MA205 - Integral Calculus
Lesson 4: Refining Estimates
Class Problems

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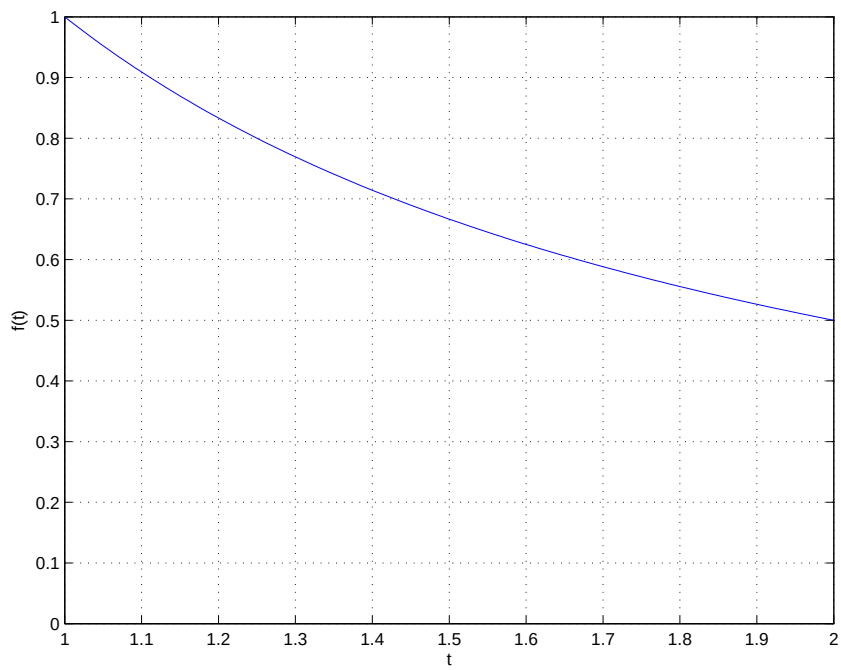
1. Let's investigate an object traveling such that its velocity (in feet per second) is given by $f(t) = \frac{1}{t}$. A graph of the velocity function is provided below.



   (a) Answer the following question by hand using 5 subdivisions: Approximately how far does this object travel between $t = 1$ and $t = 2$?

   (b) Provide a refined estimate using Mathematica with each of the following methods: Right endpoint, Left endpoint, Midpoint, and Trapezoid. The actual answer is $\ln(2)$. Which method seems to work best?

# Intervals	Right	Left	Midpoint	Trapezoid
10				
20				
30				

2. The Bombay Plague of 1905 was devastating to the region. Two mathematicians (Kermack and McKendrick) modeled the death rate after the plague struck by:

$$D(t) = 3960\left(e^{0.2t-3.4} + e^{-0.2t+3.4}\right)^{-2},$$

where $D(t)$ is measured in deaths per week. Approximate how many deaths occured in the first 30 weeks. Now improve your answer by adding more subintervals or by using a more accurate method.

3. The velocity of an object traveling in a straight line over a 10 minute period of time is given (in feet per minute) by the graph of the function $v(t) = t^3 - 15t^2 + 50t$ on $[0, 10]$. Positive velocities indicate movement away from the start point, and negative velocities indicate movement toward the start point. Before you start the problems below, plot this function in Mathematica.

   (a) Estimate the *distance traveled* by the object over this 10 minute time period using the midpoint or trapezoid rule, with 20 subintervals. (Use Mathematica!)

   (b) Estimate the *displacement* of the object after this 10 minute period. Again, use the midpoint or trapezoid rule with 20 subintervals.

   (c) When does the object come to rest? When it comes to rest, approximately where is it?