Flow of Program

1) Calculate the atmospheric density

User Inputs: gauge pressure (psig) (shows pressure inside tunnel), temp inside tunnel (K)
Calculates: atmospheric density (kg/m^3)

The air density (ρ) is calculated using the following equation:

$$\rho = \frac{P}{RT}$$

where P is the absolute pressure in Pa, T is the temperature in K, and R is the dry air constant [R=287.04 J/(Kg*K)]. The gauge pressure is an average of the pressures recorded at the beginning and at the end of the experiment.

2) Input the voltage data

User Inputs: the name of the CSV file with the voltage and time information
Calculates: saves the CSV file in program

3) Determine the curve needed to convert voltage to dynamic pressure

User Inputs: None, will use the gauge pressure entered in step 1
Calculates: slope and y-intercept of the curve that will be used to convert voltage to pressure

The manufacturer of the transducer (Tavis) provided calibration data to convert voltage to dynamic pressure. These curves were produced using the manufacturer's calibration for Tavis 1 and Tavis 2. The slope and y-intercept were previously found for each static pressure (14.7-300 psia) and will already be stored in the program.

In order to get the correct calibration curve for the static pressure used in the experiment, you will have to interpolate between two of these curves. An If statement will be used to determine the correct two curves to interpolate between based on the gauge pressure entered in step 1.

4) Convert the voltage to dynamic pressure (psid)

User Inputs: None, will use y-int and slope calculated in step 3
Calculates: dynamic pressure from voltages in Pa

5) Convert dynamic pressure to freestream wind velocity

User Inputs: None, will use dynamic pressure calculated in step 4
Calculates: freestream wind velocity from dynamic pressure

Use the following formula to convert dynamic pressure (in Pa), to freestream wind velocity [$u(z)$ in units of (m/s)]. Use the air density calculated in step 1.

$$u(z) = \sqrt{\frac{2P_{dyn}}{\rho}}$$

Note that P_{dyn} is the dynamic pressure of the gas and is a function of z (wind speed height).

6) Convert dynamic pressure to freestream wind velocity

User Inputs: None, will use free stream wind velocities found in Step 5
Calculates: smooths the data over 2 second interval using a running average

7) Determine the seconds from the start of the experiment

User Inputs: None
Calculates: seconds since start of experiment

The seconds from the start of the experiment are determined using the date/time from the transducer output. Subtract the time you're interested in from the start time of experiment. Multiply it by the number of seconds in a day (86, 400 seconds).

8) Find wind speed

User Inputs: Enter the time threshold speed was observed to occur at
Outputs: wind speed at threshold speed

Will look up the time that threshold occurred and find the corresponding threshold speed.