



2009 Ford Mustang Performance Test

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Abstract:

Automotive engineers are constantly trying to improve 0-60 mph times in order to make their cars more appealing. A useful mathematic method exists to find this time before actually manufacturing the vehicle. This can save a significant amount of time and money.

Problem statement:

Using a Torque vs. RPM curve of a vehicle of choice, find the time it takes for that vehicle to travel from 0 to 88 feet per second. To find this time, plot a "Force Inverse" vs. Velocity graph and find a Riemann sum approximation of the curve from 0 to 88 feet per second. This value will be the time.

Mathematic approach:

Values seen in Table Gear 1

$$\text{Force} = \frac{\text{Torque} \cdot \text{Drive Ratio} \cdot \text{Ratio for that Gear}}{\text{Tire Radius}}$$

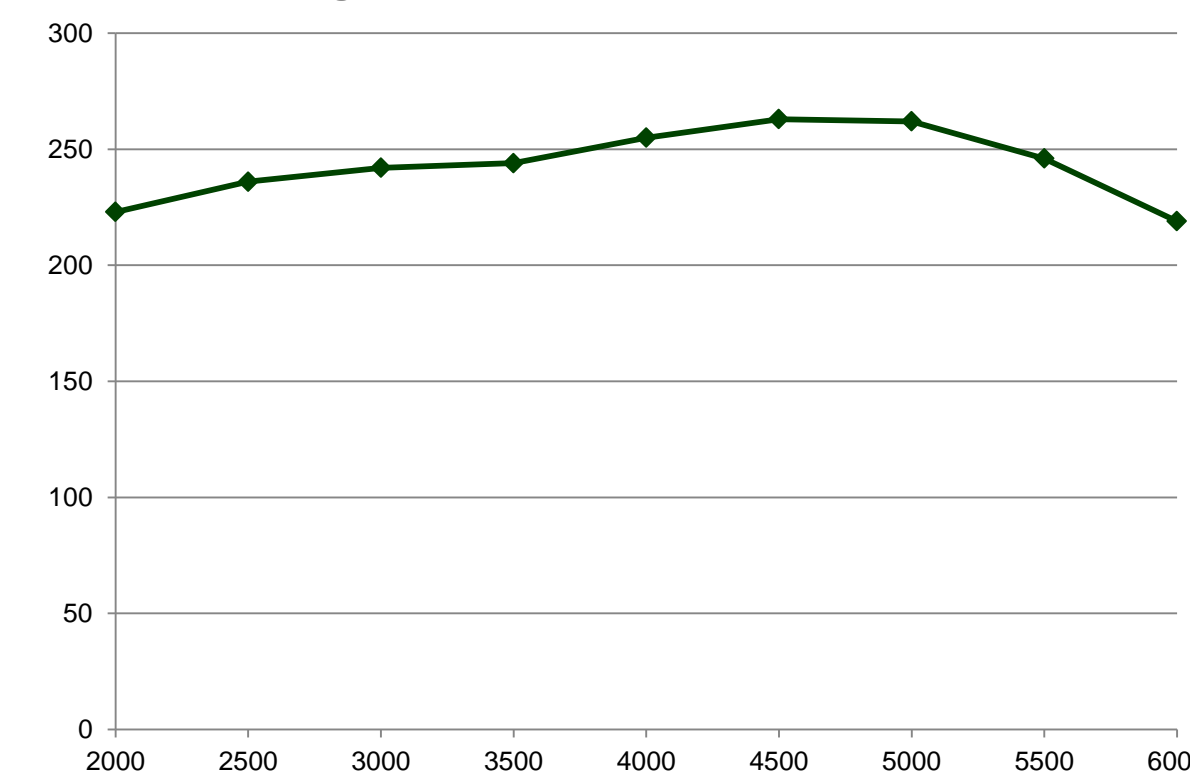
$$\text{Velocity} = \frac{\text{RPM} \cdot \text{Tire Radius} \cdot 2\pi}{\text{Drive Ratio} \cdot \text{Ratio for that Gear} \cdot 60}$$

$$\text{"Force Inverse"} = \frac{\text{Mass}}{g_c} \cdot \frac{1}{\text{Force}}$$

$$g_c = 32.2 \frac{\text{ft}}{\text{s}^2}$$



Figure 1: Torque(lb-ft) vs. RPM



Gear 1

RPM	Torque (lbs-ft)	Force (lbf)	Velocity (ft/s)	"Force Inverse" (s ² /ft)
2000	223	2375.0	19.67	0.0439
2500	236	2513.4	24.58	0.0415
3000	242	2577.3	29.50	0.0404
3500	244	2598.6	34.41	0.0401
4000	255	2715.8	39.33	0.0384
4500	263	2801.0	44.25	0.0372
5000	262	2790.3	49.16	0.0374
5500	246	2619.9	54.08	0.0398
6000	219	2332.4	59.00	0.0447

Figure 2: "Force Inverse" vs. Velocity(ft/s)

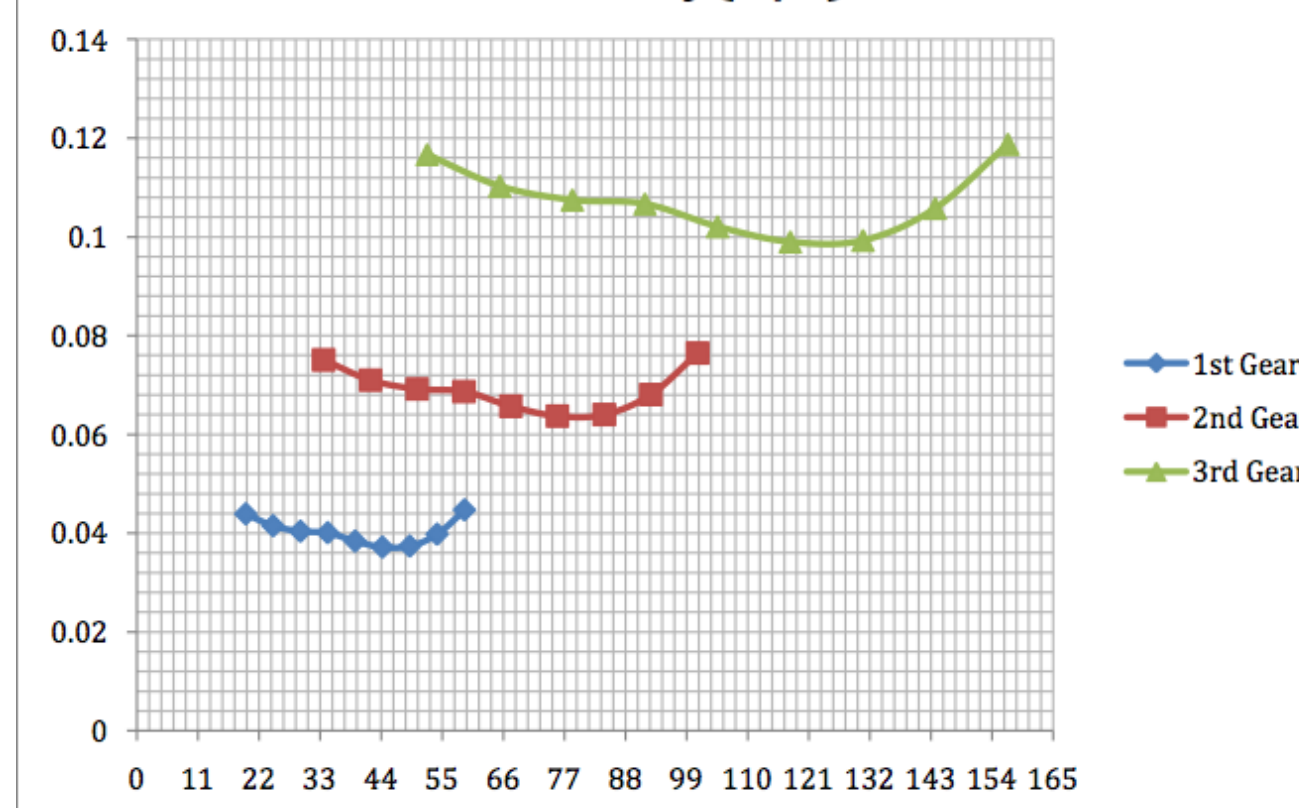
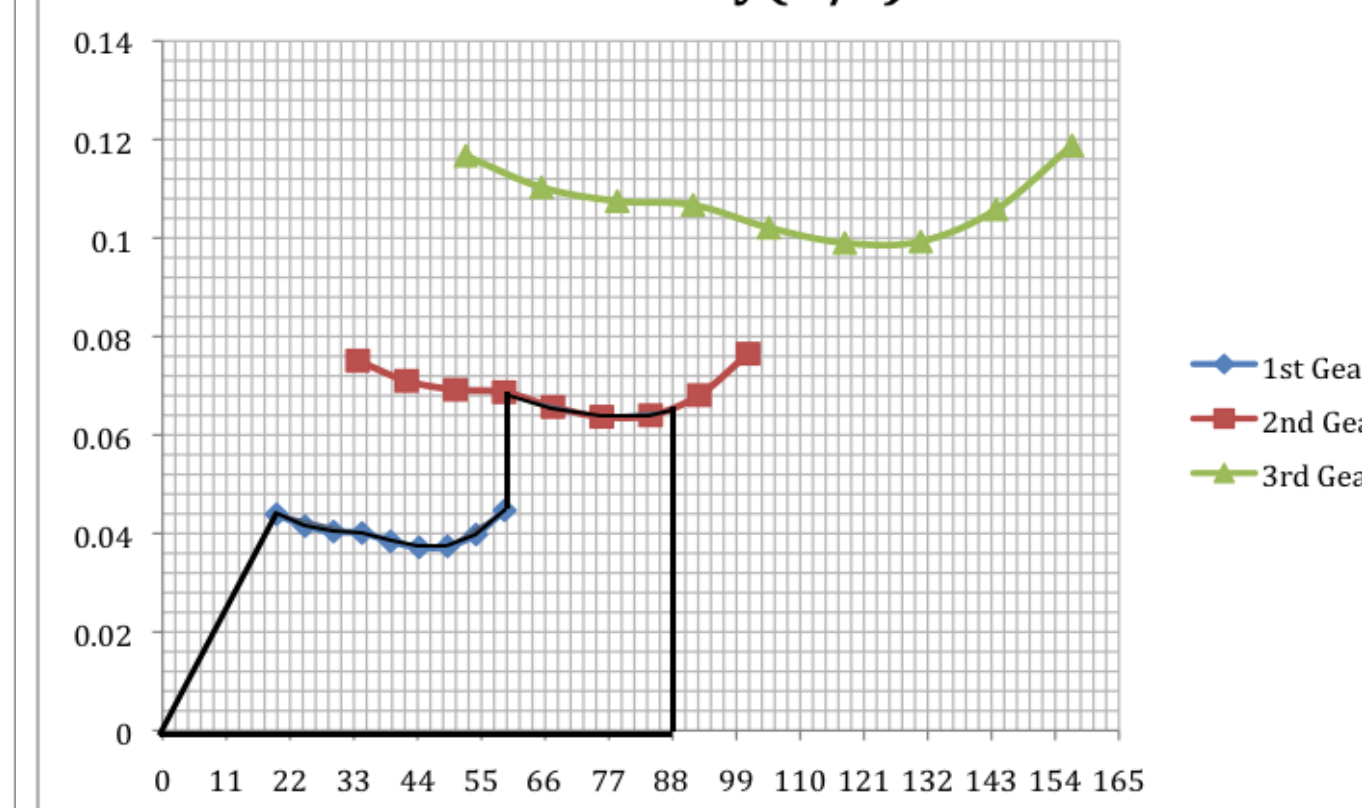


Figure 2: "Force Inverse" vs. Velocity(ft/s)



Discussion :

Plotting the "Force Inverse" vs. Velocity curve for each gear allows us to find the 0-88 ft/s time. The area beneath the curve has the units of seconds. This area can be found using the Riemann sum approximation.

$$\sum_{i=1}^n f(c_i)\Delta x.$$

The result of the Riemann sum approximation of the "Force Inverse" vs. Velocity graph was 4.109 seconds. This is a great number because most sports cars time from 0-88 (ft/s) are between 4 (ft/s) and 6 (ft/s).

Conclusion & References

More subintervals in a computer program that calculates area will result in more accuracy. This problem proves that Mechanical Engineers can calculate important values using some of the vehicles basic specifications.

Thank you to Don Dekker & RSportsCars.com