

ONE-WAY ANOVA IN SPSS

Richard Lee Rogers



One-way ANOVA

- ANalysis Of VAriance
- Bivariate statistic
 - One numeric variable
 - One categorical variable with two or more categories
- A form of the General Linear Model



Example

Descriptives

LnViolentR

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Northeast	9	5.5271	.45220	.15073	5.1795	5.8747	4.82	6.06
Midwest	12	5.7229	.25994	.07504	5.5578	5.8881	5.40	6.10
South	16	6.0068	.33469	.08367	5.8285	6.1851	5.29	6.41
West	13	5.7929	.39609	.10985	5.5535	6.0322	5.28	6.41
Total	50	5.7967	.38777	.05484	5.6865	5.9069	4.82	6.41



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Analyze > Compare Means > One-way ANOVA

The screenshot shows the SPSS software interface. The 'Analyze' menu is open, and the 'Compare Means' option is selected. The 'Compare Means' sub-menu is also open, showing various statistical tests. The 'One-Way ANOVA...' option is highlighted.

Values	Missing	Columns	Align
one	None	14	Left
one	None	2	Left

- Power Analysis >
- Reports >
- Descriptive Statistics >
- Bayesian Statistics >
- Tables >
- Compare Means >**
 - Means...
 - One-Sample T Test...
 - Independent-Samples T Test...
 - Summary Independent-Samples T Test
 - Paired-Samples T Test...
 - One-Way ANOVA...**
 - One-Sample Proportions...
 - Independent-Samples Proportions...
 - Paired-Samples Proportions...
- General Linear Model >
- Generalized Linear Models >
- Mixed Models >
- Correlate >
- Regression >
- Loglinear >
- Classify >
- Dimension Reduction >
- Scale >



Command Dialog Box

One-Way ANOVA ✕

- Northeast
- Midwest
- South
- West
- Violent Crime Rate [ViolentCrime...]
- Imprisonment Rate [Imprisonmen...]
- Poverty Rate [PovertyRate]
- Population [Population]
- Population Density [PopulationD...]
- Urban Percent [UrbanPercent]
- Black Percent [BlackPercent]
- Death Penalty [DeathPenalty]
- Education Level [EducationLevel]
- Educ High [EducHigh]
- Educ Med [EducMed]
- Educ Low [EducLow]

Dependent List:

LnViolentR

Factor:

Region

Estimate effect size for overall tests

Contrasts...

Post Hoc...

Options...

Bootstrap...

OK Paste Reset Cancel Help



Options

One-Way ANOVA: Options ×

Statistics

- Descriptive
- Fixed and random effects
- Homogeneity of variance test
- Brown-Forsythe test
- Welch test

Means plot

Missing Values

- Exclude cases analysis by analysis
- Exclude cases listwise

Confidence Intervals

Level(%):



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Test of Homogeneity of Variances

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
LnViolentR	Based on Mean	1.246	3	46	.304
	Based on Median	.778	3	46	.513
	Based on Median and with adjusted df	.778	3	40.523	.513
	Based on trimmed mean	1.204	3	46	.319



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Null hypothesis: Variances are similar for each category (homogeneity)



Goodness of Fit and Effect Size

ANOVA

LnViolentR

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.426	3	.475	3.679	.019
Within Groups	5.942	46	.129		
Total	7.368	49			

ANOVA Effect Sizes^{a,b}

		Point Estimate	95% Confidence Interval	
			Lower	Upper
LnViolentR	Eta-squared	.194	.005	.346
	Epsilon-squared	.141	-.060	.303
	Omega-squared Fixed-effect	.138	-.059	.299
	Omega-squared Random-effect	.051	-.019	.125

a. Eta-squared and Epsilon-squared are estimated based on the fixed-effect model.

b. Negative but less biased estimates are retained, not rounded to zero.



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Regression SS = $\sum (\hat{y} - \bar{y})^2$ = Distance of the predicted value from the overall mean.



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Regression SS = $\sum(\hat{y} - \bar{y})^2$ = Distance of the predicted value from the overall mean.

Residual sum of squares = $\sum(\hat{y} - y_i)^2$ = Distance of every point from its group mean.

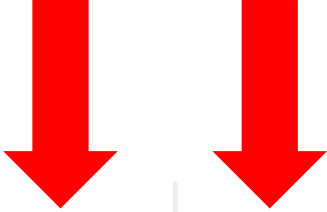


Testing the Null Hypothesis

LnViolentR

ANOVA

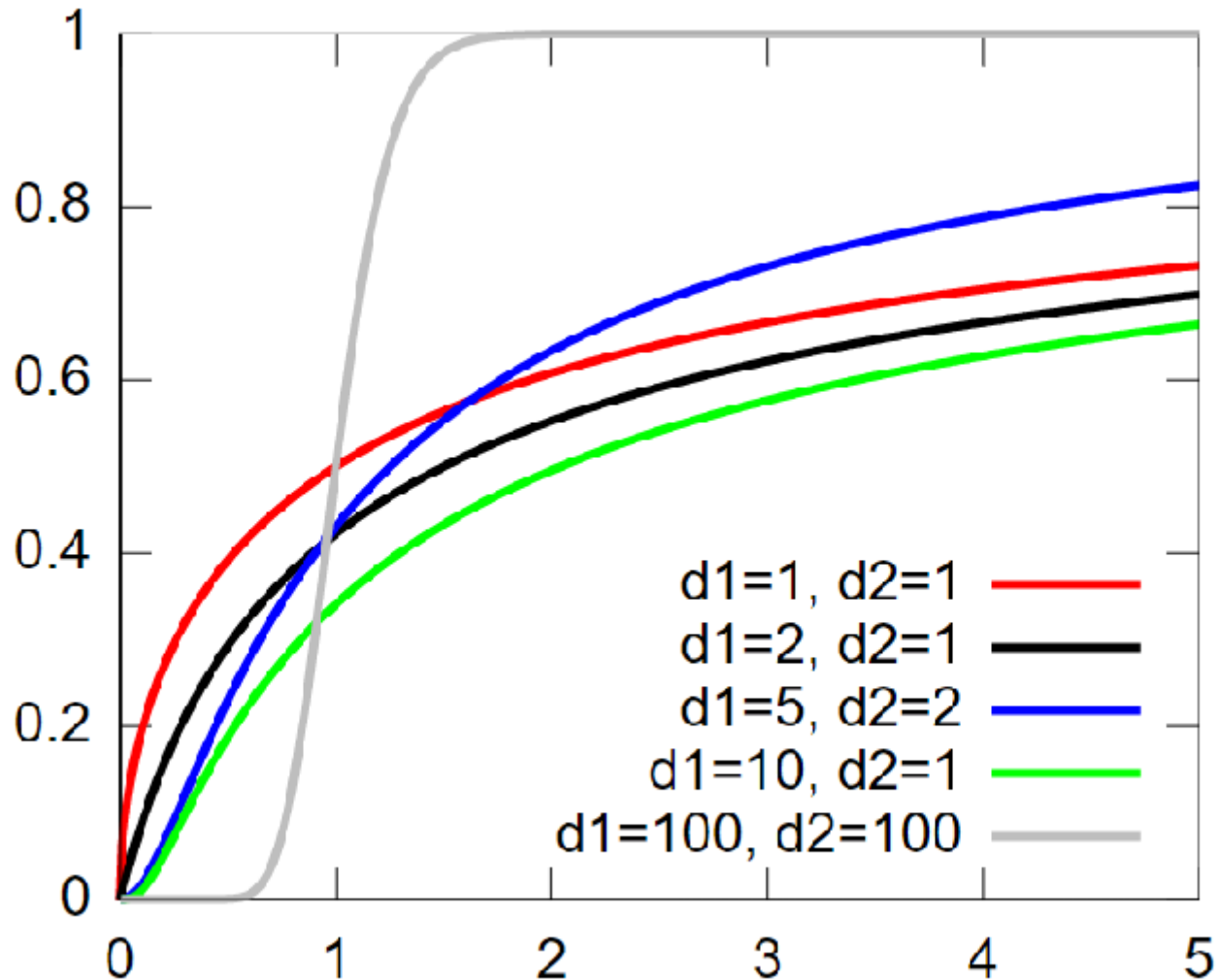
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Null hypothesis: $\bar{\mu}_1 = \bar{\mu}_2 = \bar{\mu}_3 = \bar{\mu}_4$



Cumulative Distribution Function for F



Source: Wikipedia. Graph is licensed under Creative Commons.

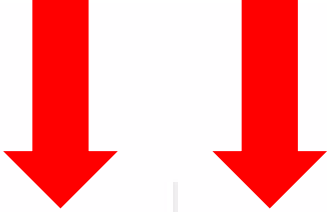


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Alternatives for Heterogeneity of Variances

Robust Tests of Equality of Means

LnViolentR

	Statistic ^a	df1	df2	Sig.
Welch	3.280	3	22.638	.039
Brown-Forsythe	3.466	3	32.135	.027

a. Asymptotically F distributed.



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Interpretation of η^2

Small .0196

Medium .13

Large .26



Goodness of Fit and Effect Size

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Comparison Plots

One-Way ANOVA: Post Hoc Multiple Comparisons ×

Equal Variances Assumed

<input type="checkbox"/> <u>L</u> SD	<input type="checkbox"/> <u>S</u> -N-K	<input type="checkbox"/> <u>W</u> aller-Duncan
<input checked="" type="checkbox"/> <u>B</u> onferroni	<input type="checkbox"/> <u>T</u> ukey	Type I/Type II Error Ratio: <input type="text" value="100"/>
<input type="checkbox"/> <u>S</u> idak	<input type="checkbox"/> <u>T</u> ukey's-b	<input type="checkbox"/> <u>D</u> unnett
<input type="checkbox"/> <u>S</u> cheffe	<input type="checkbox"/> <u>D</u> uncan	Control Category : <input type="text" value="Last"/>
<input type="checkbox"/> <u>R</u> -E-G-W F	<input type="checkbox"/> <u>H</u> ochberg's GT2	Test
<input type="checkbox"/> <u>R</u> -E-G-W Q	<input type="checkbox"/> <u>G</u> abriel	<input checked="" type="radio"/> 2-sided <input type="radio"/> < Control <input type="radio"/> > Control

Equal Variances Not Assumed

<input type="checkbox"/> <u>T</u> amhane's T2	<input type="checkbox"/> <u>D</u> unnett's T3	<input type="checkbox"/> <u>G</u> ames-Howell	<input type="checkbox"/> <u>D</u> unnett's C
---	---	---	--

Null Hypothesis test

- Use the same significance level [alpha] as the setting in Options
- Specify the significance level [alpha] for the post hoc test

Level:

[Continue](#)

[Cancel](#)

[Help](#)



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<input checked="" type="checkbox"/> Bonferroni	<input type="checkbox"/> Tukey	Type I/Type II Error Ratio: <input type="text" value="100"/>
<input type="checkbox"/> Sidak	<input type="checkbox"/> Tukey's-b	<input type="checkbox"/> Dunnett
<input type="checkbox"/> Scheffe	<input type="checkbox"/> Duncan	Control Category: <input type="text" value="Last"/>
<input type="checkbox"/> R-E-G-W F	<input type="checkbox"/> Hochberg's GT2	Test
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Equal Variances Not Assumed

<input type="checkbox"/> Tamhane's T2	<input type="checkbox"/> Dunnett's T3	<input type="checkbox"/> Games-Howell	<input type="checkbox"/> Dunnett's C
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Help



Comparison Plots

Post Hoc Tests

Multiple Comparisons

Dependent Variable: LnViolentR

Bonferroni

(I) Region	(J) Region	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Northeast	Midwest	-.19578	.15848	1.000	-.6328	.2412
	South	-.47966*	.14975	.015	-.8926	-.0668
	West	-.26574	.15585	.570	-.6954	.1640
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Comparison Plots

Post Hoc Tests

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Syntax

```
ONEWAY LnViolentR BY Region  
  /ES=OVERALL  
  /STATISTICS DESCRIPTIVES HOMOGENEITY BROWNFORSYTHE WELCH  
  /MISSING ANALYSIS  
  /CRITERIA=CILEVEL(0.95)  
  /POSTHOC=BONFERRONI ALPHA(0.05).
```



Issues in Use of One-way ANOVA

Possible Uses

- Definitely use with a categorical variable with 3 or more categories
- Use judiciously with a categorical variable with 2 or more categories
- Use to reduce comparison plots to reduce the number of categories in a categorical variable. (Reduces degrees of freedom / makes analysis simpler)

Controversies

- Reservations about the test for homogeneity
- Use with binary dependent variables



The End

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- Bivariate statistic
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