

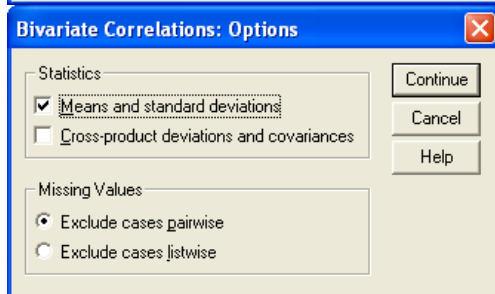
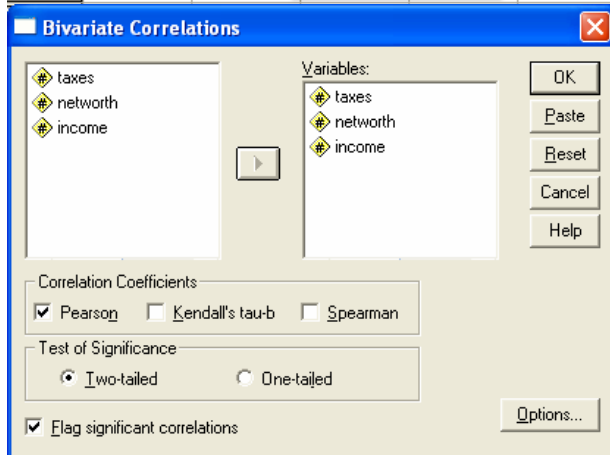
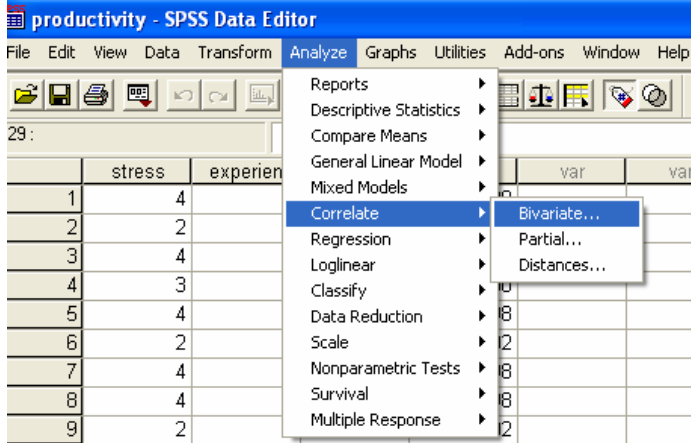
Polynomial Regression Lab

An accountant wanted to predict how much taxes are paid based on household income and household networth. All values are in thousands of dollars. The accountant was concerned there might be a nonlinear relationship.

Continued...

Income	Networth	Taxes	Income	Networth	Taxes
73	783	7	-3	143	6
33	212	6	35	787	6
21	583	6	61	539	7
42	224	6	17	190	6
8	115	6	86	604	7
60	17	5	-55	33	5
16	854	6	58	317	7
16	44	5	11	123	5
95	470	7	44	815	6
99	404	7	85	411	7
25	148	6	82	556	7
77	418	7	118	727	8
87	514	7	39	216	6
71	626	7	88	552	7
8	244	6	47	727	6
57	381	7	83	388	7
80	317	7	75	298	7
54	369	6	49	225	6
61	-58	5	35	789	6
84	-52	4	80	590	7
77	614	7	47	473	6
82	503	7	22	130	6
45	746	6	106	472	7
99	545	7	50	322	6
60	325	7	31	125	6
40	132	6	25	145	6
68	247	7	14	-93	3
84	300	7	43	216	6
31	47	5	55	248	7
21	180	6	95	399	7
91	649	7	46	340	6
92	435	7	83	577	7
56	324	7	63	287	7
71	12	5	84	275	7
86	530	7	104	377	7
76	450	7	47	444	6
44	316	6	9	202	6
49	321	6	61	444	7
69	608	7	75	506	7
73	313	7	58	278	7
68	339	7	38	903	5
28	86	5	84	450	7
76	464	7	55	447	7
22	273	6	7	113	6
85	489	7	87	361	7
76	312	7	9	89	6
80	692	7	94	350	7
48	453	6	64	578	7
25	65	5	46	377	6
89	345	7			
90	509	7			

Obtaining Descriptive Statistics and Correlations for the Variables



Correlations

Descriptive Statistics

	Mean	Std. Deviation	N
taxes	6.39	.803	100
networth	371.02	220.461	100
income	57.05	30.021	100

Correlations

		taxes	networth	income
taxes	Pearson Correlation	1	.531**	.669**
	Sig. (2-tailed)	.	.000	.000
	N	100	100	100
networth	Pearson Correlation	.531**	1	.418**
	Sig. (2-tailed)	.000	.	.000
	N	100	100	100
income	Pearson Correlation	.669**	.418**	1
	Sig. (2-tailed)	.000	.000	.
	N	100	100	100

** . Correlation is significant at the 0.01 level (2-tailed).

Creating Squared and Interaction Terms for the Predictors

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File Edit View Data Transform Analyze Graphs Utilities Ad

Compute...
 Recode...
 Visual Bander...
 Count...
 Rank Cases...
 Automatic Recode...
 Create Time Series...
 Replace Missing Values...
 Random Number Seed...
 Run Pending Transforms

	stress		stress2
10:			
1	4		.98
2	2		1.02
3	4		.98
4	3		.00
5	4		.98
6	2		1.02
7	4	5	31
			.98

Compute Variable

Target Variable: network2 = Numeric Expression: (network-371.02)**2

Type & Label...

taxes
 networkh
 income
 network2

+ < > 7 8 9
 - <= >= 4 5 6
 * = ~= 1 2 3
 / & | 0 .
 ** ~ () Delete

Functions:
 ABS(numexpr)
 ANY(test,value,value,...)
 ARSIN(numexpr)
 ARTAN(numexpr)
 CDFNORM(zvalue)
 CDF.BERNOULLI(q,p)

If...

OK Paste Reset Cancel Help

Compute Variable Use Sets

Target Variable: income2 = Numeric Expression: (income-57.05)**2

Type & Label...

taxes
 networkh
 income
 network2

+ < > 7 8 9
 - <= >= 4 5 6
 * = ~= 1 2 3
 / & | 0 .
 ** ~ () Delete

Functions:
 ABS(numexpr)
 ANY(test,value,value,...)
 ARSIN(numexpr)
 ARTAN(numexpr)
 CDFNORM(zvalue)
 CDF.BERNOULLI(q,p)

If...

OK Paste Reset Cancel Help

Compute Variable

Target Variable: incomenetwork = Numeric Expression: (income-57.05)*(network-371.02)

Type & Label...

taxes
 networkh
 income
 network2
 income2

+ < > 7 8 9
 - <= >= 4 5 6
 * = ~= 1 2 3
 / & | 0 .
 ** ~ () Delete

Functions:
 ABS(numexpr)
 ANY(test,value,value,...)
 ARSIN(numexpr)
 ARTAN(numexpr)
 CDFNORM(zvalue)
 CDF.BERNOULLI(q,p)

If...

OK Paste Reset Cancel Help

Conducting Polynomial Regression

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File Edit View Data Transform Analyze Graphs Utilities Add-ons Window Help

30 :

	stress	experien		
1	4			
2	2			
3	4			
4	3			
5	4			
6	2			
7	4			
8	4			
9	2			
10	3	9	46	
11	3	7	48	

Reports
Descriptive Statistics
Compare Means
General Linear Model
Mixed Models
Correlate
Regression
Loglinear
Classify
Data Reduction
Scale
Nonparametric Tests
Survival
Multiple Response

Linear...
Curve Estimation...
Binary Logistic...
Multinomial Logistic...
Ordinal...
Probit...
Nonlinear...
Weight Estimation...
2-Stage Least Squares...

Enter the linear versions of the predictors.

Linear Regression

Dependent: taxes

Block 1 of 1

Independent(s):
network
income

Method: Enter

Selection Variable: Rule...

Case Labels:

WLS Weight:

Statistics... Plots... Save... Options...

OK
Paste
Reset
Cancel
Help

Press the NEXT button.

Enter the squared and interaction terms for the predictors.

The screenshot shows the 'Linear Regression' dialog box. On the left, a list of variables includes 'networth', 'income', 'networth2', 'income2', and 'incomenetworth'. The 'Dependent' field contains 'taxes'. The 'Independent(s)' list contains 'networth2', 'income2', and 'incomenetworth'. The 'Method' is set to 'Enter'. The 'Block 2 of 2' indicator is visible, and the 'Next' button is highlighted. Other buttons include 'OK', 'Paste', 'Reset', 'Cancel', 'Help', 'Statistics...', 'Plots...', 'Save...', and 'Options...'.

Request F Change Statistics and Confidence Intervals

The screenshot shows the 'Linear Regression: Statistics' dialog box. Under 'Regression Coefficients', 'Estimates', 'Confidence intervals', and 'Model fit' are checked. 'R squared change' is also checked. Under 'Residuals', 'Outliers outside: 3 standard deviations' is selected. Other options include 'Covariance matrix', 'Descriptives', 'Part and partial correlations', 'Collinearity diagnostics', 'Durbin-Watson', and 'Casewise diagnostics'. Buttons for 'Continue', 'Cancel', and 'Help' are visible.

Regression

Variables Entered/Removed^b

Model	Variables Entered	Variables Removed	Method
1	income, networth ^a	.	Enter
2	income2, networth2, incomenetworth ^a	.	Enter

a. All requested variables entered.

b. Dependent Variable: taxes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.724 ^a	.525	.515	.559	.525	53.564	2	97	.000
2	.897 ^b	.804	.794	.364	.279	44.733	3	94	.000

a. Predictors: (Constant), income, network

b. Predictors: (Constant), income, network, income2, network2, incomenetwork

Is the test of nonlinearity significant using an alpha of .05?

ANOVA^c

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33.477	2	16.739	53.564	.000 ^a
	Residual	30.313	97	.313		
	Total	63.790	99			
2	Regression	51.304	5	10.261	77.244	.000 ^b
	Residual	12.486	94	.133		
	Total	63.790	99			

a. Predictors: (Constant), income, network

b. Predictors: (Constant), income, network, income2, network2, incomenetwork

c. Dependent Variable: taxes

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	5.151	.132		38.886	.000	4.888	5.414
	network	1.1E-03	.000	.305	3.957	.000	.001	.002
	income	1.4E-02	.002	.542	7.039	.000	.010	.019
2	(Constant)	5.5E+00	.114		47.960	.000	5.229	5.680
	network	1.9E-03	.000	.533	9.630	.000	.002	.002
	income	8.8E-03	.002	.331	5.703	.000	.006	.012
	network2	-7.4E-06	.000	-.563	-10.926	.000	.000	.000
	income2	4.0E-05	.000	.070	1.050	.297	.000	.000
	incomenetwork	1.2E-05	.000	.104	1.549	.125	.000	.000

a. Dependent Variable: taxes

If the test of nonlinearity is significant, then inspect the t-tests for the squared and interaction terms.

...is squared network term significant?

...is the squared income term significant?

...is the interaction term significant?

The squared term for income was removed.

All of the terms were simultaneously entered (i.e., the NEXT button was not used).

The model was re-estimated.

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File Edit View Data Transform Analyze Graphs Utilities Add-ons Window Help

30 :

	stress	experien	var	var
1	4			
2	2			
3	4			
4	3			
5	4			
6	2			
7	4			
8	4			
9	2			
10	3	9	46	
11	3	7	48	

Reports
Descriptive Statistics
Compare Means
General Linear Model
Mixed Models
Correlate
Regression
Loglinear
Classify
Data Reduction
Scale
Nonparametric Tests
Survival
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Linear...
Curve Estimation...
Binary Logistic...
Multinomial Logistic...
Ordinal...
Probit...
Nonlinear...
Weight Estimation...
2-Stage Least Squares...

Linear Regression

Dependent: taxes

Block 1 of 1
Previous Next

Independent(s):
networth
income
networth2

Method: Enter

Selection Variable: Rule...

Case Labels:

WLS Weight:

Statistics... Plots... Save... Options...

OK Paste Reset Cancel Help

Linear Regression: Statistics

Regression Coefficients

Estimates
 Confidence intervals
 Covariance matrix

Model fit
 R squared change
 Descriptives
 Part and partial correlations
 Collinearity diagnostics

Residuals

Durbin-Watson
 Casewise diagnostics

Outliers outside: 3 standard deviations
 All cases

Continue Cancel Help

Regression

Variables Entered/Removed^b

Model	Variables Entered	Variables Removed	Method
1	incomenetwork, network2, network, income ^a	.	Enter

- a. All requested variables entered.
b. Dependent Variable: taxes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.896 ^a	.802	.794	.365

- a. Predictors: (Constant), incomenetwork, network2, network, income

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	51.157	4	12.789	96.177	.000 ^a
	Residual	12.633	95	.133		
	Total	63.790	99			

- a. Predictors: (Constant), incomenetwork, network2, network, income
b. Dependent Variable: taxes

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	5.5E+00	.111		49.421	.000	5.261	5.701
	network	2.0E-03	.000	.540	9.842	.000	.002	.002
	income	8.5E-03	.002	.317	5.608	.000	.005	.011
	network2	-7.3E-06	.000	-.555	-10.877	.000	.000	.000
	incomenetwork	1.7E-05	.000	.152	3.017	.003	.000	.000

- a. Dependent Variable: taxes

This is our final model.