Practical 1

THE FOLLOWING DATA REPRESENTS THE SCORES MADE IN AN INTELLIGENCE TEST BY TWO GROUPS OF STUDENTS FROM SECTION A AND SECTION B OF A COLLEGE.

Student_No.	Section A	Section B
1	9	10
2	8	8
3	10	6
4	6	8
5	7	9
6	8	8
7	5	7
8	6	8
9	7	5
10	8	8

Test Which Group is more Consistent.

Solution:

	A	B	C	D	E	F	G	H
1				Section A			Section B	
2		Student_No.	x		(x - x̄)^2	x		(x - x̄)^2
3		1	9		2.56	10		5.29
4		2	8		0.36	8		0.09
5		3	10		6.76	6		2.89
6		4	6		1.96	8		0.09
7		5	7		0.16	9		1.69
8		6	8		0.36	8		0.09
9		7	5		5.76	7		0.49
10		8	6		1.96	8		0.09
11		9	7		0.16	5		7.29
12	n =	10	8		0.36	8		0.09
13	Total		74	SUM(C3:C12)	20.4	77	SUM(E3:E12)	18.1
14								
15			For Section A				For Section B	
16								
17		Mean (x̄)	7.4	C13/B12		Mean (x̄)	7.7	F13/B12
18		S.D	1.428285686	SQRT(E13/B12)		S.D	1.345362405	SQRT(H13/B12)
19		C.V	19.30115791	(C18/C17)*100		C.V	17.47223902	(G18/G17)*100
20								
21		Since C.V of Section B is less than C.V of Section A .So, Section B is more Consistent.						

Practical 2

The following data gives the number of minutes required for 15 boys and 15 girls students of a class to complete a task.

Male Student	5.7	6.8	7.25	8.2	8.1	7.2	6.88	7.2	7.35	7.45	6.9	7.22	6.85	6.4	6.2
Female Student	7.52	8.2	8.32	6.9	6.8	8.3	7.45	9	10.5	7.2	10.2	8.26	8.5	8.32	10

Test Which Group is more Consistent.

Solution:

	A	B	C	D	E	F	G	H	I
1									
2				Male Student			Female Student		
3			x		(x - x̄)^2	x		(x - x̄)^2	
4			5.7		1.813511111	7.52		0.713461778	
5			6.8		0.060844444	8.2		0.027115111	
6			7.25		0.041344444	8.32		0.001995111	
7			8.2		1.330177778	6.9		2.145248444	
8			8.1		1.109511111	6.8		2.448181778	
9			7.2		0.023511111	8.3		0.004181778	
10			6.88		0.027777778	7.45		0.836615111	
11			7.2		0.023511111	9		0.403648444	
12			7.35		0.092011111	10.5		4.559648444	
13			7.45		0.162677778	7.2		1.356448444	
14			6.9		0.021511111	10.2		3.368448444	
15			7.22		0.030044444	8.26		0.010955111	
16			6.85		0.038677778	8.5		0.018315111	
17			6.4		0.418177778	8.32		0.001995111	
18	n =	15	6.2		0.716844444	10		2.674315111	
19		Total	105.7	SUM(C4:C18)	5.910133333	125.47	SUM(G4:G18)	18.57057333	
20									
21				For Male Student			For Female Student		
22			Mean (x̄)	7.04666667	C19/B18	Mean (x̄)	8.364666667	G19/B18	
23			S.D	0.62770127	SQRT(E19/B18)	S.D	1.11267166	SQRT(H19/B18)	
24			C.V	8.90777588	(D23/D22)*100	C.V	13.30204423	(G23/G22)*100	
25									
26									
27			Since C.V of Male is less than C.V of female .So, the male student is more consistent.						

Practical 3

A part of the investigation of the collapse of the roof of a building, a testing laboratory is given all the available bolts that connected the steel structure at 3 structure at 3 different positions on the roof. The forces required to shear each of these bolts are as follows:

position 1	90	82	79	98	91		
position 2	105	89	93	104	89	95	86
position 3	83	89	80	94			

Perform an analysis of variance to test at 0.05 level of significance whether the differences among the sample means at the 3 positions are significant.

Solution:

position 1	position 2	position 3
90	105	83
82	89	89
79	93	80
98	104	94
91	89	
	95	
	86	

Anova : Single Factor

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
position 1	5	440	88	57.5
position 2	7	661	94.42857	55.952381
position 3	4	346	86.5	39

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	203.223	2	101.6116	1.9348517	0.1838	3.8056
Within Groups	682.714	13	52.51648			
Total	885.938	15				

H0 : There is no significant difference between the 3 positions.

H1: There is significant difference between the 3 positions.

Decision :

Since p value = 0.183 > 0.05 we accept H1.

Hence we conclude that there is significance difference among the sample means at three positions.

Practical 4

The following are the numbers of mistakes made in 5 successive days for 4 technicians working for a 4 technicians working for a photographic laboratory:

Technicians			
I	II	III	IV
6	14	10	9
14	9	12	12
10	12	7	8
8	10	15	10
11	14	11	11

Test at the level of significance 0.05 whether the differences among the 4- sample means can be attributed to chance.

Solution:

	A	B	C	D	E	F	G	H
1	Technicians							
2	I	II	III	IV				
3	6	14	10	9				
4	14	9	12	12				
5	10	12	7	8				
6	8	10	15	10				
7	11	14	11	11				
8								
9	Anova : Single Factor							
10								
11	Anova: Single Factor							
12								
13	SUMMARY							
14	*Groups*	*Count*	*Sum*	*Average*	*Variance*			
15	I	5	49	9.8	9.2			
16	II	5	59	11.8	5.2			
17	III	5	55	11	8.5			
18	IV	5	50	10	2.5			
19								
20								
21	ANOVA							
22	*Source of Variation*	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	
23	Between Groups	12.95	3	4.3167	0.6798	0.5771	3.2389	
24	Within Groups	101.6	16	6.35				
25								
26	Total	114.55	19					
27								
28	H0: There is no significant difference among 4 technicians.							
29	H1: There is significance difference among 4 technicians.							
30								
31	Decision :							
32	Since p value = 0.577 > 0.05 we accept H0..							
33	Hence, we conclude that there is no significance difference among 4 technicians							

Practical 5

The following are per acre production data for three varieties of wheat, each grown on 4 plots and state if the variety differences are significant.

	Variety Of Wheat			
		A	B	C
Plot Of Land	1	6	5	5
	2	7	5	4
	3	3	3	3
	4	8	7	4

Solution:

Anova : Two-Factor without replication

Anova: Two-Factor Without Replication

SUMMARY	Count	Sum	Average	Variance
1	3	16	5.3333	0.3333
2	3	16	5.3333	2.3333
3	3	9	3	0
4	3	19	6.3333	4.3333
A	4	24	6	4.6667
B	4	20	5	2.6667
C	4	16	4	0.6667

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	18	3	6	6	0.0308	4.7571
Columns	8	2	4	4	0.0787	5.1433
Error	6	6	1			
Total	32	11				

Setting Up hypothesis

H0r : There is no significance difference in average production of four plots of land.

H0c : There is no significance difference in average production of three varieties of wheat.

Alternative hypothes

H1r : There is significance difference in average production of four plots of land.

H1c : There is significance difference in average production of three varieties of wheat.

Decision :

1. Since p value(rows) = 0.030 < 0.05 we reject H0r.

Hence we conclude that there is significance difference in average production among four plots of land.

2. Since p value(columns) = 0.078 > 0.05 we accept H1r.

Hence we conclude that there is no significance difference in average production among three varieties of wheat.

Practical 6

Fit normal distribution to the following data and find expected frequencies.

Class	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
frequency	1	3	16	34	28	14	3	1

Solutions:

	A	B	C	D	E	F	G	H	I
5									
6		Class	Frequency(f)	MidValue(x)	fx	fx^2			
7		20-30	1	25	25	625			
8		30-40	3	35	105	3675			
9		40-50	16	45	720	32400			
10		50-60	34	55	1870	102850			
11		60-70	28	65	1820	118300			
12		70-80	14	75	1050	78750			
13		80-90	3	85	255	21675			
14		90-100	1	95	95	9025			
15		Total	100		5940	367300			
16									
17		Mean	59.4		=E15/C15				
18		SD	12.026637		=SQRT((F15/C15)-(E15/C15)^2)				
19									
20		Class	Lower limit(x	Z=(X-mean)/S	f(z)	Δf(z)=f(Zi+1)-f(Zi)	Expected frequency=N*Δf(z)		
21		below 20	infinity(-)	infinity(-)	0	0.000526329	0.052632861		0
22		20-30	20	-3.2760613	0.00053	0.006724845	0.672484501		1
23		30-40	30	-2.4445736	0.00725	0.046111738	4.611173832		5
24		40-50	40	-1.613086	0.05336	0.16386241	16.38624096		16
25		50-60	50	-0.7815984	0.21723	0.30266936	30.26693597		30
26		60-70	60	0.04988926	0.51989	0.291048388	29.10483878		29
27		70-80	70	0.88137689	0.81094	0.145688198	14.56881976		15
28		80-90	80	1.71286452	0.95663	0.037894701	3.789470097		4
29		90-100	90	2.54435215	0.99453	0.005106079	0.51060786		1
30		100 and more	100	3.37583978	0.99963				101

Practical 7

Fit the Poisson distribution and find mean.

x	0	1	2	3	4	5	6	7
f	71	112	117	57	27	11	3	1

Solution:

	A	B	C	D	E	F	G	H	I	J	K
5											
6		x	f	fx	p(x)		N.P(x)		expected frequency		
7		0	71	0	0.17086		68.1727		68		
8		1	112	112	0.30189	POISSON.DIST (B8,D17,)	120.456	C15*E8	120		ROUND(G8,0)
9		2	117	234	0.26671		106.417		106		
10		3	57	171	0.15709		62.677		63		
11		4	27	108	0.06939		27.6862		28		
12		5	11	55	0.02452		9.78386		10		
13		6	3	18	0.00722		2.88121		3		
14		7	1	7	0.00182		0.72727		1		
15		Total	399	705	0.9995	SUM(E7:E14)	398.801		399		
16											
17			Mean	1.76692	D15/C15						
18											

Practical 8

Find the Poisson distribution and find mean.

mistake package	0	1	2	3	4	5
number of packages	142	156	69	27	5	1

Solution:

	A	B	C	D	E	F	G	H	I	J	K
1											
2											
3		let x be mistake packages.									
4		let f be number of packages.									
5											
6		x	f	fx	P(x)		N.P(x)		expected frequency		
7		0	142	0	0.367879		147.1518		147		
8		1	156	156	0.367879	POISSON.DIST (B8,D17,)	147.1518	C15*E8	147		ROUND (G8,0)
9		2	69	138	0.18394		73.57589		74		
10		3	27	81	0.061313		24.5253		25		
11		4	5	20	0.015328		6.131324		6		
12		5	1	5	0.003066		1.226265		1		
13		Total	400	400	0.999406	SUM(E7:E14)	399.7623		400		
14											
15		Variance	Mean	1	D15/C15						

Practical 9

Find the Binomial distribution and find the expected frequencies for the following data.

x	0	1	2	3	4	5	6
f	7	6	19	35	23	7	1

Solution:

	A	B	C	D	E	F	G	H	I	J	K
4											
5		x	f	fx	p(x)		N.p(x)		Expected Frequency		
6		0	7	0	0.01986	BINOM.DIST (B6,C16,$	1.94666	C18*E6	2	ROUND(G6,0)	
7		1	6	6	0.10984		10.7639		11		
8		2	19	38	0.25305		24.7992		25		
9		3	35	105	0.31094		30.4722		30		
10		4	23	92	0.21491		21.0617		21		
11		5	7	35	0.07922		7.76391		8		
12		6	1	6	0.01217		1.1925		1		
13		Total	98	282	1				98		
14											
15		Mean	2.87755	D13/C13							
16		n	6								
17		p	0.47959	C15/C16							
18		N	98								
19											
20											

Practical 10

Omprakash Sharma, owner of the Kathmandu Precast Company, has hired you as a part-timer analyst. He was extremely pleased when you uncovered a positive relationship between the number of building permits issued and the amount if work available to his company. Now he wonder if it's possible to use knowledge of interest rates on first mortgages to predict the numbers of building permits that will be issued each month. You collect a sample of data covering nine months.

X	10.2	12.6	13.5	9.7	10.8	9.5	10.9	9.2	14.2
Y	786	494	289	892	343	888	509	987	187

i. Calculate the correlation coefficient between building permits and interest rate and let its significance at 1%.
ii. Estimate the best fitting regression line and compute residual for month 9.
iii. Compute the coefficient of determination and interpret its meaning.
iv. Predict building permits when the interest rate increases by 9.7%.

Solution:

	A	B	C	D	E	F
3						
4	X	Y	XY	X^2	Y^2	
5	10.2	786	8017.2	104.04	617796	
6	12.6	494	6224.4	158.76	244036	
7	13.5	289	3901.5	182.25	83521	
8	9.7	892	8652.4	94.09	795664	
9	10.8	343	3704.4	116.64	117649	
10	9.5	888	8436	90.25	788544	
11	10.9	509	5548.1	118.81	259081	
12	9.2	987	9080.4	84.64	974169	
13	14.2	187	2655.4	201.64	34969	
14	100.6	5375	56219.8	1151.12	3915429	SUM(E5:E13)
15						
16	a	2217.412	INTERCEPT(B4:B13,A4:A13)			
17	b	-144.947	SLOPE(B4:B13,A4:A13)			
18	y	2217.41 - 144.95x				
19	r^2	0.793364	((B16*B14)+(B17*C14)-(B21*(B14/B21)^2))/((E14)-(B21*(B14/B21)^2))			
20	r	0.89071	SQRT(B19)			
21	n	9				
22						
23	when x =	9.7				
24	y	811.4223	B16+(B17*B23)			
25						

Practical 11

Career airline pilots faces the risk of progressive hearing loss due to noisy cockpit noisy cockpits of most jet aircrafts. Much of the noise comes from engines but from air roar which increases at high speeds. To assess this workplace hazard a pilot measured cockpit noises level (in decibels) and airspeed. The data are shown in the given table.

X	250	340	320	330	346	260	280	395	380	400
Y	83	89	88	89	92	85	84	92	93	96

i. Determine association between noise level and air roar which is increased due to high speed. Comment on strength of association

ii. Develop a least square regression model to estimate the noise level with the help of speed of aircraft. Also interpret the regression coefficient.

Solution:

	A	B	C	D	E	F	G	H	I
3									
4	X	Y	XY	X^2	Y^2				
5	250	83	20750	62500	6889				
6	340	89	30260	115600	7921				
7	320	88	28160	102400	7744				
8	330	89	29370	108900	7921				
9	346	92	31832	119716	8464				
10	260	85	22100	67600	7225				
11	280	84	23520	78400	7056				
12	395	92	36340	156025	8464				
13	380	93	35340	144400	8649				
14	400	96	38400	160000	9216				
15	3301	891	296072	1115541	79549	SUM(E5:E14)	Total		
16									
17	a	64.19158	INTERCEPT(B4:B13,A4:A13)						
18	b	0.075457	SLOPE(B4:B13,A4:A13)						
19	y	64.191 + 0.075x							
20	r^2	0.915851	((B16*B14)+(B17*C14)-(B21*(B14/B21)^2))/((E14)-(B21*(B14/B21)^2))						
21	r	0.957001	SQRT(B19)						
22	n	10							
23									