Salahaddin University-Erbil
College of Administration and Economics
Department: Statistics and Information
2nd Examination

Subject: **Experimental Design**
Date: 12-4-2022
Stage: four
Time: **90** minutes

Q1// A) Create the **design** for: (10 Marks)

1- GLS with 4 replications.

1. CRD (2 × 3 × 2) with 2 replications.

B) Create the **Linear** Model for: (10 Marks)

1. RCBD (9 × 3 × 5) r=6.
2. CRD (9 × 4) with 5 replications.

Q2// from the following data Factorial (RCBD) **test** if there are any deferent or not? *a*=5% (40 Marks)

	b_1		b_2		b_3	
	a_1	a_2	a_1	a_2	a_1	a_2
r1	**4**	**3**	**9**	**8**	**1**	**2**
r2	**5**	**2**	**10**	**9**	**3**	**4**

Q3// from Q2 find LSD_a (least significant deference) (40 Marks)

$\mathbf{F_{(0.05;5,1)}}$= 230.1619, $\mathbf{F_{(0.05;1,5)}}$= 6.6079, $\mathbf{F_{(0.01;1,5)}}$= 16.2582, $\mathbf{F_{(0.05;2,5)}}$= 5.7861, $\mathbf{t_{(0.025;5)}}$=2.571, $\mathbf{t_{(0.05;5)}}$=2.015

Good Luck

Dr. Omiad Saber Abdullah Shwany

Salahaddin University-Erbil
College of Administration and Economics
Department: Statistics and Information
2nd Examination

Subject: **Experimental Design**
Date: 12-4-2022
Stage: four
Time: **90** minutes

Q1// A) Create the **design** for: (10 Marks)

2- GLS with 4 replications.

1. CRD (2 × 3 × 2) with 2 replications.

B) Create the **Linear** Model for: (10 Marks)

2. RCBD (9 × 3 × 5) r=6.
2. CRD (9 × 4) with 5 replications.

Q2// from the following data Factorial (RCBD) **test** if there are any deferent or not? *a*=5% (40 Marks)

	b_1		b_2		b_3	
	a_1	a_2	a_1	a_2	a_1	a_2
r1	**4**	**3**	**9**	**8**	**1**	**2**
r2	**5**	**2**	**10**	**9**	**3**	**4**

Q3// from Q2 find LSD_a (least significant deference) (40 Marks)

$\mathbf{F_{(0.05;5,1)}}$= 230.1619, $\mathbf{F_{(0.05;1,5)}}$= 6.6079, $\mathbf{F_{(0.01;1,5)}}$= 16.2582, $\mathbf{F_{(0.05;2,5)}}$= 5.7861, $\mathbf{t_{(0.025;5)}}$=2.571, $\mathbf{t_{(0.05;5)}}$=2.015

Good Luck

Dr. Omiad Saber Abdullah Shwany

Salahaddin University-Erbil
College of Administration and Economics
Department: Statistics and Information
Final Exam: 1st Trial 2021 – 2022

Subject: Experimental Design
Date: 21-5-2022 Saturday
Stage: four
Time: 3 Hours

Q1// from the following data test if there are any deferent or not? if the experimental unit are homogeneous? With five stapes, alpha=0.05: (20 Marks)

Temperature	Replications	Pressure			Sum A_i
		b_1=200	b_2=215	b_3=230	
a_1=150	r_1	90.4	90.7	90.2	542.5
	r_2	90.2	90.6	90.4	
a_2=160	r_1	90.1	90.5	89.9	541.5
	r_2	90.3	90.6	90.1	
a_3=170	r_1	90.5	90.8	90.4	543.4
	r_2	90.7	90.9	90.1	
Sum B_j		542.2	544.1	541.1	1627.4

if :

$F_{(0.05;3;6)} = 4.7571$
$F_{(0.05;6;3)} = 8.9407$
$F_{(0.05;2,9)} = 4.2565$
$F_{(0.05;4,9)} = 3.6331$

Solution//

Let Temperature = Factor A then (a1= 150, a2=160, a3=170)
Let Pressure= Factor B then (b1= 200, b2=215, b3=230), alpha=5%

(1) H_{0A}: $\mu_1 = \mu_2 = \mu_3$
H_{0B}: $\mu_1 = \mu_2 = \mu_3$
H_{0AB}: $\mu_{11} = \mu_{12} = \cdots = \mu_{33}$

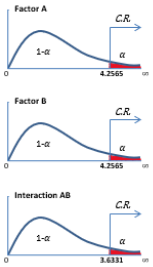
(2) H_{1A}: *at least two means are not equal*
H_{1B}: *at least two means are not equal*
H_{1AB} *at least two means are not equal*

(3) alpha=0.05

d.f.2=d.f.Error=ab(r-1)=3*3*(2-1)=9

$d.f._{1A}$=a-1=3-1=2
$d.f._{1B}$=a-1=3-1=2
$d.f._{1AB}$=(a-1)(b-1)=(3-1)(3-1)=2*2=4

$F_{A(0.05,2,9)}$= 4.2565
$F_{B(0.05,2,9)}$= 4.2565
$F_{AB(0.05,4,9)}$= 3.6331



(4)

Y...= 1627.4

$C.F. = \frac{(Y...)^2}{abr} = \frac{(1627.4)^2}{3(3)(2)} = 147135.04$

SST=$\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{2}(Y_{ijk}^2) - C.F. = (90.4^2 + 90.2^2 + \ldots + 90.1^2)$-147135.04
=147136.34-147135.04=1.298

SSA=$\frac{\sum_{i=1}^{3} Y_{i..}^2}{br} - C.F. = \frac{542.5^2+541.5^2+543.4^2}{3(2)} - 147135.04$
=147135.34-147135.04=0.301

SSB=$\frac{\sum_{j=1}^{3} Y_{.j.}^2}{ar} - C.F. = \frac{542.2^2+544.1^2+541.1^2}{3(2)} - 147135.04$
=147135.81-147135.04= 0.786

SSAB=$\frac{\sum_{i=1}^{3}\sum_{j=1}^{3} Y_{ij.}^2}{r} - C.F. - SSA - SSB$
$= \frac{180.6^2+180.4^2+\cdots+180.5^2}{2} - 147135.04 - 0.301 - 0.786 =$
= 147135.81 - 147135.04
= 0.069

$SSE_{rror} = SST - SSA - SSB - SSAB$
= 1.289-0.301-0.768-0.069= 0.160

S.O.V.	d.f.	S.S.	MS	$F_{Cal.}$	$F_{tab.}$
Factor A	2	0.301	0.151	*8.466	4.256
Factor B	2	0.768	0.384	*21.6	4.256
Interaction AB	4	0.069	0.017	0.97	3.633
Error	9	0.16	0.018		
Total	17	1.298			

(5) We reject H_{0A} and H_{0B} only.

Q2// A) From the ANOVA table below (LSD Latin Square Design) find the relative efficiency of RE (LSD: $RCBD_{(Row\ \&\ Columns)}$ and RE (LSD: CRD): (10 Marks)

S.O.V.	d.f.	SS	MS
Row	4	5.6	
Column	4	63.2	
treatments	4	46.3	
Error	12	3.54	

$$R.E._{(LD:RCBD_{Row})} = \frac{MS_{Col.} + (r-1)MS_E}{rMS_E} \times 100$$

$$R.E._{(LD:CRD)} = \frac{MS_{Row} + MS_{Col.} + (r-1)MS_E}{(r+1)MS_E} \times 100$$

1) 1151.186% (RE for LSD better than RCBD $_{Row.}$)
2) 174.9153% (RE for LSD better than RCBD $_{Col.}$)
3) 1038.418% (RE for LSD better than CRD)

Q2// B) Use LSDα with five stapeses, for the following information at alpha=0.05: (10 Marks)

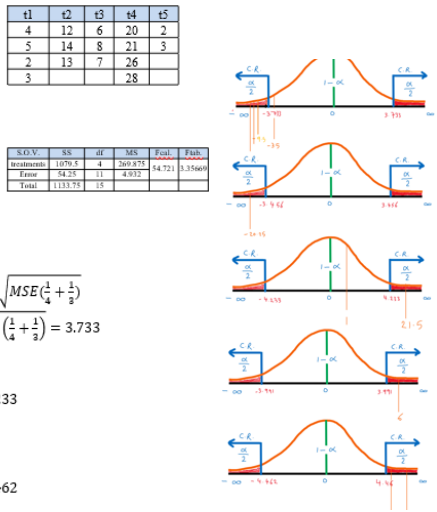
t1	t2	t3	t4	t5
4	12	6	20	2
5	14	8	21	3
2	13	7	26	
3			28	

S.O.V.	SS	df	MS	Fcal.	Ftab.	
treatments	1079.5	4	269.875	54.721	3.35669	$t_{(0.025;11)}$=2.201
Error	54.25	11	4.932			
Total	1133.75	15				

Solution: Let Alpha=0.05

(1) H_0: $\mu_1 = \mu_2$, $\mu_1 = \mu_3, \dots, \mu_4 = \mu_5$

(2) H_1: $\mu_1 \neq \mu_2$, $\mu_1 \neq \mu_3, \dots, \mu_4 \neq \mu_5$



(3) $\alpha = 0.05 \rightarrow \frac{\alpha}{2} = 0.025$

$d.f.Error = 11\ then:$

$t_{(\frac{\alpha}{2},d.f.Error)} = t_{(0.025;11)} = 2.201$

$$LSD_{\alpha\,(\mu_1=\mu_2\ ,\mu_1=\mu_3,\dots,\mu_2=\mu_4,\dots,\mu_3=\mu_4)} = t_{(\frac{\alpha}{2},d.f.Error)} \times \sqrt{MSE(\frac{1}{r_1}+\frac{1}{r_2})} = t_{(0.025;11)} \times \sqrt{MSE(\frac{1}{4}+\frac{1}{3})}$$

$$= t_{(0.025;11)} \times \sqrt{MSE\left(\frac{1}{4}+\frac{1}{3}\right)} = 2.201 \times \sqrt{4.932\left(\frac{1}{4}+\frac{1}{3}\right)} = 3.733$$

$$LSD_{\alpha\,(\mu_1=\mu_4)} = t_{(0.025;11)} \times \sqrt{MSE\left(\frac{1}{4}+\frac{1}{4}\right)} = 2.201 \times \sqrt{4.932\left(\frac{1}{4}+\frac{1}{4}\right)} = 3.456$$

$$LSD_{\alpha\,(\mu_1=\mu_5,\mu_4=\mu_5)} = t_{(0.025;11)} \times \sqrt{MSE\left(\frac{1}{4}+\frac{1}{2}\right)} = 2.201 \times \sqrt{4.932\left(\frac{1}{4}+\frac{1}{2}\right)} = 4.233$$

$$LSD_{\alpha\,(\mu_2=\mu_3)} = t_{(0.025;11)} \times \sqrt{MSE\left(\frac{1}{3}+\frac{1}{3}\right)} = 2.201 \times \sqrt{4.932\left(\frac{1}{3}+\frac{1}{3}\right)} = 3.991$$

$$LSD_{\alpha\,(\mu_2=\mu_5,\mu_3=\mu_5)} = t_{(0.025;11)} \times \sqrt{MSE\left(\frac{1}{3}+\frac{1}{2}\right)} = 2.201 \times \sqrt{4.932\left(\frac{1}{3}+\frac{1}{2}\right)} = 4.462$$

r=			Mean1	Mean2	Mean3	Mean4	Mean5
			3.5	13	7	23.75	2.5
4	Mean1	3.5		-9.5 *	-3.5 *1	-20.25 *4	1 *5
3	Mean2	13			6 *	-10.75 *3	10.5 *4
3	Mean3	7				-16.75 *3	4.5 *4
4	Mean4	23.75					21.25 *4
2	Mean5	2.5					

(5) *we not reject* H_0: $\mu_1 = \mu_3$, $\mu_1 = \mu_5$ only.

Salahaddin University-Erbil
College of Administration and Economics
Department: Statistics and Information
Final Exam: 1st Trial 2020 – 2021

Subject: Experimental Design
Date: 26-5-2021 Wednesday
Stage: four
Time: 2 Hours

Q1//

A) Create the **design** for: (15 Marks)

3- CRD with four replications and four treatments.
4- CRD (S=4, t=3, r=2).
5- RCBD with four Blocks and four treatments after that if we have messing data in $Y_{32.}$
6- GLS (Graeco Latin Square Design) with six replications.
7- Factorial CRD (2×3×2) with two replications.

B) Create the **Linear** Model for: (10 Marks)

3. RCBD (t=4, r=5)
4. Sampling CRD if (t=5, r=4, s=6).
5. LSD (Latin Square Design) if r=8.
6. GLS (Graeco Latin Square Design) with seven replications.
7. Factorial CRD (8×5×4) with ten replications.

Q2// A) from the following data (Latin Square Design) test if there are any deferent or not? If alpha=0.05: (15 Marks)

Row	Column 1	Column 2	Column 3	Column 4	Rows Total
1	1 (A)	2 (C)	4 (B)	2 (D)	9
2	2 (C)	2 (A)	1 (D)	6 (B)	11
3	5 (B)	1 (D)	0 (A)	2 (C)	8
4	1 (D)	9 (B)	2 (C)	1 (A)	13
Columns Total	9	14	7	11	41

B) From (Q2// A) above find LSD_a (Least Significant Difference) with 5 stapes. (10 Marks)

Q3// From the ANOVA table below (LSD Latin Square Design) find the relative efficiency of RE (LSD: $RCBD_{(Row\ \&\ Columns)}$ and RE (LSD: CRD): (10 Marks)

S.O.V.	d.f.	SS	MS
Row	4	1.34	
Column	4	2.83	
treatments	4	3.44	
Error	12	0.12	

if $F_{(0.05;3;6)}$= 4.7571, $F_{(0.05;6;3)}$=8.9407, $F_{(0.01;3;6)}$= 9.7795, $F_{(0.01;6;3)}$= 27.9107, $t_{(0.025,6)}$= 2.496,

$$R.E._{(LD:RCBD_{Row})} = \frac{MS_{Col.} + (r-1)MS_E}{rMS_E} \times 100 \qquad R.E._{(LD:CRD)} = \frac{MS_{Row} + MS_{Col.} + (r-1)MS_E}{(r+1)MS_E} \times 100$$

Good Luck

Dr. Omiad Saber Abdullah Shwany

Salahaddin University-Erbil
College of Administration and Economics
Department: Statistics and Information
Final Exam: 2nd Trial 2020 – 2021

Subject: Experimental Design
Date: - 6 - 2021
Stage: four
Time: 2 Hours

Q1//

A) Create the **design** for: (15 Marks)

8- CRD (S=6, t=3, r=2).
9- Factorial CRD (2×2×2) with two replications.
10- CRD with three replications and three treatments.
11- GLS (Graeco Latin Square Design) with four replications.
12- RCBD with three Blocks and four treatments after that if we have messing data in $Y_{42.}$

B) Create the **Linear** Model for: (10 Marks)

8. GLS (Graeco Latin Square Design) with 10 replications.
9. Factorial CRD (5×6×7) with ten replications.
10. LSD (Latin Square Design) if r=7.
11. Sampling CRD if (t=6, r=4, s=8).
12. RCBD (t=6, r=4)

Q2// A) from the following data (CRD) test if there are any deferent or not? If alpha=0.05: (15 Marks)

Replicate	Treatment			
	t1	t2	t3	t4
1	2	1.7	2	2.1
2	2.2	1.9	2.4	2.2
3	1.8	1.5	2.7	2.2
4	2.3		2.5	1.9
5	1.7		2.4	

B) From (Q2// A) above find LSD_a (Least Significant Difference) with 5 stapeses. (10 Marks)

Q3// From the ANOVA table below (LSD Latin Square Design) find the relative efficiency of RE (LSD: RCBD (Row & Columns) and RE (LSD: CRD): (10 Marks)

S.O.V.	d.f.	SS	MS
Row	4	0.05	
Column	4	0.72	
treatments	4	2.65	
Error	12	0.12	

if $F_{(0.025;3;13)}$= 4.3472, $F_{(0.05;3;13)}$=3.4105, $F_{(0.01;3;13)}$= 5.7394, $F_{(0.05;13;3)}$= 26.9831, $t_{(0.025,13)}$= 2.16,

$$R.E._{(LD:CRD)} = \frac{MS_{Row} + MS_{Col.} + (r-1)MS_E}{(r+1)MS_E} \times 100 \qquad R.E._{(LD:RCBD_{Row})} = \frac{MS_{Col.} + (r-1)MS_E}{rMS_E} \times 100$$

Good Luck

Dr. Omiad Saber Abdullah Shwany

Salahaddin University-Erbil
College of Administration and Economics
Department: Statistics and Information
Final Exam: 1st Trial 2020 – 2021

Subject: Experimental Design
Date: 26-5-2021 Wednesday
Stage: four
Time: 2 Hours

Q1//

A) Create the **design** for: (15 Marks)

13- CRD with four replications and four treatments.
14- CRD (S=4, t=3, r=2).
15- RCBD with four Blocks and four treatments after that if we have messing data in $Y_{32.}$
16- GLS (Graeco Latin Square Design) with six replications.
17- Factorial CRD (2×3×2) with two replications.

B) Create the **Linear** Model for: (10 Marks)

13. RCBD (t=4, r=5)
14. Sampling CRD if (t=5, r=4, s=6).
15. LSD (Latin Square Design) if r=8.
16. GLS (Graeco Latin Square Design) with seven replications.
17. Factorial CRD (8×5×4) with ten replications.

Q2// A) from the following data (Latin Square Design) test if there are any deferent or not? If alpha=0.05: (15 Marks)

Row	Column 1	Column 2	Column 3	Column 4	Rows Total
1	1 (A)	2 (C)	4 (B)	2 (D)	9
2	2 (C)	2 (A)	1 (D)	6 (B)	11
3	5 (B)	1 (D)	0 (A)	2 (C)	8
4	1 (D)	9 (B)	2 (C)	1 (A)	13
Columns Total	9	14	7	11	41

B) From (Q2// A) above find LSD_a (Least Significant Difference) with 5 stapes. (10 Marks)

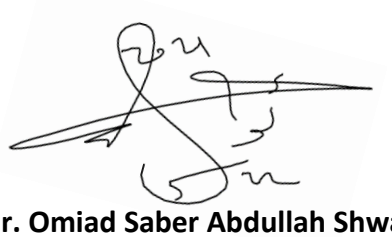
Q3// From the ANOVA table below (LSD Latin Square Design) find the relative efficiency of RE (LSD: $RCBD_{(Row\ \&\ Columns)}$ and RE (LSD: CRD): (10 Marks)

S.O.V.	d.f.	SS	MS
Row	4	1.34	
Column	4	2.83	
treatments	4	3.44	
Error	12	0.12	

if $F_{(0.05;3;6)}$= 4.7571, $F_{(0.05;6;3)}$=8.9407, $F_{(0.01;3;6)}$= 9.7795, $F_{(0.01;6;3)}$= 27.9107, $t_{(0.025,6)}$= 2.496,

$$R.E._{(LD:RCBD_{Row})} = \frac{MS_{Col.} + (r-1)MS_E}{rMS_E} \times 100 \qquad R.E._{(LD:CRD)} = \frac{MS_{Row} + MS_{Col.} + (r-1)MS_E}{(r+1)MS_E} \times 100$$

Good Luck



Dr. Omiad Saber Abdullah Shwany

Experimental Design and Analysis
Time: 90 minutes

2nd Examination

Date: 8-5-2014 Thursday

University of Salahadden-Erbil
Collage of Adm. and Economics
Statistics Department 4th Stage

Q1// Create the design (انشاء تصميم) and find the Linear Model for: (40 Degrees)

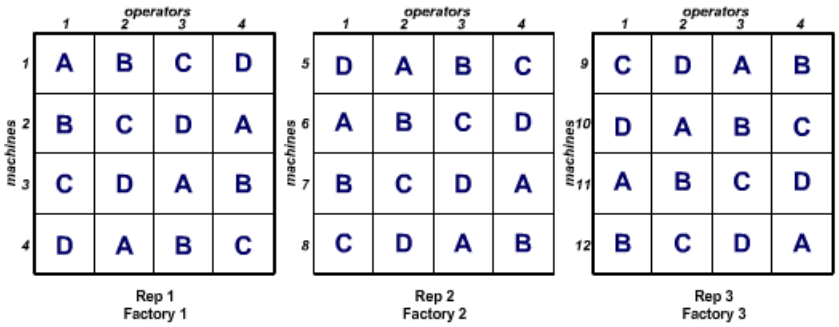
1- (4×2) CRD with 3 replications.
2- (3×3) RCBD with 2 Blocks.
3- 2^3 confounding 2blocks and 3repleaction.
4- RCBD (4×3) r=3 if Factor A is Whole Plots and Factor B (Sub-plot).

Q2// Define these designs (ما نوع التصميم المستخدم) and find the linear model: (20 Degrees)

(A)

	c1		c2		c3		c4	
r1	b1	a4	b1	a2	b3	a3	b2	a1
	b3		b2		b2		b3	
	b2		b3		b1		b1	
r2	b3	a3	b2	a1	b3	a2	b3	a4
	b2		b3		b1		b1	
	b1		b1		b2		b2	
r3	b3	a1	b2	a3	b1	a4	b3	a2
	b2		b1		b2		b2	
	b1		b3		b3		b1	
r4	b2	a2	b1	a4	b1	a1	b2	a3
	b1		b3		b3		b1	
	b3		b2		b2		b3	

(B)



Q3// Test the hypotheses with LSD if possible for: (40 Degrees)

Row	Column 1	Column 2	Column 3	Column 4	Row $(\sum R)$
1	1.640 (B)	1.210 (D)	1.425 (C)	1.345 (A)	5.620
2	1.475 (C)	1.185 (A)	1.400 (D)	1.290 (B)	5.350
3	1.670 (A)	0.710 (C)	1.665 (B)	1.180 (D)	5.225
4	1.565 (D)	1.290 (B)	1.655 (A)	0.660 (C)	5.170
Column total $(\sum C)$	6.350	4.395	6.145	4.475	21.365

If $\Longrightarrow$ $F_{(0.05;3;3)}$= 9.2766, $F_{(0.025;3;6)}$= 15.439, $t_{(0.05;\,6)}$= 2.4469; $t_{(0.025;\,6)}$= 2.9687; $F_{(0.05;3;6)}$= 4.7571

Treatment	Total
A	5.855
B	5.885
C	4.270
D	5.355

Experimental Design and Analysis
Time: 90 minutes

3rd Examination

Date: 18-5-2014 Sunday

University of Salahadden-Erbil
Collage of Adm. and Economics
Statistics Department 4th Stage

Q1// Create the design (انشاء تصميم) and find the Linear Model for: (50 Degrees)

1- 2^3 confounding 2 blocks and 2 replications.
2- GLS with 4 treatments.
3- (2×4) RCBD with 3 Blocks.
4- RCBD (4×3) r=4 if Factor A is Whole Plots and Factor B (Sub-plot).
5- (2×5) CRD with 3 replications.

Q2// The yield (نتيجه) of a chemical process is being studied. The two most important variables are thought to be the pressure and the temperature. Three levels of each factor are selected, and a factorial experiment with two replicates is performed. The yield data follow; Test the hypotheses with LSD if possible: (50 Degrees)

Temperature	*Replications*	*Pressure*			
		200	*215*	*230*	*Sum Rows*
150	r_1	90.4	90.7	90.2	542.5
	r_2	90.2	90.6	90.4	
160	r_1	90.1	90.5	89.9	541.5
	r_2	90.3	90.6	90.1	
170	r_1	90.5	90.8	90.4	543.4
	r_2	90.7	90.9	90.1	
Sum Columns		542.2	544.1	541.1	1627.4

If $\Longrightarrow$ $F_{(0.01;2;2)}= 99$, $F_{(0.025;2;9)}= 5.7147$, $F_{(0.05;2;9)}= 4.2565$, $t_{(0.025;\ 9)}= 2.685$; $t_{(0.05;\ 9)}= 2.262$

Experimental Design and Analysis
Time: 90 minutes
Date: 8-12-2016 Thursday

1st Examination

University of Salahadden-Erbil
Collage of Administration and Economics
Statistics Department 4th Stage

Q1// create the design and find the Linear Model for (دیزاین و مۆدێڵ بدۆزەوە): (30 Degrees)

1- CRD with four replications and five treatments if t_3 is missing.
2- RCBD with three Blocks and four treatments.

Q2// from the following information (CRD design) do the Duncan multiple range test with five stapes if MSE=6.23 and alpha=5%: (40 Degrees)

Treatments	t_1	t_2	t_3	t_4	t_5
Mean Value	6.4	8.7	9.1	16.3	14
r	4	6	8	7	5

Q3// find ANOVA with 5 stapes: (30 Degrees)

Blocks	Treatment			
	t_1	t_2	t_3	t_4
1	9	11	4	7
2	8	13	6	10
3	9	8	7	5

if : $F_{(0.01;6,3)}$= 27.9107, $F_{(0.01;3,6)}$= 9.7795, $F_{(0.05;3,6)}$= 4.7571, $F_{(0.05;6,3)}$= 8.9406

Dr. Omiad Saber Abdullah & M. Karzan Faezy Hamad

if:

Critical values q'(p, df; 0.05) for Duncan's multiple range tests

$d.f._{Error}$	2	3	4	5	6	7	8	9
5	3.635	3.749	3.796	3.814	3.814	3.814	3.814	3.814
:	:	:	:	:	:	:	:	:
25	2.913	3.059	3.154	3.221	3.271	3.310	3.341	3.366
29	2.892	3.039	3.135	3.202	3.253	3.293	3.326	3.352
30	2.888	3.035	3.131	3.199	3.250	3.290	3.322	3.349

Experimental Design and Analysis
Time: 90 minutes

1st Examination

Date: 6-2-2019 Thursday

University of Salahadden-Erbil
Collage of Administration and Economics
Statistics Department 4th Stage

Q1// create the design and find the Linear Model for: (30 Degrees)

1- CRD with three replications and five treatments.
2- CRD with two replications and four treatments and 5 samples.

Q2// from the following information (CRD design) do the Duncan multiple range test with five stapeses if MSE=8.23 and alpha=5%: (35 Degrees)

Treatments	t_1	t_2	t_3	t_4	t_5
Mean Value	4.31	8.7	19.1	16.3	14
r	4	6	8	7	5

Q3// find ANOVA with 5 stapes if alpha 2.5%: (35 Degrees)

replications	Treatment			
	t_1	t_2	t_3	t_4
1	9	11	4	7
2	8	13	6	10
3	9	8	7	5
4	10	15	8	8

if: $F_{(0.05;3,12)} = 3.4903$, $F_{(0.05;12,3)} = 8.7446$, $F_{(0.025;3,12)} = 4.4742$, $F_{(0.025;12,3)} = 14.3366$

Dr. Omiad Saber Abdullah

6-2-2019 Lecturer

if:

Critical values q'(p, df; 0.05) for Duncan's multiple range tests

$d.f._{Error}$	2	3	4	5	6	7	8	9
5	3.635	3.749	3.796	3.814	3.814	3.814	3.814	3.814
:	:	:	:	:	:	:	:	:
25	2.913	3.059	3.154	3.221	3.271	3.310	3.341	3.366
29	2.892	3.039	3.135	3.202	3.253	3.293	3.326	3.352
30	2.888	3.035	3.131	3.199	3.250	3.290	3.322	3.349

Experimental Design and Analysis | *University of Salahadden-Erbil*
Time: 90 minutes | *Collage of Adm. and Economics*
Date: 6-5-2021 Thursday | *2nd Examination* | *Statistics Department 4th Stage*

Q1// Create the design and find the Linear Model for: (50 Degrees)

1- (2×3×2) CRD with 3 replications.
2- LSD (Latin Square Design) with 5 treatments.
3- GLS (Graeco-Latin Square Design) with 4 treatments.
4- (4×3) CRD with 2 replications.
5- RCBD (4 treatments, 2 Blocks)

Q2// Test the hypotheses of this design (Factorial CRD): (50 Degrees)

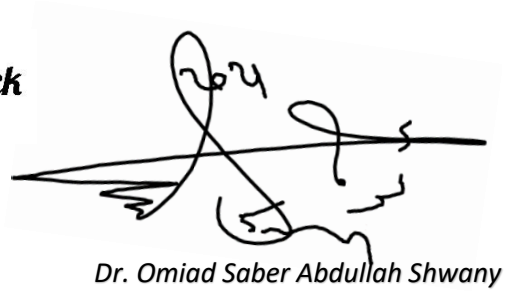
Temperature	Replications	Pressure		
		b_1	b_2	b_3
a_1	r_1	4	7	2
	r_2	2	6	4
a_2	r_1	1	5	-1
	r_2	3	6	1
a_3	r_1	5	8	4
	r_2	7	9	1

If :

$F_{(0.01,2,9)}=8.0215$, $F_{(0.01,9,2)}=99.3881$, $F_{(0.01,4,9)}=6.4221$, $F_{(0.01,9,4)}=14.6591$

$F_{(0.05,2,9)}=4.2565$, $F_{(0.05,9,2)}=19.3848$, $F_{(0.05,4,9)}=3.6331$, $F_{(0.05,9,4)}=5.9988$

good luck



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Higher Edu. and Sci. Research Ministry
Salahaddin University
College of Administration & Economic
Statistics and Informatics Department

Subject: Experimental Design
Stage: 4th
Time: 2 Hours
Date: 14/5/2023

Final Exam - Second Semester – 1st trail
2022– 2023

Q1-A// Create the **design** for: (4×3=12 Marks)

1- CRD (3×4) r=2
2- RCBD with 2 Blocks and 5 treatments
3- LSD (t=4) after that if we have messing data in Y_{342}
4- GLSD if (t=5)

Q1-B// Find the **linear model** for: (4×3=12 Marks)

1- GLSD (t=11)
2- LSD (t=9)
3- CRD (S=8, t=7, r=3)
4- CRD (6×8) r=12

Q2// from the following Data, do the five stapes to know if there are differences or not between treatments? (5×4=20 Marks)

Bβ (3)	Cγ (2)	Aα (9)	Dδ (1)	$F_{(0.05,3,15)}$= 3.2874 $F_{(0.01,12,3)}$= 27.052 $F_{(0.05,3,3)}$= 9.2766 $F_{(0.01,3,3)}$= 29.4567
Dα (2)	Aδ (10)	Cβ (3)	Bγ (4)	
Aγ (11)	Dβ (2)	Bδ (2)	Cα (3)	
Cδ (3)	Bα (2)	Dγ (2)	Aβ (10)	

Q3_A// Prove that TSS = SSt + SSE in CRD. (8 Marks)

Q3_B// From the ANOVA table for (RCBD) design compare between the relative efficiency of (RCBD) and (CRD) design: (8 Marks)

S.O.V.	d.f.	S.S.
Block	4	4.23
Treatment	3	13.2
Error	12	26.26
Total	19	

Good Luck

Dr. Bekhal Samad Sedeeq
Head of Department

Dr. Omiad Saber Abdullah
Examiner

Higher Edu. and Sci. Research Ministry
Salahaddin University
College of Administration & Economic
Statistics and Informatics Department

Subject: Testing Hypothesis
Stage: 4th Class
Time: 2 Hours
Date: / /2022

Final Exam - First Semester
2022– 2023

Q1// The following information is related to the rubber percentage of two types of Rubber plants, where the sample have been drawn independently. Test for their mean difference at the 5% significant level. Assume that the population variances are not known and are unequal. **15 Marks**

	Type I	Type II
n	12	12
Mean	5.63	6.74
Variance	0.38	1.45

Rubber Plants

Q2// Let's we have 5 treatment groups t_1, t_2, t_3, t_4, and t_5**.** Test for their mean difference at the 5% significant level and (MSE = 5.2). Find the Least Significant Difference (LSDα). **15 Marks**

t_1	t_2	t_3	t_4	t_5
4	10	28	3	8
5	14	21	4	9
2	11	24		6
3		20		

Q3// If have a random sample of 500 American adults who are questioned regarding their political affiliation and opinion on a tax reform bill. We will test if the political affiliation and their opinion on a tax reform bill are dependent at a 5% level of significance. Calculate the Chi-Square Test of Independence.

ئەگەر نمونەیەکی هەڕەمەکی 500 کەسی پێگەیشتوو ئەمریکی هەبێت کە پرسیاریان لێدەکرێت سەبارەت بە پەیوەندی سیاسی و بۆچوونیان لەسەر پرۆژە یاسای چاکسازی باج. ئێمە تاقی دەکەینەوە کە ئایا پەیوەندی سیاسی و بۆچوونیان لەسەر پرۆژە یاسای چاکسازی باج لە ئاستی 5% گرنگیدا وابەستەن یان نا.

15 Marks

	Favor	Indifferent	Opposed
Democrat	138	83	64
Republican	64	67	84

Q4// Answer 5 only: **15 Marks**

1. What are the Type I Error and Type II Error?
2. Describe Critical region, Critical Value by chart.
3. Describe one tail and two tail tests?
4. What are the Hypothese for One Sample t-test?
5. What are the differences between Statistic and Parameter?
6. What are the differences between Z-test and t-test?

If we have the following tabulated value:

$t_{(0.025;\,23)} = 2.069$	$t_{(0.025;\,22)} = 2.074$	$t_{(0.05;\,22)} = 1.717$	$Z_{(0.025)} = 1.96$	$Z_{(0.05)} = 1.645$
$F_{(0.05;5,11)} = 3.2039$	$F_{(0.05;4,11)} = 3.3567$	$F_{(0.025;4,16)} = 3.0069$	${x^2}_{(0.05;\,6)} = 12.59$	${x^2}_{(0.05;\,2)} = 5.99$

Good Luck

Dr. Bekhal S. Sdeeq	M. Alan Ghafur Rahim	Dr. Omiad Saber Abdullah
Head of Department	Examiner	Examiner

Higher Edu. and Sci. Research Ministry
Salahaddin University-Erbil
College of Administration & Economic
Statistics and Informatics Department

Subject: Testing Hypothesis
Stage: 4th Class
Time: 2 Hours
Date: / 1 /2023

Final Exam - First Semester- 2nd Trial
2022– 2023

Q1// We randomly select 15 calls from each call center and calculate the average call lengths. The two call centers seem to have different average call lengths. Is this difference statistically significant? Assume these two samples come from populations with unequal variances. Use level of significance (0.05). **15 Marks**

	Sample size	mean (sec)	Standard deviation
Call Center A	15	122	15
Call Center B	15	135	20

Q2// The illness caused by a virus in a city concerning some restaurant inspectors is not consistent with their evaluations of the cleanliness of restaurants. In order to investigate this possibility, the director has five restaurant inspectors to grade the cleanliness of three restaurants. Carry out two-way ANOVA at 5% level of significance, the results are shown below. **15 Marks**

Inspectors مفتش **(Treatments)**	Restaurants **(Blocks)**		
	I	**II**	**III**
1	21	5	34
2	15	7	36
3	20	15	27
4	22	19	20
5	26	14	35

Q3// The following table shows three different airlines' row variables and the number of delayed or on-time flights column variable from light stats.com. Does on-time performance depend on the airline? Calculate the Chi-Square Test of Independence at 5% level of significance. **15 Marks**

	Delayed تاخیر دەبێت	On-time لە کاتی خۆی
American	112	843
Southwest	114	1416
United	61	896

Q3// If we have the following information test the Dunnett test.

If MSE=2.6 and α = 0.05 **15 Marks**

Treatments	**Control t_1**	**t_2**	**t_3**	**t_4**
Mean	4	8.5	7	11.5
n	5	3	4	3

If we have the following tabulated value:

$t_{(0.025;\,29)} = 2.045$	$t_{(0.025;\,28)} = 2.048$	$t_{(0.05;\,29)} = 1.699$	$Z_{(0.025)} = 1.96$	$Z_{(0.05)} = 1.645$
$t_{(0.05;\,28)} = 1.701$	$t_{(0.025;\,10)} = 2.228$	$t_{(0.025;\,11)} = 2.201$	$F_{(0.025;\,4,10)} = 4.271$	$F_{(0.025;\,5,10)} = 4.236$
$F_{(0.05;4,8)} = 3.838$	$F_{(0.05;4,10)} = 3.48$	$F_{(0.05;2,8)} = 4.459$	$x^2{}_{(0.05;\,6)} = 12.59$	$x^2{}_{(0.05;\,2)} = 5.99$
Dunnett's $t_{(0.05;14)} = 2.63$		Dunnett's $t_{(0.05;11)} = 2.72$		

Good Luck

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