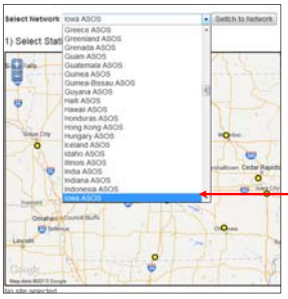
Wind Data

Wind Power Management

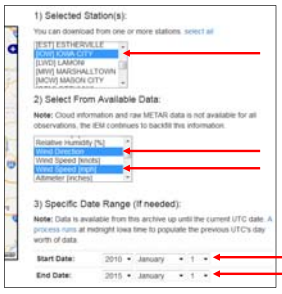
THE UNIVERSITY OF IOWA

Finding Historical Wind Data



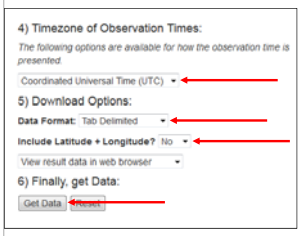
- Go to: http://mesonet.agron.iastate.edu/request/download.phtml
- Select the location of the automated surface observing system (ASOS) you are interested in

Finding Historical Wind Data



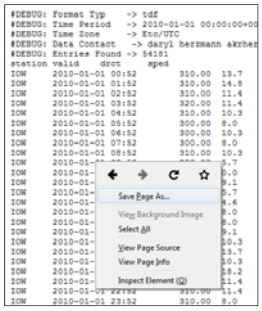
- Select the station or city you are interested in
- Select the weather data you are interested in (hold alt while clicking to select multiple parameters)
- Select the date range you want data for (choose several years if you want to capture the inter-annual wind patterns)

Finding Historical Wind Data



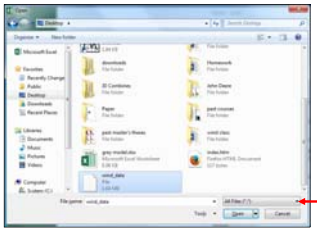
- Select a time zone (the default UTC time is fine for most applications)
- Select the file format (Microsoft Excel can open both tab and comma delimited files)
- If using a GIS software such as Openwind, include latitude and longitude. We don't need it today.
- Get data

Finding Historical Wind Data



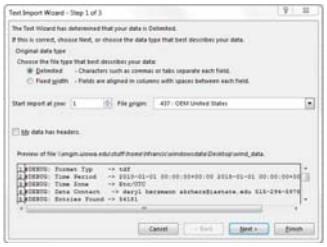
- Right click anywhere on the page and select “Save Page As…”
- Save as .txt file
- Select file name and location
- Select “Save”

Wind Distribution in Excel



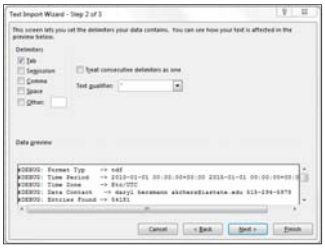
- Open Microsoft Excel
- Select “File”->”Open”
- Change file type to “All Files”
- Locate the saved file and select “Open”

Wind Distribution in Excel



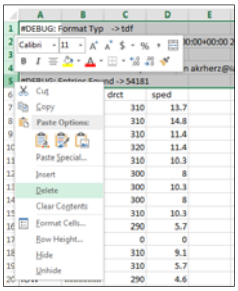
- Verify that “Delimited” is selected
- Click “Next”

Wind Distribution in Excel



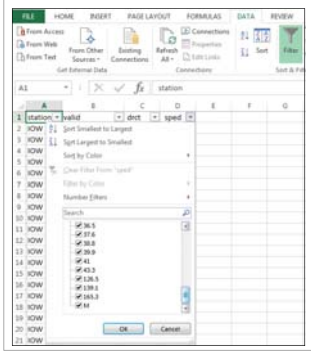
- Verify that the correct delimiter is selected. If “Tab Delimited” data was obtained from the Mesonet website, select “Tab”
- Click “Finish”

Wind Distribution in Excel



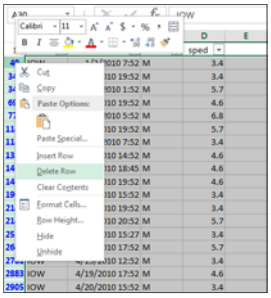
- The first five rows of data contain header information and are not needed. Highlight the first five rows, right click, and select delete.

Wind Distribution in Excel



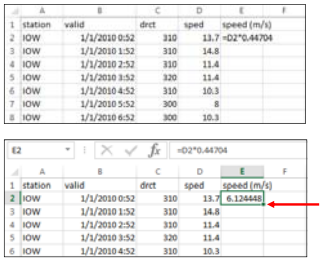
- Real data often contains errors
- Go to the "DATA" tab and select "Filter" to see all values in each column
- The "sped" column contains several errors including values of 165.3 mph
- The value "M" is likely a default error output for the anemometer
- "M" occurs in both the direction and speed columns

Wind Distribution in Excel



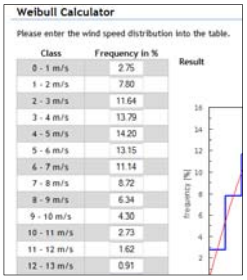
- Use the "Filter" feature to select only values of "M" in column "drct"
- Highlight all rows containing "M"
- Right click and select "Delete Row"
- Use the "Filter" feature to show all values
- Repeat the process for column "sped"
- The remaining data should no longer contain speed or direction values of "M"

Wind Distribution in Excel



- The data was collected hourly over a five year period
- Let's create a histogram of the data
- First, convert the wind speed from mph to m/s using a conversion factor of 0.44704
- Double click the green square to compute the conversion for all rows

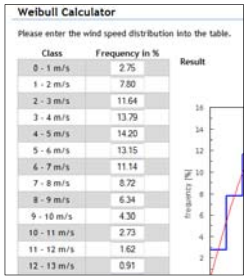
Wind Distribution in Excel



- The Weibull calculator requires frequency in bins of 1 m/s at:
- Use excel to determine the inter-annual frequency for each wind speed range

http://www.wind-data.ch/tools/weibull.php?lng=en

Wind Distribution in Excel



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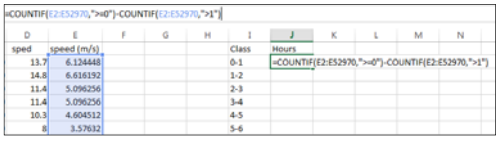
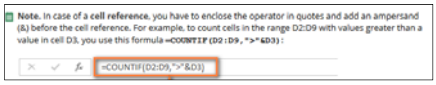
Wind Distribution in Excel



- To accomplish this, use the COUNTIF function
- For a value between 0 and 1, use the following formula: =COUNTIF(E2:E52970,">=0")-COUNTIF(E2:E52970,">1")

Wind Distribution in Excel



- It is possible to save time by using cell references instead of actual numerical values
- If done this way, you can write the equation once and let excel autofill the remaining equations

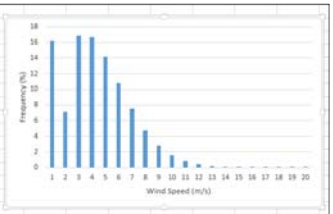
Wind Distribution in Excel

Class	Hours	Frequency
0-1	8590	=(J2/J23)*100
1-2	3779	
2-3	8921	
3-4	8836	
4-5	7507	
5-6	5733	
6-7	3956	
7-8	2493	
8-9	1497	
9-10	813	
10-11	455	
11-12	214	
12-13	100	
13-14	34	
14-15	18	
15-16	5	
16-17	11	
17-18	2	
18-19	1	
19-20	1	
total	52966	

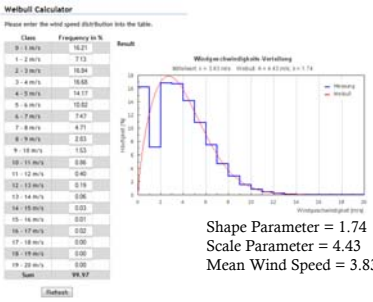
- To determine the frequency, divide the hours for each bin by the total hours and multiply by 100
- Double click the green square to autofill the rest of the values
- "J23" keeps the total hours (denominator) constant while the numerator changes for each bin

Wind Distribution in Excel

Class	Hours	Frequency
0-1	8590	16.217951
1-2	3779	7.1347657
2-3	8921	16.84288
3-4	8836	16.6824
4-5	7507	14.173243
5-6	5733	10.823925
6-7	3956	7.4689423
7-8	2493	4.706793
8-9	1497	2.8263414
9-10	813	1.5349469
10-11	455	0.8590416
11-12	214	0.4040328
12-13	100	0.1888004
13-14	34	0.0641921
14-15	18	0.0339841
15-16	5	0.00944
16-17	11	0.020768
17-18	2	0.003776
18-19	1	0.001888
19-20	1	0.001888
total	52966	100



Wind Distribution Online

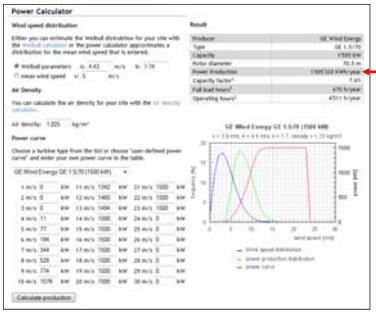


Note: You may get slightly different values depending on which outliers were removed.

Shape Parameter = 1.74
Scale Parameter = 4.43
Mean Wind Speed = 3.83 m/s

http://www.wind-data.ch/tools/weibull.php?lng=en

Weibull Energy Calculator



http://www.wind-data.ch/tools/powercalc.php?lng=en

Excel Energy Calculators

- An energy estimation can also be made in Excel without fitting the data to a Weibull distribution
- Multiply the frequency at each wind speed by the power produced by a specific turbine at each wind speed by the number of hours in a year
- Sum the total energy at each wind speed to estimate the power produced by a turbine at a location per year
- The estimation will likely be different than the Weibull curve estimation

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Excel Power Calculator

				GE 1.5-70 Wind Turbine		
Class	Hours	Frequency		Wind Speed	Power	Energy
0-1	8590	16.217951		0-1	0	0
1-2	3779	7.1347657		1-2	0	0
2-3	8921	16.84288		2-3	0	0
3-4	8836	16.6824		3-4	11	16085.82
4-5	7507	14.173243		4-5	77	95664.77
5-6	5733	10.823925		5-6	194	184068.1
6-7	3956	7.4689423		6-7	344	225221.4
7-8	2493	4.706793		7-8	528	217846.7
8-9	1497	2.8263414		8-9	774	191759.8
9-10	813	1.5349469		9-10	1079	145180
10-11	455	0.8590416		10-11	1342	101055.2
11-12	214	0.4040328		11-12	1460	51708.45
12-13	100	0.1888004		12-13	1494	24725.52
13-14	34	0.0641921		13-14	1500	8440.439
14-15	18	0.0339841		14-15	1500	4468.468
15-16	5	0.00944		15-16	1500	1241.241
16-17	11	0.020768		16-17	1500	2730.73
17-18	2	0.003776		17-18	1500	496.4964
18-19	1	0.001888		18-19	1500	248.2482
19-20	1	0.001888		19-20	1500	248.2482
total	52966	100				1271190 kWh/year

Note: You may get slightly different values depending on which outliers were removed.