**Department of (Statistics and informatics)**

**College of (Administration and Economics)**

**University of Salahaddin - Erbil**

**Subject: Experimental design and Analysis**

**Course Book – (Year 4)**

**Lecturer's name Dr. Omiad Saber Abdullah PhD**

**Academic Year: 2021/2022**

# Course Book

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| **1. Course name** | **Experimental Design and Analysis** |
| **2. Lecturer in charge** | **Assistant Proph. Dr. Omiad Saber Abdullah** |
| **3. Department/ College** | **Statistics/ Adm. & Eco.** |
| **4. Contact** | **e-mail: Omiad.abdullah@su.edu.krd**<br>**Tel: (07504660477)** |
| **5. Time (in hours) per week** | **Theory: 2**<br>**Practical: 1** |
| **6. Office hours** | |
| **7. Course code** | |
| **8. Teacher's academic profile** | **1997 : B.Sc : Statistics/ collage of Adm. & Eco. in Salahaddin university.**<br>**2002 : M.Sc : Statistics/ collage of Adm. & Eco. in Salahaddin university.**<br>**2012 : PhD : Statistics/ collage of Adm. & Eco. in Salahaddin university.** |
| **9. Keywords** | **Experimental Design, SPSS, Biostatistics** |

**10. Course overview:**

A branch of statistics that attempts to outline the way in which experiments should be carried out so the data gathered will have statistical value.In the design of experiments, the experimenter is often interested in the effect of some process or intervention (the "treatment") on some objects (the "experimental units"), which may be people, parts of people, groups of people, plants, animals, materials, etc. Design of experiments is thus a discipline that has very broad application across all the natural and social sciences.

**11. Course objective:**

The topic of the course is applied Experimental Design. Key features are:

1. The topics of design and analysis will be studied together. The idea behind this approach is that to choose an appropriate design it is necessary to understand the properties of the anticipated data analysis.

2. The emphasis will be on applications, rather than theory.

3. Applications in the agricultural, biological, ecological, and medical sciences will be emphasized, rather than applications in manufacturing or business.

4. Most statistical computations in this course will be done in Minitab.

Entry requirements

- Skill of working with computer
- Skill of working with SPSS Application

**12. Student's obligation**

Exams, and Assignments

**13. Forms of teaching**

Data show, whiteboard

**14. Assessment scheme**

Breakdown of overall assessment and examination

Two examination season and Activity daily.

15. Student learning outcome:

Teaching students the philosophy of all design with the mathematical model and manual analyzing and application through SPSS.

## 16. Course Reading List and References:

- Key references: [1 3 2 4]

1. Federer, W. T., Experimental design. *Experimental design.* 1955.
2. Kirk, R. E., *Experimental design*. Wiley Online Library: 1982.
3. Winer, B. J.; Brown, D. R.; Michels, K. M., *Statistical principles in experimental design*. McGraw-Hill New York: 1971; Vol. 2.
4. Box, G. E.; Hunter, J. S.; Hunter, W. G., Statistics for experimenters: design, innovation, and discovery. *AMC* 2005, *10*, 12.

- Useful references:

(الراوي ، خاشع محمود وعبد العزيز محمد خلف الله. 2000. تصميم وتحليل التجارب الزراعية. كلية الزراعة والغابات. جامعة الموصل – العراق)

- Magazines and review (internet):

(Google Scholar)

| Week | Topics | References |
|---|---|---|
| 1,2,<br>3,4 | Preliminaries<br>• General Goals of Experimental Design and some definition<br>• Experiment, Replication, Treatment, Experimental unit, Factor, Experimental error<br>• Design structure and treatment structure<br>• Analysis of variance, Ideal Conditions (assumptions)<br>• Basic Principles of Experimental Design/(Data transformation) | Chapter1 |
| 5,6,<br>7,8 | Completely Randomized Design(CRD)<br>• Completely Randomized Design Definitions<br>• Principles and Usage<br>• Lay out of Experiment<br>• Liner model<br>• Data Analysis/ (one-way ANOVA Table)<br>• Advantages/Disadvantages<br>• Multiple Mean Comparisons<br>• Type of Models (Fixed or Random)<br>• Completely Randomized Design under unequally replication<br>• Liner model<br>• Data Analysis/ (one-way ANOVA Table)<br>• Multiple Mean Comparisons | Chapter2 |
| 9,10,<br>11,12 | Complete Randomized Block Design (CRBD)<br>• Completely Randomized Block Design Definitions<br>• Principles and Usage<br>• Lay out of Experiment (One-way Blocking)<br>• Liner model<br>• Data Analysis /( ANOVA Table)<br>• Advantages/Disadvantages<br>• Missing Value & Relative of Efficiency (%RE)<br>• Multiple comparisons | Chapter3 |

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| 13,14,<br>15,16,<br>17 | Latin Square Design(LS)<br>Latin Square Design Definitions<br>• Principles and Usage<br>• Lay out of Experiment (Two-way Blocking )<br>• Liner model<br>• Data Analysis (multi-way ANOVA)<br>• Missing data& Relative of Efficiency (%RE)<br>Greek Latin Square Design(GLS)<br>• Lay out of Experiment<br>• Liner model ,(ANOVA Table ) | Chapter4 |
| 18,19,<br>20,21 | Factorial experiments<br>• Some Definition and Symbol<br>• Two-way experiments<br>• three-way experiments<br>• Advantages/Disadvantages<br>• Factorial experiments using completely randomized design<br>• Lay out of Experiment<br>• Liner Models<br>• Data Analysis (ANOVA Table)<br>• Multiple comparisons for factorial experiments<br>• Factorial experiments using complete randomized block design<br>• Lay out of Experiment<br>• Liner Models<br>• Data Analysis (ANOVA Table)<br>• Factorial experiments using Latin square Design<br>• Lay out of Experiment<br>• Liner Models<br>• Analysis of variance(ANOVA Table) | Chapter5 |
| 22,23,<br>24,25 | Confounding<br>• Confounding Definitions<br>• Principles and Usage<br>• Layout of Confounding in 2*2 experiment<br>• Layout of Confounding in 2*3 experiment<br>• Complete Confounding<br>• Partial Confounding<br>• Examples | Chapter6 |
| 26,27,<br>28 | Split-plot design<br>• Split plot design Definitions<br>• Principles and Usage<br>• whole plot<br>• Sub plot<br>• Liner Model and Assumptions when whole plot experiment is Completely Randomized Design.<br>• Liner Model and Assumptions when whole plot experiment is Completely Randomized Blocked<br>• Analysis of variance on whole plot and sub-plot,<br>• Multiple comparisons<br>• Example | Chapter7 |

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| 29,30 | Analysis of Covariance<br>• Analysis of Covariance Definitions<br>• Principles and Usage<br>• Lay out of Experiment<br>• Models and one-way analysis of covariance in completely randomized design<br>• Examples | Chapter8 |

## 19. Examinations:

***1. Compositional:*** In this type of exam the questions usually starts with Explain how, What are the reasons for…?, Why…?, How….?
With their typical answers
Examples should be provided

***2. True or false type of exams:***

In this type of exam a short sentence about a specific subject will be provided, and then students will comment on the trueness or falseness of this particular sentence. Examples should be provided

***3. Multiple choices:***

In this type of exam there will be a number of phrases next or below a statement, students will match the correct phrase. Examples should be provided.
Create the design and find the Linear Model for:

1- $2^3$ confounding 2blocks and 3repleaction.
2- Split Design (RCBD) (3×5) and r=2.

Test the hypotheses with 5 steps at alpha5%:

| 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 |

From the ANOVA table below (LSD Latin Square Design) find the relative efficiency of RE (LSD: RCBD) and RE (LSD: CRD) and discuss (ناقش) the results:
(15 Degrees)

| S.O.V. | d.f. | SS |
|---|---|---|
| Row | 3 | 0.030 |
| Column | 3 | 0.827 |
| treatments | 3 | 0.427 |
| Error | 6 | 0.129 |
| Total | 15 | 1.413 |

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

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