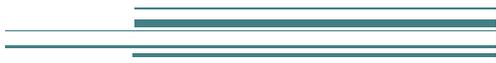


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Engineering Application in Integral Calculus - Automobile Velocity



Gina Rablau

Engineering Application in Integral Calculus -Automobile Velocity

A Mini-Project for Module 1

Project Description

This project demonstrates the following concepts in integral calculus:

1. Riemann sums
2. Definite integrals

Project description.

- Find the total distance traveled by a car by integrating the velocity function. When one is only given *data*, there are two ways to estimate the total distance – either use numerical integration and the given data, or find a polynomial regression curve to the data, and then integrate. One hopes that the two estimates are fairly close.
- Estimate when (in seconds) the total distance traveled equals a tenth of a mile.

Numerical Example

The data in the table below was taken from the *Motor Trend Magazine* the July , 1997 issue for the Mercedes – Benz SLK 230

t (s)	0	2.3	3.6	5.0	6.9	9.0	11.4
v (mph)	0	30	40	50	60	70	80

I estimated the total distance traveled, D , using Riemann sums with six subdivisions ($n = 6$). The result was $D = 564 / 3600 \approx 1.56667$ miles. Then I fitted the velocity data with a regression polynomial of degree three (polynomials of degree one or two did not fit well data) using Matlab. I obtained the velocity function $v(t) = 0.0483t^2 - 1.2599t + 15.0979t + 0.2883$.

Next, I estimated the total distance traveled using the regression polynomial.

$$D \cong \frac{1}{3600} \int_0^{11.4} v(t) dt \cong 0.1572, \text{ which is very close to the other estimate.}$$

To estimate when (in seconds) the total distance traveled equals a tenth of a mile, I used Matlab to approximate the roots of the corresponding polynomial equation. Setting

$$\frac{1}{3600} \int_0^t v(\pi) d\pi = 0.1 \Rightarrow \int_0^t (0.0483t^3 - 1.2599t^2 + 15.0979t + 0.2883) dt = 360$$

$$\Leftrightarrow 0.0121t^4 - 0.4100t^3 + 7.5490t + 0.2833t - 360 = 0.$$

\Leftrightarrow Matlab returned the *only one positive real root*, $t \approx 8.5116$ seconds.

Your Assignment

1. Obtain automobile (of your choice) velocity data from Motor Trend Magazine or any other publication of your choice. The data must be time t as a function of velocity v .
2. Estimate the total distance traveled using Riemann sums.
3. Fit the velocity data with a regression polynomial of degree three using Matlab or any other software and obtained the velocity function.
4. Estimate the total distance traveled using the regression polynomial.