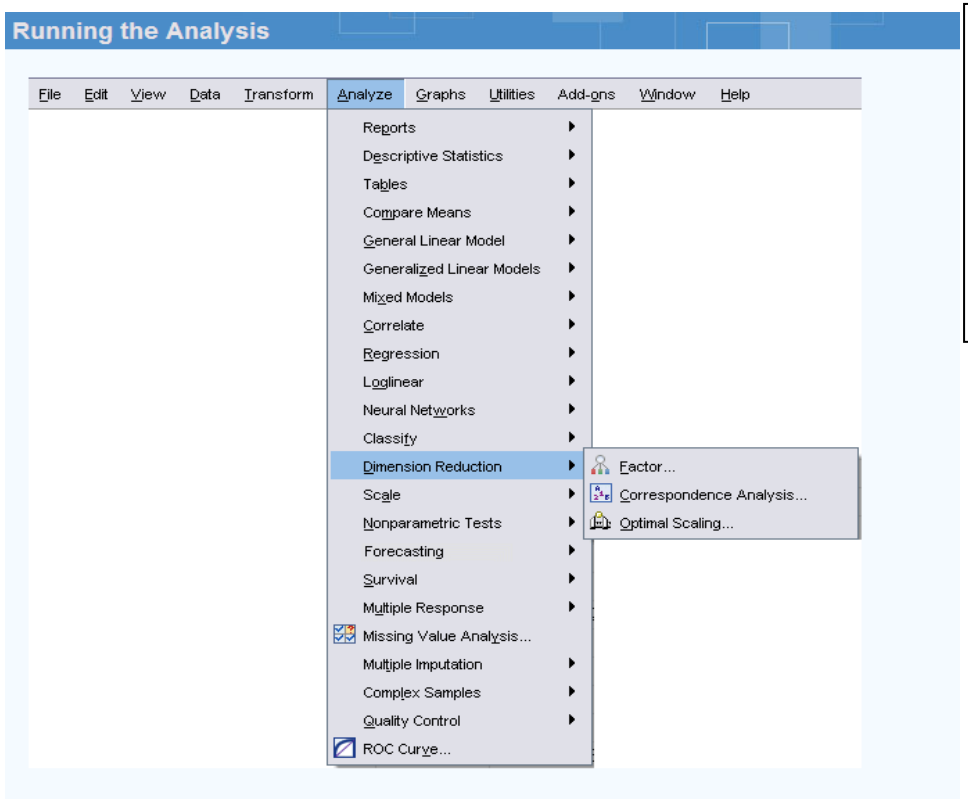
PRINCIPAL COMPONENT ANALYSIS

The principal components method of extraction begins by finding a linear combination of variables that accounts for as much variation in the original variables as possible. This method is most often used to reduce the number of variables in the data file.

How to Run the Analysis:

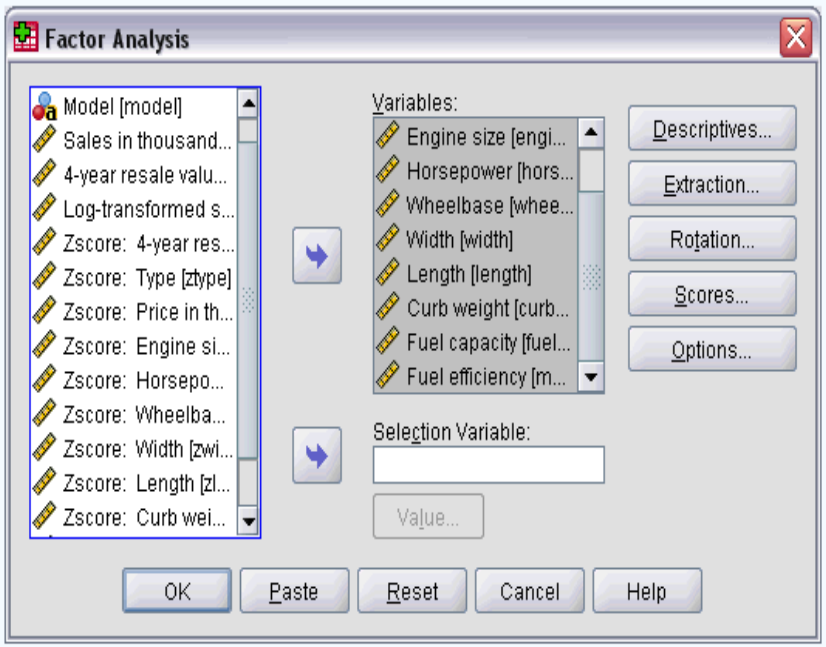


To run a principal components factor analysis, from the menus choose:

Analyze
Dimension Reduction
Factor...

PRINCIPAL COMPONENT ANALYSIS

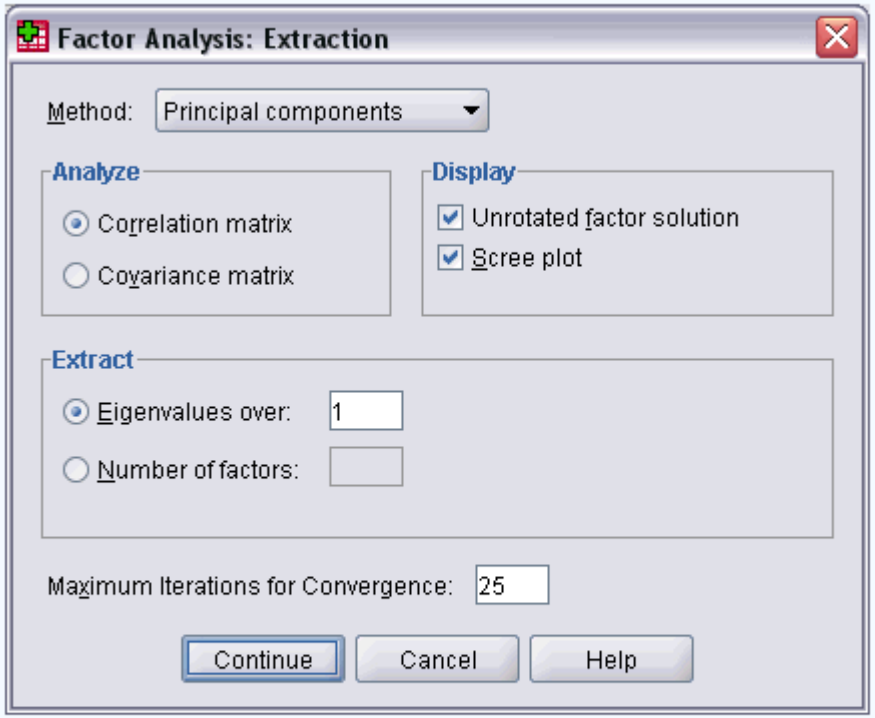
Running the Analysis



- **Select Explanatory variables.**
- **Click Extraction.**

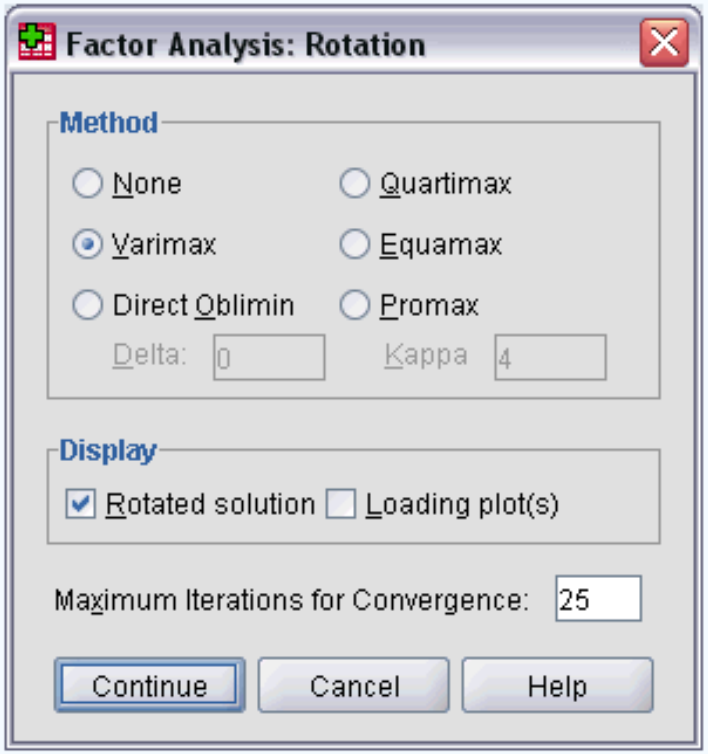
PRINCIPAL COMPONENT ANALYSIS

Running the Analysis



- **Select Scree plot.**
- **Click Continue.**
- **Click Rotation in the Factor Analysis dialog box.**

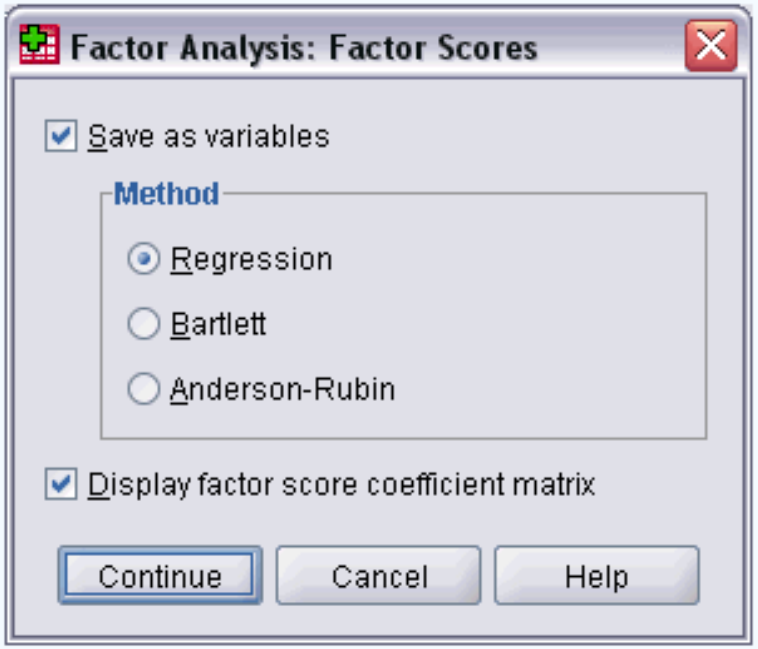
Running the Analysis



- **Select Varimax in the Method group.**
- **Click Continue.**
- **Click Scores in the Factor Analysis dialog box.**

PRINCIPAL COMPONENT ANALYSIS

Running the Analysis



- **Select Save as variables and Display factor score coefficient matrix.**
- **Click Continue.**
- **Click OK in the Factor Analysis dialog box.**

How to Read the Output:

Communalities

	Initial	Extraction
Vehicle type	1.000	.930
Price in thousands	1.000	.876
Engine size	1.000	.843
Horsepower	1.000	.933
Wheelbase	1.000	.881
Width	1.000	.776
Length	1.000	.919
Curb weight	1.000	.891
Fuel capacity	1.000	.861
Fuel efficiency	1.000	.860

Communalities indicate the amount of variance in each variable that is accounted for

Communalities

	Initial	Extraction
Vehicle type	1.000	.930
Price in thousands	1.000	.876
Engine size	1.000	.843
Horsepower	1.000	.933
Wheelbase	1.000	.881
Width	1.000	.776
Length	1.000	.919
Curb weight	1.000	.891
Fuel capacity	1.000	.861
Fuel efficiency	1.000	.860

Initial communalities are estimates of the variance in each variable accounted for by all components or factors. For principal components extraction, this is always equal to 1.0 for correlation analyses.

PRINCIPAL COMPONENT ANALYSIS

Communalities

	Initial	Extraction
Vehicle type	1.000	.930
Price in thousands	1.000	.876
Engine size	1.000	.843
Horsepower	1.000	.933
Wheelbase	1.000	.881
Width	1.000	.776
Length	1.000	.919
Curb weight	1.000	.891
Fuel capacity	1.000	.861
Fuel efficiency	1.000	.860

Extraction communalities are estimates of the variance in each variable accounted for by the components. The communalities in this table are all high, which indicates that the extracted components represent the variables well. If any communalities are very low in a principal components extraction, you may need to extract another component.

Total Variance Explained

	Initial Eigenvalues		
Component	Total	% of Variance	Cumulative %
1	5.994	59.938	59.938
2	1.654	16.545	76.482
3	1.123	11.227	87.709
4	.339	3.389	91.098
5	.254	2.541	93.640
6	.199	1.994	95.633
7	.155	1.547	97.181
8	.130	1.299	98.480
9	.091	.905	99.385
10	.061	.615	100.000

The variance explained by the initial solution, extracted components, and rotated components is displayed. This first section of the table shows the Initial Eigenvalues.

PRINCIPAL COMPONENT ANALYSIS

Total Variance Explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	5.994	59.938	59.938
2	1.654	16.545	76.482
3	1.123	11.227	87.709
4	.339	3.389	91.098
5	.254	2.541	93.640
6	.199	1.994	95.633
7	.155	1.547	97.181
8	.130	1.299	98.480
9	.091	.905	99.385
10	.061	.615	100.000

The Total column gives the eigenvalue, or amount of variance in the original variables accounted for by each component.

Total Variance Explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	5.994	59.938	59.938
2	1.654	16.545	76.482
3	1.123	11.227	87.709
4	.339	3.389	91.098
5	.254	2.541	93.640
6	.199	1.994	95.633
7	.155	1.547	97.181
8	.130	1.299	98.480
9	.091	.905	99.385
10	.061	.615	100.000

The % of Variance column gives the ratio, expressed as a percentage, of the variance accounted for by each component to the total variance in all of the variables.

Total Variance Explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	5.994	59.938	59.938
2	1.654	16.545	76.482
3	1.123	11.227	87.709
4	.339	3.389	91.098
5	.254	2.541	93.640
6	.199	1.994	95.633
7	.155	1.547	97.181
8	.130	1.299	98.480
9	.091	.905	99.385
10	.061	.615	100.000

The Cumulative % column gives the percentage of variance accounted for by the first n components. For example, the cumulative percentage for the second component is the sum of the percentage of variance for the first and second components.

Total Variance Explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	5.994	59.938	59.938
2	1.654	16.545	76.482
3	1.123	11.227	87.709
4	.339	3.389	91.098
5	.254	2.541	93.640
6	.199	1.994	95.633
7	.155	1.547	97.181
8	.130	1.299	98.480
9	.091	.905	99.385
10	.061	.615	100.000

For the initial solution, there are as many components as variables, and in a correlations analysis, the sum of the eigenvalues equals the number of components. You have requested that eigenvalues greater than 1 be extracted, so the first three principal components form the extracted solution.

PRINCIPAL COMPONENT ANALYSIS

Total Variance Explained

Component	Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	5.994	59.938	59.938
2	1.654	16.545	76.482
3	1.123	11.227	87.709

The second section of the table shows the extracted components. They explain nearly 88% of the variability in the original ten variables, so you can considerably reduce the complexity of the data set by using these components, with only a 12% loss of information.

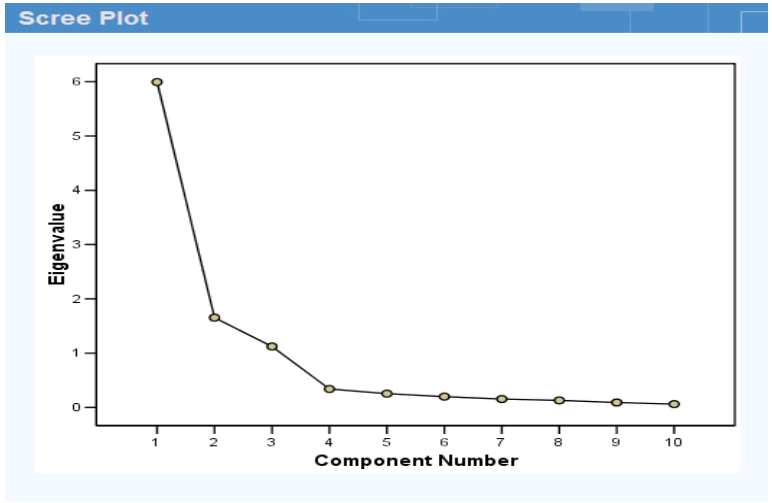
Total Variance Explained

Component	Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	5.994	59.938	59.938
2	1.654	16.545	76.482
3	1.123	11.227	87.709

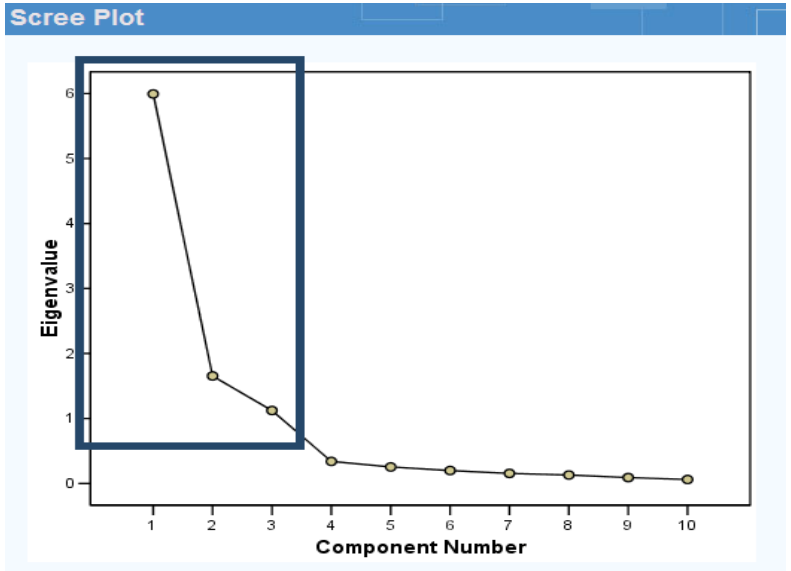
Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	3.220	32.199	32.199
2	3.134	31.344	63.543
3	2.417	24.166	87.709

The rotation maintains the cumulative percentage of variation explained by the extracted components, but that variation is now spread more evenly over the components. The large changes in the individual totals suggest that the rotated component matrix will be easier to interpret than the unrotated matrix.

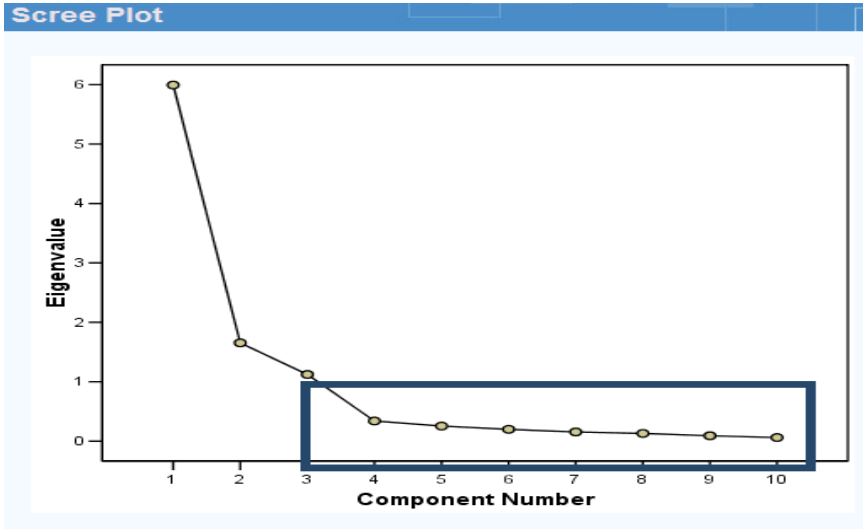
PRINCIPAL COMPONENT ANALYSIS



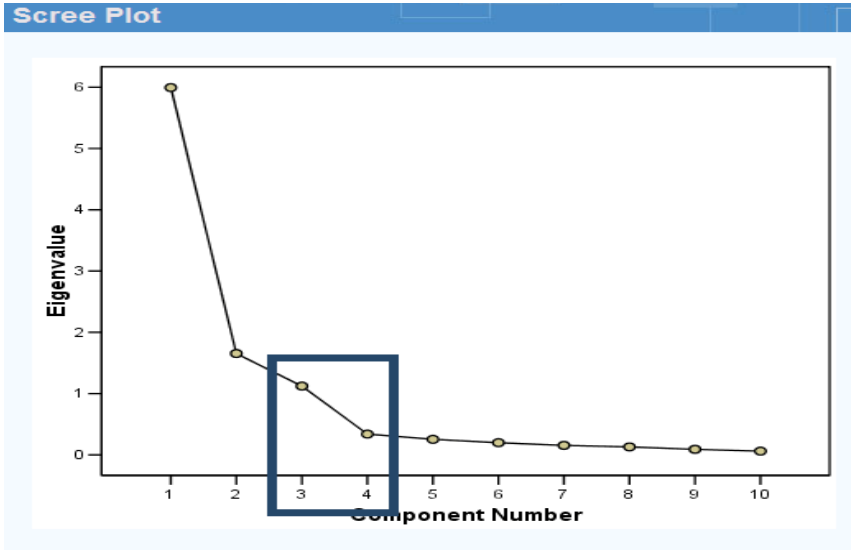
The scree plot helps you to determine the optimal number of components. The eigenvalue of each component in the initial solution is plotted.



Generally, you want to extract the components on the steep slope.



The components on the shallow slope contribute little to the solution.



The last big drop occurs between the third and fourth components, so using the first three components is an easy choice.

PRINCIPAL COMPONENT ANALYSIS

Rotated Component Matrix

	Component		
	1	2	3
Vehicle type	-.101	.095	.954
Price in thousands	.935	-.003	.041
Engine size	.753	.436	.292
Horsepower	.933	.242	.056
Wheelbase	.036	.884	.314
Width	.384	.759	.231
Length	.155	.943	.069
Curb weight	.519	.533	.581
Fuel capacity	.398	.495	.676
Fuel efficiency	-.543	-.318	-.681

The rotated component matrix helps you to determine what the components represent.

Rotated Component Matrix

	Component		
	1	2	3
Vehicle type	-.101	.095	.954
Price in thousands	.935	-.003	.041
Engine size	.753	.436	.292
Horsepower	.933	.242	.056
Wheelbase	.036	.884	.314
Width	.384	.759	.231
Length	.155	.943	.069
Curb weight	.519	.533	.581
Fuel capacity	.398	.495	.676
Fuel efficiency	-.543	-.318	-.681

The first component is most highly correlated with Price in thousands and Horsepower. Price in thousands is a better representative, because it is less correlated with the other two components.

Rotated Component Matrix

	Component		
	1	2	3
Vehicle type	-.101	.095	.954
Price in thousands	.935	-.003	.041
Engine size	.753	.436	.292
Horsepower	.933	.242	.056
Wheelbase	.036	.884	.314
Width	.384	.759	.231
Length	.155	.943	.069
Curb weight	.519	.533	.581
Fuel capacity	.398	.495	.676
Fuel efficiency	-.543	-.318	-.681

The second component is most highly correlated with Length.

Rotated Component Matrix

	Component		
	1	2	3
Vehicle type	-.101	.095	.954
Price in thousands	.935	-.003	.041
Engine size	.753	.436	.292
Horsepower	.933	.242	.056
Wheelbase	.036	.884	.314
Width	.384	.759	.231
Length	.155	.943	.069
Curb weight	.519	.533	.581
Fuel capacity	.398	.495	.676
Fuel efficiency	-.543	-.318	-.681

The third component is most highly correlated with Vehicle type.

Rotated Component Matrix

	Component		
	1	2	3
Vehicle type	-.101	.095	.954
Price in thousands	.935	-.003	.041
Engine size	.753	.436	.292
Horsepower	.933	.242	.056
Wheelbase	.036	.884	.314
Width	.384	.759	.231
Length	.155	.943	.069
Curb weight	.519	.533	.581
Fuel capacity	.398	.495	.676
Fuel efficiency	-.543	-.318	-.681

This suggests that you can focus on Price in thousands, Length, and Vehicle type in further analyses, but you can do even better by saving component scores.