Assignment 1 (Mean wind speed and the Weibull distribution)**.**

You will investigate two different data sets of wind measurements, within the context of probability distributions and statistics. These data sets are:

1. A couple decades of data, including wind speed and direction from a 70 m-tall mast on the island of Sprogø (Great Belt Bridge), Denmark—
   - the file is named `sprogo_1.zip`, with (4) data columns of timestamp, wind speed at 70m, wind direction at 67.5m, and wind direction at 70m ;
   - invalid data are indicated by an 'error flag' value of `999`, `99.99`, or similar ;
   - each Sprogø datapoint is a 10-minute average.
2. A few hours data of turbulence measurements from DTU's Høvsøre turbine test center on the west coast of Denmark—
   - the file is named `hovsore_1.zip`, with (2) data columns being timestamp and streamwise wind velocity component;
   - invalid data are indicated by an error 'flag' of `99.99` or similar ;
   - the data are sampled at 20 Hz .

Inspect the time-series and do the following tasks:

1. Find the mean and standard deviation of wind speed from each data set.
2. Appropriately calculate the mean and standard deviation of wind direction for the Sprogø data, over the entire period.
3. Plot the probability density function (PDF) of speed for each data set.
4. Plot the cumulative distribution function (CDF) of speed for each data set.
5. For the turbulence data, re-plot the PDF using normalized variables, and overplot the *theoretical* (ideal) PDF.
6. For Sprogø data set, estimate the Webull-A and k parameters, using two different methods:
   - based on the first and second (non-central) moments, μ and m_2;
   - based on the third moment (m_3) and CDF-at-mean, $F(\mu)$.
7. Based on the estimated Weibull parameters, plot the theoretical Weibull-PDFs, together with the Sprogø data's PDF from task 3 above.
8. Investigate the Sprogø data conditioned on wind direction: divide the data into 12 directional sectors (30° wide) and centered on 0°, 30°, ...330° (be careful around 0°). For each sector, calculate A and k based on one of the two methods discussed in task 6 above, and compare the fitted Weibull-PDFs with the measured data.
9. What are the seasonal and daily trends in the Sprogø data? Answer this by calculating appropriate statistics, and produce meaningful plots.