International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

On Randomized Complete Block Design

Hadeel Salim AL Kutubi*

Faculty of Computer Science and Mathematics, Kufa University, Najaf, 54001, Iraq

Email: hadeel.alkutubi@uokufa.edu.iq

Abstract

This study presented the evaluate of 20 types of cancer disease in Tikrit teaching hospital in Tikrit for the period from 1995 to 2005 . the data analyzed by RCBD (Randomized complete block design) to explain the significant difference between all kind of cancer disease and all age groups.

Keywords: Randomized; complete block design; cancer.

1. Introduction

The randomized complete block design (RCBD) is a standard design for bio statistic experiments in which similar experimental units are grouped into blocks or replicates. It is used to control variation in an experiment by, for example, accounting for spatial effects in field or greenhouse. The defining feature of the RCBD is that each block sees each treatment exactly once.Randomized complete block designs differ from the completely randomized designs in that the experimental units are grouped into blocks according to known or suspected variation which is isolated by the blocks. Variation such as fertility, sand, and wind gradients, or age and litter of animals can be isolated by appropriate blocking. Therefore, within each block, the conditions are as homogeneous as possible, but between blocks, large differences may exist. There are many studies on this topic, including one [6]: He compared the effectiveness of split-plot design (SPD) over randomized complete block design (RCBD).

---

* Corresponding author.

The data used for comparison is a 2 1 x 5 2 split-plot experiment with three replicates, Reference [10] reviews the problems associated with ignoring animal grouping during data analyses, and examples are provided for appropriate methods to use when animals are grouped in pens, Reference [9] provide a way to intuitively understand the error structure and resulting statistical analysis in split-plot designs through building on concepts found in simple designs, such as completely randomized and randomized complete block designs, and then provide a way for students to "see" the error structure graphically, Reference [11] study the consequences of more realistic assumptions about $z_{i\,j}$. and verify that the usual F test, for testing treatment effects, can be used even if there is a constant covariance between responses from experimental units in the same block [12]. The goal of his research (1) to demonstrate the consequences of constructing an *F*-statistic based on a mean square error for testing the significance of treatment effects under the restricted randomization; (2) to describe an alternative method, based on split-plot analysis of variance, to analyze designed experiments that yield better power under the restricted randomization, Reference [5] derive asymptotic procedures as well as finite approximations,

for the analysis of data arising from series of such experiments [8]. He is an attempt to build some new functions of Randomized Complete Block Design in R-software. Different computer programs are developed using Rsoftware. All these functions are run on real data set .The present work is an attempt to show the flexibility of R, Reference [7] consider two the most popular in practice designs for three – factorial experiments, split – split plot design and split – plot χ split – block (SPSB).

2. Patients and Methods

2.1 Patients

We taken 1555 case from Tikrit teaching hospital (1995-2005) in Tikrit . Data contain 20 types of cancer disease divided between age groups . So we will present the CRBD design to find the significant difference between the types of cancer and age groups.

2.2 The Randomized Complete Block Design RCBD

The randomized complete block design (RCBD) is perhaps the most commonly encountered design that can be analyzed as a two – way ANOVA. In this design , a set of experimental unit is grouped (blocked) in a way that minimizes the variability among the units within groups (blocks). The objective is to keep the experimental error within each block as well as possible. Each block contains a complete set of treatments, therefore differences among blocks are not due to treatments, and this variability can be estimated as a separate source of variation. The removal of an appreciable amount of this source of variation reduces experimental error and improves the ability of the experiment to detect smaller treatment differences. The greater the variability among blocks the more efficient the design becomes. In the absence of appreciable block differences the design is not as efficient as a completely randomized design (CRD) [1,2,3,4].

Sources of Variation:

H_0: , H_a: , $\sum Y_{i.}$, $\sum Y_{.j}$, $CF = \frac{(Y_{..})^2}{rt}$, $SST = \sum\sum {Y_{ij}}^2 - Cf$, $df\ for\ total = rt - 1$, $SSt = \frac{\sum {Y_i}^2}{r} - CF$, $df\ for\ treatment\ = t - 1$, $MSt = \frac{SSt}{df\ t}$, $SSB = \frac{\sum {Y_{.j}}^2}{t} - CF$, $df\ for\ Blocks\ (Reps) = r - 1$, $MSB = \frac{SSB}{df\ B}$, $SSE = SST - SSt - SSB$, $df\ E = df\ T\ - df\ t\ - df\ B$, $MSE = \frac{SSE}{df\ E}$, $F_c = \frac{MST}{MSE}$ $F_{table} = df\ t$, $df\ E$

Table 1: ANOVA table for RCBD

S.O.V	df	SS	MS	F
Block (reps.)	r-1	SSB	MSB	F - Block
Treatment	t-1	SSt	MSt	F- treatment
Error	(r-1)(t-1)	SSE	MSE	
Total	rt-1	SST		

3. Results and Discussion

Table 2: Cancer types in 1995 distributed on age groups

Types	1-20 T1	21-40 T2	41-60 T3	61-80 T4	81-100 T5
Leukemia	6	7	11	14	4
Lung	0	8	12	2	17
Bladder	0	0	2	7	6
Prostate	0	0	3	6	0
Bone	0	1	0	0	1
Brain	3	0	0	2	0
Stomach	0	0	0	0	0
Pancreas	0	0	2	0	4
Rectum	0	0	0	2	3
Kidney	1	1	0	3	2
Liver	0	0	0	0	0
Urinary	0	0	1	3	0
Larynx	0	0	2	4	8
Thyroid gland	0	0	1	0	3
Colon	0	3	0	0	1
Lymphoma	0	0	0	0	1
Small intestine	0	5	0	0	0
Skin	0	0	0	0	0
Uterus	0	2	4	5	9
Breast	6	9	5	7	8

Table 3: Significant different between all age groups (1995) by ANOVA

S.O.V	df	SS	MS	F
Block (reps.)	19	193.79	10.199	1.05
Treatment	4	1712.11	428.02	44.125
Error	76	739.79	9.7	
Total	99			

$F_{table} = 2.45$, so there exist significant deference between the age groups because the $F_{cal.} > F_{tab.}$, but there is no significant deference between cancer's types .

Table 4: Cancer types in 1996 distributed on age groups

Types	1-20 T1	21-40 T2	41-60 T3	61-80 T4	81-100 T5
Leukemia	120	6	7	11	2
Lung	0	3	5	1	2
Bladder	0	0	1	3	1
Prostate	0	0	5	0	2
Bone	2	0	1	0	0
Brain	0	1	5	0	0
Stomach	0	2	1	2	0
Pancreas	0	0	3	0	4
Rectum	0	0	3	8	1
Kidney	2	2	0	3	7
Liver	0	0	0	0	4
Urinary	1	3	0	0	4
Larynx	1	0	0	2	1
Thyroid gland	0	0	0	0	1
Colon	0	2	0	3	1
Lymphoma	1	0	0	0	0
Small intestine	0	0	0	0	0
Skin	0	0	0	0	0
Uterus	0	2	2	8	6
Breast	0	2	2	6	1

Table 5: Significant different between all age groups (1996) by ANOVA

S.O.V	df	SS	MS	F
Block (reps.)	19	184.78	9.725	1.103
Treatment	4	109.11	27.27	3.09
Error	76	669.77	8.812	
Total	99			

$F_{table} = 2.45$, so there exist significant deference between the age groups because the $F_{cal.} > F_{tab.}$, but there is no significant deference between cancer's types .

Table 6: Cancer types in 1997 distributed on age groups

Types	1-20 T1	21-40 T2	41-60 T3	61-80 T4	81-100 T5
Leukemia	1	1	2	5	0
Lung	0	2	0	0	4
Bladder	0	1	0	3	4
Prostate	0	0	0	0	6
Bone	0	0	0	1	0
Brain	3	0	2	1	0
Stomach	0	0	0	0	1
Pancreas	0	3	0	3	0
Rectum	0	0	0	0	3
Kidney	0	4	0	3	1
Liver	0	1	2	1	0
Urinary	0	0	0	0	4
Larynx	2	0	0	3	1
Thyroid gland	0	0	0	0	0
Colon	0	1	0	3	0
Lymphoma	0	1	0	2	0
Small intestine	0	0	0	3	0
Skin	2	0	2	0	0
Uterus	0	0	1	3	1
Breast	0	0	0	1	0

Table 7: Significant different between all age groups (1997) by ANOVA

S.O.V	df	SS	MS	F
Block (reps.)	19	193.28	10.17	1.433
Treatment	4	1212.25	303.06	42.714
Error	76	539.22	7.095	
Total	99			

$F_{table} = 2.45$, so there exist significant deference between the age groups because the $F_{cal.} > F_{tab.}$, but there is no significant deference between cancer's types .

Table 8: Cancer types in 1998 distributed on age groups

Types	1-20 T1	21-40 T2	41-60 T3	61-80 T4	81-100 T5
Leukemia	8	3	2	5	0
Lung	1	4	1	6	3
Bladder	0	0	4	3	1
Prostate	0	0	1	2	5
Bone	2	0	2	0	0
Brain	3	1	1	0	1
Stomach	0	0	2	0	2
Pancreas	0	2	0	3	0
Rectum	0	0	2	0	0
Kidney	2	0	0	1	3
Liver	0	0	0	0	0
Urinary	0	1	2	0	3
Larynx	0	0	1	0	0
Thyroid gland	0	1	0	0	0
Colon	0	0	1	0	2
Lymphoma	0	0	0	0	0
Small intestine	0	2	1	1	3
Skin	0	0	0	0	0
Uterus	0	0	2	2	2
Breast	0	0	5	5	0

Table 9: Significant different between all age groups (1998) by ANOVA

S.O.V	df	SS	MS	F
Block (reps.)	19	201.78	10.62	1.17
Treatment	4	1681.13	420.28	46.337
Error	76	689.77	9.07	
Total	99			

$F_{table} = 2.45$, so there exist significant deference between the age groups because the $F_{cal.} > F_{tab.}$, but there is no significant deference between cancer's types .

Table 10: Cancer types in 1999 distributed on age groups

Types	1-20 T1	21-40 T2	41-60 T3	61-80 T4	81-100 T5
Leukemia	4	0	6	2	2
Lung	1	3	5	2	1
Bladder	0	2	0	4	0
Prostate	0	0	2	0	3
Bone	3	0	0	1	0
Brain	2	1	0	0	1
Stomach	0	0	4	1	1
Pancreas	0	0	0	1	3
Rectum	0	0	0	0	1
Kidney	1	0	2	2	3
Liver	0	1	0	1	1
Urinary	0	2	0	2	2
Larynx	1	0	2	0	0
Thyroid gland	1	0	2	0	3
Colon	0	0	3	0	4
Lymphoma	0	0	2	0	2
Small intestine	1	0	6	0	6
Skin	4	0	0	0	2
Uterus	0	0	0	1	0
Breast	0	0	1	3	2

Table 11: Significant different between all age groups (1999) by ANOVA

S.O.V	df	SS	MS	F
Block (reps.)	19	177.55	9.344	0.84
Treatment	4	1645.2	411.3	37.15
Error	76	841.74	11.07	
Total	99			

$F_{table} = 2.45$, so there exist significant deference between the age groups because the $F_{cal.} > F_{tab.}$, but there is no significant deference between cancer's types .

Table 12: Cancer types in 2000 distributed on age groups

Types	1-20 T1	21-40 T2	41-60 T3	61-80 T4	81-100 T5
Leukemia	4	4	4	3	2
Lung	1	3	2	4	1
Bladder	0	2	6	1	2
Prostate	0	0	2	3	1
Bone	2	1	3	1	1
Brain	5	1	2	1	3
Stomach	0	0	2	3	1
Pancreas	0	1	2	1	2
Rectum	0	2	1	1	3
Kidney	2	1	2	4	3
Liver	0	0	1	3	1
Urinary	0	0	0	0	3
Larynx	2	2	2	3	1
Thyroid gland	0	2	1	1	3
Colon	0	0	1	1	2
Lymphoma	0	0	0	1	1
Small intestine	0	0	2	1	3
Skin	0	0	0	0	1
Uterus	0	0	3	0	0
Breast	0	0	1	3	1

Table 13: Significant different between all age groups (2000) by ANOVA

S.O.V	df	SS	MS	F
Block (reps.)	19	144.51	7.60	0.824
Treatment	4	1682.4	420.6	45.61
Error	76	701.32	9.22	
Total	99			

$F_{table} = 2.45$, so there exist significant deference between the age groups because the $F_{cal.} > F_{tab.}$, but there is no significant deference between cancer's types .

Table 14: Cancer types in 2001 distributed on age groups

Types	1-20 T1	21-40 T2	41-60 T3	61-80 T4	81-100 T5
Leukemia	6	2	6	2	4
Lung	0	2	1	1	5
Bladder	0	0	1	1	3
Prostate	0	2	1	1	0
Bone	1	0	3	1	2
Brain	4	2	2	1	4
Stomach	0	0	2	1	3
Pancreas	0	0	0	1	2
Rectum	0	0	1	2	3
Kidney	1	0	0	2	5
Liver	0	3	1	2	0
Urinary	0	0	0	2	1
Larynx	1	0	2	1	1
Thyroid gland	0	0	1	2	1
Colon	0	1	3	0	2
Lymphoma	0	0	1	3	1
Small intestine	0	2	3	2	0
Skin	1	0	0	1	1
Uterus	0	0	2	0	0
Breast	0	0	0	1	0

Table 15: Significant different between all age groups (2001) by ANOVA

S.O.V	df	SS	MS	F
Block (reps.)	19	244.32	12.85	1.317
Treatment	4	1810.12	452.53	46.413
Error	76	741.25	9.75	
Total	99			

$F_{table} = 2.45$, so there exist significant deference between the age groups because the $F_{cal.} > F_{tab.}$, but there is no significant deference between cancer's types .

Table 16: Cancer types in 2002 distributed on age groups

Types	1-20 T1	21-40 T2	41-60 T3	61-80 T4	81-100 T5
Leukemia	12	3	9	12	5
Lung	0	0	2	3	1
Bladder	0	0	5	1	3
Prostate	0	0	0	0	1
Bone	2	0	0	1	0
Brain	3	1	1	0	1
Stomach	0	0	0	4	1
Pancreas	1	0	0	0	0
Rectum	0	0	3	0	1
Kidney	3	0	0	5	0
Liver	1	0	0	0	0
Urinary	0	0	0	0	0
Larynx	1	3	2	0	2
Thyroid gland	0	0	0	0	0
Colon	0	0	1	0	0
Lymphoma	2	0	0	0	0
Small intestine	0	3	0	1	2
Skin	0	0	0	0	0
Uterus	0	0	3	0	0
Breast	0	0	1	3	1

Table 17: Significant different between all age groups (2002) by ANOVA

S.O.V	df	SS	MS	F
Block (reps.)	19	187.10	9.847	1.045
Treatment	4	1654.41	413.60	43.89
Error	76	716.12	9.422	
Total	99			

$F_{table} = 2.45$, so there exist significant deference between the age groups because the $F_{cal.} > F_{tab.}$, but there is no significant deference between cancer's types .

Table 18: Cancer types in 2003 distributed on age groups

Types	1-20 T1	21-40 T2	41-60 T3	61-80 T4	81-100 T5
Leukemia	8	1	2	15	15
Lung	0	2	1	0	1
Bladder	0	0	5	1	4
Prostate	0	0	0	4	2
Bone	1	0	2	2	0
Brain	6	0	0	2	0
Stomach	0	0	0	2	3
Pancreas	0	0	0	1	0
Rectum	0	0	0	0	1
Kidney	2	0	0	3	1
Liver	6	2	0	5	2
Urinary	0	0	0	0	0
Larynx	1	0	3	1	0
Thyroid gland	0	0	0	2	1
Colon	0	1	3	0	5
Lymphoma	0	0	0	0	2
Small intestine	0	0	2	0	3
Skin	0	0	0	0	0
Uterus	0	3	0	4	0
Breast	0	0	3	0	1

Table 19: Significant different between all age groups (2003) by ANOVA

S.O.V	df	SS	MS	F
Block (reps.)	19	174.64	9.19	1.531
Treatment	4	1423.17	355.79	59.29
Error	76	456.47	6.00	
Total	99			

$F_{table} = 2.45$, so there exist significant deference between the age groups because the $F_{cal.} > F_{tab.}$, but there is no significant deference between cancer's types .

Table 20: Cancer types in 2004 distributed on age groups

Types	1-20 T1	21-40 T2	41-60 T3	61-80 T4	81-100 T5
Leukemia	8	5	2	5	4
Lung	2	0	3	6	1
Bladder	0	0	2	7	3
Prostate	0	0	2	0	6
Bone	2	0	2	0	1
Brain	3	3	7	2	2
Stomach	0	0	0	2	0
Pancreas	0	0	0	0	2
Rectum	0	0	0	0	0
Kidney	3	0	5	2	4
Liver	0	2	0	0	0
Urinary	0	9	1	1	2
Larynx	1	0	0	0	0
Thyroid gland	0	0	0	3	0
Colon	0	2	5	2	0
Lymphoma	0	0	0	0	0
Small intestine	0	0	0	2	2
Skin	0	0	0	0	0
Uterus	0	0	3	0	1
Breast	0	0	2	0	3

Table 21: Significant different between all age groups (2004) by ANOVA

S.O.V	df	SS	MS	F
Block (reps.)	19	178.44	9.39	0.89
Treatment	4	1765.52	441.38	41.91
Error	76	800.85	10.53	
Total	99			

$F_{table} = 2.45$, so there exist significant deference between the age groups because the $F_{cal.} > F_{tab.}$, but there is no significant deference between cancer's types .

Table 22: Cancer types in 2005 distributed on age groups

Types	1-20 T1	21-40 T2	41-60 T3	61-80 T4	81-100 T5
Leukemia	10	2	8	1	3
Lung	0	2	3	3	6
Bladder	0	0	0	12	7
Prostate	0	0	0	6	7
Bone	12	1	7	9	5
Brain	4	2	0	0	7
Stomach	0	0	1	0	1
Pancreas	0	1	0	0	0
Rectum	0	0	5	3	1
Kidney	1	0	2	2	1
Liver	3	2	0	1	1
Urinary	0	0	0	1	0
Larynx	0	0	0	2	2
Thyroid gland	1	0	0	2	0
Colon	1	0	0	2	1
Lymphoma	0	0	3	2	6
Small intestine	0	1	0	0	1
Skin	0	1	0	0	4
Uterus	0	1	1	1	1
Breast	0	1	3	0	1

Table 23: Significant different between all age groups (2005) by ANOVA

S.O.V	df	SS	MS	F
Block (reps.)	19	210.41	11.07	1.127
Treatment	4	1759.12	439.78	44.77
Error	76	746.54	9.822	
Total	99			

$F_{table} = 2.45$, so there exist significant deference between the age groups because the $F_{cal.} > F_{tab.}$, but there is no significant deference between cancer's types .

4. Conclusion

1. There exist significant deference between the age groups

2. There is no significant deference between cancer's types

5. Recommendations

It is possible to use the same data for cancer patients that were taken from a general hospital in the city of Tikrit in Iraq to be used again in new statistical methods such as designing a new experiment or a global trial to give us another type of results related to cancerous injuries in the city.

Reference

[1]. AlKutubi H. S. , Ibrahim N. and Yaseen N. K. 2009. On statistical analysis of cancer tumors in Tikrit hospital . European journal of scientific research , Vol.35, No. 1, 106-120.

[2]. AlKutubi H. S. and Yaseen N. K. 2009. On completely random design of cancer in Tikrit teaching hospital. European journal of scientific research , Vol.35, No. 4, 633-640.

[3]. AlKutubi H. S , 2009. Experimental design of HIV patients. European journal of scientific research , Vol.35, No. 1, 65-75.

[4]. Bland, Martin, 2000. An introduction to medical statistics, Third edition, Oxford University Press ,Inc., New York.

[5]. Bathke A. C, Harrar S. W, Wang H., Ke Zhang and Piepho H. Series of randomized complete block experiments with non – normal. Computational statistics and data analysis, Vol. 54, 2010: 1840 – 1857.

[6]. David, I. J., Adehi, M. U. Effectiveness of Split-Plot Design over randomized Complete Block Design in Some Experiments. Biology Agriculture and healthcare, Vol. 4, No. 19, 2014.

[7]. Deregowska K. A., Mejza I. and Mejza S. On the relative efficiency of split – split – plot design to split – plot χ split – block design. Colloquium biometricum, Vol. 44, 2014: 69 – 78.

[8]. Jeelani M. I, Nazir N, Sharma M. K, Bhat A, Gul M. and Kumar B. R Codes for Randomized Complete Block Design. International Journal of Information Science and System, Vol. 6, No. 1, 2018: 1-8.

[9]. Robinson T. J., Brenneman W. A. and Myery W. R. An intuitive Graphical approach to understanding the split- plot experiment. Journal of statistics education, Vol. 17, No. 1, 2009.

[10]. St-Pierre N. R. Design and analysis of pen studies in the animal sciences. Journal of dairy science, Vol. 90, 2007.

[11]. Peres C. A. Testing the effect of blocking in a randomized complete block design (RCBD). Journal communications in statistics – theory and methods, Vol. 10, issue 23, 1981.

[12]. Pilla R. S, Kitska D. J, Loader C. Statistical analysis of modified complete randomized designs: applications to chemo – orientation studies. Journal of experimental biology, 2005, 208:1267-1276.