Maharshi Dayanand University,Rohtak

Department of Mathematics

Practical Of

Sampling Techniques and Design Of Experiments

Submitted To:

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Submitted By:

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Roll No: 5402

5-Year Integrated M.Sc.(Hons.) Mathematics

(8th Sem)

Index

Sr. No.	Experiments	Date	Signature
1	Estimate the total number of words in the dictionary, calculate the standard error of the total, and determine the 95% confidence limits.	13-02-2025	
2	Estimate the total number of signs in the given dataset and calculate the 99% confidence limits for the total.	20-02-2025	
3	Estimate the total number of inhabitants in 201 cities using both Simple Random Sampling (SRS) and Stratified Random Sampling.	27-02-2025	
4	Estimate the total number of words in the dictionary using Stratified Random Sampling, and calculate the standard error and 95% confidence limits.	05-03-2025 & 06-03-2025	
5	Using SRS with proportional allocation, and with strata equally proportional, estimate the number of inhabitants in 64 cities based on the given data.	19-03-2025	
6	Estimate using Systematic Sampling where rows represent the strata, and compare the precision of: 1. Systematic Sampling 2.Random Sampling 3. Stratified Sampling	27-03-2025	
7	Test the variety effect in a Completely Randomized Design (CRD) experiment using the given data, and perform ANOVA to analyze the results.	02-04-2025	
8	Test the variety effect in a Randomized Block Design (RBD) experiment using the given data, and determine the efficiency of RBD relative to CRD.	03-04-2025	
9	Test the variety effect in a Latin Square Design using the provided data.	09-04-2025	
10	Find out the main effect and interaction effect in 2^3-Experiment. Analyse the data and write down ANOVA Table	16-04-2025	
11	Identify the main effects and interaction effects in a 2^3-factorial experiment, and construct the corresponding ANOVA table.	17-04-2025	

Exp1

Sr. No.	Page No.	No. Of Words(y_i)	y_i^2
1	58	26	676
2	83	16	256
3	361	35	1225
4	116	18	324
5	85	18	324
6	192	25	625
7	291	29	841
8	358	26	676
9	181	16	256
10	114	17	289
11	46	15	225
12	539	11	121
13	176	12	144
14	125	13	169
15	238	22	484
16	20	8	64
17	529	33	1089
18	49	8	64
19	35	19	361
20	388	34	1156
21	15	19	361
22	82	31	961
23	216	24	576
24	368	25	625
25	385	15	225
26	295	29	841
27	306	31	961
28	20	24	576
	Total	**599**	**14495**

Signature Per Sheet(y_i)	No. Of Sheets(f_i)	f_iy_i	$f_iy_i^2$
50	5	250	12500
48	7	336	16128
45	3	135	6075
43	2	86	3698
41	3	123	5043
39	2	78	3042
35	2	70	2450
32	2	64	2048
30	1	30	900
29	1	29	841
25	3	75	1875
22	2	44	968
16	1	16	256
4	2	8	32
3	4	12	36
Total	40	1356	55892

Exp3

Sr. No.	Population in Thousands	y_i	No. Of Cities(f_i)	$f_i y_i$	$f_i y_i^2$
1	50-100	75	25	1875	140625
2	100-150	125	19	2375	296875
3	150-200	175	15	2625	459375
4	200-250	225	13	2925	658125
5	250-300	275	22	6050	1663750
6	300-350	325	32	10400	3380000
7	350-400	375	15	5625	2109375
8	400-450	425	17	7225	3070625
9	450-500	475	11	5225	2481875
10	500-550	525	8	4200	2205000
11	550-600	575	6	3450	1983750
12	600-650	625	2	1250	781250
13	650-700	675	1	675	455625
14	700-750	725	3	2175	1576875
15	750-950	850	2	1700	1445000
16	950-1150	1050	3	3150	3307500
17	1150-1400	1275	2	2550	3251250
18	1400-1900	1650	1	1650	2722500
19	1900-2150	2025	2	4050	8201250
20	2150-2500	2325	2	4650	10811250
		Total	201	73825	51001875

Tabulation and Observations

Strata	No. of Pages	Sample Size	Pages No.
A-E	230	10	34, 43, 54, 63, 71, 114, 137, 192, 203, 214
F-J	67	4	239, 260, 271, 289
K-O	134	5	298, 312, 335, 353, 374
P-T	26	4	443, 444, 449, 454
U-Z	93	5	461, 466, 479, 490, 531
	550	28	

STRATUM A-E

S.No.	Page No.	No. of words(y1i)	$y1i^2$
1	34	29	841
2	43	30	900
3	54	23	529
4	63	39	1521
5	71	27	729
6	114	19	361
7	137	14	196
8	192	27	729
9	203	42	1764
10	214	19	361
	Total	269	7931

STRATUM K-O

S.No.	Page No.	No. of words(y3i)	$y3i^2$
1	298	33	1089
2	312	37	1369
3	335	25	625
4	353	40	1600
5	374	27	729
	Total	162	5412

STRATUM F-J

S.No.	Page No.	No. of words(y2i)	$y2i^2$
1	239	19	361
2	260	10	100
3	271	21	441
4	289	26	676
	Total	76	1578

STRATUM P-T

S.No.	Page No.	No. of words(y4i)	$y4i^2$
1	443	42	1764
2	444	22	484
3	449	38	1444
4	454	16	256
	Total	118	3948

STRATUM U-Z

S.No.	Page No.	No. of words(y5i)	$y5i^2$
1	461	23	529
2	466	22	484
3	479	25	625
4	490	14	196
5	531	21	441
	Total	105	2275

Calculations

Sr. No.	ni	ΣYi	$Yi = \Sigma Yi/ni$	Ni	NiYi	(1-fi)/ni	Wi	Si^2	$((1-fi)/ni)Wi^2Si^2$
1	10	269	26.9	230	6187.0	0.095652	0.418182	77.211111	1.29153
2	4	76	19.0	67	1273.0	0.235075	0.121818	44.666667	0.155816
3	5	162	32.4	134	4341.6	0.192537	0.243636	40.8	0.466291
4	4	118	29.5	26	767.0	0.211538	0.047273	155.666667	0.073589
5	5	105	21.0	93	1953.0	0.189247	0.169091	17.5	0.094691
Total					14521.6				2.081917

	1st Stratum	
S.No.	y_i	y_i^2
1	1100	1210000
2	1079	1164241
3	963	927369
4	956	913936
5	915	837225
6	879	772641
7	879	772641
8	870	756900
9	822	675684
10	818	669124
11	789	622521
12	785	616225
13	738	544644
14	717	514089
15	714	509796
16	693	480249
Total	13717	11987285

	2nd Stratum	
S.No.	y_i	y_i^2
1	659	434281
2	652	425104
3	651	423801
4	640	409600
5	637	405769
6	636	404496
7	629	395641
8	614	376996
9	609	370881
10	601	361201
11	582	338724
12	581	337561
13	580	336400
14	572	327184
15	569	323761
16	566	320356
17	563	316969
18	559	312481
19	552	304704
20	541	292681
21	526	276676
22	520	270400
23	510	260100
24	489	239121
25	483	233289
26	461	212521
27	457	208849
28	444	197136
29	378	142884
30	350	122500
31	347	120409
32	336	112896
33	332	110224
34	301	90601
35	290	84100
36	289	83521
37	284	80656
38	273	74529
39	273	74529
40	264	69696
41	232	53824
42	220	48400
43	203	41209
44	182	33124
45	165	27225
46	163	26569
47	154	23716
48	124	15376
Total	21043	10552671

Exp6

Strata	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Strata Total T_{oj}**
A	0	1	1	2	5	4	7	7	8	6	**41**
B	6	8	9	10	13	12	15	16	16	17	**122**
C	18	19	20	20	24	23	25	28	29	27	**233**
D	26	30	31	31	33	32	35	37	38	38	**331**
Sample Total ($n\bar{y}_{io}$)	50	58	61	63	75	71	82	88	91	88	**$\Sigma T_{ij} = 727$**

Sample Units

320	455	334	325	328
340	417	331	358	383
398	420	340	430	383
360	358	370	358	375
350	400	375	378	308
372	355	320	395	400

	1st Class	
	y_i	y_i^2
320	-40	1600
340	-20	400
398	38	1444
360	0	0
350	-10	100
372	12	144
Total	**-20**	**3688**

	2nd Class	
	y_i	y_i^2
455	95	9025
417	57	3249
420	60	3600
358	-2	4
400	40	1600
355	-5	25
Total	**245**	**17503**

	3rd Class	
	y_i	y_i^2
334	-26	676
331	-29	841
340	-20	400
370	10	100
375	15	225
320	-40	1600
Total	**-90**	**3842**

	4th Class	
	y_i	y_i^2
325	-35	1225
358	-2	4
430	70	4900
358	-2	4
378	18	324
395	35	1225
Total	**84**	**7682**

	5th Class	
	y_i	y_i^2
328	-32	1024
383	23	529
383	23	529
375	15	225
308	-52	2704
400	40	1600
Total	**17**	**6611**

Exp8

BLOCKS							
		I	II	III	IV	Total (T_{io})	Square Of Total
A	y	8	8	6	8	30	900
	y^2	64	64	36	64	228	
B	y	10	8	9	10	37	1369
	y^2	100	64	81	100	345	
C	y	12	10	10	9	41	1681
	y^2	144	100	100	81	425	
	Total (T_{oj})	30	26	25	27		
	Square Of Total	900	676	625	729		

Treatments Combinations	Blocks				Treatments Totals(T_i)	T_i^2
	I	II	III	IV		
1	-6	-3	0	-1	-10	100
k	-4	7	-9	2	-4	16
p	-7	11	-9	-5	-10	100
kp	9	9	1	5	24	576
Block Totals(B_i)	-8	24	-17	1	G = 0	
B_i^2	64	576	289	1		

Yate's Method For 2^2 Experiment				
Treatments Combination (1)	Total Yield Form All Blocks (2)	Total (3)	Factorial Effects Totals (4)	SS $(5) = (4)^2/4r$
1	-10	-14	0 = G	0
k	-4	14	40 = [K]	100
p	-10	6	28 = [P]	49
kp	24	34	28 = [KP]	49

Treatments Combination(1)	Treatments Total (2)	(3)	(4)	(5)	(6)
1	[1]	[1] + [a] = u_1	u1 + u2 = v1	v1 + v2 = w1	G.T.
a	[a]	[b] + [ab] = u_2	u3 + u4 = v2	v3 + v4 = w2	[A]
b	[b]	[c] + [ac] = u_3	u5 + u6 = v3	v5 + v6 = w3	[B]
ab	[ab]	[bc] + [abc] = u_4	u7 + u8 = v4	v7 + v8 = w4	[AB]
c	[c]	[a] - [1] = u_5	u2 - u1 = v5	v2 - v1 = w5	[C]
ac	[ac]	[ab] - [b] = u_6	u4 - u3 = v6	v4 - v3 = w6	[AC]
bc	[bc]	[ac] - [c] = u7	u6 - u5 = v7	v6 - v5 = w7	[BC]
abc	[abc]	[abc] - [bc] = u8	u8 - u7 = v8	v8 - v7 = w8	[ABC]

exp11

Blocks	i	ii	iii	iv
Treatments				
1	47.2	51.2	51.1	43.2
a	44.7	60.3	70.2	61.2
b	45.3	55.8	57.3	52.1
ab	62.7	50.2	55.3	69.3
c	63.4	56.6	63.2	42.3
ac	45.3	52.3	59.8	38.2
bc	57.6	47.7	55.2	48.3
abc	49.3	59.8	56.8	52.5

Taking Deviation y = 49.3						
Treatments	**i**	**ii**	**iii**	**iv**	**Treatments(T)**	**T^2**
1	2.1	-1.9	-1.8	6.1	4.5	20.25
a	4.6	-11	-20.9	-11.9	-39.2	1536.64
b	4	-6.5	-8	-2.8	-13.3	176.89
ab	-13.4	-0.9	-6	-20	-40.3	1624.09
c	-14.1	-7.3	-13.9	7	-28.3	800.89
ac	4	-3	-10.5	11.1	1.6	2.56
bc	-8.3	1.6	-5.9	1	-11.6	134.56
abc	0	-10.5	-7.5	-3.2	-21.2	449.44
Blocks(B)	-21.1	-39.5	-74.5	-12.7	-147.8	4745.32
B^2	445.21	1560.25	5550.25	161.29		

y	y^2
2.1	4.41
4.6	21.16
4	16
-13.4	179.56
-14.1	198.81
4	16
-8.3	68.89
0	0
-1.9	3.61
-11	121
-6.5	42.25
-0.9	0.81
-7.3	53.29
-3	9
1.6	2.56
-10.5	110.25
Total	**847.6**

y	y^2
-1.8	3.24
-20.9	436.81
-8	64
-6	36
-13.9	193.21
-10.5	110.25
-5.9	34.81
-7.5	56.25
6.1	37.21
-11.9	141.61
-2.8	7.84
-20	400
7	49
11.1	123.21
1	1
-3.2	10.24
Total	**1704.68**

2552.28

Grand Total	**-147**
Raw SS	**2552.28**
CF	**682.65125**
Total SS	**1869.62875**
SSB	**281.97375**
SST	**503.67875**
SSE	**1083.97635**

Yates Method For 2^3 Experiment					
Treatment Combination	**Total Yield**	**1**	**2**	**3**	**SS = $[3]^2/32$**
1	4.5	-34.7	-88.3	-147.8	682.65125
a	-39.2	-53.6	-59.5	-50.4	79.38
b	-13.3	-26.7	-70.7	-25	19.53125
ab	-40.3	-32.8	20.3	-22.8	16.245
c	-28.3	-43.7	-18.9	28.8	25.92
ac	1.6	-27	-6.1	91	258.78125
bc	-11.6	29.9	16.7	12.8	5.12
abc	-21.2	-9.6	-39.5	-56.2	98.70125

Source Of Variation	SS	df	MSS	F	Tabulated F
					5%
Blocks	281.97375	3	93.99125	1.820903595	3.07
Treatments	503.67875	7	71.95410714	1.393975422	2.49
a	79.38	1	79.38	1.537838121	4.33
b	19.53125	1	19.53125	0.378381215	4.33
ab	16.245	1	16.245	0.314716305	4.33
c	25.92	1	25.92	0.502151223	4.33
ac	258.78125	1	258.78125	5.01339974	4.33
bc	5.12	1	5.12	0.099190365	4.33
abc	98.70125	1	98.70125	1.912150981	4.33
Error	1083.97625	21	51.61791667		
Total	**1869.62875**	**31**			

	1st Stratum	
S.No.	y_i	y_i^2
1	1035	1071225
2	1020	1040400
3	1007	1014049
4	983	966289
5	951	904401
6	949	900601
7	907	822649
8	895	801025
9	885	783225
10	840	705600
11	832	692224
12	814	662596
13	807	651249
14	768	589824
15	714	509796
16	686	470596
Total	14093	12585749

	2nd Stratum	
S.No.	y_i	y_i^2
1	653	426409
2	650	422500
3	644	414736
4	620	384400
5	618	381924
6	601	361201
7	589	346921
8	572	327184
9	572	327184
10	570	324900
11	551	303601
12	542	293764
13	541	292681
14	539	290521
15	534	285156
16	533	284089
17	523	273529
18	509	259081
19	480	230400
20	475	225625
21	475	225625
22	465	216225
23	455	207025
24	430	184900
25	416	173056
26	415	172225
27	412	169744
28	360	129600
29	346	119716
30	346	119716
31	318	101124
32	293	85849
33	286	81796
34	276	76176
35	262	68644
36	246	60516
37	245	60025
38	244	59536
39	225	50625
40	224	50176
41	223	49729
42	218	47524
43	216	46656
44	185	34225
45	166	27556
46	155	24025
47	126	15876
48	117	13689
Total	19461	9127385

Signature Per Sheet(y_i)	No. Of Sheets(f_i)	f_iy_i	$f_iy_i^2$
50	4	200	10000
48	7	336	16128
45	1	45	2025
43	2	86	3698
41	1	41	1681
39	3	117	4563
35	2	70	2450
32	2	64	2048
30	1	30	900
29	1	29	841
25	3	75	1875
22	2	44	968
16	5	80	1280
4	2	8	32
3	4	12	36
Total	40	1237	48525

Exp1

Sr. No.	Page No.	No. Of Words(y_i)	y_i^2
1	44	24	576
2	266	29	841
3	516	13	169
4	499	18	324
5	158	31	961
6	503	10	100
7	628	20	400
8	53	9	81
9	90	36	1296
10	302	15	225
11	321	26	676
12	623	22	484
13	74	35	1225
14	303	34	1156
15	604	16	256
16	24	8	64
17	393	17	289
18	252	10	100
19	481	14	196
20	210	21	441
21	140	16	256
22	529	17	289
23	630	40	1600
24	603	32	1024
25	245	8	64
26	113	30	900
27	48	20	400
28	211	19	361
29	191	27	729
30	343	13	169
31	123	36	1296
32	15	16	256
33	250	24	576
	Total	**706**	**17780**