



predictum

Oneway ANOVA Illustration  
Confidence Intervals, Hypothesis Testing & Power

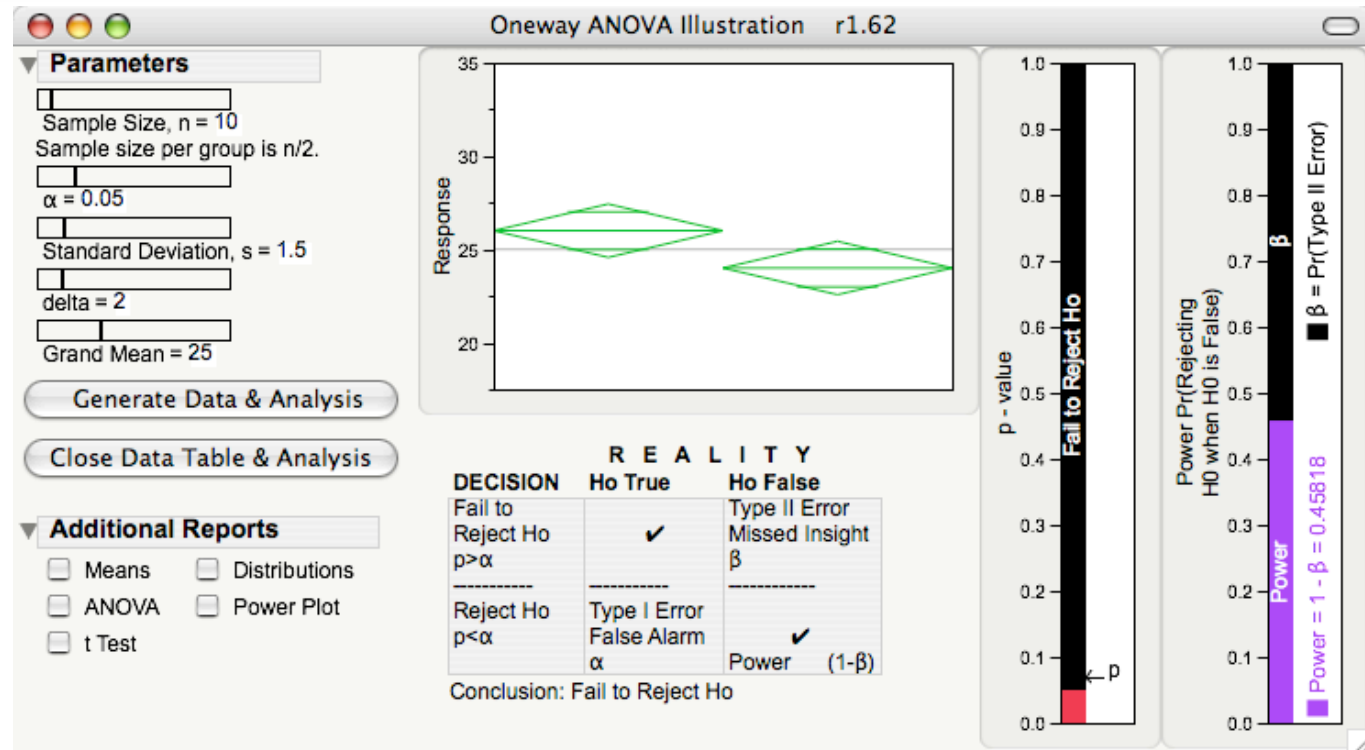
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minimum requirements:  
JMP v 7.02 + curiosity  
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# Oneway ANOVA: Instructions

## Learning Objectives

- Type I and Type II errors
- Power
- Operating Characteristic Curves
- Affects of alpha, n, s and delta on power
- Interpreting p-values
- Confidence Intervals
- Hypothesis testing
- t distribution
- F distribution



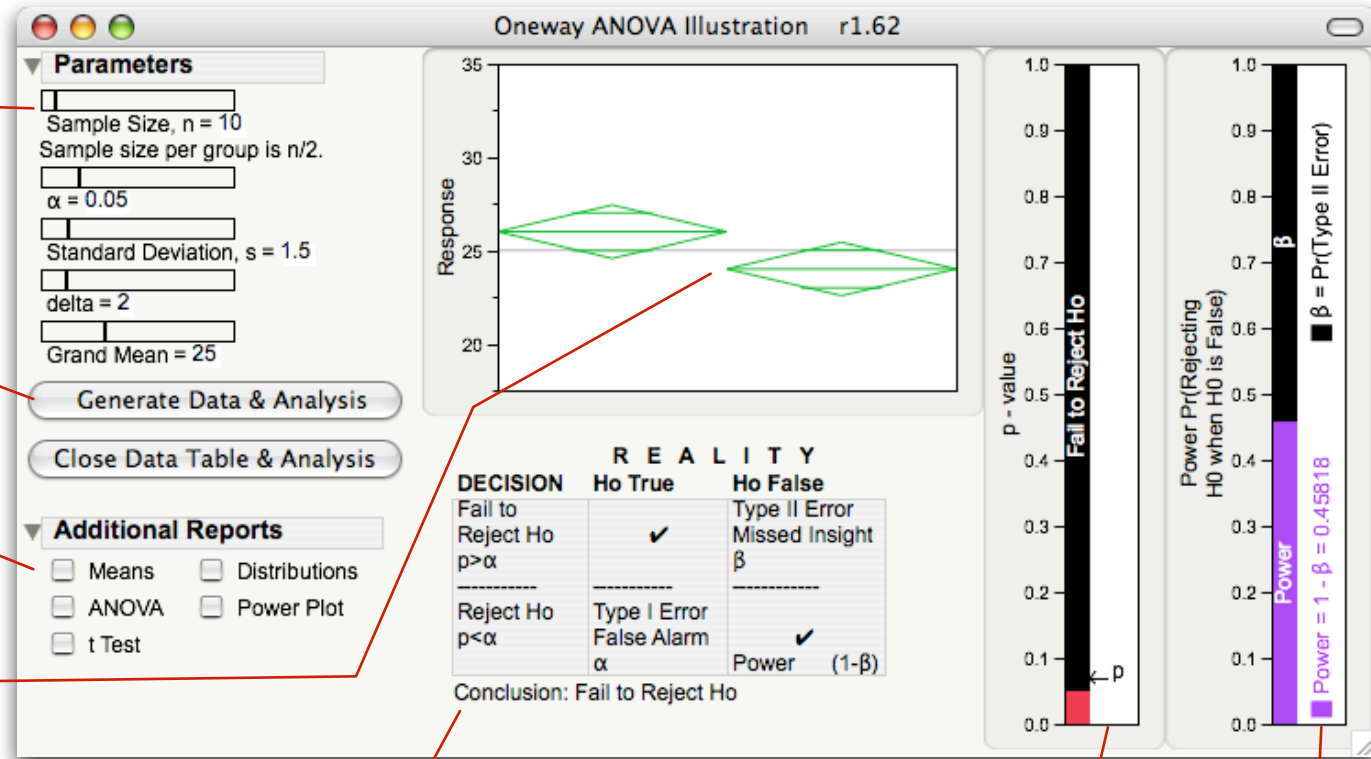
Parameters: sample size, alpha, standard deviation, delta and grand mean: these sliders dynamically drive various graphical elements.

Generate a new data table containing a random set of data according to the parameters specified above and produce a Oneway ANOVA analysis.

Click on these buttons to reveal additional dynamic reports at the bottom of the window. Details on these reports can be found on pages following.

These confidence interval diamonds expand and move as the Parameter Sliders are adjusted.

The conclusion to the hypothesis test is updated as the sliders are released.



The p-value moves according to the t and F tests. The red area corresponds to alpha. Both the p-value and the reject region adjust according to the parameters.

Power (the purple area) expands and contracts dynamically according to the Parameters. The Power and Beta values adjust dynamically as well.



The Analysis of Variance table appears with the addition of an illustration of F distributions (one under the null hypothesis and one under the alternate) to the right. The F value in the distribution plot updates along with the Analysis of Variance table dynamically updates according to the parameters in the upper-left.

Oneway ANOVA Illustration
r1.62

**Parameters**

Sample Size, n = 10  
Sample size per group is n/2.

$\alpha = 0.05$

Standard Deviation, s = 1.5

delta = 2

Grand Mean = 25

Generate Data & Analysis

Close Data Table & Analysis

**Additional Reports**

Means  Distributions

ANOVA  Power Plot

t Test

**REALITY**

DECISION	Ho True	Ho False
Fail to Reject Ho $p > \alpha$	✓	Type II Error Missed Insight $\beta$
Reject Ho $p < \alpha$	Type I Error False Alarm $\alpha$	✓ Power (1- $\beta$ )

Conclusion: Fail to Reject Ho

**Analysis of Variance**

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Model	1	10.0001	10.0001	4.4445	0.0681
Error	8	18	2.25		
C. Total	9	28.0001			

not to scale

The report includes a complete set of statistics associated with the t Test. The horizontal, red arrow in the graphic shows the confidence interval for the difference. The formula for the t Test appears at the very right. The table under the t Test along with the graphics dynamically updates according to the parameters in the upper-left.

### Oneway ANOVA Illustration r1.62

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Conclusion: Fail to Reject Ho

**t Test**

A - B  
Assuming equal variances

Difference	2	t Ratio	2.10819
Std Err Dif	0.94868	DF	8
Upper CL Dif	4.18766	Prob >  t	0.0681
Lower CL Dif	-0.1877	Prob > t	0.034
Confidence	0.95	Prob < t	0.966

$$t_{\bar{y}_1 - \bar{y}_2} = \frac{(\bar{y}_1 - \bar{y}_2)}{s_{\bar{y}_1 - \bar{y}_2}}$$

not to scale

The Power Plot shows how Power changes as the sample size is adjusted. The delta, standard deviation and alpha sliders dynamically change the relationship curve.

**Parameters**

- Sample Size,  $n = 10$
- Sample size per group is  $n/2$ .
- $\alpha = 0.05$
- Standard Deviation,  $s = 1.5$
- delta = 2
- Grand Mean = 25

**Additional Reports**

- Means
- Distributions
- ANOVA
- Power Plot
- t Test

	Ho True	Ho False
Fail to Reject Ho $p > \alpha$	✓	Type II Error Missed Insight $\beta$
Reject Ho $p < \alpha$	Type I Error False Alarm $\alpha$	Power (1- $\beta$ )

Conclusion: Fail to Reject Ho

Power Plot: Power vs Sample Size



Clicking on the show distributions button slides the diamonds over to make way for the two t distributions. Each moves in accordance with its respective diamond.

**Parameters**

Sample Size,  $n = 10$   
Sample size per group is  $n/2$ .  
 $\alpha = 0.05$   
Standard Deviation,  $s = 1.5$   
 $\delta = 2$   
Grand Mean = 25

**Additional Reports**

- Means
- Distributions
- ANOVA
- Power Plot
- t Test

**REALITY**

DECISION	Ho True	Ho False
Fail to Reject Ho $p > \alpha$	✓	Type II Error Missed Insight $\beta$
Reject Ho $p < \alpha$	Type I Error False Alarm $\alpha$	Power ✓ $(1 - \beta)$

Conclusion: Fail to Reject Ho

not to scale



This straight-forward means report shows the means for the two groups as well as the upper and lower confidence intervals (the top and bottom of the diamonds). The table under the Means for Oneway ANOVA dynamically updates according to the parameters in the upper-left.

Oneway ANOVA Illustration
r1.62

**Parameters**

Sample Size, n = 10  
Sample size per group is n/2.

$\alpha = 0.05$

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Generate Data & Analysis

Close Data Table & Analysis

**Additional Reports**

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**Means for Oneway Anova**

Level	Number	Mean	Std Error	Lower %	Upper %
A	5	26	0.67082	24.57	27.43
B	5	24	0.67082	22.57	25.43

**R E A L I T Y**

DECISION	Ho True	Ho False
Fail to Reject Ho $p > \alpha$	✓	Type II Error Missed Insight $\beta$
Reject Ho $p < \alpha$	Type I Error False Alarm $\alpha$	✓ Power (1- $\beta$ )

Conclusion: Fail to Reject Ho

Power Pr(Rejecting H0 when H0 is False) =  $1 - \beta = 0.45818$



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