs.)	Annual income ('10,000 Rs.)	Size of family
A	10	15	3
B	7	15	6
C	12	23	4
D	12	18	3
E	6	12	5
F	8	14	2
G	10	15	4

Estimate annual savings of a family, whose family size is 3 and annual income is Rs. 1,80,000. Also calculate coefficient of determination. [10]

$$\text{Ans: } Y_c = 3.627 + 0.513X_1 - 0.661X_2; \text{ Rs } 10,878; R^2_{y,12} = 0.7976$$

10. 2067 (I) Q.No. 11

A household survey in a town obtained following information about the expenditure on food of the family.

Family	1	2	3	4	5	6	7
Food exp. ('00) (Y)	5	7	8	10	11	15	14
Income ('000) (X_1)	7	9	10	12	13	14	15
Family size (X_2)	2	3	4	3	5	4	6

Find the expenditure on food of a family with income of Rs.20,000 and family size 4. [10]

$$\text{Ans: } \hat{Y} = -4 + 1.18X_1 + 0.13X_2; 2012$$

11. 2067 (II) Q.No. 11

A sample of 10 values of three variables X_1 , X_2 , and X_3 were given as

$\Sigma X_1 = 10$	$\Sigma X_1^2 = 20$	$\Sigma X_1 X_2 = 10$
$\Sigma X_2 = 20$	$\Sigma X_2^2 = 68$	$\Sigma X_1 X_3 = 20$
$\Sigma X_3 = 30$	$\Sigma X_3^2 = 170$	$\Sigma X_2 X_3 = 64$

- Find multiple regression equation of X_3 on X_1 and X_2 and estimate X_3 when $X_1 = 2$ and $X_2 = 4$.
- Coefficient of multiple determination and interpret the result. [5]

Ans: (i) $\hat{X}_3 = 4.999 - 1.333 X_1 - 0.333 X_2$; Estimate = 1.001 (ii) $R^2_{3,12} = 0.149975$; 14.9975% of the total variation in the dependent variable X_3 has been explained by the independent variables X_1 and X_2 .

12. 2067 (II) (Old) Q.No. 12

Fit the best regression line to the following data

Productivity	25	28	26	30	34	37
Labour	50	48	50	55	60	65
Inputs	5	10	9	8	12	11

- What will be the productivity if input is 15 and labour is 70?
- Compute coefficient of multiple determination. [10]

Ans: (i) $X_1 = \text{productivity}$; $X_2 = \text{labour}$; $X_3 = \text{inputs}$; $\hat{X}_1 = -4.9149 + 0.542 X_2 + 0.577 X_3$; 41.676 (ii) $R^2_{1,23} = 0.964$

13. 2066 Q.No. 11

Given the following data. Determine the multiple regression equation of X_3 on X_1 and X_2 and coefficient of multiple determination.

X_1	9	12	10	7	17
X_2	2	5	4	3	6
X_3	4	5	5	3	8

$$\text{Ans: } X_3 = -0.309 + 0.504X_1 - 0.058X_2; R^2 = 0.972$$

14. 2066 Partial Q.No. 12

- (a) If simple correlation coefficients between fertilizer and seed, and productivity and productivity and fertilizer are respectively 0.87, 0.93 and 0.85; find coefficient of multiple determination of productivity on fertilizer and seed.
- (b) Given

$n = 7$	$\Sigma X_1 = 210$	$\Sigma X_2 = 21$	$\Sigma X_3 = 56$
$\Sigma X_1 X_2 = 535$	$\Sigma X_2 X_3 = 181$	$\Sigma X_3 X_1 = 1645$	
$\Sigma X_1^2 = 7750$	$\Sigma X_2^2 = 75$	$\Sigma X_3^2 = 472$	

Find regression equation of X_2 on X_1 and X_3 .

Ans: (a) 0.872 (b) $\hat{X}_2 = 8.324 - 0.054X_1 - 0.463X_3$

15. 2065 (I) Q.No. 9

For the following data on sales of a product, the advertising expenses and the price of the product, estimate the line that best describes the data.

Year	Y Sales ('00 units sold)	X_1 Advertising expenses ('00 Rs.)	X_2 Price ('00 Rs./unit)
1	2	1	2
2	3	2	2
3	5	3	2
4	4	5	3
5	1	7	4
6	2	6	4
7	3	4	5
8	2	5	6
9	5	3	6
10	3	4	6
Total	30	40	40

Also, obtain the coefficient of determination and coefficient of multiple correlation. [10]

Ans: 0.428 and 0.183

16. 2065 (II) Q.No. 12

A sample of 10 values of three variables X_1 , X_2 and X_3 were obtained as

$\Sigma X_1 = 10$	$\Sigma X_2 = 20$	$\Sigma X_3 = 30$
$\Sigma X_1^2 = 20$	$\Sigma X_2^2 = 68$	$\Sigma X_3^2 = 170$
$\Sigma X_1 X_2 = 10$	$\Sigma X_1 X_3 = 15$	$\Sigma X_2 X_3 = 64$

Find:

- (i) Partial correlation between X_1 and X_3 eliminating the effect of X_2 .
- (ii) Multiple correlation between X_1 , X_2 and X_3 assuming X_1 as dependent variable.

Ans: (i) 0.727 (ii) 0.767

17. 2064 Q.No. 12

From the following data estimate regression line that fits the data best.

op	X_1	X_2	Also,
10	8	4	$\Sigma X_1 Y = 2427$
17	21	9	$\Sigma X_2 Y = 1482$
18	14	11	$\Sigma X_1 X_2 = 1435$
26	17	20	$\Sigma X_1^2 = 2367$
35	36	13	$\Sigma X_2^2 = 1571$
4	9	28	$\Sigma Y^2 = 2630$
Total: 110	105	85	

Also find the coefficient of determination.

Ans: $Y = 3.09 + 0.9X_1 - 0.08X_2$, $R^2 = 0.793$ [10]

18. 2063 Q.No. 12

A survey on income of some families resulted the following data:

Expenditure on food (Rs. '000) (Y)	Annual income (Rs. '000) (X ₁)	Family size (X ₂)
7	30	3
9	45	2
10	35	4
11	55	5
13	30	1

Estimate the expenditure on foods of a family with annual income Rs. 60,000 and having 4 family members. [10]

Ans: 10,907

19. 2062 Q.No. 11

Shyam Sundar, owner and General Manager of the Campus Stationary Store, is concerned about the sales behaviour of a compact cassette tape recorder sold at the store. He realizes that there are many factors that might help explain the sales, among which advertising and price the major ones.

Following data is recorded:

Sales (units sold) (Y)	Advertising (no. of ad.) (X ₁)	Price (Rs.) (X ₂)
33	3	125
61	6	115
70	10	140
82	13	130
17	9	145
24	6	140
Total 287	47	795

$\Sigma X_1 Y = 2528$; $\Sigma X_1 X_2 = 6300$; $\Sigma X_2^2 = 105975$; $\Sigma X_2 Y = 37425$; $\Sigma X_1^2 = 431$; $\Sigma Y^2 = 17299$

a. Estimate the multiple regression equation that best fits the data.

b. If advertising is 7 units and Rs. 132 is the price, what is the expected sales? [10]

Ans: (a) $Y = 219.23 + 6.381 X_1 - 1.671 X_2$ (b) 43

20. 2061 Q.No. 11

A Trekking agency has observed following data:

No. of tourists (Y) ('000)	Temperature (°C) X ₁	Cost of promotional activities (Rs. '00) X ₂
6	15	8
7	15	9
6	14	10
8	16	11
9	15	9
14	17	7
50	92	54

Estimate regression line. Also find the number of tourist if temperature of city decreases to 10°C and the promotional cost is Rs. 1200. [10]

Ans: $Y = -20.4588 + 2.1955X_1 - 0.5413X_2$; -5

21. 2060 Q.No. 12

The internal revenue service is trying to estimate the monthly amount of unpaid taxes discovered in last 6 months by its auditing division with the support of field audit (in terms of labour hours) and the computer use (hours). [10]

Unpaid tax '000 Rs.	Labour hour	Computer hours
12	10	6
19	23	11
20	16	13
28	19	22
37	38	15
10	11	30

What will be the expected unpaid tax when field audit hour is 30 and computer hour is also 30?

Ans: $r = \text{Rs. } 31,164$

22. 2059 Q.No. 11

A household survey on monthly expenditure on food yield following data:

Monthly expenditure (100 Rs.)	Monthly income (1000 Rs.)	Size of the Family (No.)
10	2	4
15	4	5
20	5	7
25	7	10
30	6	8
35	6	11
40	5	4

- a. Estimate the line of best fit.
 b. Obtain the multiple correlation coefficient and coefficient of determination. [10]

Ans: (a) $X_1 = 3.34507 + 6.7977 X_2 - 1.76056 X_3$, (b) 0.72, 0.5187

23. 2058 Q.No. 12

Following data reveals the sales of a company due to the number of sales persons and the years of experience.

Sales '000 Rs.	No. of sales person involved	Average years of experience
20	2	5
30	3	7
25	5	11
20	4	10
40	2	8
60	1	7
15	4	8

- (i) Estimate the best line of fit. [10]
 (ii) Estimate the sales of the company using one sales person with experience of nine years.

Ans: (i) $X_1 = 21.2184 - 15.336 X_2 + 6.8487 X_3$; (ii) Rs. 67520.70

24. 2057 (I) Q.No. 12

Compute multiple regression equation to estimate the value of Y when $X_1 = 50$ and $X_2 = 100$ from the following: [10]

Y	16	9	8	12	16	18	10	7
X_1	7	9	10	9	12	11	13	9
X_2	5	10	17	12	10	15	8	5

Ans: (a) $Y = 8.86 - 0.26X_1 + 0.66X_2$ (b) 60.86

25. 2057 (II) Q.No. 12

State the significance of multicollinearity. Estimate multiple regression equation of yield of crop on amount of rainfall and fertilizer from the following: [10]

Yield of crop in kg.	10	12	14	16	18	20	22
Amount of rainfall in inches	1	2	3	4	5	6	7
Amount of fertilizer	5	8	10	12	6	10	5

Ans: $Y = 8 + 2X_1$

MBA

1. 2055 Q.No. 5 b

Mr. Shrestha, owner and general manager of the Shrestha Audio Store, is concerned about the sales behaviour of a compact cassette tape recorder sold at the store. He realizes that there are many factors, which might help to explain sales, but believes that advertising and price are major determinants.

Sales (units sold)	33	61	70	82	17	25
Advertising (no.)	3	6	10	13	9	7
Price (Rs.)	1250	1160	1400	1300	1470	1400

Calculate the least square equation to predict sales from advertising and price. If advertising is 7 and price 1320, what sales would you predict? [10]

$$\text{Ans: } \hat{Y} = -4.366 + 1.447 X_1 - 0.563 X_2; \text{ Rs. } 2232.20$$

2. 2054 Q.No. 5 b

The information given below has been gathered from a random sample of apartment renters in a city. We are trying to predict rent in rupees per month based on the size of the apartment (no. of rooms) and the distance from the downtown (in km).

Rent (Rs.)	360	1000	450	525	350	315
No. of rooms	2	6	3	4	2	1
Distance from downtown	1	2	3	4	10	4

Calculate the least square equation that best relates those three variables. If someone looking for a 5-bed room apartment two kilometers from downtown, what rent should be expected to pay? [10]

$$\text{Ans: } X_1 = 115.743 + 134.047 X_2 - 4.471 X_3, 777.04$$

3. 2053 Q.No. 3

a. The information below has been gathered from a random sample of apartment renters of Kathmandu city. We are trying to predict rent (in Rs. Per month) based on the size of the apartment (no. of rooms) and the distance from downtown (in miles).

Rent in Rs.	Number of Rooms	Distance of downtown
360	2	1
1000	6	1
450	3	2
540	4	3
350	2	10
300	1	4

i. Estimate the least squares equation that best relates these variables.

ii. If Mr. X is looking for a 2-bed room apartment two miles from downtown. What rent should be expected to pay? [10]

$$\text{Ans: (i) } X_1 = 95.55 + 137.5 X_2 - 2.3 X_3, \text{ (ii) } 365.95$$

b. Find $R^2_{0.12}$ and interpret the result on the basis of the following values. [10]

$\sum X_0 = 272$	$\sum X_1 = 441$	$\sum X_2 = 147$
$\sum X_0 X_1 = 12005$	$\sum X_0 X_2 = 4013$	$\sum X_1 X_2 = 6485$
$\sum X_1^2 = 19461$	$\sum X_2^2 = 2173$	$\sum X_0^2 = 7428$ and $n = 10$

$$\text{Ans: } 0.722\%, \text{ Variation in } X_0 \text{ is explained by } X_1 \text{ \& } X_2$$

4. 2052 Q.No. 3

A developer of food for pigs would like to determine what relationship exists among the age of a pig when it starts receiving a newly developed food supplement, the initial weight of the pig at the same time, and the amount of gain in a one-week period with the food supplement. The following information is the result of a study of 8 piglets:

Piglet No.	Initial weight (lbs)	Initial age (weeks)	Weight gain
1	39	8	7
2	52	6	6
3	48	7	7

4	46	12	8
5	61	9	9
6	34	6	4
7	25	10	3
8	55	6	4

Required:

- a. Complete the coefficient of multiple determine.
 b. How much might we expect a pig to gain in a week with the food supplement if it was 9 weeks old weighted 48 lbs?

[10+10]

Ans: (a) 0.63 (b) 6.88

5. 2051 Q.No. 3

Estimate the relationship between the use of inputs and labour on productivity from the following data:

Productivity	15	18	16	20	24	27
Inputs	5	8	7	6	10	9
Labour	40	45	50	55	60	50

- i. What will be the productivity if inputs will be 12 and labour 65?
 ii. Compute the coefficient of multiple determination.

[10+10]

Ans: (i) 29.44 (ii) 0.658

6. 2050 Q.No. 4 b

Compute the partial correlation coefficient from the following information by elimination the effect of the third variable X_3 .

The coefficient of correlation between X_1 and $X_2 = 0.80$

The coefficient of correlation between X_1 and $X_3 = 0.65$

The coefficient of correlation between X_2 and $X_3 = 0.70$

[10]

Ans: 0.635

7. 2042 Q.No. 4

Following table gives the results of a study of 10 workers of a certain factory:

Employee social number	Output units (Y)	Test score (X_1)	Experience (Y_{rs}) (X_2)
1	32	160	5.5
2	15	80	6.0
3	30	112	9.5
4	34	185	5.0
5	35	152	8.0
6	10	90	3.0
7	39	170	9.0
8	26	140	5.0
9	11	115	0.5
10	23	150	1.5
Total	255	1354	53

Estimate the multiple regression equation. Also, estimate the output units for an employee whose test score is 100 and experience is 5 years.

[20]

Ans: $Y = -13.825 + 0.21 \times X_1 + 1.999 \times X_2$; 17.00**8. 2040 Q.No. 6**

Past experience shows the following result of productivity per hectare with the respective uses of chemical fertilizers and seeds. Calculate the coefficient of multiple correlation: [20]

Year	X_1 Fertilizer (in kg)	X_2 Seeds (in kg)	Y Productivity (in kg)
1976	45	2	2000
1977	30	1.8	2100
1978	70	3	1800
1979	75	2.5	1900
1980	65	2	2400
1981	80	3	2500

Ans: $R_{3,12} = 0.388$, $R_{3,12}^2 = 0.149$

9. 2039 Q.No. 7

The executive director of the National Sales Executive's Association knows what relationship exists among a salesman's score on an aptitude test, the no. of years of experience in this field, the person's annual sales. The following information was compiled for six randomly selected sales persons.

Sales person	Aptitude score (X_1)	Years of experience (X_2)	Quantity annual sales (in Rs. '000) Y
A	84	7	36
B	74	5	28
C	89	8	39
D	78	7	30
E	92	10	45
F	70	3	22

- Develop the estimating equation that test describes those.
- If a salesperson score 83 on the aptitude test and has seven years of experience, what annual sales might he expect this person? [20]

Ans: $Y = -30.94 + 0.72 X_1 + 0.85 X_2$; 34.77

Question Bank Nepal