

Wind Rose Statlet



Revised: 10/9/2017



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Summary

The *Wind Rose Statlet* displays data on a circular plot, depicting the frequency distribution of variables such as wind speed and direction. It may be used to display the distribution at a single point in time, or it may show changes over time in a dynamic manner.

Sample StatFolio: *windrose.sgp*

Sample Data

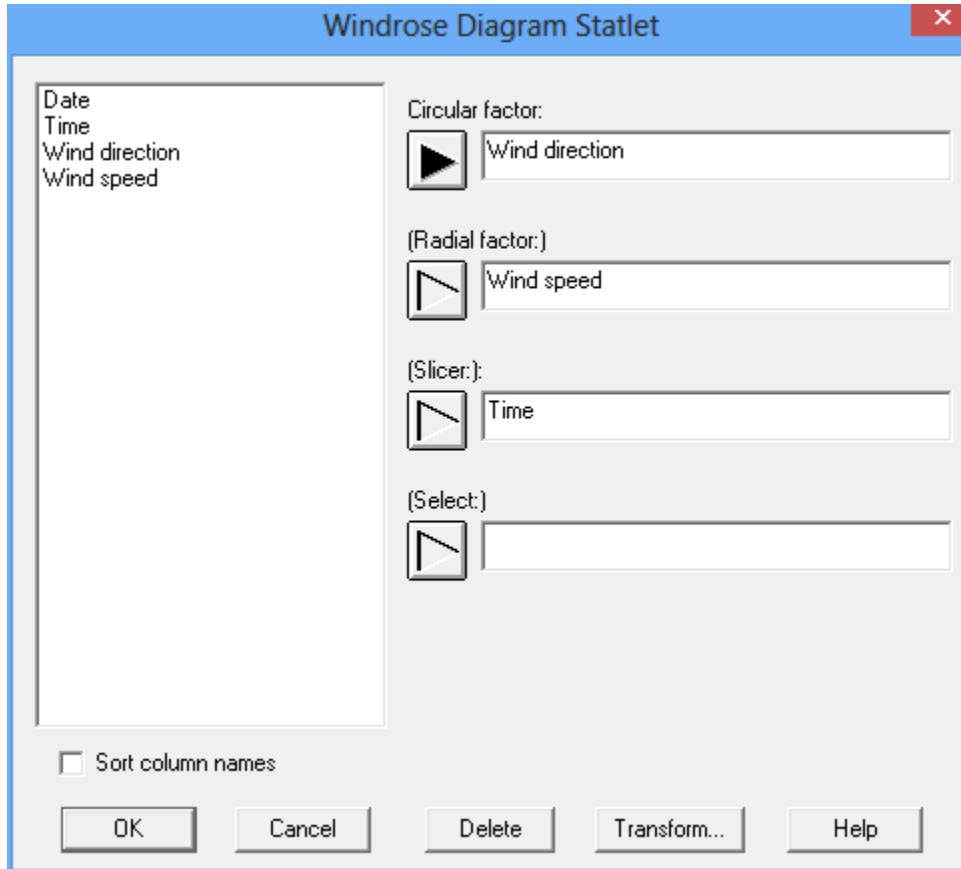
The file *Aberdeen wind data.sgd* contains hourly measurements of the wind speed and direction at the Aberdeen, Idaho Weather Station averaged over every hour during 2014. It was obtained from the U.S. Department of Interior AgriMet weather network at <http://www.usbr.gov/pn/agrimet/webaghrread.html>.

The first several rows of that file are shown below:

Date	Time	Wind direction	Wind speed
1/1/2014	0:00	233.6	5.62
1/1/2014	1:00	222.6	5.64
1/1/2014	2:00	212.5	7.64
1/1/2014	3:00	221.9	6.82
1/1/2014	4:00	241.8	8.56
1/1/2014	5:00	238.4	5.08
1/1/2014	6:00	252	6.25
1/1/2014	7:00	262.9	7.28
1/1/2014	8:00	313.1	3.8
1/1/2014	9:00	283.4	2.84
1/1/2014	10:00	306.6	4.04
1/1/2014	11:00	334.4	3.15
1/1/2014	12:00	6.19	3.25
1/1/2014	13:00	293.8	2.83
1/1/2014	14:00	49.63	1.62

Data Input

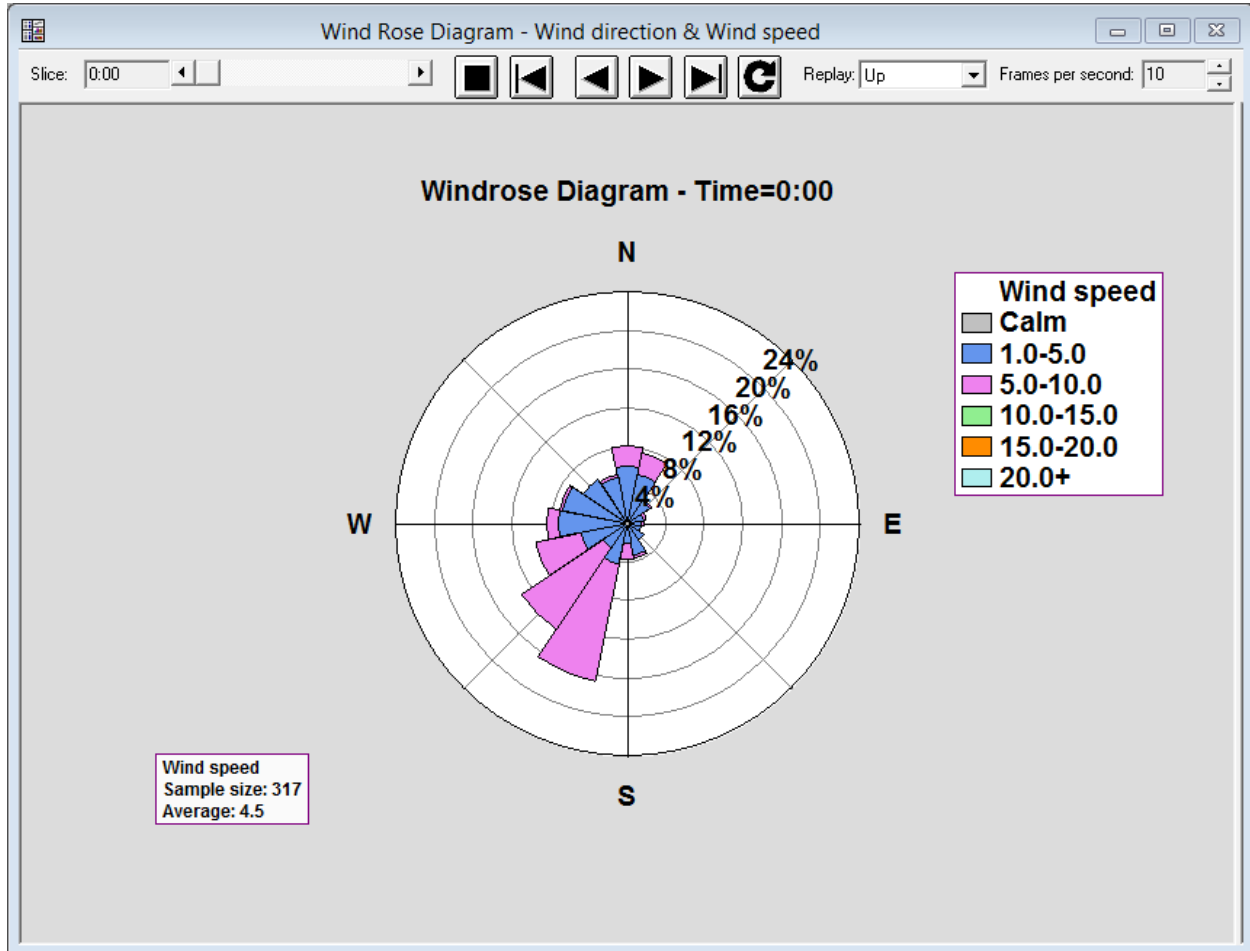
The data input dialog box requests the names of the columns containing the data values to be plotted:



- **Circular factor:** name of a numeric column containing the location of each observation on a circle ranging from 0° at the top clockwise to 360° . The most common application is the angle from which the wind is coming.
- **Radial factor:** name of a second numeric column containing a variable to be tabulated in the radial direction. The most common application is wind speed. This column is normally supplied but is not required.
- **Slicer:** name of a numeric column used to define subsets of the data. This variable, often a measure of time, is changed dynamically to illustrate changes in the data. There should be p unique values of this variable. If there is only 1 time period in the file, this column may be omitted.
- **Select:** optional subset selection.

Statlet

The output of this procedure is displayed in a dynamic Statlet window. When first created, the window displays data for the first time period (or the first value of the *Slicer*) as shown below:



The length of the petals represents the percentage of time that the wind was coming from a particular direction. Each petal is subdivided to show the distribution of wind speed at each direction.



Slice scrollbar: used to change the time period at which the data are displayed.



Forward button: used to start a timer which plots the data for each time period in increasing order.



Backward button: used to start a timer which plots the data for each time period in decreasing order.



Fast forward button: advances to the last time period.



Rewind button: rewinds to the first time period.



Replay button: causes the sequence of time periods to be replayed over and over.



Stop button: stops the timer or replay.

Replay:

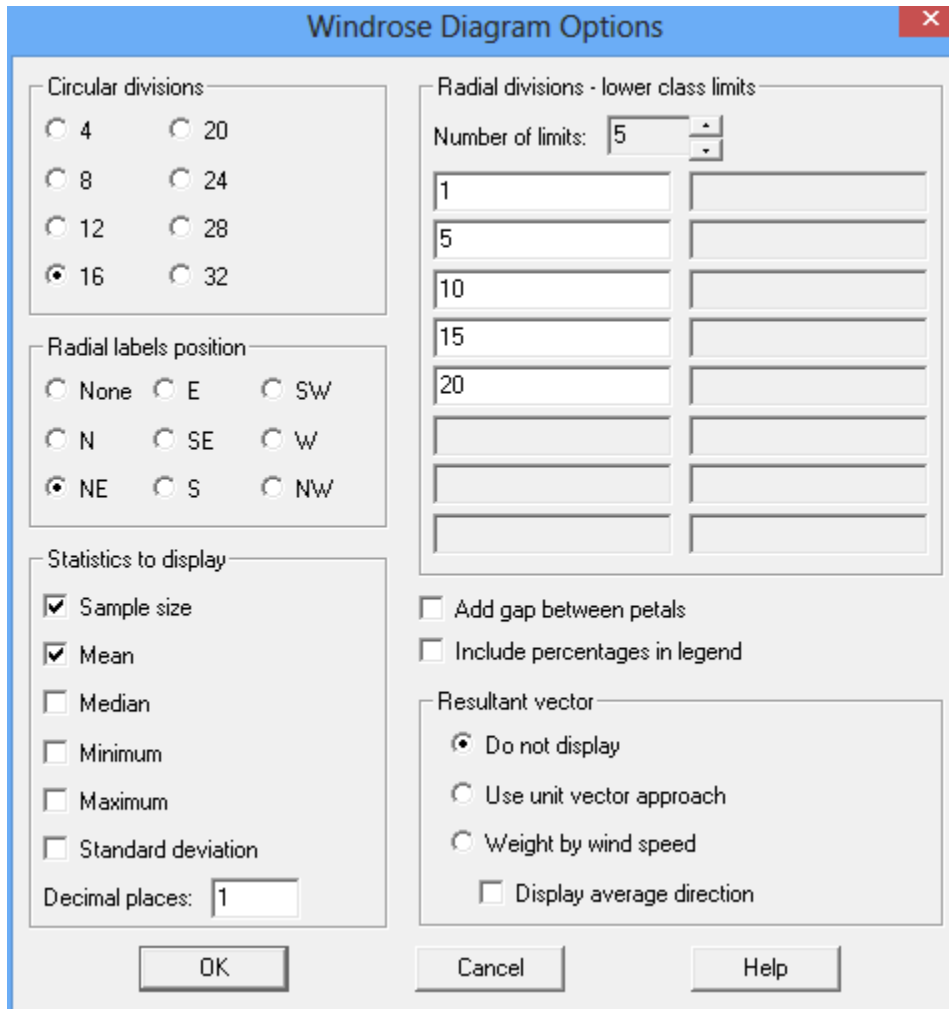
Replay pulldown list: specifies the direction for the time sequence when the replay button is pushed.

Frames per second:

Frames per second spinner: specifies the rate at which the time period is changed.

Analysis Options

The *Analysis Options* dialog box allows for various special effects to be applied:

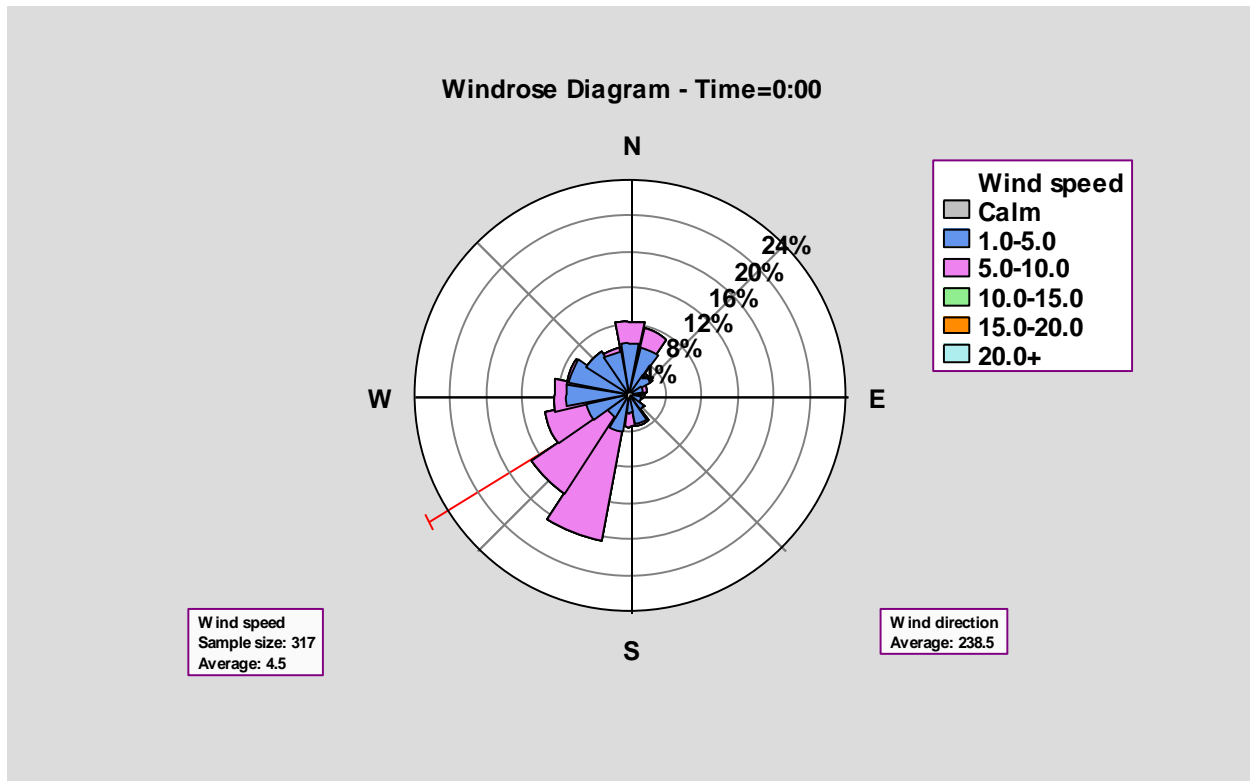


The following options are available:

- **Circular divisions:** specifies the number of divisions into which the circle is divided.
- **Radial divisions:** indicates the lower limit for each subdivision of the petals. If the initial lower limit is greater than 0, an additional “Calm” subdivision will be created to tabulate any values less than that lower limit.
- **Radial labels position:** indicates the location of the radial labels (if any) on the diagram.
- **Add gap between petals:** If selected, a small gap will be left between adjacent petals.
- **Include percentages in legend:** If selected, the legend box will display both the labels for each radial division and the percentages for each division.

- **Statistics to display:** Statistics to be displayed for the radial factor (usually wind speed).
- **Resultant vector:** If selected, a resultant vector will be displayed in the direction of the average of the circular factor (usually wind direction). This may be done using either a unit vector approach, in which the wind speed is not considered, or a vector approach which gives more weight to higher speeds when determining the average direction.

The plot below shows a wind rose with a resultant vector calculated using the vector approach.



Calculations

Let:

u_i = observed wind speed for the i^{th} observation.

θ_i = observed wind direction for the i^{th} observation, measured in degrees clockwise from north.

n = number of observations

Scalar wind speed calculations:

$$\text{Average: } \bar{u} = \frac{\sum_{i=1}^n u_i}{n} \quad (1)$$

$$\text{Standard deviation: } s = \frac{\sum_{i=1}^n (u_i - \bar{u})^2}{n-1} \quad (2)$$

Weighted vector calculations:

$$\text{East-west component: } V_E = -\frac{1}{n} \sum u_i \sin(\theta_i) \quad (3)$$

$$\text{North-south component: } V_N = -\frac{1}{n} \sum u_i \cos(\theta_i) \quad (4)$$

Unit vector calculations:

$$\text{East-west component: } V_E = -\frac{1}{n} \sum \sin(\theta_i) \quad (5)$$

$$\text{North-south component: } V_N = -\frac{1}{n} \sum \cos(\theta_i) \quad (6)$$

Mean wind direction:

$$\bar{\theta} = \text{atan}(V_E/V_N) + F \quad (7)$$

$$\text{where } F = 180 \text{ if } \text{atan}(V_E/V_N) < 180 \quad (8)$$

$$F = -180 \text{ if } \text{atan}(V_E/V_N) > 180 \quad (9)$$