One-way Analysis of Variance (ANOVA)

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ABSTRACT

When specific conditions are met, an ANOVA is the most effective statistical approach for comparing means across many groups. This article compares, using one-way ANOVA, the means of the eggs laid by Kadaknath hens within a week of various treatments. The next section discusses the one-way analysis process, benefits, drawbacks, and conclusion. When specific conditions are met, an ANOVA is the most effective statistical approach for comparing means across many groups. This article compares, using one-way ANOVA, the means of the eggs laid by Kadaknath hens within a week of various treatments. The next section discusses the one-way analysis process, advantages, limitations, and conclusion.

INTRODUCTION

ANOVA technique was introduced by R. A. Fisher. An improved version of the paired t-test, the ANOVA is a sort of parametric test used to analyse experiment data. When certain presumptions are satisfied, an ANOVA is used to compare the means of various groups (Snedecor and Cochran, 1980). There are two types of analysis of variance, or ANOVA: one-way and two-way. Two independent variables are employed in two-way ANOVA as opposed to just one in one-way ANOVA. The basic process for analysing eggs from Kadaknath hens collected is shown (Alikhanov et al., 2021).

Assumptions (Wang *et al*., 2024):

1. **Independence of observations**: It is considered that each group's observations

or data points are unrelated to one another.

2. **Normality**: Every group's (or population's) data ought to be distributed normally.

3. **Homogeneity, or equality, of variances**: All groups' data variances, or their dispersion or spread, ought to be roughly identical.

4. **Mutual independence of groups:** In order for a group or data point to be considered as belonging to only one group and not any other, it must be the case that the groups being compared are mutually exclusive.

5. **Random sampling:** A random sample of the populations should be used to collect the data.

6. **Measurement scale**: ANOVA makes the assumption that the variable being measured, or the dependent variable, is measured on a continuous scale.

Example of one-way ANOVA:

Take the eggs that the Kadaknath hens lay in a week as an illustration (Ewonetu et al., 2018).

Table No.1: Eggs laid by Kadaknath hens in a week

Date	T1	T2	T3
9-Jun	13	15	12
10-Jun	22	26	25
11-Jun	23	22	24
12-Jun	19	21	23
13-Jun	21	23	20
14-Jun	22	20	21
15-Jun	12	14	13
Total	132	141	138

Procedure (Snedecor and Cochran, 1980):

Step 1: Calculation of correction factor (CF) = $(GT)^2/N$

$= (131+141+138)^2/21$

$= (411)^2/21$

$= 8043.85$

Step 2: Calculation of Total sum of squares (TSS) = $\sum$

$= (X_1^2 + X_2^2 + \ldots\ldots\ldots\ldots + X_{21}^2) - C.F$

$= (13^2+22^2+ \ldots\ldots\ldots\ldots +13^2) - 8043.85$

$= 8447 - 8043.85$

$= 403.15$

Step 3: Calculation of Treatment sum of squares (T_rSS)

$= (\sum X_i^2/n_i) - C.F$

$= (X_1^2/n_1+X_2^2/n_2 +X_3^2/n_3) - C.F$

$= (132^2/7 +141^2/7+138^2/7) - 8043.85$

$= 8049.85 - 8043.85$

$= 6$

Step 4: Calculation of Error sum of squares (ESS) = TSS $- T_rSS$

$= 403.15 - 6$

$=397.15$

Step 5: ANOVA Table

Source of variation	Degree of freedom	Sum of Squares	Mean sum of squares	F value
Between treatment	n – 1 = 3 – 1 = 2	(T_rSS)= 6	$MSST_r$ = T_rSS /n –1 = 6/2 = 3	F_c = $MSST_r$ / MESS = 3 / 22.06 = 0.13
Within treatment (error)	N – n = 21 – 3 = 18	ESS = 397.15	MESS = ESS/N – n =397.15/18 = 22.06	
Total	N – 1 = 21 – 1 = 20	TSS = 403.15		

Step 6: Comparing the F_{cal} value with the table value from the f- table at (n – 1) (N – n) degrees of freedom at a 5% level of significance. F – table value at (2, 20) is 3.49. F_{cal} is 0.13 (Fcal < Ftable).

CONCLUSION:

The ANOVA table is used to determine the mean difference. The result is not significant at the 5% level of significance, and the null hypothesis is accepted. F-table value at (2, 20) is 3.49 Fcal is 0.13 (Fcal < Ftable). This indicates that the means of the three treatments do not differ significantly from one another.

Advantages of ANOVA (Snedecor and Cochran, 1980):

1. It is a better method than the z- and t-tests.
2. Fit for variables with multiple dimensions.
3. A simultaneous analysis of multiple factors.
4. Suitable for use in three or more groups.
5. An effective and affordable parametric testing technique.
6. The one-way ANOVA technique forms the basis of the experimental design.

Limitations of ANOVA (Snedecor and Cochran, 1980):

1. Analysing an ANOVA under strict assumptions about the type of data is challenging.
2. The lack of a unique interpretation for the significance of the two means makes it less useful than the t-test.
3. Interpreting instances of multiple interactions and their level of significance is not always simple.
4. It has a set, challenging set for creating research experiment designs.
5. The post-ANOVA t-test is necessary for additional testing.
6. Sometimes, solving numerical problems takes a lot of time and requires certain knowledge and abilities.
7. In contrast to the t-test, it offers no extra information.

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