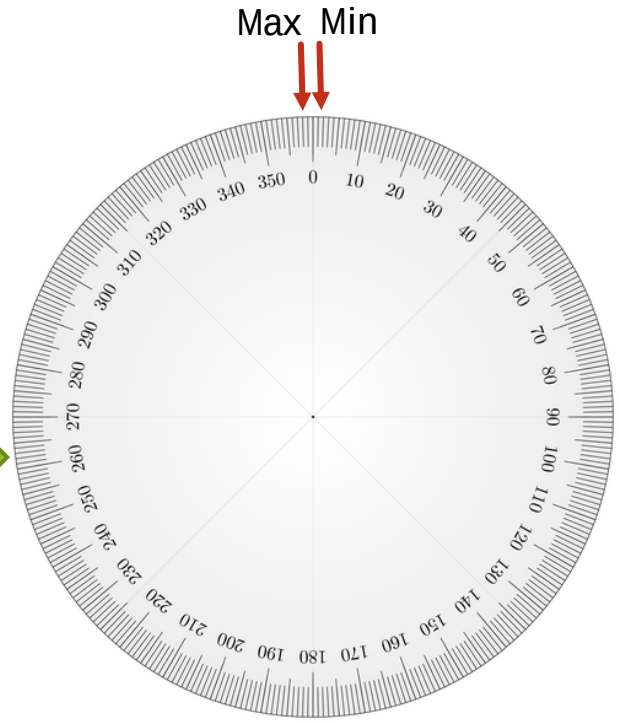
How to Figure out Average Wind Direction with a Kestrel 5000 Series Unit

Kestrel®
Weather & Environmental Meters
by NK

Kestrel customers may ask why they cannot use the Min/Max/Avg function on the Direction screen of the Kestrel.

It is easier to understand the Minimum and Maximum functions. If we look at a standard compass directions, it is pretty obvious that a “max” of 359 is almost identical to a “min” of 0 or 1.

So this calculation is pretty meaningless.



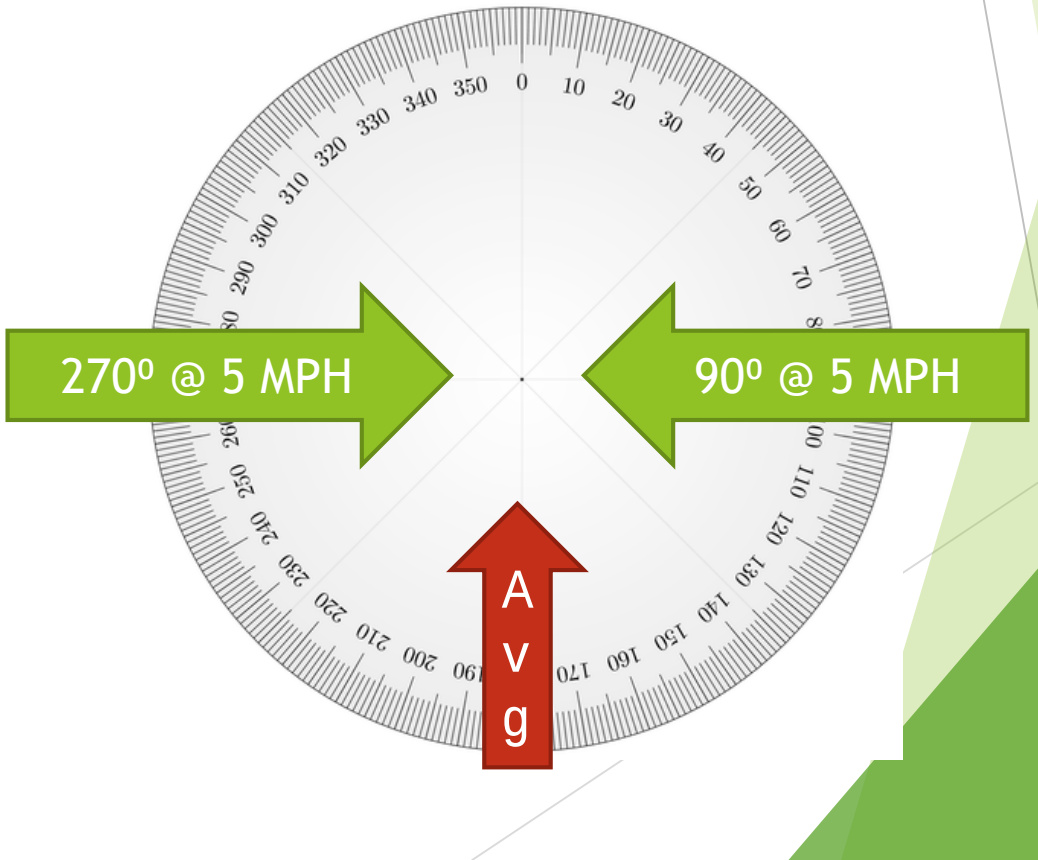
But what about finding out the average directional value, or more commonly how to find out the Average Wind Direction?

Typical averaging is done by summing up the values and dividing by the number of values. This does not work with average wind direction however as you are using polar coordinates.

For example, suppose you had two winds of equal magnitude blowing from the complete opposite directions during a certain time as shown.

Typical averaging would give you an average wind direction of 180 degrees (270 + 90) / 2)) = 180

This is obviously incorrect as we know the wind never blew from the South during this time.

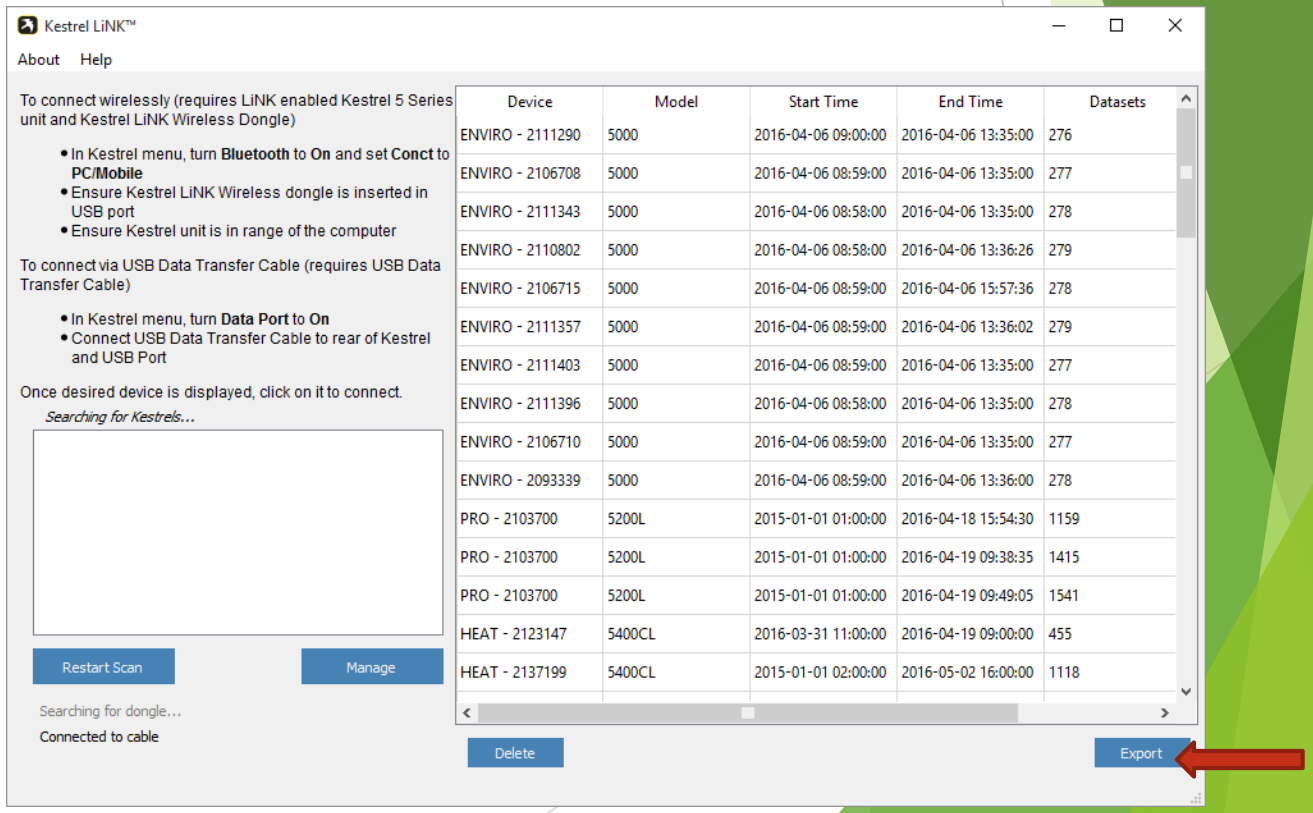


So how to go about finding the average wind direction then?

The answer is by using a Mean of Circular Quantities which is essentially doing vector mathematics.

NK has developed an Excel Spreadsheet Template that can help users figure out their average wind direction during a specific set of time from the exported CSV file.

The first step would be to upload your data and then export the file as a CSV file through one of our Kestrel LiNK apps.



Device	Model	Start Time	End Time	Datasets
ENVIRO - 2111290	5000	2016-04-06 09:00:00	2016-04-06 13:35:00	276
ENVIRO - 2106708	5000	2016-04-06 08:59:00	2016-04-06 13:35:00	277
ENVIRO - 2111343	5000	2016-04-06 08:58:00	2016-04-06 13:35:00	278
ENVIRO - 2110802	5000	2016-04-06 08:58:00	2016-04-06 13:36:26	279
ENVIRO - 2106715	5000	2016-04-06 08:59:00	2016-04-06 15:57:36	278
ENVIRO - 2111357	5000	2016-04-06 08:59:00	2016-04-06 13:36:02	279
ENVIRO - 2111403	5000	2016-04-06 08:59:00	2016-04-06 13:35:00	277
ENVIRO - 2111396	5000	2016-04-06 08:58:00	2016-04-06 13:35:00	278
ENVIRO - 2106710	5000	2016-04-06 08:59:00	2016-04-06 13:35:00	277
ENVIRO - 2093339	5000	2016-04-06 08:59:00	2016-04-06 13:36:00	278
PRO - 2103700	5200L	2015-01-01 01:00:00	2016-04-18 15:54:30	1159
PRO - 2103700	5200L	2015-01-01 01:00:00	2016-04-19 09:38:35	1415
PRO - 2103700	5200L	2015-01-01 01:00:00	2016-04-19 09:49:05	1541
HEAT - 2123147	5400CL	2016-03-31 11:00:00	2016-04-19 09:00:00	455
HEAT - 2137199	5400CL	2015-01-01 02:00:00	2016-05-02 16:00:00	1118

CSV File

Device Name	HEAT - 2169248																			
Device Model	KESTREL_5400CL																			
Serial Number	2169248																			
FORMATTED DATE_TIME	Crosswinc	Globe Ten	Wind Chil	Density Al	Station Pr	Psychro W	Natural W	TWL	Barometri	Headwinc	Altitude	Wind Spe	WBGT	Dew Poin	Relative H	Direction	Heat Stres	Direction	Temperature	
YYYY-MM-DD HH:MM:SS	mph	Â°F	Â°F	ft	inHg	Â°F	Â°F	w/m^2	inHg	mph	ft	mph	Â°F	Â°F	%	Â°	Â°F	Â°	Â°F	
7/12/2017 15:42	0	80	86.4	2,287	29.79	78.4	68.2	205	29.79	0	112	0	71.2	75.8	70.7	155	97.9	155	86.4	
7/12/2017 15:42	0	81.3	86.2	2,270	29.79	78.3	68.2	201.8	29.79	0	115	0	71.4	75.5	70.4	18	97.2	18	86.3	
7/12/2017 15:42	0	82.4	86	2,257	29.79	77.7	70	199.4	29.79	0	116	0	72.9	74.9	69.2	18	96.3	19	86.1	
7/12/2017 15:42	0	84.1	86	2,257	29.79	77.5	70.2	195.9	29.79	0	115	0	73.4	74.6	68.5	18	96.1	18	86.2	
7/12/2017 15:43	0	85.7	86.2	2,257	29.79	77.5	70.6	191.4	29.79	0	115	0	74	74.4	68	98	96.3	98	86.3	
7/12/2017 15:43	0	87	87.4	2,335	29.8	78.4	71	187.3	29.8	0	112	0	74.6	75.2	67.2	98	98.8	98	87.4	
7/12/2017 15:43	0	88.7	88.2	2,385	29.8	78.8	71.5	183	29.8	0	112	0	75.3	75.6	66.4	158	100	158	88.2	
7/12/2017 15:43	0	90.3	88.2	2,390	29.79	78.6	71.7	179	29.79	0	112	0	75.8	75.1	65.2	153	99.5	153	88.3	
7/12/2017 15:43	0.5	90	88.3	2,393	29.8	78.4	74.2	170.6	29.8	1.7	108	1.8	78	74.8	64.1	342	99.5	343	88.5	
7/12/2017 15:43	0.9	89.6	88.3	2,393	29.8	78.4	75.7	159.8	29.8	-1.1	112	1.4	79.3	74.8	64.2	228	99.5	229	88.5	
7/12/2017 15:44	0	90.9	88.3	2,395	29.79	78.1	76.2	154.4	29.79	0	112	0	80.1	74.5	63.6	189	99.3	190	88.4	
7/12/2017 15:44	0	92.5	88.3	2,388	29.8	77.9	76.2	150.4	29.8	0	112	0	80.4	74.2	62.8	189	99.3	189	88.5	
7/12/2017 15:44	0	93.5	88	2,353	29.8	77.4	78.6	144.7	29.8	0	112	0	82.4	73.8	62.9	165	98.1	166	88	
7/12/2017 15:44	0	94.9	88	2,358	29.79	77.2	78.6	142.4	29.79	0	112	0	82.6	73.5	62.1	165	97.7	166	88.1	
7/12/2017 15:44	0	96.2	88.3	2,370	29.8	77.4	79	138.6	29.8	0	112	0	83.1	73.4	61.5	165	98.4	166	88.3	
7/12/2017 15:44	0	97.3	88.2	2,368	29.79	77.2	79	136.1	29.79	0	112	0	83.4	73.1	60.9	166	97.5	166	88.3	
7/12/2017 15:45	0	98.2	88	2,337	29.79	76.6	79.2	133.9	29.79	0	112	0	83.7	72.5	60.3	166	96.8	166	88	
7/12/2017 15:45	0	98.7	88.2	2,353	29.79	76.6	80.1	129.1	29.79	0	115	0	84.5	72.6	60	165	97	166	88.2	
7/12/2017 15:45	0	99.5	88.3	2,368	29.79	76.8	80.2	126.9	29.79	0	115	0	84.8	72.5	59.6	121	97.3	122	88.4	
7/12/2017 15:45	2.6	100.3	88.2	2,358	29.79	76.6	80.4	124.5	29.79	1.4	115	3	85.1	72.3	59.2	42	96.8	43	88.3	
7/12/2017 15:45	2	101	88	2,340	29.79	76.5	80.6	122.4	29.79	0.8	115									
7/12/2017 15:45	0	101.6	87.6	2,315	29.79	76.3	80.8	120.9	29.79	0	116									
7/12/2017 15:46	0	102.3	88.2	2,363	29.79	76.8	81	118.1	29.79	0	116									
7/12/2017 15:46	0	102.9	88.3	2,385	29.79	77.2	81.3	115.5	29.79	0	116									
7/12/2017 15:46	0	103.3	88.3	2,393	29.79	77.5	81.6	112.8	29.79	0	120									
7/12/2017 15:46	0	103.9	89.1	2,4[illegible]	29.79	78.1	81.6	111.9	29.79	0	116									
7/12/2017 15:46	0	104.5	89.8	2,483	29.79	78.4	81.6	111.1	29.79	0	116									
7/12/2017 15:46	0	105.2	90	2,498	29.79	78.3	81.5	110.3	29.79	0	116									
7/12/2017 15:47	0	105.8	90.1	2,505	29.79	78.3	81.5	109.6	29.79	0	116									
7/12/2017 15:47	0	106.1	89.1	2,418	29.79	77.2	81.6	108.1	29.79	0	116									
7/12/2017 15:47	0	106.6	88.5	2,375	29.79	76.8	81.9	105.8	29.79	0	115									
7/12/2017 15:47	0	106.9	88.9	2,410	29.79	77.2	82	104.8	29.79	0	115									
7/12/2017 15:47	0	107.3	89.4	2,450	29.79	77.5	81.7	105.9	29.79	0	115									
[illegible]	0	107.4	90	2,478	29.79	77.7	81.7	105.7	29.79	0	115									

HEAT - 2169248

Ready

Wind Speed

Direction

Date

Open up the CSV file and the Wind Direction Template.

Kestrel Wind Rose and Wind Average

Time/Date	Wind Direction	Wind Speed
YYYY-MM-DD HH:MM:SS	Â°	mph
7/12/2017 15:4	155	0
7/12/2017 15:4	18	0
7/12/2017 15:4	18	0
7/12/2017 15:4	19	0
7/12/2017 15:4	98	0
7/12/2017 15:4	98	0
7/12/2017 15:4	158	0
7/12/2017 15:4	153	0
7/12/2017 15:4	342	1.8
7/12/2017 15:4	228	1.4
7/12/2017 15:4	189	0
7/12/2017 15:4	189	0
7/12/2017 15:4	165	0
7/12/2017 15:4	166	0
7/12/2017 15:4	165	0
7/12/2017 15:4	166	0
7/12/2017 15:4	166	0
7/12/2017 15:4	165	0
7/12/2017 15:4	121	0
7/12/2017 15:4	42	3
7/12/2017 15:4	291	2.1
7/12/2017 15:4	289	0
7/12/2017 15:4	289	0
7/12/2017 15:4	289	0
7/12/2017 15:4	289	0
7/12/2017 15:4	291	0
7/12/2017 15:4	291	0
7/12/2017 15:4	291	0
7/12/2017 15:4	290	0
7/12/2017 15:4	289	0
7/12/2017 15:4	289	0
7/12/2017 15:4	289	0
7/12/2017 15:4	288	0
7/12/2017 15:4	277	0
7/12/2017 15:4	277	0
7/12/2017 15:4	277	0
7/12/2017 15:4	277	0
7/12/2017 15:4	277	0
7/12/2017 15:4	277	0
7/12/2017 15:4	277	0
7/12/2017 15:4	277	0

Copy & Paste Data Log Wind Data Here
(Date/Time in column A, Direction in column B, Wind Speed in column C)

Simple Wind Average

Ave Wind Speed (all values, including 0 wind instanc	0.0	mph
Ave Wind Speed (not including instances of 0 wind)	1.8	mph
Ave Wind Direction	91	Deg

Note - 360=N, 90=E, 180=S, 270=W

Wind Rose User Input Value

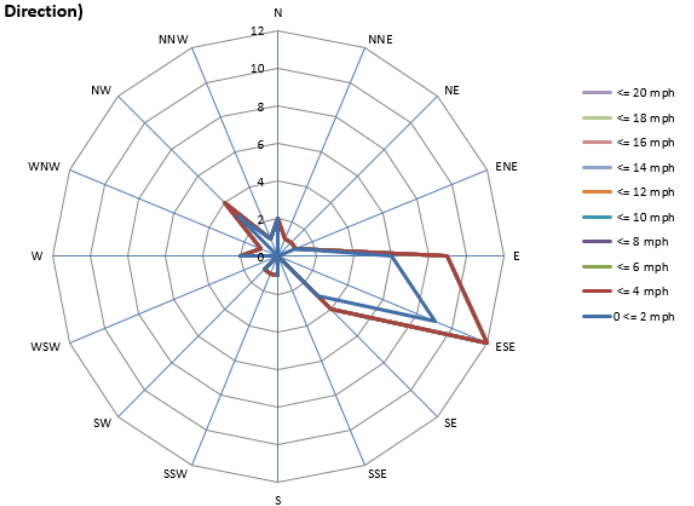
Wind Speed Increment	2	mph

Note - This graph is currently set up for 20,000 data points. If your data set is larger, make sure to adjust cell formulas below.
Note - Column A of data log shows True north. If Magnetic North is required, find that column in data log and copy it into column B.

Wind Direction Template

You can set the wind speed increments here

Kestrel Wind Rose
(Instances of Wind Speed In a Given Direction)

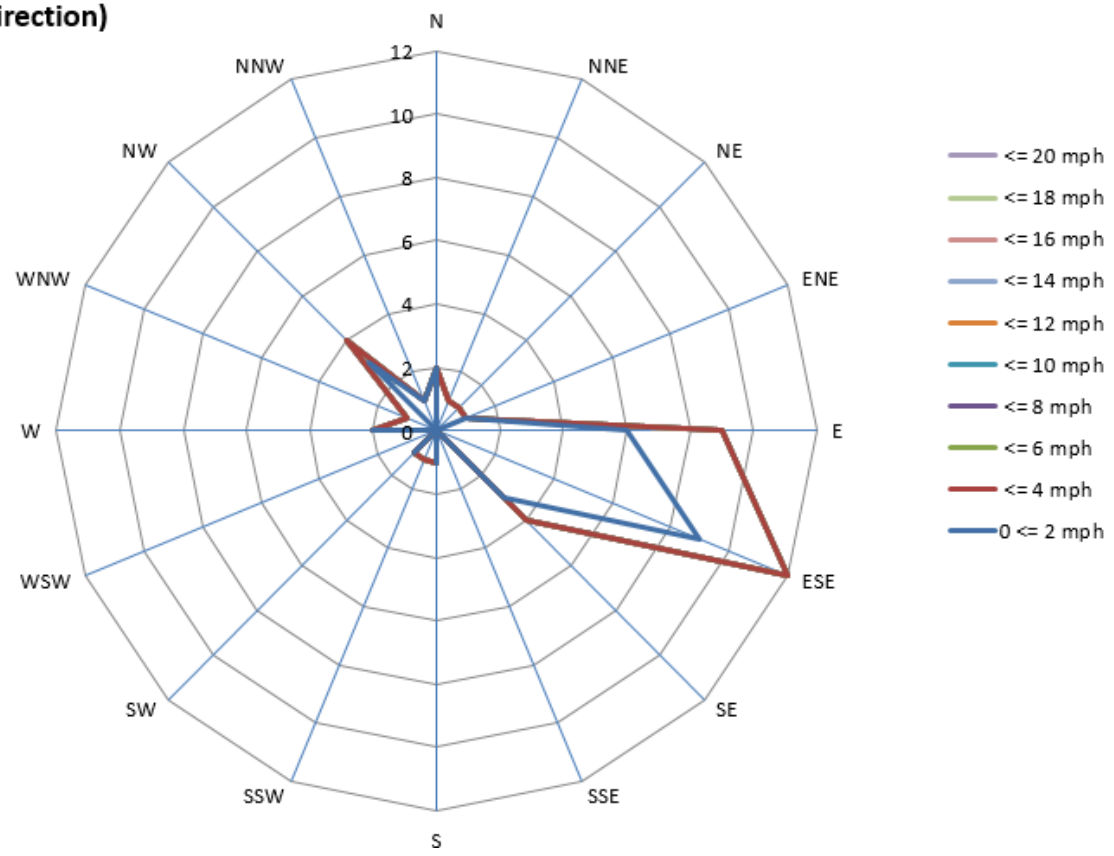


Locate the Time/Date, Wind Speed and Direction Columns.

Cut and paste them into the template in the appropriate columns as shown.

Kestrel Wind Rose

(Instances of Wind Speed In a Given Direction)



Each line represents the amount of times a wind occurred in that direction.

For instance there were 12 times the wind blew in the ESE direction.

The color of the line represents the intensity of the wind.

However it is very important to note that the wind DID NOT blow 12 times at 4 mph! The wind blew 9 times in that direction at 2 mph and then an addition 3 more times at 4 mph.

Key

Deg.	Direction
0	N
22.5	NNE
45	NE
67.5	ENE
90	E
112.5	ESE
135	SE
157.5	SSE
180	S
202.5	SSW
225	SW
247.5	WSW
270	W
292.5	WNW
315	NW
337.5	NNW

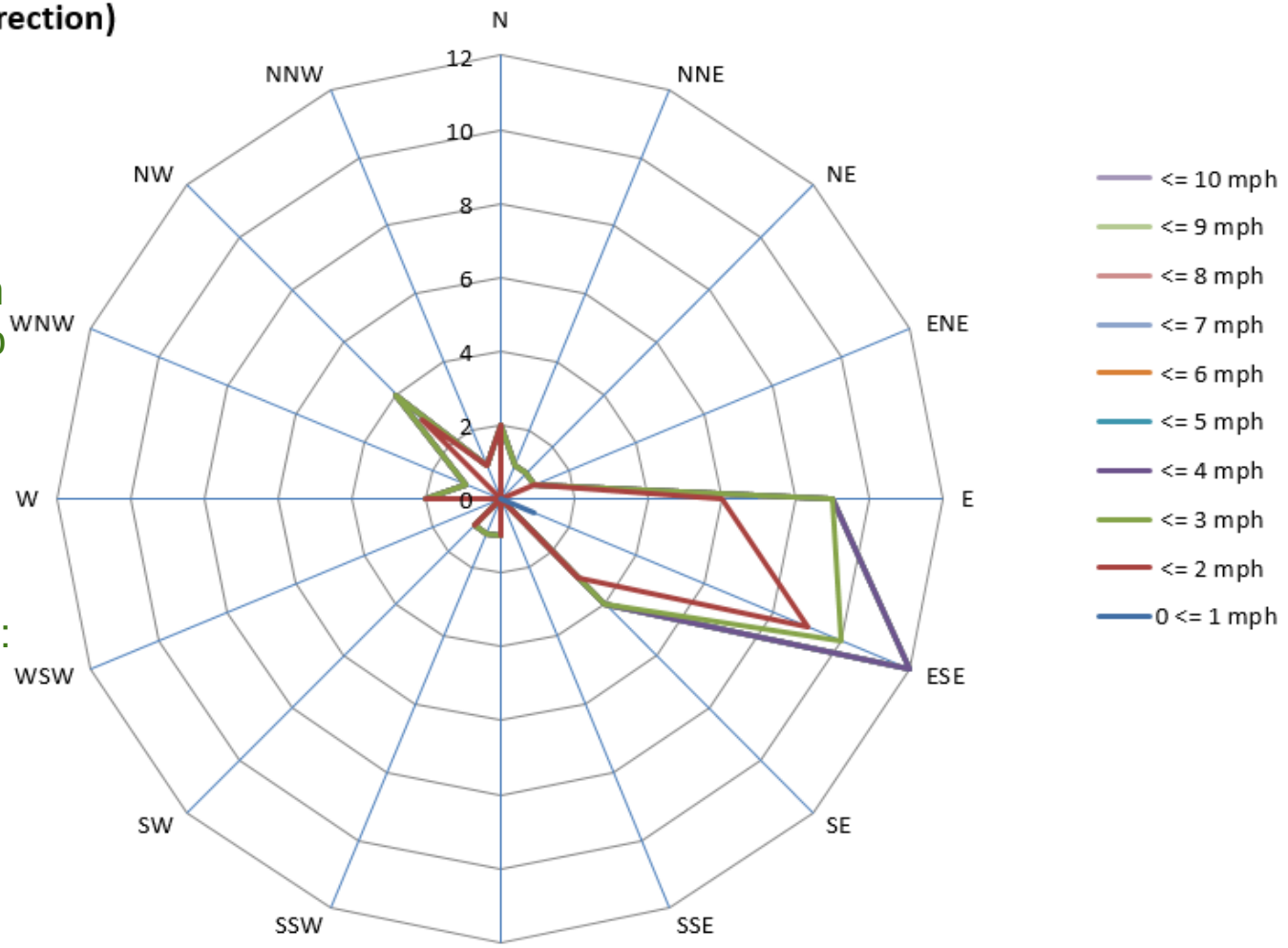
Wind Rose User Input Value		
Wind Speed Increment	1	mph

Note - This graph is currently set up for 20,000 data points. If your data set is larger, make sure to adjust cell formulas below.

Note - Column A of data log shows True north. If Magnetic North is required, find that column in data log and copy it into column B.

Kestrel Wind Rose

(Instances of Wind Speed In a Given Direction)



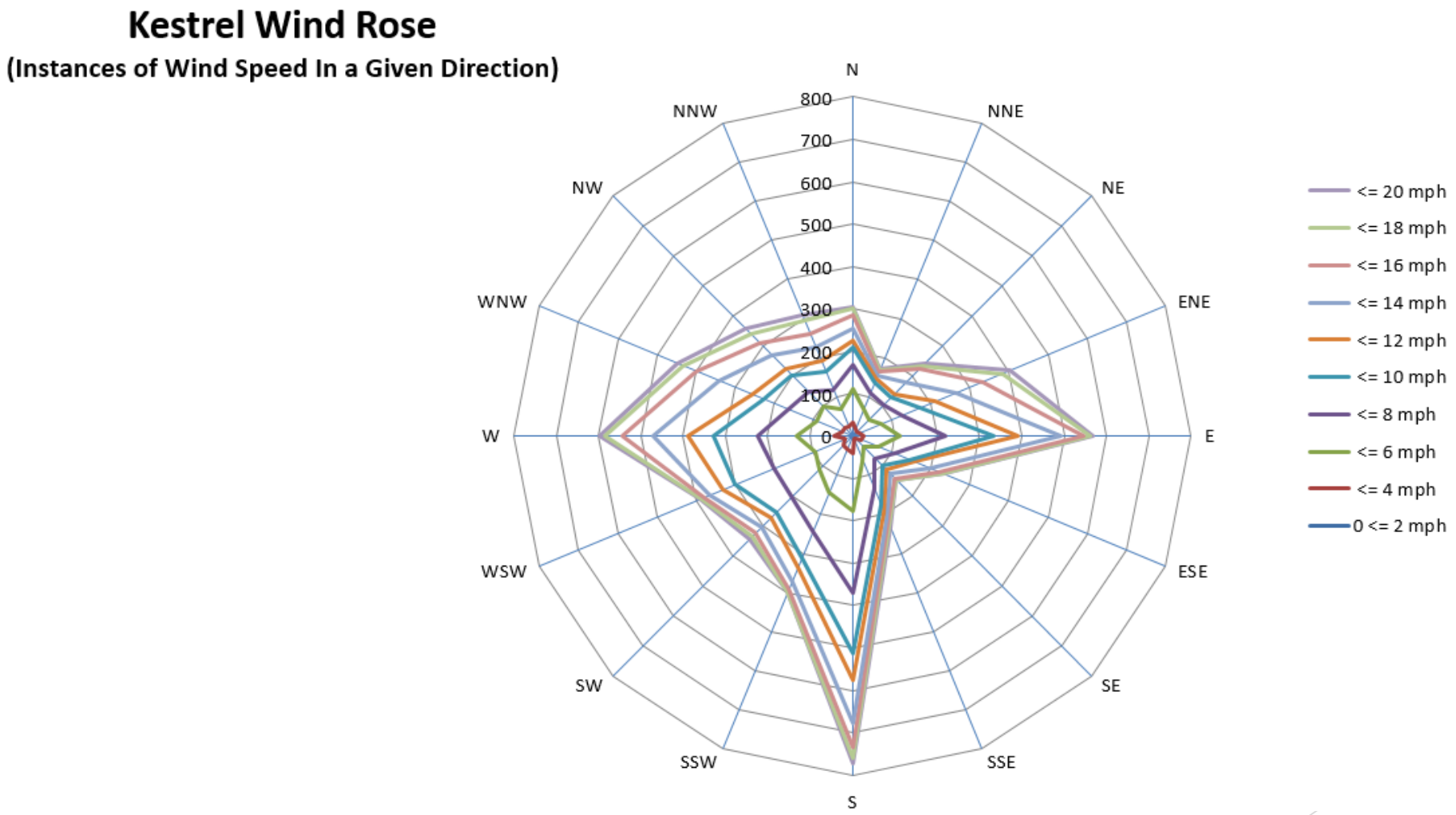
If we want greater precision, we can change the Wind Speed Increment to 1.

Now the lines are broken down by 1 mph increments.

In this case we have in ESE direction:

- 1 instance of a 0-1 mph
- 8 instances of a 1-2 mph wind
- 1 instance of a 2-3 mph wind
- 2 instances of a 3-4 mph wind

Example showing hourly Wind Speed and direction from Atlantic City, NJ (1/1/2017 through 7/18/17)



Kestrel Wind Rose and Wind Average

e Data Log Wind Data Here

n column A, Direction in column B, Wind Speed in column C)

Simple Wind Average

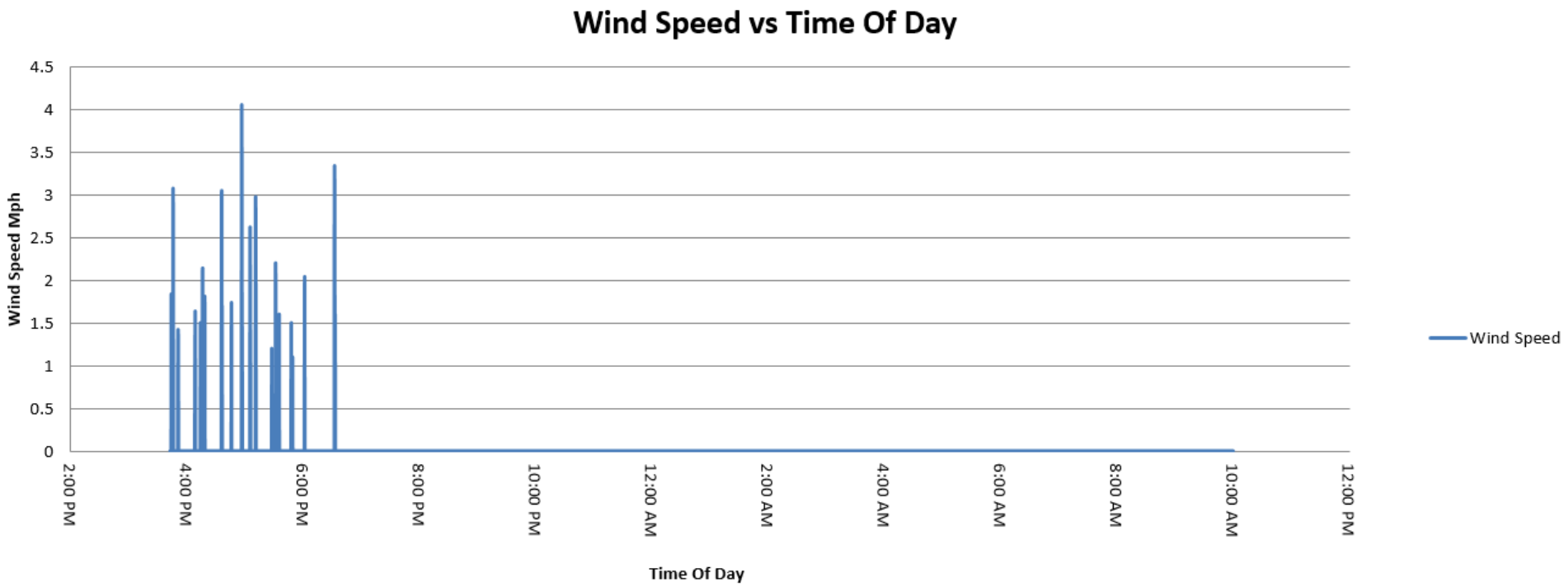
Ave Wind Speed (all values, including 0 wind instances)	0.0	mph
Ave Wind Speed (not including instances of 0 wind)	1.8	mph
Ave Wind Direction	91	Deg

Note - 360=N, 90=E, 180=S, 270=W

The other calculations show

- Ave Wind Speed (with 0 wind values)
- Ave Wind Speed (w/o 0 wind values)
- Ave Wind Direction (does not count 0 wind values)

And also a graph that shows the wind speed vs the time of day.



For more information email techsupport@nkhome.com