MECH 4420 Homework #2
(Due Monday 2/1/2016 in class)

1) Braking. (These aren't meant to be tricky, so don't over-analyze)

a) Suppose you are traveling at 60mph on the highway and you notice an unexpected road block. If your reaction time is 0.4s, how long do you travel before you begin to brake? If braking follows immediately at 0.9g, how long do you travel before you stop? What if only 0.5g is possible due to road conditions? 0.3g?

b) Assuming the parameters from problem 2, what braking force is required to decelerate the vehicle at 0.5g. Simulate the car braking at 0.5 g and compare the stopping distance to what was predicted in part a. Now add air-drag and rolling resistance – what is the stopping distance (show plots).

c) Federal Motor Vehicle Safety Standard 121 (FMVSS 121), which governs vehicles with air brakes, mandates that a loaded straight truck should be able to stop from 60mph in a distance of 310 feet. To what constant deceleration rate does this correspond? Assume no time delay.

d) Let's say that your car has a cg height of 0.5m, a wheelbase of 2.5m and a 50-50 weight balance between the front and rear. If the tire/road interface has a peak friction coefficient of 0.9, you have no ABS system and you want to avoid locking the wheels, what peak deceleration can you achieve if you have ideal proportioning? If you have no proportioning?

2) Download the braking data from the website. Assume the effective radius of the wheel is 0.35 m.

a) For the first set of data, plot the GPS Velocity and Tire Velocity ("hold on") on the top half of a page ("subplot(2,1,1)"). Plot tire slip vs time on the bottom half of the page ("subplot(2,1,2)"). Any ideas what the "blip" in the data is due to?

b) For the second set of data, plot tire slip vs. time. Then plot the tire slip vs. Force (mass of the car in 1500 kg). Estimate the tire's longitudinal stiffness.