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Analysis of Variance Table ANOVA

here's a complete, self-contained numerical example of a One-Way ANOVA, solved two ways: (A) direct/menu method (what you click in Minitab) and (B) commands/session method (Minitab Session commands). I'll show the dataset, full calculations (numbers), the ANOVA table, p-value, interpretation, and the exact Minitab commands you can paste into the Session window.

Example dataset

Three groups (3 treatments), 4 observations each:

Row	Group	Score
1	A	8
2	A	9
3	A	6
4	A	7
5	B	10
6	B	12
7	B	9
8	B	11
9	C	5
10	C	4
11	C	6
12	C	7

So Group A = {8, 9, 6, 7} ; Group B = {10, 12, 9, 11} ; Group C = {5, 4, 6, 7}.

Step 1 — summary statistics (computed)

- $n_1 = n_2 = n_3 = 4$, total N = 12
- Group means:

  - mean(A) = 7.5
  - mean(B) = 10.5
  - mean(C) = 5.5
- Grand mean X¯..\bar{X}_{..}X¯.. = 7.8333333333 (≈ 7.8333)

Computed sums of squares:

- **SS_between (treatment)** = $\sum n_j(\bar{X}_j - \bar{X}_{..})^2$ = **50.6666666667**
- **SS_within (error)** = $\sum\sum(x_{ij} - \bar{X}_j)^2$ = **15.0**
- **SS_total** = **65.6666666667** (SS_between + SS_within)

Degrees of freedom:

- DF_between = k − 1 = 3 − 1 = **2**
- DF_within = N − k = 12 − 3 = **9**
- DF_total = N − 1 = **11**

Mean squares:

- MS_between = SS_between / DF_between = 50.6666666667 / 2 = **25.3333333333**
- MS_within = SS_within / DF_within = 15.0 / 9 = **1.6666666667**

F statistic:

- F = MS_between / MS_within = 25.3333333333 / 1.6666666667 = **15.2**

P-value (F with df1=2, df2=9):

- p ≈ **0.00130**

ANOVA table (numeric)

Source	DF	SS	MS	F	P
Between (Groups)	2	50.6667	25.3333	15.20	0.0013
Within (Error)	9	15.0000	1.6667		
Total	11	65.6667			

Interpretation: p = 0.0013 < 0.05 → **reject H_0**. There is strong evidence that **at least one group mean differs** from the others

Step 2 — Menu (direct) method in Minitab

1. **Enter the data** in the Worksheet:
   - Put `Score` in column C1 (enter the 12 numeric values).
   - Put `Group` in column C2 (enter categorical labels A, A, A, A, B, B, B, B, C, C, C, C).

   Example layout:

   - C1 = Score: 8,9,6,7,10,12,9,11,5,4,6,7
   - C2 = Group: A,A,A,A,B,B,B,B,C,C,C,C
2. **Run One-Way ANOVA**:
   - Menu: `Stat` → `ANOVA` → `One-Way` → select **Response = Score (C1)** and **Factor = Group (C2)**.
   - Click **OK**.
   - (Optional) For multiple comparisons: in the One-Way dialog choose **Comparisons** → select **Tukey** (or Bonferroni) to see pairwise tests.
3. **Read output**:
   - The Session/Results window will show the ANOVA table (should match the numbers above) and any requested multiple comparisons.

Step 3 — Commands (Session commands) method in Minitab

```
MTB >  OneWay;

SUBC>   Response C2;

SUBC>   Categorical C1;

SUBC>   IType 0;

SUBC> end

MTB >
```

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Regression Analysis

Let's cover Regression Analysis in Minitab using both methods:

1-Direct Method (Menus / Dialogs)

2-Indirect Method (Session Commands)

I'll use an easy example with numbers, then show both ways.

Example Dataset

We want to predict **Sales (Y)** from **Advertising Budget (X)**.

Row	Advertising (X)	Sales (Y)
1	10	25
2	20	40
3	30	45
4	40	60
5	50	65

```
MTB > Fitline C2 C3;
SUBC>   Confidence 95.0.
MTB > Fitline 'y' 'x';
SUBC>   Confidence 95.0.
MTB >
```

Regression Analysis: y versus x

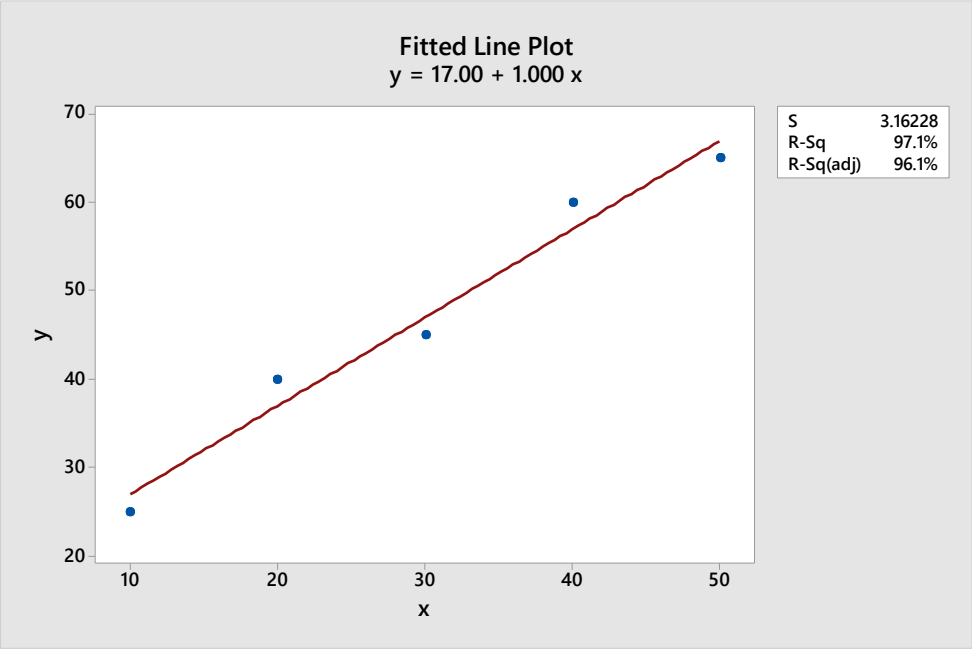
The regression equation is
y = 17.00 + 1.000 x

Model Summary

S	R-sq	R-sq(adj)
3.16228	97.09%	96.12%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	1000	1000	100.00	0.002
Error	3	30	10		
Total	4	1030			



Summary

- **Direct Method (Menu):** Use `Stat → Regression → Fit Regression Model` → select Y and X → OK.
- **Indirect Method (Command):** Use `REGRESS C2 1 C1.` in Session Window.
- Both methods produce the **same regression equation, ANOVA table, coefficients, and model diagnostics**.