

REGRESSION WITH DUMMY VARIABLES IN SPSS AND PSPP

Richard Lee Rogers

Output

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

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			

OLS Regression

Linear Regression

State_Name
State_Abbrev
Region_Name
Region
Northeast
Midwest
South
West
Violent_Crime_Rate
Imprisonment_Rate
Poverty_Rate
Population
Population_Density
Urban_Percent
Black_Percent
Death_Penalty
Education_Level
Educ_High

Dependent: Lviolent

Block 1 of 1

Previous Next

Independent(s):
Midwest
South
West

Method: Enter

Selection Variable: Rule...

Case Labels:

WLS Weight:

OK Paste Reset Cancel Help

Statistics...
Plots...
Save...
Options...
Style...
Bootstrap...

Regression Coefficients

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.527	.120		46.135	.000
	Midwest	.196	.158	.218	1.235	.223
	South	.480	.150	.583	3.203	.002
	West	.266	.156	.304	1.705	.095

a. Dependent Variable: LnViolentR

Comparison to Descriptive Statistics

Descriptives

LnViolentR

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	South	.480	.150	.583	3.203	.002
	West	.266	.156	.304	1.705	.095

a. Dependent Variable: LnViolentR

Midwest

Descriptives

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					Lower Bound	Upper Bound		
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Midwest	12	5.7229	.25994	.07504	5.5578	5.8881	5.40	6.10
South	16	5.8888	.33469	.08367	5.8285	6.1851	5.29	6.41
West	13	5.7929	.29609	.10985	5.5535	6.0322	5.28	6.41
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	West	.266	.156	.304	1.705	.095

a. Dependent Variable: LnViolentR

South

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	5.7923	.39609	.10985	5.5535	6.0322	5.28	6.41
Total	50	5.7967	.38777	.05484	5.6865	5.9069	4.82	6.41

Coefficients^a

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		B	Std. Error	Beta		
1	(Constant)	5.527	.120		46.135	.000
	Midwest	.196	.158	.218	1.235	.223
	South	.480	.150	.583	3.203	.002
	West	.206	.156	.304	1.705	.095

a. Dependent Variable: LnViolentR

West

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
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West	13	5.7929	.39609	.10985	5.5535	6.0322	5.28	6.41
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	South	.480	.150	.583	3.203	.002
	West	.266	.156	.304	1.705	.095

a. Dependent Variable: LnViolentR

ANOVA Tables

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^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.426	3	.475	3.679	.019 ^b
	Residual	5.942	46	.129		
	Total	7.368	49			

a. Dependent Variable: LnViolentR

b. Predictors: (Constant), West, Midwest, South

ANCOVA

Linear Regression

Region
Northeast
Midwest
South
West
Violent_Crime_Rate
Imprisonment_Rate
Poverty_Rate
Population
Population_Density
Urban_Percent
Black_Percent
Death_Penalty
Education_Level
Educ_High
Educ_Med
Educ_Low
Temperature

Dependent:
Lviolent

Block 1 of 1
Previous Next

Independent(s):
South
West
Poverty_Rate

Method: Enter

Selection Variable:
Rule...

Case Labels:

WLS Weight:

OK Paste Reset Cancel Help

Statistics...
Plots...
Save...
Options...
Style...
Bootstrap...

ANCOVA Output

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.474 ^a	.225	.156	.35620

a. Predictors: (Constant), Poverty Rate, West, Midwest, South

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.216	.258		20.185	.000
	Midwest	.149	.161	.166	.927	.359
	South	.353	.175	.429	2.015	.050
	West	.198	.162	.227	1.222	.228
	Poverty Rate	.025	.018	.213	1.354	.183

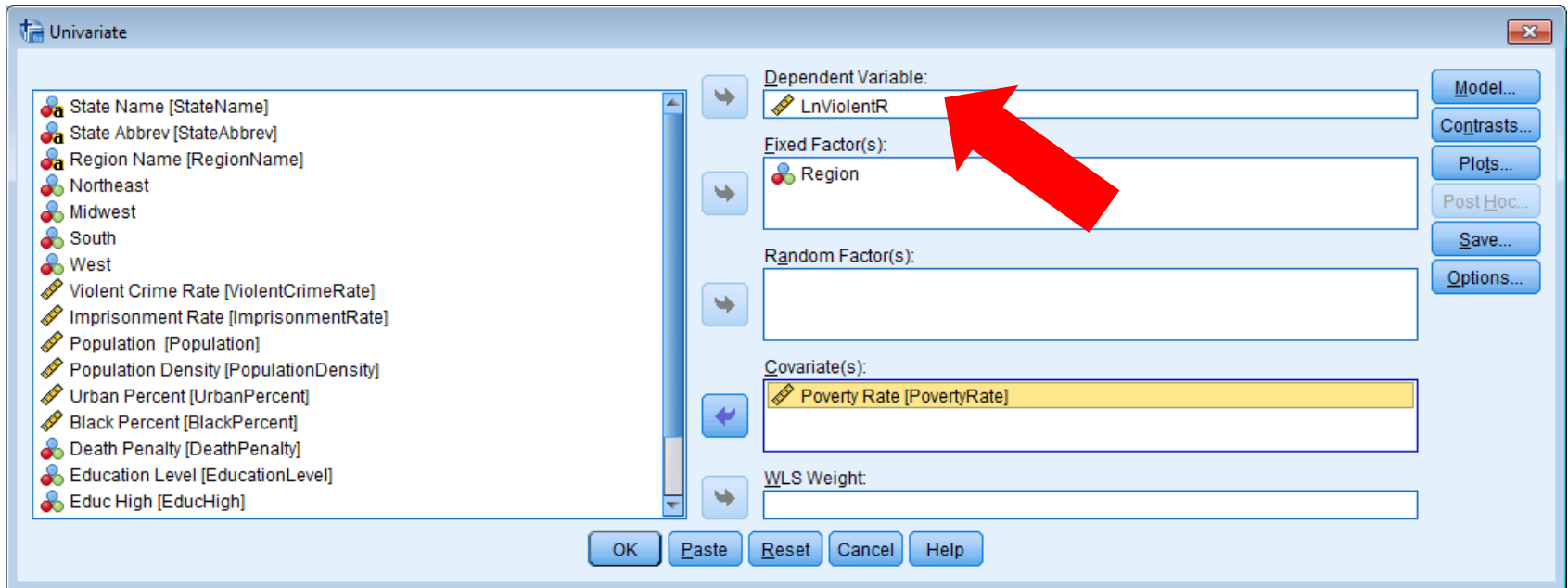
a. Dependent Variable: LnViolentR

Analyze>General Linear Model>Univariate

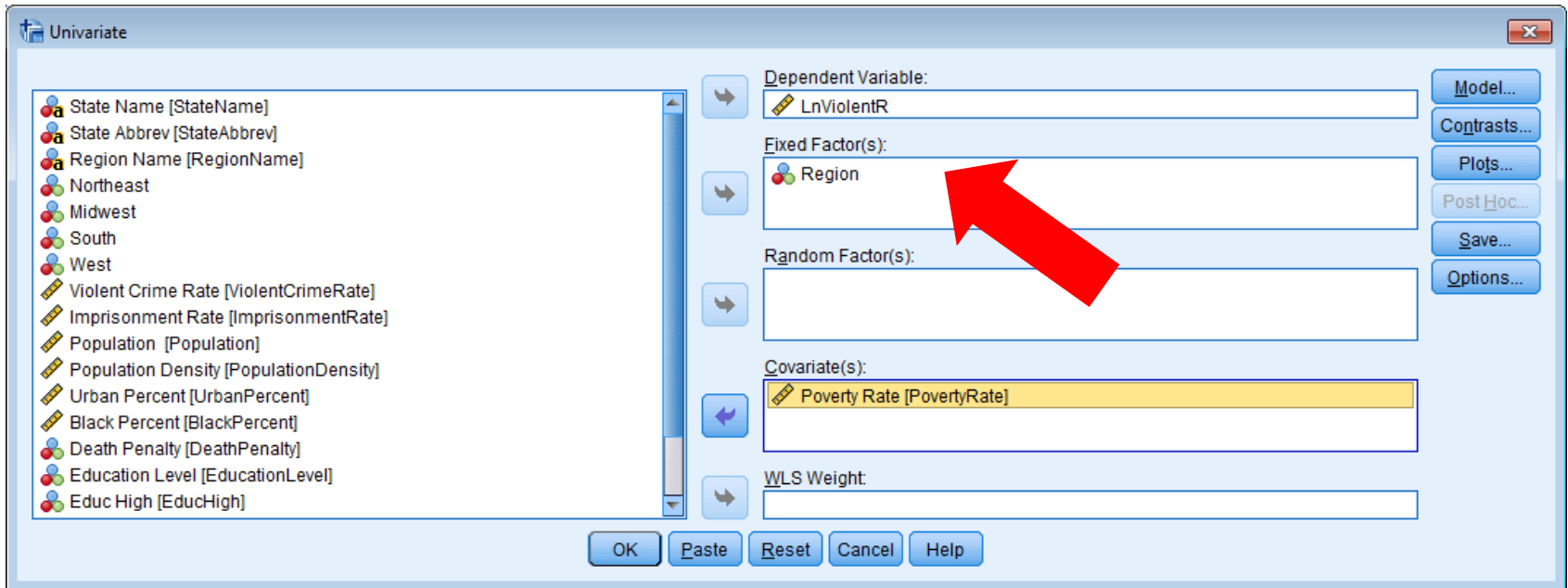
The screenshot shows the IBM SPSS Statistics Data Editor interface. The 'Analyze' menu is open, and the path 'General Linear Model > Univariate' is selected. The main data table is visible, showing 36 rows of data for US states and 13 columns of variables. The status bar at the bottom indicates 'General Linear Model' and 'IBM SPSS Statistics Processor is ready'.

	StateName	StateAbbrev	Midwest	South	West	ViolentCrimeRate	LnViolentR	ImprisonmentRate	PovertyRate	Population	PopulationDensity	UrbanPercent	BlackPercent
1	Connecticut	CT	0	0	0	273	5.61	376	10.9	3580709	742.6	87.99	10.300000000000000
2	Maine	ME	0	0	0	123	4.82	148	14.1	1328188	43.1	38.66	1.000000000000000
3	Massachusetts	MS	0	0	0	428	6.06	200	11.6	6587536	858.0	91.97	7.000000000000000
4	New Hampshire	NH	0	0	0	188	5.24	209	8.8	1318194	147.8	60.30	1.200000000000000
5	New Jersey	NJ	0	0	0	308	5.73	286	10.4	8821155	1210.1	94.68	14.500000000000000
6	New York	NY	0	0	0	398	5.99	288	16.0	19465197	417.0	87.87	15.200000000000000
7	Pennsylvania	PA	0	0	0	355	5.87	403	13.8	12742886	285.5	78.66	10.800000000000000
8	Rhode Island	RI	0	0	0	248	5.52	197	14.7	1051302	1017.1	90.73	6.400000000000000
9	Vermont	VT	0	0	0	135	4.91	265	11.5	626431	68.0	38.90	9.000000000000000
10	Illinois	IL	0	1	0	429	6.06	373	15.0	12869257	232.0	88.49	14.900000000000000
11	Indiana	IN	0	1	0	332	5.81	434	16.0	6516992	183.4	72.44	9.100000000000000
12	Iowa	IA	0	1	0	256	5.55	309	12.8	3062309	55.3	64.02	2.700000000000000
13	Kansas	KS	0	1	0	354	5.87	317	13.8	2871238	35.4	74.20	6.200000000000000
14	Michigan	MI	0	1	0	445	6.10	445	17.5	9876187	175.0	74.57	14.200000000000000
15	Minnesota	MN	0	1	0	221	5.40	185	11.9	5344861	68.1	73.27	4.600000000000000
16	Missouri	MO	0	1	0	447	6.10	508	15.8	6010688	87.9	70.44	11.500000000000000
17	Nebraska	NE	0	1	0	253	5.54	247	13.1	1842641	24.3	73.13	4.500000000000000
18	North Dakota	ND	0	1	0	247	5.51	226	12.2	683932	10.5	59.90	1.100000000000000
19	Ohio	OH	Midwest	2	0	307	5.73	448	16.4	11544951	283.2	77.92	12.000000000000000
20	South Dakota	SD	Midwest	2	0	254	5.54	416	13.9	824082	11.1	56.65	1.100000000000000
21	Wisconsin	WI	Midwest	2	0	237	5.47	366	13.1	5711767	106.0	70.15	6.100000000000000
22	Alabama	AL	South	3	0	420	6.04	648	19.0	4802740	95.4	59.04	26.400000000000000
23	Arkansas	AR	South	3	0	481	6.18	552	19.5	2937979	56.9	56.16	15.800000000000000
24	Delaware	DE	South	3	0	559	6.33	443	11.9	907135	475.1	83.30	21.000000000000000
25	Florida	FL	South	3	0	515	6.25	556	17.0	19057542	346.6	91.16	15.900000000000000
26	Georgia	GA	South	3	0	373	5.92	550	19.1	9815210	173.7	75.07	30.000000000000000
27	Kentucky	KY	South	3	0	238	5.47	458	19.1	4369358	111.3	58.38	7.700000000000000
28	Louisiana	LA	South	3	0	555	6.32	867	20.4	4574836	107.1	73.19	32.000000000000000
29	Maryland	MD	South	3	0	494	6.20	387	10.1	5828289	610.8	87.20	29.400000000000000
30	Mississippi	MS	South	3	0	270	5.60	686	22.6	2978512	63.7	49.35	37.300000000000000
31	North Carolina	NC	South	3	0	350	5.86	373	17.9	9656401	202.6	66.09	21.600000000000000
32	Oklahoma	OK	South	3	0	455	6.12	654	17.2	3791508	56.1	66.24	8.000000000000000
33	South Carolina	SC	South	3	0	572	6.35	495	18.9	4679230	158.8	66.33	28.500000000000000
34	Tennessee	TN	South	3	0	608	6.41	432	18.3	6403353	157.5	66.39	16.800000000000000
35	Texas	TX	South	3	0	408	6.01	648	18.5	25674681	101.2	84.70	11.900000000000000
36	Virginia	VA	South	3	0	197	5.29	468	11.5	8096604	209.2	75.45	19.900000000000000

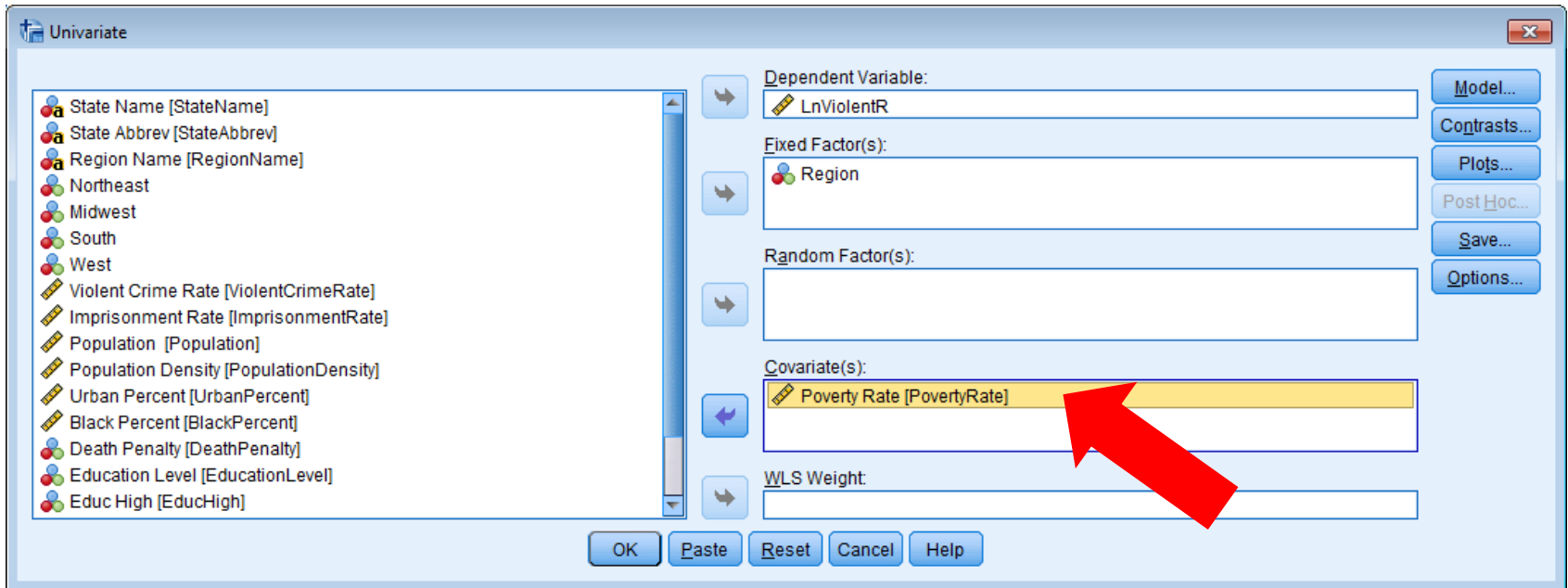
Univariate Dialog Box



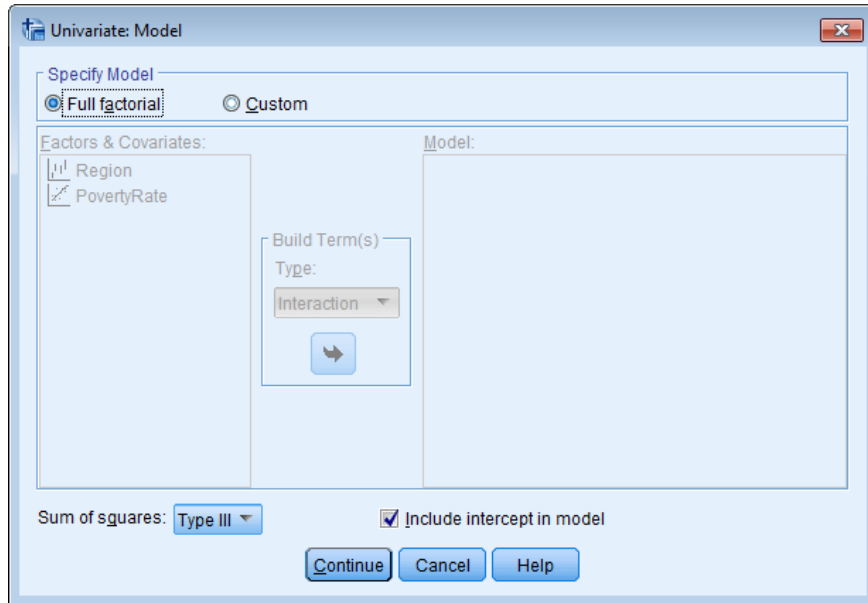
Univariate Dialog Box



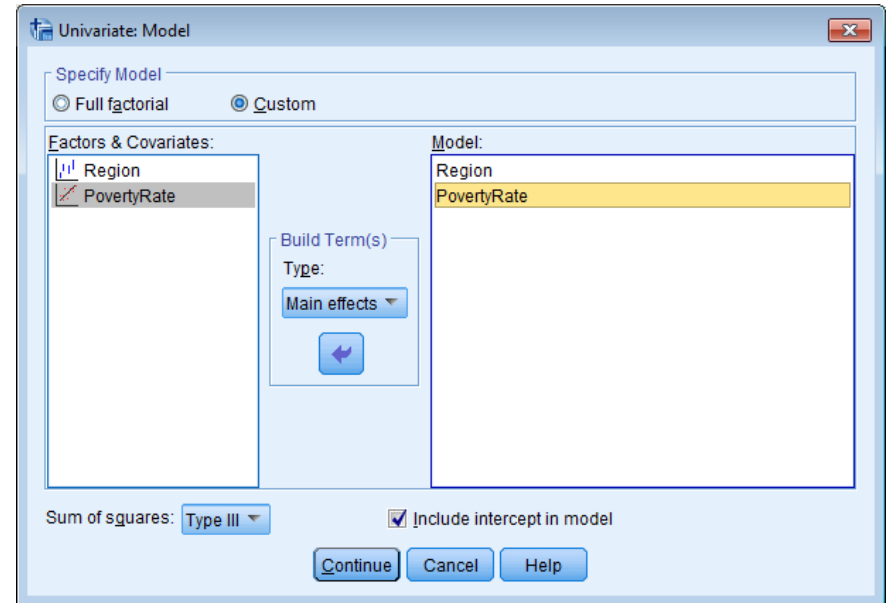
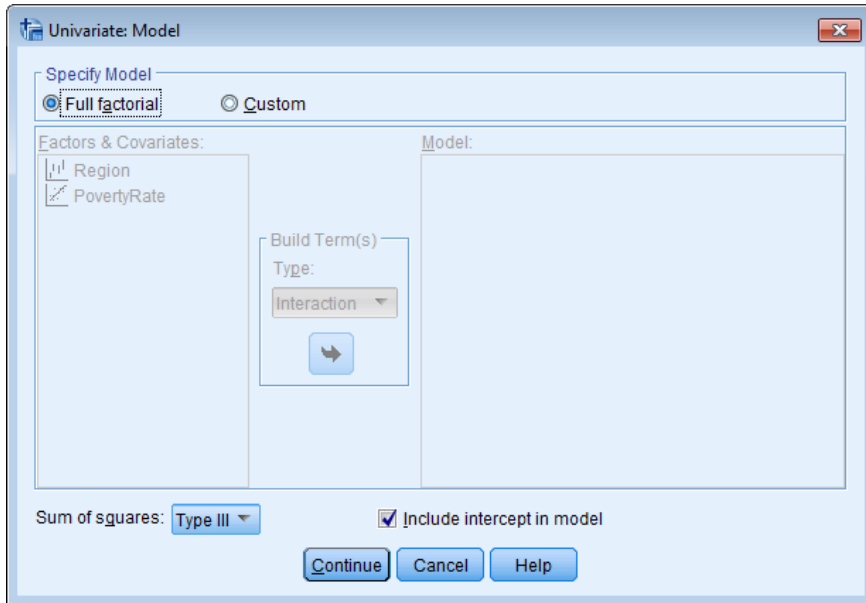
Univariate Dialog Box



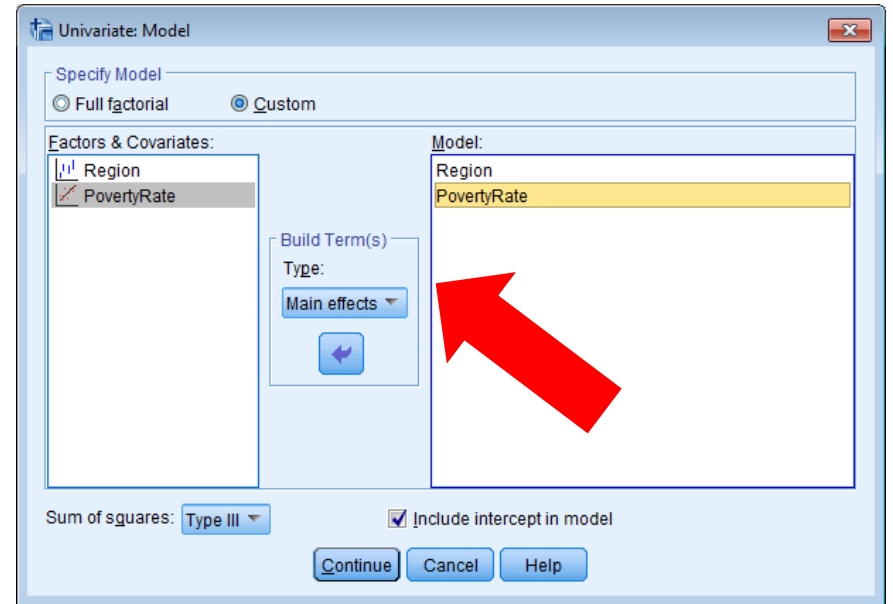
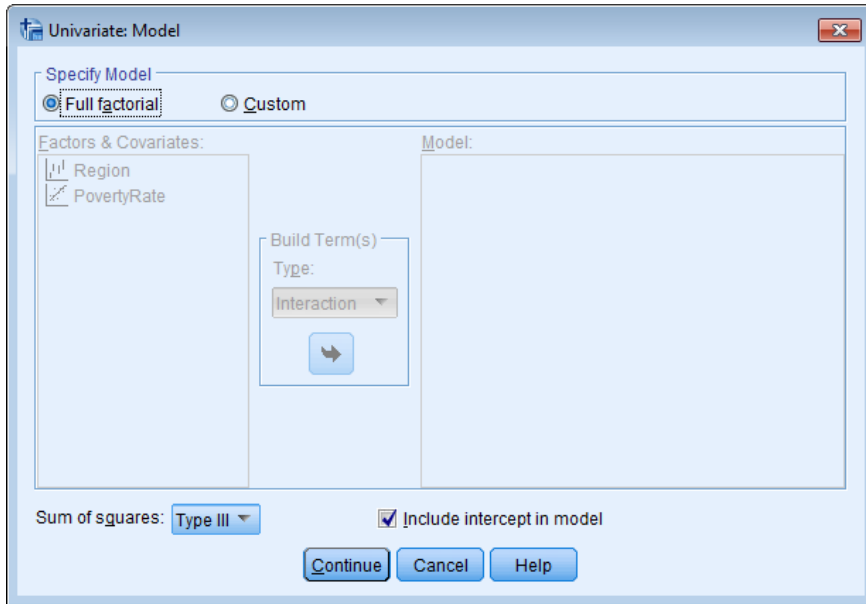
Univariate Model



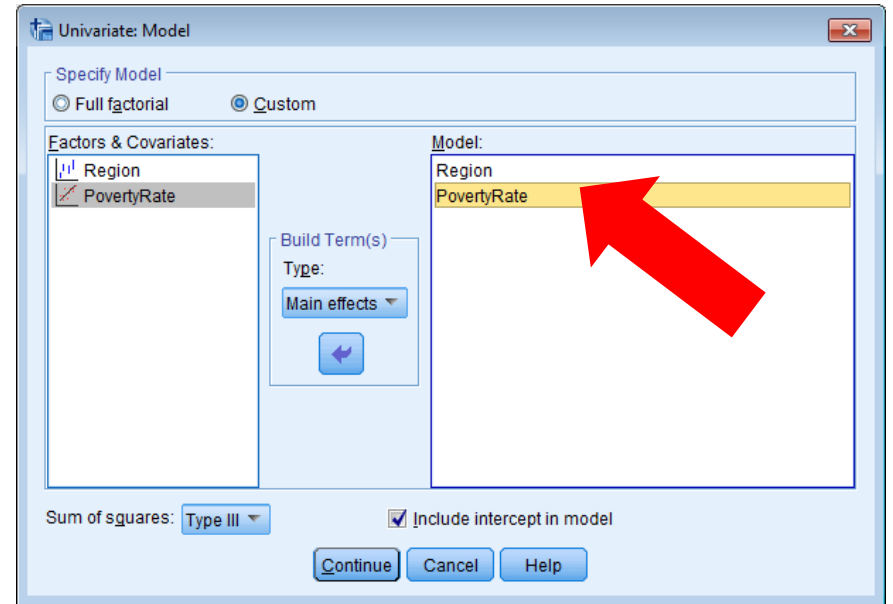
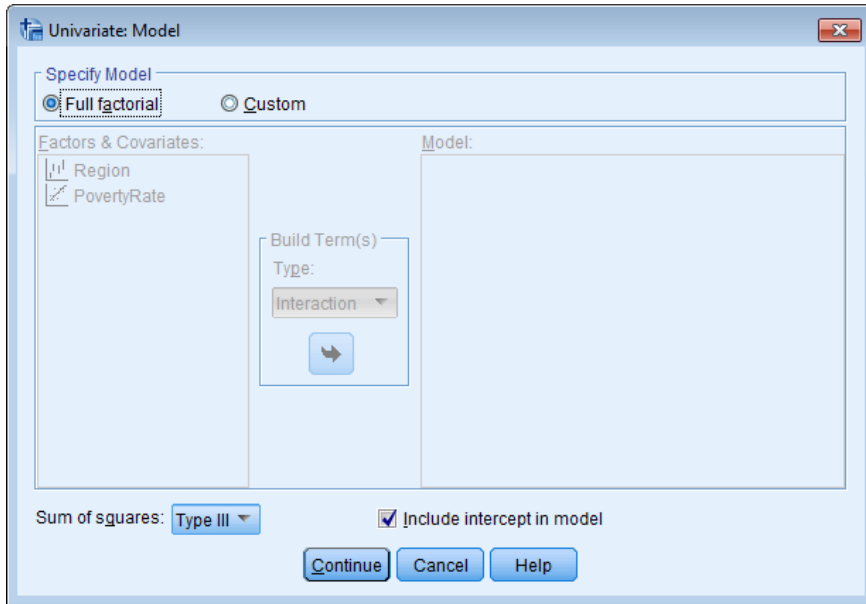
Univariate Model



Univariate Model



Univariate Model



Univariate Options

Univariate: Options

Display

<input checked="" type="checkbox"/> Descriptive statistics	<input type="checkbox"/> Homogeneity tests
<input checked="" type="checkbox"/> Estimates of effect size	<input type="checkbox"/> Spread vs. level plot
<input checked="" type="checkbox"/> Observed power	<input type="checkbox"/> Residual plot
<input checked="" type="checkbox"/> Parameter estimates	<input type="checkbox"/> Lack of fit
<input type="checkbox"/> Contrast coefficient matrix	<input type="checkbox"/> General estimable function

Heteroskedasticity Tests

<input type="checkbox"/> Modified Breusch-Pagan test Model...	<input type="checkbox"/> F test Model...
<input type="checkbox"/> Breusch-Pagan test Model...	<input type="checkbox"/> White's test

Parameter estimates with robust standard errors

- HC0
- HC1
- HC2
- HC3
- HC4

Significance level: .05 Confidence intervals are 95.0 %

Continue Cancel Help

Coefficients

Parameter Estimates

Dependent Variable: LnViolentR

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared	Noncent. Parameter	Observed Power ^b
					Lower Bound	Upper Bound			
Intercept	5.415	.296	18.277	.000	4.818	6.012	.881	18.277	1.000
[Region=1]	-.198	.162	-1.222	.228	-.525	.128	.032	1.222	.223
[Region=2]	-.049	.143	-.344	.732	-.338	.239	.003	.344	.063
[Region=3]	.155	.140	1.107	.274	-.127	.437	.026	1.107	.191
[Region=4]	0 ^a	.	.	.	.	.	.	.	.
PovertyRate	.025	.018	1.354	.183	-.012	.062	.039	1.354	.263

a. This parameter is set to zero because it is redundant.

b. Computed using alpha = .05

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.216	.258		20.185	.000
	Midwest	.149	.161	.166	.927	.359
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a. Dependent Variable: LnViolentR

Coefficients

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Coefficients



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[Region=4]	0 ^a
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a. This parameter is set to zero because it is redundant.

b. Computed using alpha = .05

Partial Eta-Squared Effect Sizes

Small	.01	.1 ²
Medium	.09	.3 ²
Strong	.25	.5 ²

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
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	South	.353	.175	.429	2.015	.050
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	Poverty Rate	.025	.018	.213	1.354	.183

a. Dependent Variable: LnViolentR

Goodness of Fit

Tests of Between-Subjects Effects

Dependent Variable: LnViolentR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power ^b
Corrected Model	1.658 ^a	4	.415	3.267	.020	.225	13.069	.794
Intercept	47.467	1	47.467	374.113	.000	.893	374.113	1.000
Region	.535	3	.178	1.405	.254	.086	4.215	.347
PovertyRate	.232	1	.232	1.832	.183	.039	1.832	.263
Error	5.710	45	.127					
Total	1687.463	50						
Corrected Total	7.368	49						

a. R Squared = .225 (Adjusted R Squared = .156)

b. Computed using Alpha = .05

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.474 ^a	.225	.156	.35620

a. Predictors: (Constant), Poverty Rate, West, Midwest, South

Partial Eta-Squared Effect Sizes

Small .01 .1²

Medium .09 .3²

Strong .25 .5²



Goodness of Fit

Tests of Between-Subjects Effects

Dependent Variable: LnViolentR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power ^b
Corrected Model	1.658 ^a	4	.415	3.267	.020	.225	13.069	.794
Intercept	47.467	1	47.467	374.113	.000	.893	374.113	1.000
Region	.535	3	.178	1.405	.254	.086	4.215	.347
PovertyRate	.232	1	.232	1.832	.183	.039	1.832	.263
Error	5.710	45	.127					
Total	1687.463	50						
Corrected Total	7.368	49						

a. R Squared = .225 (Adjusted R Squared = .156)

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Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.474 ^a	.225	.156	.35620

a. Predictors: (Constant), Poverty Rate, West, Midwest, South

Goodness of Fit

Tests of Between-Subjects Effects

Dependent Variable: LnViolentR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power ^b
Corrected Model	1.658 ^a	4	.415	3.267	.020	.225	13.069	.794
Intercept	47.467	1	47.467	374.113	.000	.893	374.113	1.000
Region	.535	3	.178	1.405	.254	.086	4.215	.347
PovertyRate	.232	1	.232	1.832	.183	.039	1.832	.263
Error	5.710	45	.127					
Total	1687.463	50						
Corrected Total	7.368	49						

a. R Squared = .225 (Adjusted R Squared = .156)

b. Computed using alpha = .05

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.474 ^a	.225	.156	.35620

a. Predictors: (Constant), Poverty Rate, West, Midwest, South

Analyze>General Linear Models> Generalized Linear Models

Generalized Linear Models

Type of Model | Response | Predictors | Model | Estimation | Statistics | EM Means | Save | Export

Choose one of the model types listed below or specify a custom combination of distribution and link function.

Scale Response _____

- Linear
- Gamma with log link

Ordinal Response _____

- Ordinal logistic
- Ordinal probit

Counts _____

- Poisson loglinear
- Negative binomial with log link

Binary Response or Events/Trials Data _____

- Binary logistic
- Binary probit
- Interval censored survival

Mixture _____

- Tweedie with log link
- Tweedie with identity link

Custom _____

- Custom

Distribution: Link function:

Parameter

- Specify value
- Value:
- Estimate value

Power:

OK | Paste | Reset | Cancel | Help

GLM Response Tab

Generalized Linear Models

Type of Model **Response** Predictors Model Estimation Statistics EM Means Save Export

Variables:

- State Name [StateName]
- State Abbrev [StateAbbrev]
- Region Name [RegionName]
- Region
- Northeast
- Midwest
- South
- West
- Violent Crime Rate [ViolentCrimeRate]
- Imprisonment Rate [ImprisonmentRate]
- Poverty Rate [PovertyRate]
- Population [Population]
- Population Density [PopulationDensity]
- Urban Percent [UrbanPercent]
- Black Percent [BlackPercent]
- Death Penalty [DeathPenalty]
- Education Level [EducationLevel]
- Educ High [EducHigh]
- Educ Med [EducMed]
- Educ Low [EducLow]
- Temperature

Dependent Variable

Dependent Variable: LnViolentR

Category order (multinomial only): Ascending

Type of Dependent Variable (Binomial Distribution Only)

Binary

Reference Category...

Number of events occurring in a set of trials

Trials

Variable

Trials Variable:

Fixed value

Number of Trials:

Scale Weight

Scale Weight Variable:

OK Paste Reset Cancel Help

GLM Predictors Tab

The screenshot shows the 'Generalized Linear Models' dialog box with the 'Predictors' tab selected. The dialog has a title bar with a close button and a menu bar with buttons for 'Type of Model', 'Response', 'Predictors', 'Model', 'Estimation', 'Statistics', 'EM Means', 'Save', and 'Export'. The 'Predictors' tab is active, showing a list of variables on the left and three sections for selecting predictors: 'Factors', 'Covariates', and 'Offset'. The 'Variables' list includes: State Name [StateName], State Abbrev [StateAbbrev], Region Name [RegionName], Northeast, Midwest, South, West, Violent Crime Rate [ViolentCrimeRate], Imprisonment Rate [ImprisonmentRate], Population [Population], Population Density [PopulationDensity], Urban Percent [UrbanPercent], Black Percent [BlackPercent], Death Penalty [DeathPenalty], Education Level [EducationLevel], Educ High [EducHigh], Educ Med [EducMed], Educ Low [EducLow], and Temperature. The 'Factors' section contains 'Region'. The 'Covariates' section contains 'Poverty Rate [PovertyRate]'. The 'Offset' section has 'Variable' selected, with an empty 'Offset Variable' field and an empty 'Value' field. At the bottom are buttons for 'OK', 'Paste', 'Reset', 'Cancel', and 'Help'.

Generalized Linear Models

Type of Model Response **Predictors** Model Estimation Statistics EM Means Save Export

Variables:

- State Name [StateName]
- State Abbrev [StateAbbrev]
- Region Name [RegionName]
- Northeast
- Midwest
- South
- West
- Violent Crime Rate [ViolentCrimeRate]
- Imprisonment Rate [ImprisonmentRate]
- Population [Population]
- Population Density [PopulationDensity]
- Urban Percent [UrbanPercent]
- Black Percent [BlackPercent]
- Death Penalty [DeathPenalty]
- Education Level [EducationLevel]
- Educ High [EducHigh]
- Educ Med [EducMed]
- Educ Low [EducLow]
- Temperature

Factors:

- Region

Covariates:

- Poverty Rate [PovertyRate]

Offset

Variable

Offset Variable:

Fixed value

Value:

OK Paste Reset Cancel Help

GLM Factor Options

Generalized Linear Models: Options

User-Missing Values

Specify how to treat cases with user-missing values on factors

Exclude

Include

Cases with user-missing values on the dependent variable, covariates, scale weight variable, or offset variable are always excluded.

Category Order for Factors

Ascending

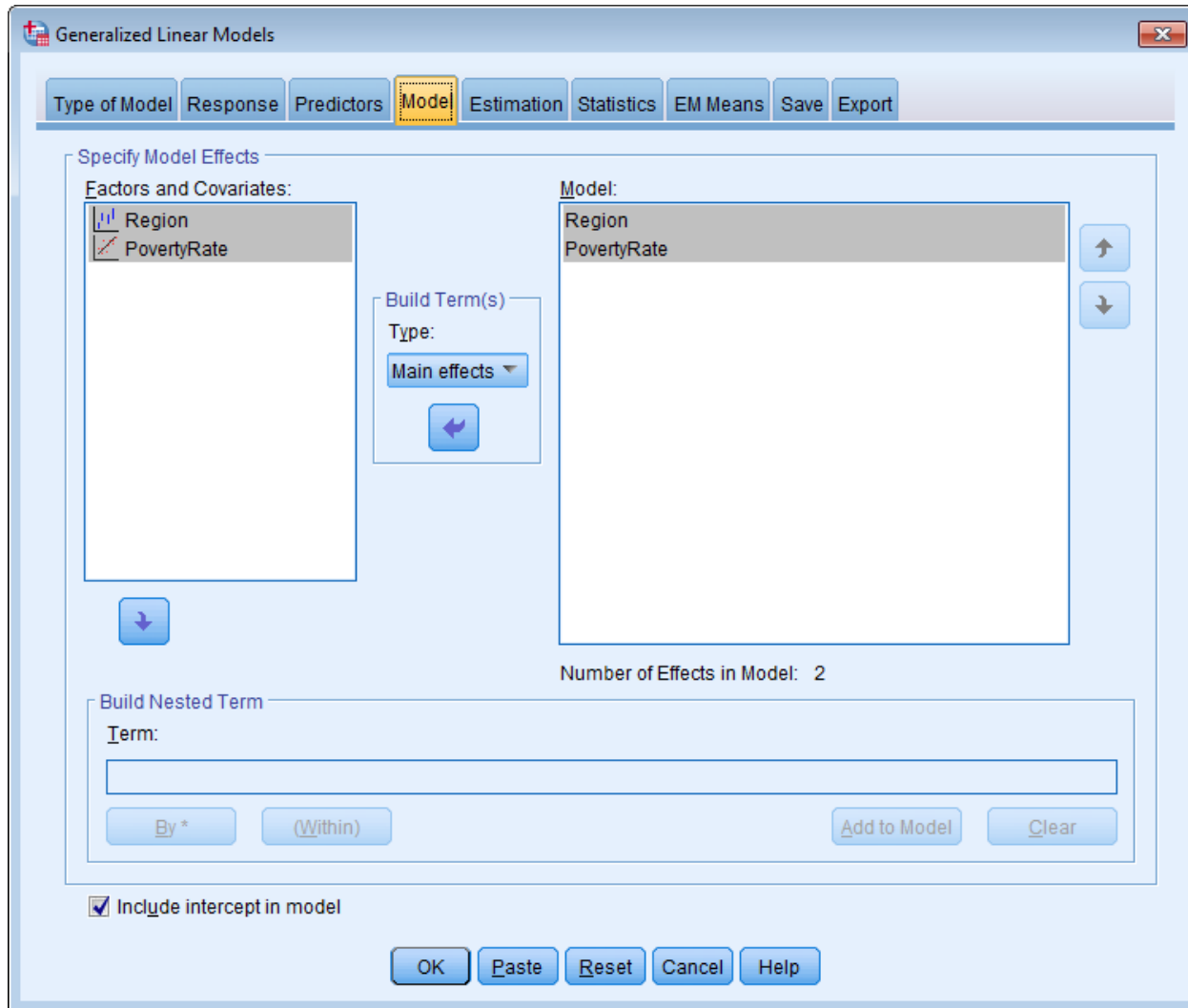
Descending

Use data order

The last unique category may be associated with a redundant parameter in the estimation algorithm.

Continue Cancel Help

GLM Models



GLM Statistics

The screenshot shows the 'Generalized Linear Models' dialog box with the 'Statistics' tab selected. The dialog is divided into several sections: 'Model Effects', 'Print', and a bottom row of buttons. The 'Model Effects' section includes 'Analysis Type' (Type III), 'Confidence Interval Level (%)' (95), 'Chi-square Statistics' (Wald selected), 'Confidence Interval Type' (Wald selected), and 'Log-Likelihood Function' (Full). The 'Print' section has a list of checkboxes for various output options, with 'Case processing summary', 'Descriptive statistics', 'Model information', 'Goodness of fit statistics', 'Model summary statistics', and 'Parameter estimates' checked. At the bottom, there are buttons for 'OK', 'Paste', 'Reset', 'Cancel', and 'Help'.

Generalized Linear Models

Type of Model Response Predictors Model Estimation **Statistics** EM Means Save Export

Model Effects

Analysis Type: Type III Confidence Interval Level (%): 95

Chi-square Statistics

Wald
 Likelihood ratio

Confidence Interval Type

Wald
 Profile likelihood

Tolerance level: .0001

Log-Likelihood Function: Full

Print

Case processing summary
 Descriptive statistics
 Model information
 Goodness of fit statistics
 Model summary statistics
 Parameter estimates

Contrast coefficient (L) matrices
 General estimable functions
 Iteration history
Print Interval: 1
 Lagrange multiplier test of scale parameter or negative binomial ancillary parameter

Include exponential parameter estimates
 Covariance matrix for parameter estimates
 Correlation matrix for parameter estimates

OK Paste Reset Cancel Help

Comparison of Parameter Estimates

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	5.216	.2452	4.736	5.697	452.702	1	.000
[Region=4]	.198	.1540	-.103	.500	1.660	1	.198
[Region=3]	.353	.1663	.027	.679	4.510	1	.034
[Region=2]	.149	.1526	-.150	.448	.954	1	.329
[Region=1]	0 ^a	.	.	.	.	.	.
Poverty Rate	.025	.0175	-.009	.059	2.036	1	.154
(Scale)	.114 ^b	.0228	.077	.169			

Dependent Variable: LnViolentR

Model: (Intercept), Region, Poverty Rate

a. Set to zero because this parameter is redundant.

b. Maximum likelihood estimate.

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.216	.258		20.185	.000
	Midwest	.149	.161	.166	.927	.359
	South	.353	.175	.429	2.015	.050
	West	.198	.162	.227	1.222	.228
	Poverty Rate	.025	.018	.213	1.354	.183

a. Dependent Variable: LnViolentR

Goodness of Fit

Goodness of Fit^a

	Value	df	Value/df
Deviance	5.710	45	.127
Scaled Deviance	50.000	45	
Pearson Chi-Square	5.710	45	.127
Scaled Pearson Chi-Square	50.000	45	
Log Likelihood ^b	-16.700		
Akaike's Information Criterion (AIC)	45.400		
Finite Sample Corrected AIC (AICC)	47.353		
Bayesian Information Criterion (BIC)	56.872		
Consistent AIC (CAIC)	62.872		

Dependent Variable: LnViolentR

Model: (Intercept), Region, Poverty Rate

- a. Information criteria are in smaller-is-better form.
- b. The full log likelihood function is displayed and used in computing information criteria.

Univariate vs. GLM

- Univariate provides output very similar to Regression with the exception of reference category of a dichotomous variable.
- Generalized Linear Models allows for corrections to the order of dichotomous variables but give different goodness-of-fit statistics.
- Need to recode variable if order of categories does not have reference value as first or last category.