Groups of characteristics

Definition

The groups of characteristics represent the frequencies of different characteristics, e.g. from list of complains or error memory entries. This process serves to find combinations which occur most frequently, in particular for defective units.

Purpose and benefit

By determining frequencies, the aim is to recognize patterns, in order to draw conclusions about errors which cannot be highlighted by means of regression techniques. With the aid of the so-called Chi² multi-field test, it is possible to determine significant differences.

Procedure and example

The following simplified table with complaints about a NOx sensor should be the basis of the following descriptions:

columns of parameters

results

	A	B	C	D	E
1	km/Month	Sensor Position	Supplier ASIC	Country	Error memory
2	354	50	C	Rest Europe	no error
3	418	120	B	Germany	no error
4	581	120	B	USA	no error
5	1750	50	A	USA	no error
6	1892	120	C	USA	no error
7	765	80	C	USA	no error
8	2489	120	B	Rest Europe	no error
9	1194	120	A	Germany	no error
10	875	50	C	Germany	no error
11	2374	80	B	Asia	no error
12	2264	80	B	Asia	no error
13	1157	80	A	Rest Europe	no error
14	376	120	A	USA	error flag
15	987	50	C	Asia	no error
16	865	120	B	Asia	no error
17	987	120	A	Rest Europe	error flag
18	1470	120	A	USA	no error
19	1298	50	A	Asia	no error
20	1156	120	C	Asia	no error
21	605	50	B	Germany	no error
22	554	120	A	Asia	error flag
23	876	50	A	USA	no error

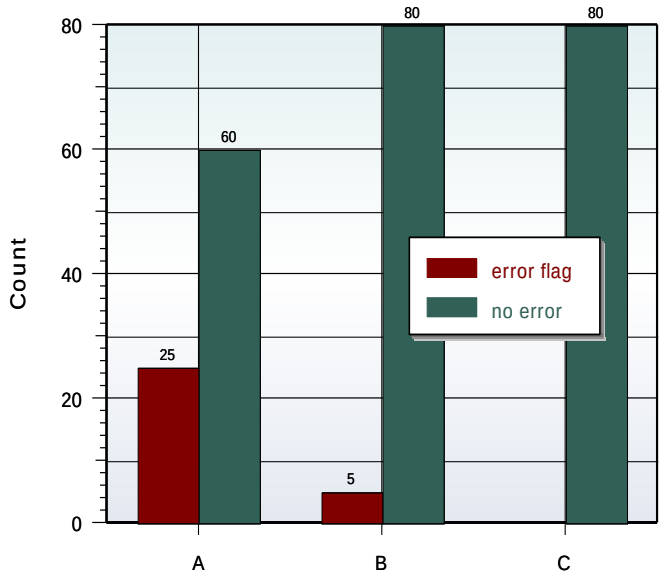
The column of the results is here the error memory entry in the ECU. Here data without errors must also be present in order that a relative comparison can be made.

It is now necessary to determine the combinations for which the system lists the most entries with errors. The first step is to count the entries with errors. Later, this represents the reference value for the main group.

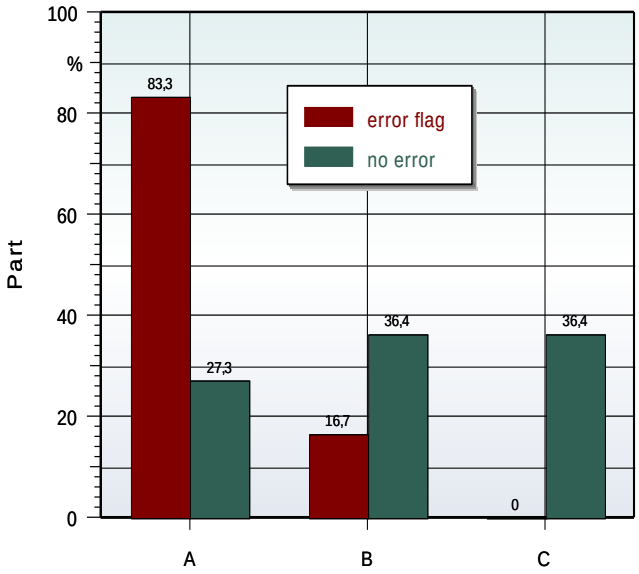
For the parameter columns, the frequencies of the characteristics are now divided between entries without and with errors. Ideally, the column of the results should have exactly as many entries without errors as with errors.

If characteristics such as Supplier occur at different frequencies, then this is relativized by percentualizing into “no errors” and “errors”. The chart on the left displays the absolute

frequency, and the chart on the right displays the relative percentage ratios:



absolute number of suppliers



relatively frequency of suppliers

In this example, Supplier A occurred 60 times without errors. Altogether there were 220 units without errors. For Supplier A, the proportion of units without errors is therefore 60/220 = 27.3%. However, entries with errors occur for Supplier A 25 times, of a total of 30 defective units. Entries with errors therefore occur for Supplier A at 25/30 = 83.3%. The relative comparison therefore represents the situation more truly than the absolute comparison. The differences can be tested for significance using a χ^2 multi-field test.
The second step now determines which row combinations occur more than once. These are removed in order that the combinations are unique (unique specimens). It is useful to recognize here that defective units arise for distances traveled greater than 1200 km/Month, for large sensor separations, and predominantly for Supplier A (first block with 6 rows). The Country (of sale) has a relatively insignificant effect.

The relationship becomes particularly clear when a continuous dividing line is possible by the boundary of no error. In the example, this line is first interrupted starting from the column “Country” (of sale)

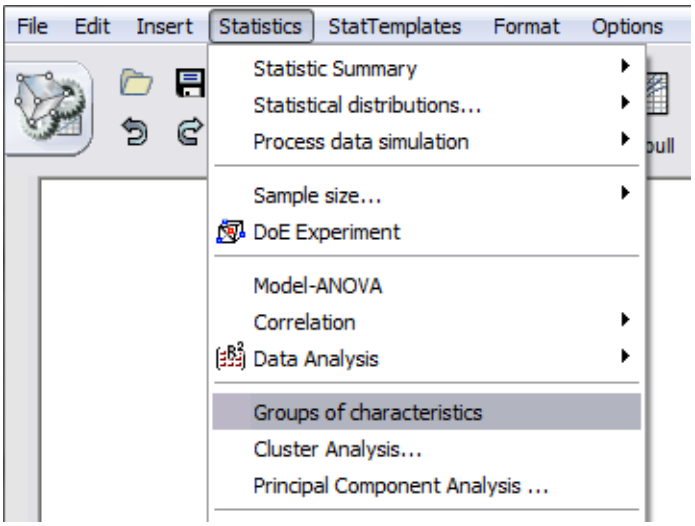
Error memo	km/Month	Sensor Pos	Supplier AS	Country
error flag	0 ...400	120	A	USA
Count:30	400 ...800	Count:20	B	Rest Europe
	Count:20		A	Germany
			Count:20	Asia
		80		Count:10
	800 ...1200	120		Rest Europe
no error	0 ...400	50	C	Count:10
Count:220	400 ...800	Count:30	Count:10	Germany
	Count:60		B	Rest Europe
			Count:35	Germany
				USA
				Asia
		120		Germany

Groups of characteristics

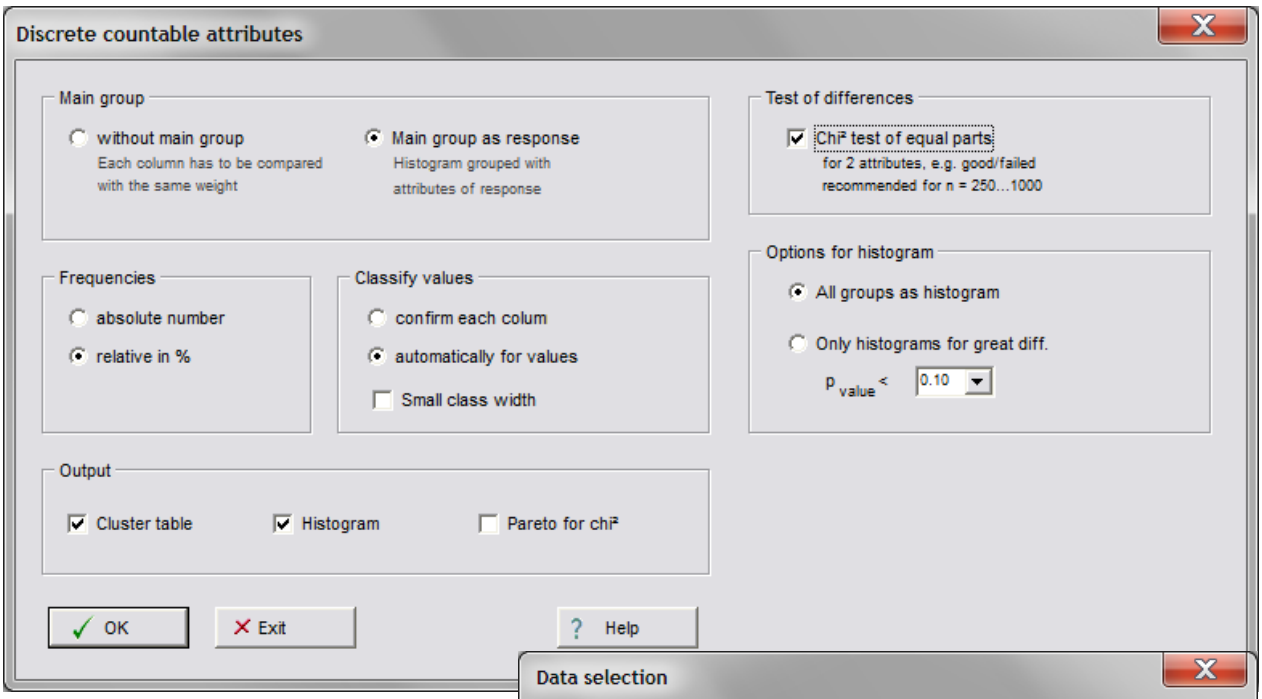
Using Visual-XSel

For discrete data analysis there is new the so called ***Groups of characteristics*** via the menu ***Statistics***.

The example for this methode will be found in Menu ***File/Examples*** – Example_Group_Characteristics.vxg



For this data use the shown options:



Use the column Error Memory for the ***Main group***, the other for ***Represented data***.

The charts of the result are shown at the first chapter (***Procedure and example***).