People's Democratic Republic of Algeria

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Protocol 04 – One way ANOVA

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Objective

Our objective is to perform a one-way analysis of variance (ANOVA-1) using the SPSS software. Then we will explore the steps for testing the homogeneity of variances through a practical example.

Example 1 (ANOVA 1). *We aim to compare three types of feed based on their effect on milk production. We randomly assign 15 cows as follows:*

- A_1 *to the first 5 cows,*
- A_2 *to the next 5 cows,*
- A_3 *to the last 5 cows.*

A_1	A_2	A_3
38	42	30
40	45	32
41	43	41
35	44	34
36	39	33

At a significance level $\alpha = 5\%$, test the hypothesis that the feeds have no effect on milk production.

Solution Using SPSS

1. Data Entry:. Enter all values into a single variable called "Production", and create a second variable named "Feed" to indicate group membership.

	Production	feed
1	38,00	1,00
2	40,00	1,00
3	41,00	1,00
4	35,00	1,00
5	36,00	1,00
6	42,00	2,00
7	45,00	2,00
8	43,00	2,00
9	44,00	2,00
10	39,00	2,00
11	30,00	3,00
12	32,00	3,00
13	41,00	3,00
14	34,00	3,00
15	33,00	3,00

Figure 1: Data entry in SPSS

2. Running the Test:. Navigate in SPSS through:

`Analyze` → `Compare Means` → `One-Way ANOVA`

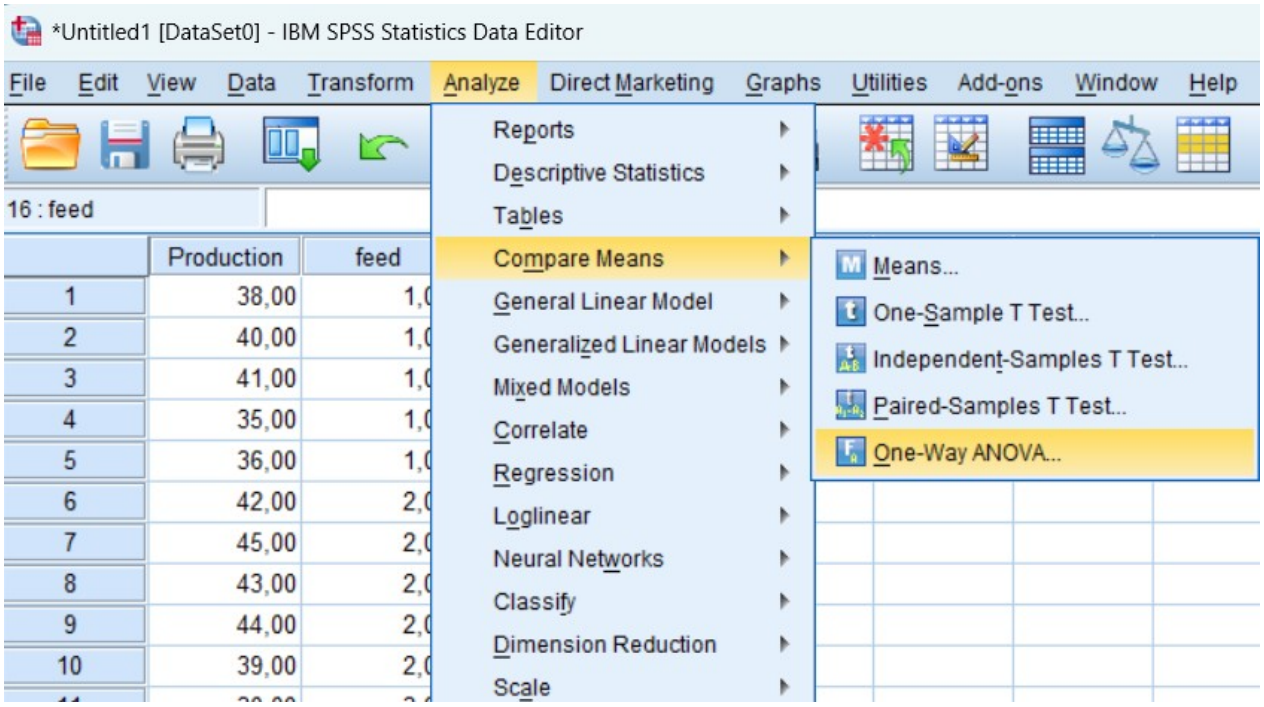

Figure 2: One-Way ANOVA menu in SPSS

3. Assigning Variables:.

- Dependent List: This space is reserved for the quantitative variable that we want to analyze. In our example, it corresponds to the variable "Production".
- Factor: This box is reserved for the qualitative variable (the factor) that indicates the grouping of the observations. In our example, this box is reserved for the grouping variable "feed".

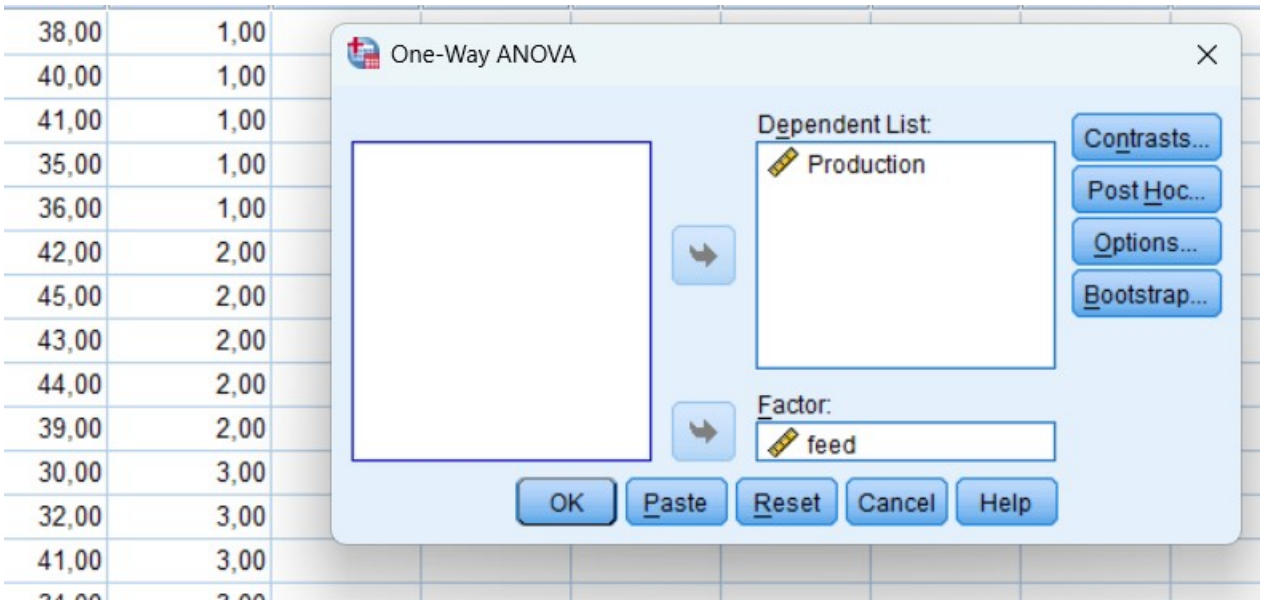

Figure 3: Variable assignment window

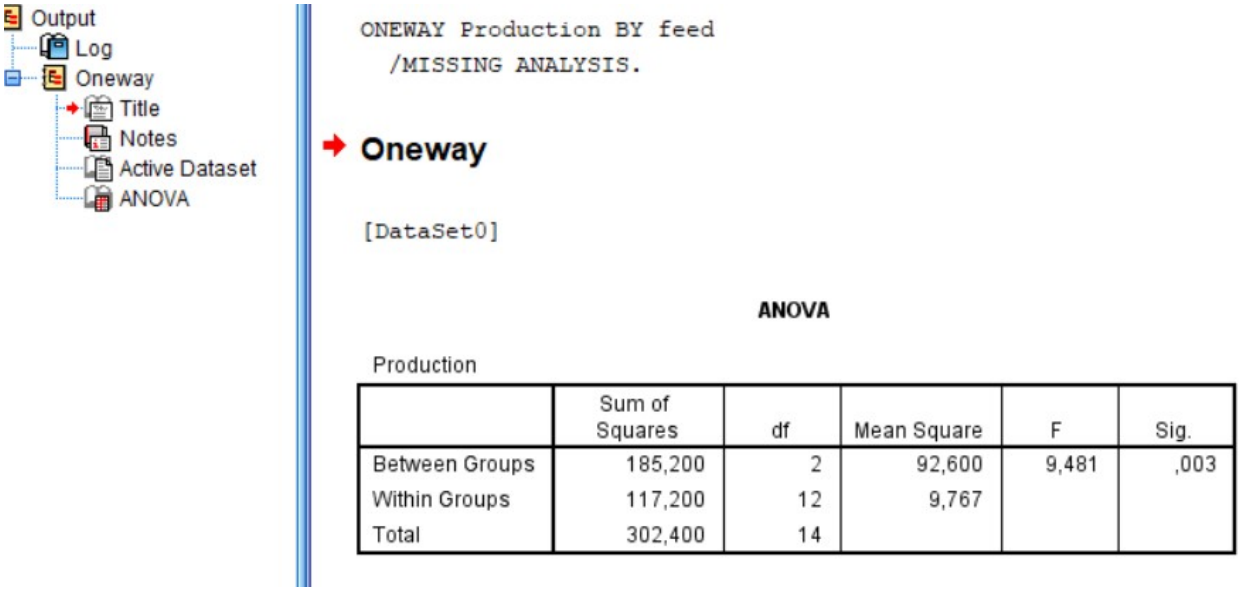

Figure 4: ANOVA results in SPSS

4. *Results Output:.* **Interpretation of the results:**
Compare the significance value (p-value) with $\alpha = 0.05$:

$$\begin{cases} \alpha < \text{p-value: } H_0 \text{ accepted (no significant effect)} \\ \alpha \geq \text{p-value: } H_0 \text{ rejected (significant effect)} \end{cases}$$

Thus, in our example, the feed type has a significant effect on milk production.

Test of Homogeneity of Variances

Example 2. *Using the previous example, test whether there is a significant difference between group variances at the 5% level.*

Repeating steps 2 and 3 of the one-factor ANOVA mentioned earlier, before displaying the results. That is, before clicking the **OK** button the following steps must be carried out:

- Select the **Options** button located on the right side of the window.
- After clicking this button, a new window will appear in which you must check the box **"Test of homogeneity of variance"**.
- Click the **Continue** button.
- Then, click **OK** to display the results.

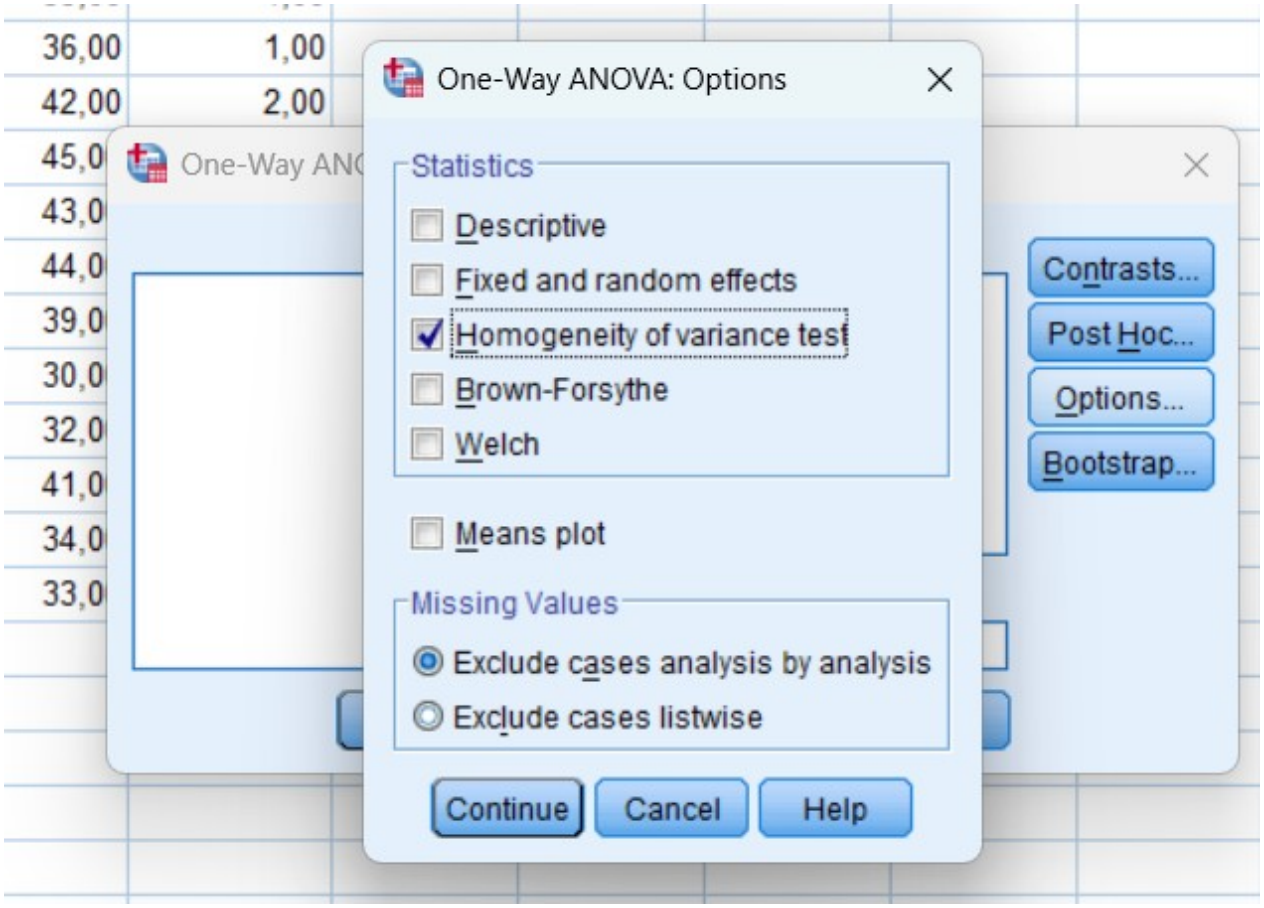

Figure 5: Enabling the homogeneity of variance test

Test of Homogeneity of Variances

Production

Levene Statistic	df1	df2	Sig.
,455	2	12	,645

ANOVA

Production

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	185,200	2	92,600	9,481	,003
Within Groups	117,200	12	9,767		
Total	302,400	14			

Figure 6: Final output: ANOVA + homogeneity test

Interpretation of the results:
To decide whether the variances are equal or not, we proceed as follows:

- If the p-value is **greater than** the significance level, the variances are equal.
- If the p-value is **less than** the significance level, the variances are unequal.

Based on the results obtained in our example, we observe that for a risk level $\alpha = 0.05$, the variances are equal because the p-value (0.645) is greater than the significance level.

We conclude that there is **no significant difference** between the variances, i.e., we accept H_0.

Exercises (Manual then Verified in SPSS)

Example 3. *We compare two types of seeds in terms of germination percentage:*

Seed Type 1	82	85	80	88	90	84
Seed Type 2	75	78	74	79	81	/

At a 1% significance level, test whether the two samples come from populations with the same standard deviation.

Example 4. *We aim to compare four fertilizers (A, B, C, D) based on tomato plant height (in cm):*

A	*B*	*C*	*D*
42	47	38	45
44	50	40	48
41	46	37	52
43	49	39	54
45	51	41	57

- *Test whether the fertilizer type has a significant effect on plant height.*
- *Test the equality of variances (using SPSS only).*