PERFORMANCE AND SAFETY
MUSTANG COBRA VS JEEP GRAND CHEROKEE

Goal: In this project will use data gathered from the hotrod.com and ford.com websites to construct mathematical models used to analyze the acceleration and braking capabilities of both the Mustang Cobra and the Jeep Grand Cherokee. Upon completion of the analysis you will write up a brief report to the consumer for each vehicle based upon your results and observations.

Names and Primary Reponsibilities of Group Members:

Main Computations Analyst:

Geometer:

Recorder/Editor:

Technology Operator:

Development Stage: In this stage your team will develop two models $y_a(t)$ (acceleration model) and $y_b(t)$ (braking model) measuring distance traveled while accelerating and braking based upon the properties of acceleration/deceleration of cars.

1. Brakes generally provide constant **deceleration**, $d\frac{ft}{s^2}$, similar to the way acceleration due to gravity affects a falling object. Use this deceleration function $f(t) = d$ to determine functions $v_b(t)$ and $y_b(t)$ giving models for a vehicle's velocity and distance traveled after t seconds. (Let the variable v_o denote the initial velocity of the vehicle. Note: the initial distance traveled will be zero.)

2. Most vehicles have **acceleration** proportional to the difference between the current velocity and thier maximum velocity, M. In this case the acceleration equation looks like this:

$$\frac{dv}{dt} = k(M - v)$$

   Show by substituting both v_a and $\frac{dv_a}{dt}$ into the above equation that the velocity function $v_a(t) = M - Me^{-kt}$ satisfies this equation.

3. Use the velocity function to determine the corresponding distance function $y_a(t)$. Remember that the initial distance is zero feet.

Record the four functions here:

Distance traveled while accelerating: $y_a(t) =$
Corresponding velocity function: $v_a(t) =$

Distance traveled while braking: $y_b(t) =$
Corresponding velocity function: $v_b(t) =$

Modeling Stage: Led by the **Computations Analyst** in this stage your team will construct the specific models for both braking and acceleration distances for the Mustang Cobra and the Jeep Grand Cherokee using the data given in Table 1.

Table 1 contains acceleration and braking data for the Cobra and for the Grand Cherokee. (Note 60mph is approximately 97ft/s.)

	Acc. from 0 to 60 mph	**Braking from 60mph to 0**	**Max Velocity**
Mustang Cobra	4.4 s	109 ft	150
Jeep Cherokee	5.6 s	136 ft	110

- **Mustang Cobra** Use the appropriate functions above as well as the data for the Mustang to determine the specific models as follows.

  1. Braking distance of the Mustang Cobra: (The time it takes the cobra to reach zero velocity should give a distance of 109 ft. Use this fact to find the needed constant d.)

  2. Accelerating distance of the Mutstang Cobra: (It takes 4.4 second to reach a velocity of 60mph. Use this fact to find the needed constant k.)

- **Jeep Cherokee** Use the appropriate functions above as well as the data for the Cherokee to determine the specific models here.
  1. Braking distance of the Jeep Cherokee:

  2. Accelerating distance of the Jeep Cherokee:

Testing Stage: Okay, time for the team to make comparisons on vehicular performance based upon your models.

1. Which vehicle has better braking distance in an emergency city driving situation, say decelerating on the highway from 60 to 30 when approaching a sudden accident or construction site?

2. Which vehicle would take off faster at a light, say from 0 to 30mph?

3. Which vehicle would win a drag race of 500 feet?

4. For each vehicle, determine a ratio of feet needed to accelerate from 0 to 60mph divided by feet needed to brake from 60mph to 0. Which vehicle has more equally powered acceleration and deceleration capabilities at this speed?

Consumer Report: