Generating Synthetic Wind Data

When you have no access to measured wind speed data, you can create hourly wind speed data using HOMER's synthetic wind speed data generation algorithm. This algorithm requires you to enter a few parameters, from which it generates artificial but statistically reasonable hourly wind speed data. The algorithm produces data that mimic the characteristics of real wind speed, including strong and sustained gusts, long lulls between windy periods, and seasonal and diurnal patterns.

Parameters

To generate synthetic hourly wind speed data, go to the Wind Resources Inputs window and choose Enter monthly averages. You must enter the twelve monthly average wind speeds, as well as the following four parameters:

Parameter	Description
Weibull *k*	Reflects the breadth of the distribution of wind speeds over the year.
Autocorrelation factor	Reflects how strongly the wind speed in one hour tends to depend on the wind speed in the previous hour.
Diurnal pattern strength	Reflects how strongly the wind speed depends on the time of day.
Hour of peak wind speed	The hour of day that tends to be windiest on average.

One can estimate the value of each of these parameters without detailed knowledge of the wind data in a particular location. The articles on each of the parameters give guidance for doing so.

Algorithm

HOMER follows a five-step process to synthesize one year of hourly wind speed data:

Step 1

In the first step of the algorithm, HOMER generates a sequence of 8,760 autocorrelated numbers (one for each hour of the year) using the first-order autoregressive model:

$$z_t = a \cdot z_{t-1} + f(t)$$

where:

z_t = the value in time step i

z_{t-1} = the value in time step i-1

a = the autoregressive parameter

$f(t)$ = a 'white noise' function that returns a random number drawn from a normal distribution with mean of zero and a standard deviation of 1

HOMER sets the autoregressive parameter equal to the autocorrelation coefficient. The resulting sequence of numbers conforms to a normal distribution with a mean of zero and a standard deviation of 1.

Step 2

In the second step of the algorithm, HOMER creates a sequence of 8,760 numbers by piecing together the desired average diurnal wind speed profile, repeated every day. Because the average wind speed varies by month, the average diurnal wind speed profile is scaled to a different value each month, but within each month the diurnal pattern simply repeats over and over.

Step 3

In the third step, HOMER performs a probability transformation on the sequence of numbers generated in Step 2 so that it conforms to the same normal distribution as the sequence generated in Step 1.

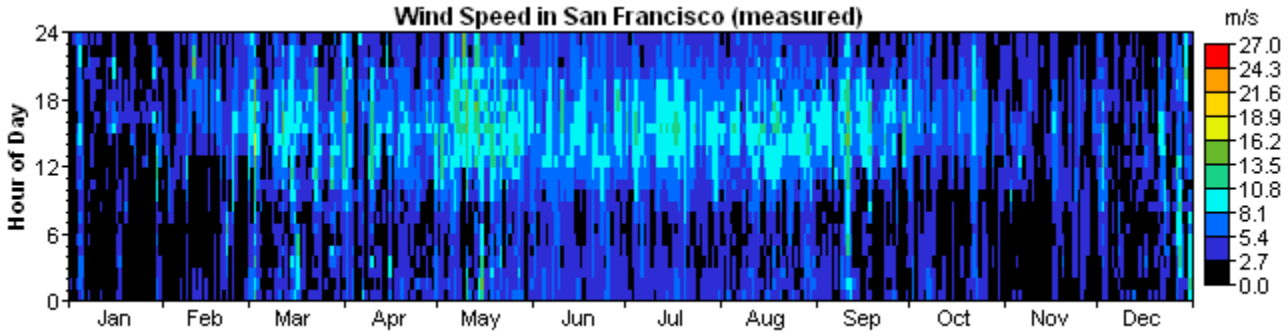
Step 4

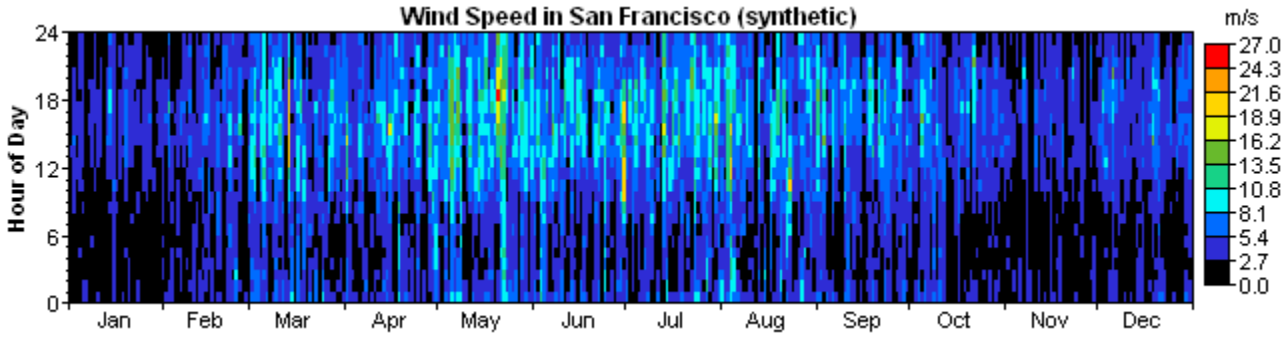
In the fourth step, HOMER adds the sequence generated in Step 3 to the sequence generated in Step 1. The resulting sequence conforms to a normal distribution, but exhibits the desired degree of autocorrelation.

Step 5

In the fifth and final step, HOMER performs a probability transformation on the sequence generated in Step 4 to make it conform to the desired Weibull distribution.

The two **DMaps** below demonstrate the results of the synthetic wind data generation algorithm. The first shows the measured wind speed data for San Francisco, California from the TMY2 data set. The second shows the synthetic wind speed data that HOMER generated from the monthly average wind speeds and the four wind data parameters measured from the real data:





For assistance in finding wind data, see **Finding data to run HOMER**

See also

Generating synthetic solar data
Generating synthetic load data
Finding data to run HOMER

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