Example 1. A car starts from rest and its distance traveled is recorded in the table in 2-second intervals.

<table>
<thead>
<tr>
<th>Time (t)</th>
<th>Distance (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
</tr>
</tbody>
</table>

a. Graph the data.

b. Find the average speed for t = 0 to t = 8.

c. Estimate the velocity at t = 6.

d. Use a quadratic regression equation, d(t), to model the data.

Example 2. An arrow is shot upward on the moon with a velocity of 50 m/s. Its height after 1 second is given by

\[ h = 50t - \frac{1}{2}gt^2 \]

a. Find the velocity of the arrow.
b. Find the acceleration of the arrow.
c. What is the velocity of the arrow at t = 1 second?
d. What is the velocity of the arrow at t = 2 seconds?
e. When will the arrow hit the moon?
f. With what velocity will the arrow hit the moon?
Topic 13 Applications of polynomials

Problem 3: A cylindrical tank holds 100,000 gallons of water, which can be drained from the bottom of the tank in 4 hours. Heres Torricellis Law:

gives the volume \( V \) of the water remaining in the tank after \( t \) minutes.

\[
V(t) = 100,000 \left[ \frac{t}{30} - \frac{t^2}{3600} \right]
\]

\[
V'(t) = \frac{100,000}{3} \left[ -\frac{t}{3600} \right]
\]

a) Find the rate at which the water is flowing out of the tank.
b) What are the units?
c) Plot \( t = 0, 10, 20, 40, 60 \). Find the flow rate and the amount of water in the tank.

\[
m = \frac{7 - 2.4}{10} = 0.5
\]

\[
\frac{1}{2} = -0.25
\]

\[
s = -16t^2 + 40t + s
\]

\[
\frac{ds}{dt} = 40 - 32t
\]

\[
s = \frac{ds}{dt} = 24t
\]

\[
a = \frac{d^2s}{dt^2} = 24
\]

\[
0 = 24t
\]

\[
0 = t
\]

\[
s = 4t^2 + 2t + 2
\]

\[
\frac{ds}{dt} = 4t + 2
\]

\[
25 = -4.9t^2 + 120t
\]

\[
\frac{ds}{dt} = -9.8t + 120
\]

\[
\frac{d^2s}{dt^2} = -9.8(s) + 120 = 71 m/s^2
\]

\[
\frac{d^3s}{dt^3} = -9.8(10) + 120 = 22 m/s^3
\]
\[
\begin{align*}
\int (3x^3 - 4x - 4) \, dx &= \frac{3}{3}x^4 - \frac{4}{2}x - 4x + C \\
&= x^4 - 2x^2 - 4x + C
\end{align*}
\]