Chapter 31
Automatic Regression for Maximizing Linear Relationships (55 patients)

General Purpose

Automatic linear regression is in the Statistics Base add-on module SPSS version 19 and up. X-variables are automatically transformed in order to provide an improved data fit, and SPSS uses rescaling of time and other measurement values, outlier trimming, category merging and other methods for the purpose. This chapter is to assess whether automatic linear regression is helpful to obtain an improved precision of analysis of clinical trials.

Specific Scientific Question

In a clinical crossover trial an old laxative is tested against a new one. Numbers of stools per month is the outcome. The old laxative and the patients' age are the predictor variables. Does automatic linear regression provide better statistics of these data than traditional multiple linear regression does.

Data Example

Patno	newtreat	oldtreat	age categories
1,00	24,00	8,00	2,00
2,00	30,00	13,00	2,00

(continued)

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Patno	newtreat	oldtreat	age categories
3,00	25,00	15,00	2,00
4,00	35,00	10,00	3,00
5,00	39,00	9,00	3,00
6,00	30,00	10,00	3,00
7,00	27,00	8,00	1,00
8,00	14,00	5,00	1,00
9,00	39,00	13,00	1,00
10,00	42,00	15,00	1,00

patno = patient number
newtreat = frequency of stools on a novel laxative
oldtreat = frequency of stools on an old laxative
agecategories = patients' age categories (1 = young, 2 = middle-age, 3 = old)

Only the first 10 patients of the 55 patients are shown above. The entire file is in extras.springer.com and is entitled "automaticlinreg". We will first perform a standard multiple linear regression.

Command:

Analyze….Regression….Linear….Dependent: enter newtreat….Independent: enter oldtreat and agecategories….click OK.

Model summary				
Model	R	R Square	Adjusted R Square	Std. error of the estimate
1	,429[a]	,184	,133	9,28255

[a]Predictors: (Constant), oldtreat, agecategories

ANOVA[a]						
Model		Sum of squares	df	Mean square	F	Sig.
	Regression	622,869	2	311,435	3,614	,038[b]
1	Residual	2757,302	32	86,166		
	Total	3380,171	34			

[a]Dependent variable: newtreat
[b]Predictors: (Constant), oldtreat, agecategories

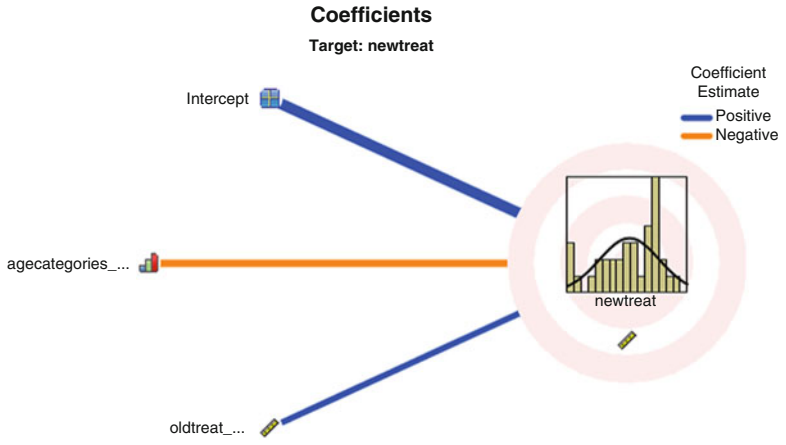
Coefficients[a]					
	Unstandardized coefficients		Standardized coefficients		
Model	B	Std. Error	Beta	t	Sig.
(Constant)	20,513	5,137		3,993	,000
1 agecategories	3,908	2,329	,268	1,678	,103
oldtreat	,135	,065	,331	2,070	,047

[a]Dependent variable: newtreat

Automatic Data Preparation		
Target: newtreat		
Field	Role	Actions taken
(agecategories_transformed)	Predictor	Merge categories to maximize association with target
(oldtreat_transformed)	Predictor	Trim outliers

If the original field name is X, then the transformed field is displayed as (X_transformed) The original field is excluded from the analysis and the transformed field is included instead

An interactive graph shows the predictors as lines with thicknesses corresponding to their predictive power and the outcome in the form of a histogram with its best fit Gaussian pattern. Both of the predictors are now statistically very significant with a correlation coefficient at $p < 0.0001$, and regression coefficients at p-values of respectively 0.001 and 0.007.



Coefficients			
Target: newtreat			
Model term	Coefficient ▶	Sig.	Importance
Intercept	35.926	.000	
Agecategories_transformed=0	–11.187	.001	0.609
Agecategories_transformed=1	0.000[a]		0.609
Oldtreat_transformed	0.209	.007	0.391

[a]This coefficient is set to zero because it is redundant

Effects					
Target: newtreat					
Source	Sum of squares	df	Mean square	F	Sig.
Corrected model ▶	1.289,960	2	644,980	9,874	,000
Residual	2.090,212	32	65,319		
Corrected total	3380,171	34			

Returning to the data view of the original data file, we now observe that SPSS has provided a novel variables with values for the new treatment as predicted from statistical model employed. They are pretty close to the real outcome values.

Patno	newtreat	oldtreat	age categories	Predicted Values
1,00	24,00	8,00	2,00	26,41
2,00	30,00	13,00	2,00	27,46
3,00	25,00	15,00	2,00	27,87
4,00	35,00	10,00	3,00	38,02
5,00	39,00	9,00	3,00	37,81
6,00	30,00	10,00	3,00	38,02
7,00	27,00	8,00	1,00	26,41
8,00	14,00	5,00	1,00	25,78
9,00	39,00	13,00	1,00	27,46
10,00	42,00	15,00	1,00	27,87

patno = patient number
newtreat = frequency of stools on a novel laxative
oldtreat = frequency of stools on an old laxative
agecategories = patients' age categories (1 = young, 2 = middle-age, 3 = old)

The Computer Teaches Itself to Make Predictions

The modeled regression coefficients are used to make predictions about future data using the Scoring Wizard and an XML (eXtended Markup Language) file (winRAR ZIP file) of the data file. Like random intercept models (see Chap. 6) and other generalized mixed linear models (see Chap. 9) automatic linear regression includes the possibility to make XML files from the analysis, that can subsequently be used for making outcome predictions in future patients. SPSS uses here software called winRAR ZIP files that are "shareware". This means that you pay a small fee and be registered if you wish to use it. Note that winRAR ZIP files have a archive file format consistent of compressed data used by Microsoft since 2006 for the purpose of filing XML files. They are only employable for a limited period of time like e.g. 40 days. Below the data of 9 future patients are given.

Newtreat	oldtreat	agecategory
	4,00	1,00
	13,00	1,00
	15,00	1,00
	15,00	1,00

(continued)

Newtreat	oldtreat	agecategory
	11,00	2,00
	80,00	2,00
	10,00	3,00
	18,00	2,00
	13,00	2,00

Enter the above data in a novel data file and command:

Utilities….click Scoring Wizard….click Browse….Open the appropriate folder with the XML file entitled "exportautomaticlinreg"….click on the latter and click Select….in Scoring Wizard double-click Next….mark Predicted Value….click Finish.

Newtreat	oldtreat	agecategory	predictednewtreat
	4,00	1,00	25,58
	13,00	1,00	27,46
	15,00	1,00	27,87
	15,00	1,00	27,87
	11,00	2,00	27,04
	80,00	2,00	41,46
	10,00	3,00	38,02
	18,00	2,00	28,50
	13,00	2,00	27,46

In the data file SPSS has provided the novel variable as requested. The first patient with only 4 stools per month on the old laxative and young of age will have over 25 stools on the new laxative.

Conclusion

SPSS' automatic linear regression can be helpful to obtain an improved precision of analysis of clinical trials and provided in the example given better statistics than traditional multiple linear regression did.

Note

More background theoretical and mathematical information of linear regression is available in Statistics applied to clinical studies 5th edition, Chap. 14, entitled Linear regression basic approach, and Chap. 15, Linear regression for assessing precision confounding interaction, Chap. 18, Regression modeling for improved precision, pp 161–176, 177–185, 219–225, Springer Heidelberg Germany, 2013, from the same authors.