5.3 Optimization Problems Involving Exponential Functions

Apr. 4. 2013

- Optimizing means determining the values of the independent variable so that the values of a function that models a situation can be minimized or maximized
- The techniques used to optimize an exponential function model are the same as those to optimize polynomial and rational functions.
- Apply the algorithm introduced in Chapter 3 to solve an optimization problem:
  1) Understand the problem, and identify quantities that can vary. Determine a function in one variable that represents the quantity to be optimized.
  2) Determine the domain of the function to be optimized, using the information given in the problem.
  3) Use the algorithm for finding extreme values (from Ch. 3) to find the absolute max or min values of the function on the domain.
  4) Use the result from step 3 to answer the original problem.
  5) Graph the original function using tech. to confirm results.

Practice

1. —

2. a) $f'(x) = -e^{-x} - (-3)e^{-3x}$

$0 = 3e^{-3x} - e^{-x}$

$= e^{-3x}(3 - e^{2x})$

$\cancel{e^{-x} = 0}$ $\quad -e^{2x} = -3$

$e^{2x} = \ln 3$

$\ln e^{2x} = \ln 3$

$x = \dfrac{\ln 3}{2}$

$f(0) = 0 \leftarrow \text{min}$

$f(10) = 4.53 \times 10^{-05}$

$f\left(\dfrac{\ln 3}{2}\right) = 0.384 \leftarrow \text{max}$

b) $m(x) = 1(e^{-2x}) + (x+2)(-2)e^{-2x}$

$= e^{-2x}(1 + (2+x)(-2))$

$= e^{-2x}(1 - 4 - 2x)$

$= e^{-2x}(-2x - 3)$

$\dfrac{-3}{2}$

$f(-4) = -5961.92 \leftarrow \text{min}$

$f(3/2) = 10.04 \leftarrow \text{max}$

$f(4) = 2.012 \times 10^{-3}$