Categorical Data

Categorical variables represent types of data which may be divided into groups. Examples of categorical variables are race, sex, age group, and educational level. While the latter two variables may also be considered in a numerical manner by using exact values for age and highest grade completed, it is often more informative to categorize such variables into a relatively small number of groups.

Analysis of categorical data generally involves the use of data tables. A ***two-way table*** presents categorical data by counting the number of observations that fall into each group for two variables, one divided into rows and the other divided into columns. For example, suppose a survey was conducted of a group of 20 individuals, who were asked to identify their hair and eye color. A two-way table presenting the results might appear as follows:

	Eye Color			
Hair Color	Blue	Green	Brown	Black	Total
Blonde	2	1	2	1	6
Red	1	1	2	0	4
Brown	1	0	4	2	7
Black	1	0	2	0	3
Total	5	2	10	3	20

The totals for each category, also known as ***marginal distributions***, provide the number of individuals in each row or column without accounting for the effect of the other variable (in the example above, the total number of individuals with blue eyes, regardless of hair color, is 5).

Since simple counts are often difficult to analyze, two-way tables are often converted into percentages. In the above example, there are 4 individuals with red hair. Since there were a total of 20 observations, this means that 20% of the individuals surveyed are redheads. One also might want to investigate the percentages within a given category -- of the 4 redheads, 2 (50%) have brown eyes, 1 (25%) has blue eyes, and 1 (25%) has green eyes.

For a more detailed example, consider the following dataset, "Weights of 1996 US Olympic Rowing Team." The first column gives the name of the rower, the second gives his event, and the third gives his weight. There are 8 different event categories, with weight given as numeric data.

Auth	LW_double_sculls	154	Klepacki	four	205
Beasley	single_sculls	224	Koven	eight	200
Brown	eight	214	Mueller	quad	215
Burden	eight	195	Murphy	eight	220
Carlucci	LW_four	160	Murray	four	205
Collins,D	LW_four	155	Peterson,M	pair	210
Collins,P	eight	195	Peterson,S	LW_double_sculls	160
Gailes	quad	205	Pfaendtner	LW_four	160
Hall	four	195	Schnieder	LW_four	158
Holland	pair	195	Scott	four	208
Honebein	eight	200	Segaloff	coxswain	121
Jamieson	quad	210	Smith	eight	207
Kaehler	eight	210	Young	quad	207

Data source: Team member biographies given on the NBC Olympic Web Site. Dataset available through the JSE Dataset Archive.

Before creating a two-way table for events and weights, the analyst must first divide the numeric "weight" column into groups, creating a categorical variable. Using the MINITAB "DESCRIBE" command gives the following information about the weight data:

```
Descriptive Statistics

Variable        N     Mean   Median  Tr Mean    StDev  SE Mean
Weight         26   191.85   202.50   193.46    26.27     5.15

Variable      Min      Max       Q1       Q3
Weight     121.00   224.00   160.00   210.00
```

One might choose, based on this information, to divide the weight values into 4 groups, such as under 150 lbs, 150-175 lbs, 175-200 lbs, and over 200 lbs. Once the data has been categorized (the MINITAB "CODE" command may be used to perform this function), the MINITAB "TABLE" command will create two-way tables, as follows:

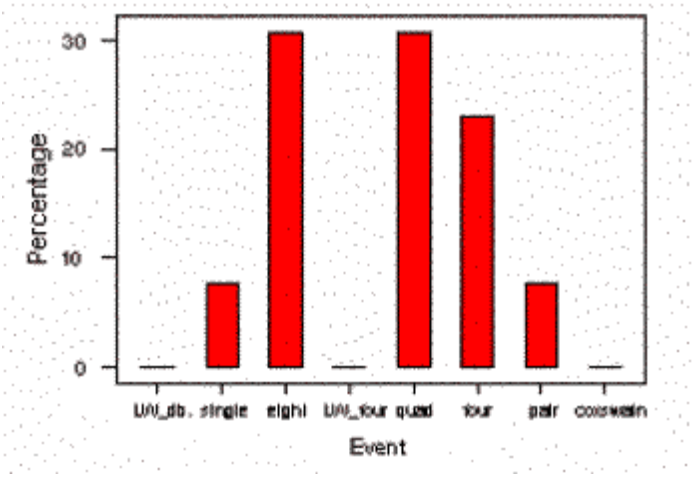
```
Rows: Event     Columns: Weight_Class

             <150    150-175   175-200  >200      All

LW_doubl       0        2        0        0        2
single_s       0        0        0        1        1
eight          0        0        4        4        8
LW_four        0        4        0        0        4
quad           0        0        0        4        4
four           0        0        1        3        4
pair           0        0        1        1        2
coxswain       1        0        0        0        1
All            1        6        6       13       26
```

Using the "ROWPERCENT" subcommand reproduces this table with the percentages of rowers in each weight category by event:

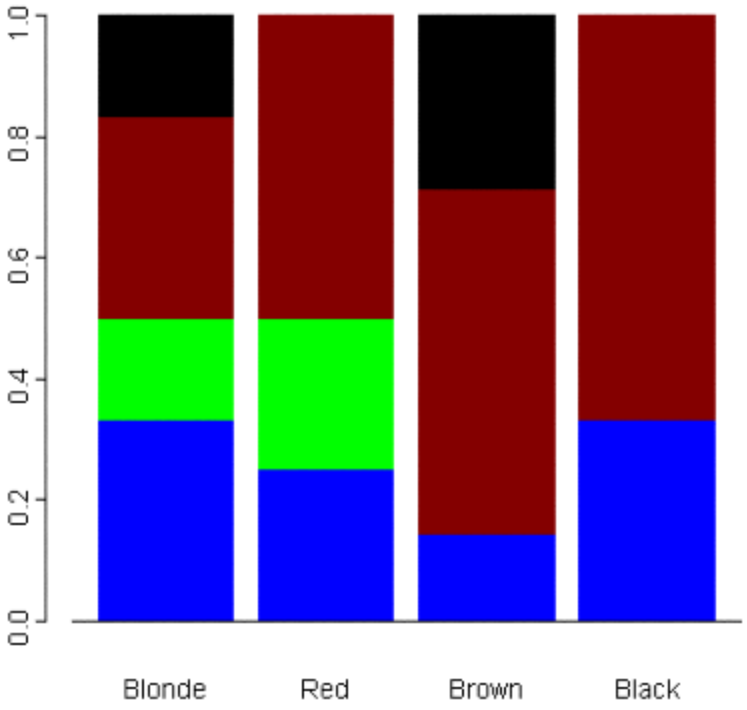
```
Rows: Event     Columns: Weight_Class

               0        1        2        3      All

LW_doubl      --   100.00       --       --   100.00
single_s      --       --       --   100.00   100.00
eight         --       --    50.00    50.00   100.00
LW_four       --   100.00       --       --   100.00
quad          --       --       --   100.00   100.00
four          --       --    25.00    75.00   100.00
pair          --       --    50.00    50.00   100.00
coxswain  100.00       --       --       --   100.00
All         3.85    23.08    23.08    50.00   100.00
```

These results indicate that half of all rowers are in the upper weight class, with the remainder evenly divided between the two middle classes (with the exception of the coxswain, who is the only team member in the lightest weight group). Similarly, the "COLPERCENT" subcommand provides the percentage of rowers in each event category by weight.

In addition to creating data tables, an analyst might want to create a graphical representation of categorical data using a bar graph. A bar graph representing the percentage of rowers in the heaviest weight category in each event is shown to the left.



Another useful graphical tool for analyzing categorical data is a ***segmented bar graph***. For the simple hair color/eye color example above, a segmented bar graph depicting the breakdown of eye color for each hair color appears to the right. The segments of each bar are color-coded to correspond to the appropriate eye color.



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