# An Experimental Design for Nursing Student

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**Abstract**

In this study we present five variables of lecturer's evaluation in department of community health nursing, college of Nursing, Kufa university in Iraq for 2011. The data is analyzed using completely random design, LSD and factorial Experiment to explain the significant difference between all variables (scientific ,personality ,ability of evaluation and ability of communication ) for each type of evaluation. SPSS program (version 16) was used throughout this study to analyze the data and to generate various Tables .

Keywords: Analysis of variance, Experimental design , Completely random design and Factorial Experiment .

## Introduction

Experimental design units are chosen at random from the population to which inferences are to be made. The total sample is randomly divided into groups and the different treatments under study are then applied to the groups, one treatment to a group. If the treatments differ from each other then the various treatment groups will have different mean values at the end of the experiment. For the completely random design the general method is the analysis of variance.

The process of using the ANOVA (analysis of variance)is best learned by studying examples. In a completely randomized design there are k treatments, each of which is assigned at random to a group of experimental units.

We present in this study the significant difference between all courses for student of department of community health nursing, college of Nursing, Kufa University, Iraq . First we present the theoretical part about statistical methods like experimental design, analysis of variance and then calculate the significant difference for the level of student comprehension between all courses in each stage in department and find the best from this courses using LSD.

## Material and Method

### 1.Completely Random Design

In a completely randomized design each experimental unit has an equal and independent chance of receiving any one of the treatments. The basic assumption underlying this design is that the observed values in any one group represent a random sample of all possible values of all experimental units under that particular treatment. Calculations from analysis of variance displayed in an ANOVA table.

Table 1: ANOVA for the completely randomized design

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Squares | F |
|---|---|---|---|---|
| Among treatments | k-1 | SST | MST=SST/(k-1) | MST/MSE |
| Within treatments | N-k | SSE | MSE=SSE/(N-k) | |
| Total | N-1 | SS | | |

The total sum of squares(SS) is the total of the squared deviations of the observations from overall mean of the data. Such that,

$SS_{Total} = \sum_{all} Y^2 - \frac{(\sum_{all} Y)^2}{N}$ , where N=$n_1$ +$n_2$ +$n_3$ +….+$n_k$ , ,k=number of treatments

For convenience of calculations ,the term $\frac{(\sum_{all} Y)^2}{N}$ , and the computational formula for SSE is given by $SS_{Within} = SSE = \sum_{all} Y^2 - \sum_{i=1}^{k} \frac{(T_i)^2}{n_i}$. The final source of variation to be calculated is the among treatments variation(the failure of the k treatment means to be alike).The computational formula is given by

$$SS_{Among} = SST = \sum_{i=1}^{k} \frac{(T_i)^2}{n_i} - CF$$

A final calculation short –cut may be developed by utilizing the relationship

$SS_{Total} = SS_{Within} + SS_{Among}$ =SSE+SST

The general procedure for computing the mean square column for the ANOVA is to compute first the sum of squares and enter in the ANAVA table; then compute the degrees of freedom and enter in the table. Finally to compute the mean square by dividing the degrees of freedom into the sum of squares.

$MST = \frac{SST}{k-1}$ and $MSE = \frac{SSE}{N-k}$

The test of the significance of differences among means is accomplished by computing the ratio of the estimate of $\sigma^2$ based on between variation (MST) to the estimate based on within variation(MSE).This ratio is called an F statistic. The larger this ratio ,the greater the difference between the two values and the less likely the null hypothesis is true. $F = \frac{MST}{MSE}$

## 2.Factorial Experiment

we have the experiment like

| A | B | $Y_{ijk}$ | | | | Y |
|---|---|---|---|---|---|---|
| $a_1$ | $b_1$ | $Y_{111}$ | $Y_{112}$ | $Y_{113}$ | $Y_{114}$ | $Y_{11.}$ |
| | $b_2$ | $Y_{121}$ | $Y_{122}$ | $Y_{123}$ | $Y_{124}$ | $Y_{12.}$ |
| $a_2$ | $b_1$ | $Y_{211}$ | $Y_{212}$ | $Y_{213}$ | $Y_{214}$ | $Y_{21.}$ |
| | $b_2$ | $Y_{221}$ | $Y_{222}$ | $Y_{223}$ | $Y_{224}$ | $Y_{22.}$ |
| Total | | | | | | $Y_{..}$ |

First step:

$$CF=\frac{(Y_{..})^2}{rab}\ ,\ SST=\sum Y_{ijk}^2-CF\ ,\ SS(A)=\frac{\sum Y_{i..}^2}{br}-CF,\ SSt=\frac{\sum Y_{ij}^2}{r}-C,\ \text{SSe=SST-SSt}$$

Second step: Construct (A×B) table

| a \ b | $b_1$ | $b_2$ | Y |
|---|---|---|---|
| $a_1$ | $Y_{11.}$ | $Y_{12.}$ | $Y_{1..}$ |
| $a_2$ | $Y_{21.}$ | $Y_{22.}$ | $Y_{2..}$ |
| $Y_{j.}$ | $Y_{.1.}$ | $Y_{.2.}$ | $Y_{..}$ |

$$SSB=\frac{\sum Y_{j.}^2}{ar}-CF\ ,\qquad \text{SSAB= SSt – SSA – SSB}$$

Third step**:** Construct ANOVA table

Table 2:ANOVA for the Factorial Experiment

| s.o.v | Df | SS | MS | F | $F_{table}$ |
|---|---|---|---|---|---|
| Treatment | (ab-1) | SSt | SSt/(ab-1) | MSt/ MSe | $f_{\alpha,dft,dfe}$ |
| A | (a-1) | SSA | SSA/(a-1) | MSA/ MSe | $f_{\alpha,dfA,dfe}$ |
| B | (b-1) | SSB | SSB/(b-1) | MSB/ MSe | $f_{\alpha,dfB,dfe}$ |
| AB | (a-1)(b-1) | SSAB | SSAB/(a-1)(b-1) | MSAB/MSe | $f_{\alpha,dfAB,dfe}$ |
| Error | ab(r-1) | SSe | SSe/ab(r-1) | | |
| Total | rab-1 | SST | | | |

B1= Understanding ,

B2= Scientific ,

B3= Personality ,

B4=Ability of evaluation and

B5=Ability of communication

**3.Least Significant Difference Test (LSD):**

In this test ,the difference between any two means is declared significant in this test at some desired point, usually the 0.05 level of significance, when it exceeds the value derived from: $ts_{\bar{x}}\sqrt{2}$. The LSD test utilizes the standard error of a difference between two means, $\sqrt{2S_{\bar{x}}}$, which serves as the least significant difference between two means when multiplied by the tabulated values of "t" at either the 0.05 or 0.01 levels of significance. This test is applicable only when the F-test for the homogeneity of the means in the experiment is significant.

**Results and Discussion**

In this study, we get nine Tables to explain the significant differences between all variables using ANOVA Table , completely randomized design and factorial experiment. To find the best variables we used least significant difference test (LSD).

**Table 1: ANOVA for significant different between courses for second stage**

| S.O.V. | d.f. | SS | MS | F | F-Table |
|---|---|---|---|---|---|
| Tret. | 4 | 4646.5 | 1161.63 | 162.02** | 3.4796 |
| Error | 95 | 680.5 | 7.17 | | |

**There exist strong significant different between all courses for second stage

**Table 2: ANOVA of significant different between courses for second stage depend on five variables**

| S.O.V. | d.f. | SS | MS | F | F-Table |
|---|---|---|---|---|---|
| Rep. | 24 | 404.47 | 16.85 | 3.72 | |
| A | 4 | 22448.78 | 5612.19 | 1238.9** | 3.3192 |
| B | 4 | 116.52 | 29.13 | 6.43* | 3.3192 |
| AB | 17 | 22160.83 | 1385.05 | 2613.3** | 1.8783 |
| Error | 725 | 3282.25 | 4.03 | | |

* There exist significant different between all courses for second stage

** There exist strong significant different between all courses for second stage depend on five variables

**Table 3: Result of LSD test for second stage.**

| The material | B1 | B2 | B3 | B4 | B5 | Mean |
|---|---|---|---|---|---|---|
| A1 | 7.35 | 8.3 | 8.70 | 7.3 | 6.65 | 7.66 |
| A2 | 6.95 | 7.10 | 6.70 | 6.55 | 5.80 | 6.62 |
| A3 | 6.45 | 7.75 | 7.80 | 6.60 | 6.25 | 6.45 |
| A4 | 7.40 | 8.40 | 8.25 | 8.05 | 7.45 | 7.91 |
| A5 | 5.80 | 5.95 | 6.80 | 5.65 | 5.60 | 5.96 |
| LSD | 2.4060 | | | | | 2.406 |
| The mean | 6.79 | 7.50 | 7.65 | 6.83 | 6.35 | |
| LSD | 42.14 | | | | | |
| Best | B3 | B2 | B4 | B1 | B5 | |

**Table 4: ANOVA for significant different between courses for third stage**

| S.O.V. | d.f. | SS | MS | F | F-Table |
|---|---|---|---|---|---|
| Tret. | 4 | 14259.11 | 3564.78 | 23.82 | 3.4796 |
| Error | 95 | 14220.44 | 149.69 | | |

**There exist significant different between all courses for third stage

**Table 5: ANOVA of significant different between courses for third stage depend on five variables**

| S.O.V. | d.f. | SS | MS | F | F-Table |
|---|---|---|---|---|---|
| Rep. | 24 | 44397.46 | 1849.89 | 34.79 | |
| A | 4 | 2317.51 | 579.37 | 10.89* | 3.3192 |
| B | 4 | 56.05 | 14.51 | 0.263^ | 3.3192 |
| AB | 16 | 46658.9 | 2916.18 | 54.84** | 1.8783 |
| Error | 725 | 38553.05 | 53.17 | | |

* There exist significant different between all courses for third stage

** There exist strong significant different between all courses for third stage depend on five variables

^ There is not significant different between courses for third stage

**Table 6: Result of LSD test for third stage.**

| The material | B1 | B2 | B3 | B4 | B5 | Mean |
|---|---|---|---|---|---|---|
| A1 | 8.0625 | 8.6562 | 9.0625 | 8.5000 | 8.2500 | 8.5062 |
| A2 | 8.78125 | 8.7812 | 8.7187 | 8.1875 | 8.1566 | 8.5250 |
| A3 | 9.03125 | 9.4062 | 9.6250 | 9.0625 | 8.5625 | 9.1375 |
| A4 | 5.78125 | 5.9062 | 5.7500 | 5.2812 | 5.3750 | 5.6187 |
| A5 | 4.90625 | 5.3437 | 5.6562 | 4.9687 | 5.0625 | 5.1875 |
| LSD | 0.6978 | | | | | 0.6978 |
| The mean | 7.305 | 7.6187 | 7.7625 | 7.200 | 7.081 | |
| LSD | 5.36143 | | | | | |
| Best | B3 | B2 | B1 | B4 | B5 | |

**Table 7: ANOVA for significant different between courses for fourth stage**

| S.O.V. | d.f. | SS | MS | F | F-Table |
|---|---|---|---|---|---|
| Tret. | 7 | 684900.48 | 97842.93 | 35.99 | 2.6393 |
| Error | 248 | 674326.83 | 2719.06 | | |

**There exist significant different between all courses for fourth stage

**Table 8: ANOVA of significant different between courses for fourth stage depend on five variables**

| S.O.V. | d.f. | SS | MS | F | F-Table |
|---|---|---|---|---|---|
| Rep. | 39 | 2213.7 | 56.76 | 8.66 | |
| A | 7 | 1065.35 | 152.19 | 23.23** | 2.6393 |
| B | 4 | 161.12 | 40.28 | 6.15* | 3.3192 |
| AB | 28 | 987.23 | 35.25 | 5.38* | 1.6964 |
| Error | 1160 | 7605.42 | 7.55 | | |

* There exist significant different between all courses for fourth stage

** There exist strong significant different between all courses for fourth stage depend on five variables

**Table 9: Result of LSD test for fourth stage**

| The material | B1 | B2 | B3 | B4 | B5 | Mean |
|---|---|---|---|---|---|---|
| A1 | 6.3790 | 6.7240 | 8.2413 | 6.0689 | 6.6551 | 6.8136 |
| A2 | 7.8965 | 8.4482 | 8.6551 | 7.5517 | 7.4482 | 7.9999 |
| A3 | 8.5517 | 9.0689 | 8.8965 | 8.3440 | 8.2668 | 8.6254 |
| A4 | 7.8965 | 8.2413 | 8.4137 | 7.5862 | 6.9310 | 7.8137 |
| A5 | 5.7586 | 5.7586 | 6.1724 | 5.1034 | 5.7586 | 5.7103 |

| | | | | | | |
|---|---|---|---|---|---|---|
| A6 | 6.5172 | 6.3448 | 6.5172 | 5.8275 | 5.6206 | 6.1654 |
| A7 | 7.5862 | 7.7931 | 7.8965 | 7.0344 | 7.4137 | 7.5447 |
| A8 | 6.4482 | 6.3793 | 6.5172 | 6.5172 | 6.3103 | 6.3103 |
| LSD | 0.5697 | | | | | 0.6978 |
| The mean | 7.1292 | 7.3440 | 7.6700 | 6.7600 | 6.7300 | |
| LSD | 1.488 | | | | | |
| Best | B3 | B2 | B1 | B4 | B5 | |

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# تصميم تجربة لطلبة التمريض

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الملخّص

في هذه الدراسةِ تم نُقدّيمُ خمسة متغيّراتِ لتقييمِ المُحاضرِ في فرع تمريض صحة المجتمع، كليَّة التمريض، جامعة الكوفة في العراق عام ٢٠١١. إنّ البياناتَ قد تم تحليلها باستعمال تصميم تام التعشية، LSD وتجربة عاملية لتَوضيح الاختلاف الهامِّ بين كُلّ المتغيّرات (العلمية، الشخصية، القدرة على التقييمِ والقدرةِ على توصيل المادة) لكُلّ نوع من المتغيراتِ. برنامج SPSS (نسخة ١٦) أستخدم في هذه الدراسةِ لتَحليل البياناتِ ولتَوليد النتائج والجداول المُخْتَلِفةِ