Ministry of Higher Education and Scientific Research
University of El Oued
Faculty of life and Natural Sciences
Department of Biology

Practical work on Bio-statistic

"ANOVA One way, ANOVA Tow way with replications and ANOVA Tow way without replications on Excel"

From Doctors and Master's

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ANOVA One Way

Steps

Step 1: Click the "Data" tab in the ribbon and then click "Data Analysis." Install the Data Analysis Toolpak if you don't see Data Analysis as an option.

Step 2: Click "ANOVA one factor" and then click "OK."

Step 3: Type the location for your data into the Input Range box. For example, type "A2:C30" if your data is in cells A2 through C30. Make sure to include the location of your headers and group/individual names, not just the raw data.

Step 4: Choose an Output Range. For example, select an area to the right of your data to display the ANOVA output.

Step 5: Choose an alpha level. In most cases, you can leave the default (0.05).

Step 6: Click "OK."

Step 7: Analyze the results from the ANOVA output. The two most important factors in using ANOVA to accept or reject the null hypothesis are:

1. Is the F-value (F)larger than the f critical value ($F\ crit$)? If so, there is a statistical significance to the results, leading you to reject the null hypothesis.
2. Is the p-value smaller than your chosen alpha level? If so, that would also lead you to reject the null hypothesis.

- One-Factor ANOVA, also known as factorial analysis, is an extension to the one-way analysis of variance. In a one-factor analysis, there are two variables, rather than one as in a single factor analysis. The assumption is that both variables and factors, affect the dependent variable. Each factor contains two or more classes and the degree of freedom for each variable is one less than the number of levels .

In a one-factor ANOVA there are two sets of hypothesis:

The sample means of the first factor (variable) are equal.

The sample means of the second factor (variable) are equal.

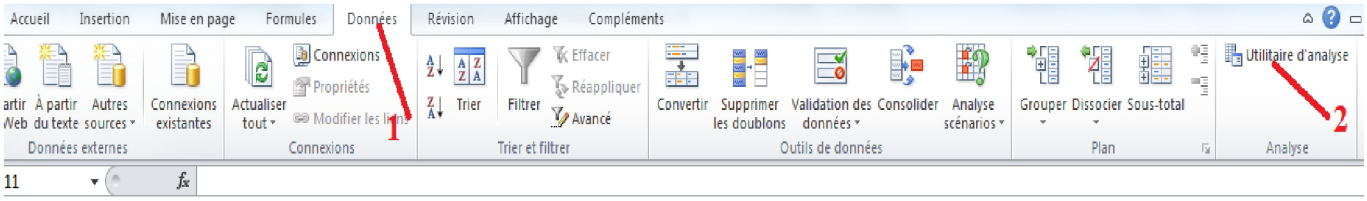
In the example below, test scores have been recorded from nine different students .

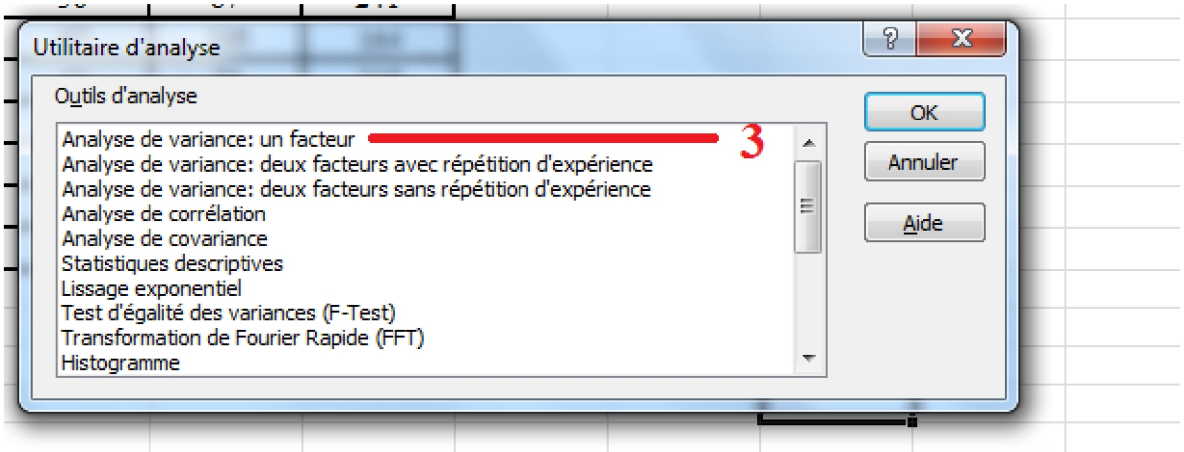
F11

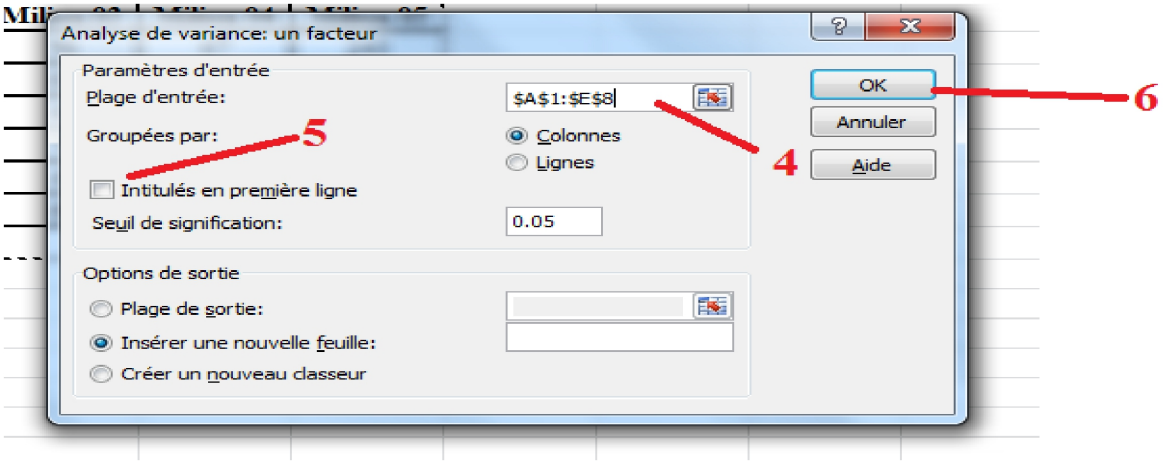
	A	B	C	D	E	F
1	**Milieu 01**	**Milieu 02**	**Milieu 03**	**Milieu 04**	**Milieu 05**	
2	12	141	56	87	241	
3	15	146	67	105	164	
4	18	135	43	79	225	
5	24	147	78	123	257	
6	32	154	45	114	248	
7	31		69		158	
8	15				236	
9						
10						

Anova: One-Factor Dataset

1. On the XLMiner Analysis ToolPak pane, click Anova: Two-factor Without Replication.
2. Click the Input Range field and enter the cell range A1:E8.
3. Leave "Labels in First Row" selected since the first row in the data range includes the column labels.
4. Leave Alpha at the default of 0.05. This is the level of significance for the hypothesis test.
5. Click the Output Range field
6. Click OK.







Analyse de variance: un facteur

RAPPORT DÉTAILLÉ

Groupes	*Nombre d'échantillon*	*Somme*	*Moyenne*	*Variance*
Milieu 01	7	147	21	65.3333333
Milieu 02	5	723	144.6	50.3
Milieu 03	6	358	59.66666667	196.666667
Milieu 04	5	508	101.6	336.8
Milieu 05	7	1529	218.4285714	1639.61905

ANALYSE DE VARIANCE

Source des variations	*Somme des carrés*	*Degré de liberté*	*Moyenne des carrés*	*F*	*Probabilité*	*Valeur critique pour F*
Entre Groupes	159242.719	4	39810.67976	77.9901328	9.5266E-14	2.75871047
A l'intérieur des groupes	12761.44762	25	510.4579048			
Total	172004.1667	29				

Columns refer to the five categories of milieux. The p-value in cell F14 is very close to 0. This means that the probability of obtaining an F statistic of 2.75 or larger when the null hypothesis is true is also very close to 0. Since the p-value is less than the specified alpha of 0.05 and the calculated F statistic is much larger than the value for F crit, the null hypothesis is rejected. There is a significant statistical difference in the calculated means of the four categories. Support for this statement can be found in cells D5:D9 which display the average values for each category.

ANOVA Two Way with Replication

Steps

Step 1: Click the "Data" tab in the ribbon and then click "Data Analysis." Install the Data Analysis Toolpak if you don't see Data Analysis as an option.

Step 2: Click "ANOVA two factors with replication" and then click "OK."

Step 3: Type the location for your data into the Input Range box. For example, type "A2:C30" if your data is in cells A2 through C30. Make sure to include the location of your headers and group/individual names, not just the raw data.

Step 4: Choose an Output Range. For example, select an area to the right of your data to display the ANOVA output.

Step 5: Choose an alpha level. In most cases, you can leave the default (0.05).

Step 6: Click "OK."

Step 7: Analyze the results from the ANOVA output. The two most important factors in using ANOVA to accept or reject the null hypothesis are:

3. Is the F-value (F)larger than the f critical value ($F\ crit$)? If so, there is a statistical significance to the results, leading you to reject the null hypothesis.
4. Is the p-value smaller than your chosen alpha level? If so, that would also lead you to reject the null hypothesis.

- Two-Factor ANOVA, also known as factorial analysis, is an extension to the one-way analysis of variance. In a two-factor analysis, there are two variables, rather than one as in a single factor analysis. The assumption is that both variables and factors, affect the dependent variable. Each factor contains two or more classes and the degree of freedom for each variable is one less than the number of levels .

In a two-factor ANOVA there are three sets of hypothesis:

The sample means of the first factor (variable) are equal.

The sample means of the second factor (variable) are equal.

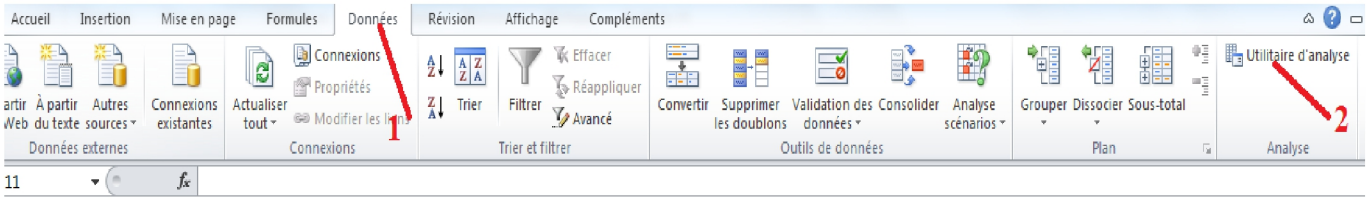
In the example below, test scores have been recorded from three plants and five milieus

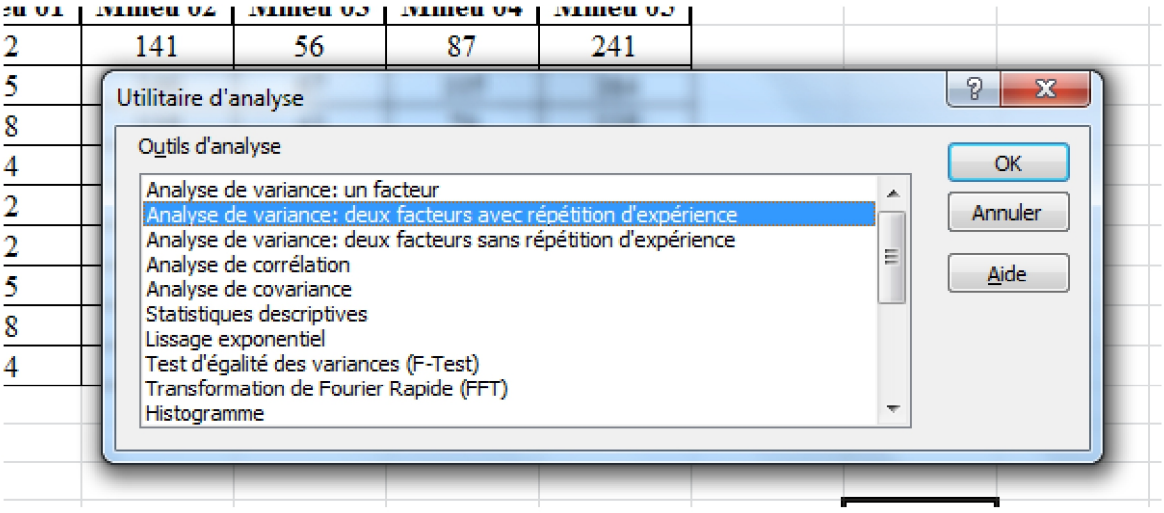
H14

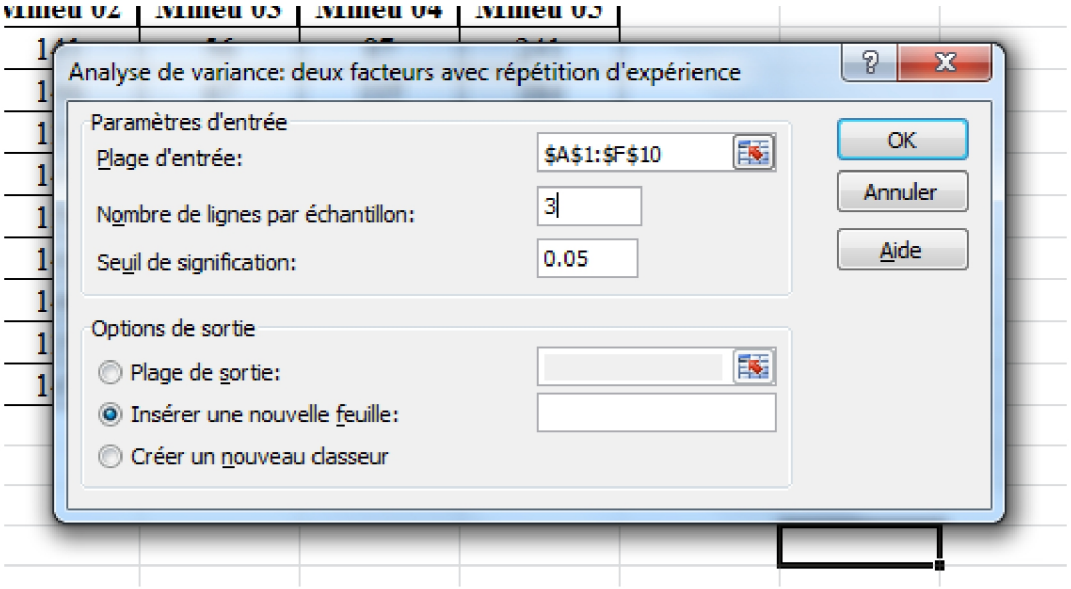
	A	B	C	D	E	F	G
1	Plantes	**Milieu 01**	**Milieu 02**	**Milieu 03**	**Milieu 04**	**Milieu 05**	
2		12	141	56	87	241	
3		15	146	67	105	164	
4	1	18	135	43	79	225	
5		24	147	78	123	257	
6		32	154	45	114	248	
7	2	12	141	56	87	241	
8		15	146	67	105	164	
9		18	135	43	79	225	
10	3	24	147	78	123	257	
11							
12							

Anova: Two-Factor with Replication Dataset

7. On the XLMiner Analysis ToolPak pane, click Anova: Two-factor Without Replication.
8. Click the Input Range field and enter the cell range A1:F10.
9. Leave "Labels in First Row" selected since the first row in the data range includes the column labels.
10. Leave Alpha at the default of 0.05. This is the level of significance for the hypothesis test.
11. Click the Output Range field
12. Click OK.







Analyse de variance: deux facteurs avec répétition d'expérience

RAPPORT DÉTAILLÉ	Milieu 01	Milieu 02	Milieu 03	Milieu 04	Milieu 05	Total
1						
Nombre d'échantillo	3	3	3	3	3	15
Somme	45	422	166	271	630	1534
Moyenne	15	140.6666667	55.33333333	90.333333	210	102.2666667
Variance	9	30.33333333	144.3333333	177.33333	1651	5224.92381
2						
Nombre d'échantillo	3	3	3	3	3	15
Somme	68	442	179	324	746	1759
Moyenne	22.66666667	147.3333333	59.66666667	108	248.66667	117.2666667
Variance	101.3333333	42.33333333	282.3333333	351	64.333333	6660.780952
3						
Nombre d'échantillo	3	3	3	3	3	15
Somme	57	428	188	307	646	1626
Moyenne	19	142.6666667	62.66666667	102.33333	215.33333	108.4
Variance	21	44.33333333	320.3333333	489.33333	2232.3333	5314.542857
Total						
Nombre d'échantillo	9	9	9	9	9	
Somme	170	1292	533	902	2022	
Moyenne	18.88888889	143.5555556	59.22222222	100.22222	224.66667	
Variance	43.86111111	38.02777778	196.9444444	315.44444	1316.25	

ANALYSE DE VARIANCE

Source des variations	*Somme des carrés*	*Degré de liberté*	*Moyenne des carrés*	*F*	*Probabilité*	*Valeur critique pour F*
Échantillon	1706.177778	2	853.0888889	2.1467957	0.1344697	3.315829501
Colonnes	227225.4222	4	56806.35556	142.95303	4.449E-19	2.689627574
Interaction	1656.711111	8	207.0888889	0.5211386	0.831019	2.266163274
A l'intérieur du grou	11921.33333	30	397.3777778			
Total	242509.6444	44				

Rows refer to test scores for each of the three plants. Cell E26 contains the p-value for the calculated value of F (in cell E26) found by the Analysis ToolPak. Notice that the p-value or probability of obtaining an F statistic of 3.31 or larger when the null hypothesis is true is 0.1344. Since the p-value is less than the specified alpha of 0.05, the null hypothesis is rejected; there is a significant statistical difference between the means of each student's test scores.

Columns refer to the five categories of milieus. The p-value in cell F27 is very close to 0. This means that the probability of obtaining an F statistic of 2.68 or larger when the null hypothesis is true is also very close to 0. Since the p-value is less than the specified alpha of 0.05 and the calculated F statistic is much larger than the value for F crit, the null hypothesis is rejected. There is a significant statistical difference in the calculated means of the four categories.

The interaction between columns and rows refer to the five categories of milieus and three plants. The p-value in cell F28 is very close to 0. This means that the probability of obtaining an F statistic of 2.28 or larger the null hypothesis is true is 0.831. Since the p-value is less than the specified alpha of 0.05, the null hypothesis is rejected; there is a significant statistical difference between the means of each student's test scores.

ANOVA Two Way without Replication

Steps

Step 1: Click the "Data" tab in the ribbon and then click "Data Analysis." Install the Data Analysis Toolpak if you don't see Data Analysis as an option.

Step 2: Click "ANOVA two factors without replication" and then click "OK."

Step 3: Type the location for your data into the Input Range box. For example, type "A2:C30" if your data is in cells A2 through C30. Make sure to include the location of your headers and group/individual names, not just the raw data.

Step 4: Choose an Output Range. For example, select an area to the right of your data to display the ANOVA output.

Step 5: Choose an alpha level. In most cases, you can leave the default (0.05).

Step 6: Click "OK."

Step 7: Analyze the results from the ANOVA output. The two most important factors in using ANOVA to accept or reject the null hypothesis are:

5. Is the F-value (F)larger than the f critical value ($F\ crit$)? If so, there is a statistical significance to the results, leading you to reject the null hypothesis.
6. Is the p-value smaller than your chosen alpha level? If so, that would also lead you to reject the null hypothesis.

- Two-Factor ANOVA, also known as factorial analysis, is an extension to the one-way analysis of variance. In a two-factor analysis, there are two variables, rather than one as in a single factor analysis. The assumption is that both variables and factors, affect the dependent variable. Each factor contains two or more classes and the degree of freedom for each variable is one less than the number of levels .

In a two-factor ANOVA there are two sets of hypothesis:

The sample means of the first factor (variable) are equal.

The sample means of the second factor (variable) are equal.

In the example below, test scores have been recorded from nine different students .

	A	B	C	D	E
1		Test Scores			
2	Students	Math	Reading	Science	Socal Studies
3	1	98	92	92	98
4	2	95	97	81	84
5	3	96	91	76	76
6	4	93	90	73	86
7	5	92	85	63	67
8	6	91	81	77	97
9	7	82	78	62	95
10	8	89	98	65	86
11	9	87	79	75	72

Anova: Two-Factor without Replication Dataset

13. On the XLMiner Analysis ToolPak pane, click Anova: Two-factor Without Replication.
14. Click the Input Range field and enter the cell range A2:E11.
15. Leave "Labels in First Row" selected since the first row in the data range includes the column labels.
16. Leave Alpha at the default of 0.05. This is the level of significance for the hypothesis test.
17. Click the Output Range field and then enter cell A15
18. Click OK.

The results are shown below.

	A	B	C	D	E	F	G
15	Anova: Two-Factor Without Replication						
16							
17	*SUMMARY*	*Count*	*Sum*	*Average*	*Variance*		
18	1	4	380	95	12		
19	2	4	357	89.25	62.91666667		
20	3	4	339	84.75	106.25		
21	4	4	342	85.5	77.66666667		
22	5	4	307	76.75	194.9166667		
23	6	4	346	86.5	83.66666667		
24	7	4	317	79.25	184.9166667		
25	8	4	338	84.5	195		
26	9	4	313	78.25	42.25		
27							
28	Math	9	823	91.44444444	24.27777778		
29	Reading	9	791	87.88888889	56.11111111		
30	Science	9	664	73.77777778	91.69444444		
31	Socal Studies	9	761	84.55555556	123.5277778		
32							
33							
34	ANOVA						
35	*Source of Variation*	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
36	Rows	1058	8	132.25	2.428668594	0.04427048538	2.355081495
37	Columns	1571.861111	3	523.9537037	9.622003061	0.0002352738902	3.008786594
38	Error	1306.888889	24	54.4537037			
39							
40	Total	3936.75	35				

Rows refer to test scores for each of the nine students. Cell F36 contains the p-value for the calculated value of F (in cell E36) found by the Analysis ToolPak. Notice that the p-value or probability of obtaining an F statistic of 2.355 or larger when the null hypothesis is true is 0.04427. Since the p-value is less than the specified alpha of 0.05, the null hypothesis is rejected; there is a significant statistical difference between the means of each student's test scores.

Columns refer to the four categories of test scores: mathematics, reading, science and social studies. The p-value in cell F37 is very close to 0. This means that the probability of obtaining an F statistic of 3.01 or larger when the null hypothesis is true is also very close to 0. Since the p-value is less than the specified alpha of 0.05 and the calculated F statistic is much larger than the value for F crit, the null hypothesis is rejected. There is a significant statistical difference in the calculated means of the four categories. Support for this statement can be found in cells D28:D31 which display the average values for each category.