Math 324  Problem 14 Solution  25 March 2004

Use Bernoulli's theorem

\[ \frac{1}{2} \rho V_A^2 + p A_A + p_A = \frac{1}{2} \rho V_B^2 + p A_B + p_B \]

to estimate the force the wind exerts on you.

Assume the streamline is horizontal, so that \( p A_A - p A_B \) (gravitational potential energy unchanged) and assume \( v_B = 0 \) (wind comes to a stop on you).

Then \( \frac{p_B - p_A}{2} = \frac{1}{2} \rho V_A^2 \).

Also, the force on you is \( p_A - p_A \) where \( A \) is your (frontal) surface area, and \( p_A \) = atmospheric pressure is also the pressure on your back, in the lee of the wind. Since \( V_A = 25 \text{ mph} = 9 \text{ m/s} \) and \( \rho = 1 \text{ kg/m}^3 \), we have \( \frac{p_B - p_A}{2} = 40 \text{ N/m}^2 \).

If (my) frontal area is about 0.5 \text{ m}^2, the net force on me due to pressure (\( p_A \) on the front, \( p_A \) on the back) is about 20 N, which is the weight of about 2 kg, or about 4 pounds. This seems about right in common sense terms.