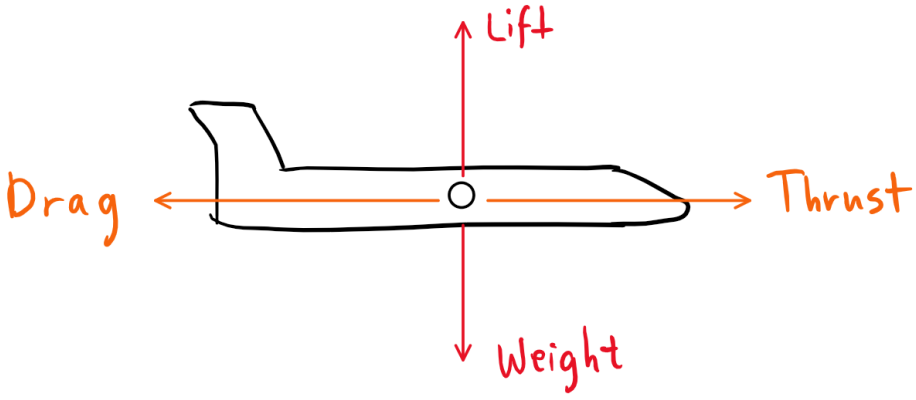
MECH105: Homework 12

For a jet in steady, level flight, thrust balances drag and lift balances weight. Under these conditions, the optimal cruise speed occurs when the *ratio of drag force to velocity is minimized.*



The drag, C_D, can be computed as:

$$C_D = C_{D0} + \frac{{C_L}^2}{\pi * AR}$$

where C_{D0} is the drag coefficient at zero lift, C_L is the lift coefficient, and AR is the aspect ratio.

For steady level flight, the lift coefficient is:

$$C_L = \frac{2W}{\rho v^2 A}$$

where W is the jet's weight (in Newtons), ρ is the air density (kg/m^3), v is the velocity (m/s) and A is the wing planform area (m^2).

The drag force can be computed as:

$$F_D = W\frac{C_D}{C_L}$$

Use these formulas to determine the optimal steady cruise velocity for a 670 kN jet flying 10 km above sea level. Employ the following parameters in your computation:

$A = 150m^2$,$AR = 6.5$,$C_{D0} = 0.018$, and $\rho = 0.413kg/m^3$

For full credit (and this is actually a hint so you're welcome), include a plot of v vs F_D/v for v ranging from 100 to 1000 m/s.