Assignment 6

1. In the year 2000, a student takes out a 20000 dollars loan at an annual interest rate of r (interest compounded continuously). The student makes one loan payment of 10000 dollars in 2015, then one more loan payment of L in 2020 after which the student owes nothing.
   (a) If the student's debt is 40000 dollars in 2005, what is r?

   (b) At what rate (in dollars per year) is the student's debt increasing in 2010? (use the value of r from part (a)).

   (c) Use the value of r from part (a) to find L.

2. Suppose that you invest in a high-interest saving account in which the interest rate is compounding continuously at 3.5%. (a) If you invest 10,000 dollars in 2013, how long will it take for the money to double?

(b)You recommend this scheme to your friend who invests 5000 dollars in 2014. When will he have 10,000 dollars in his account?

(c)How long should you invest the money so that you have 12,000 dollars in your account?

3. Consider the demand equation

$$q = f(p) = \frac{1}{\sqrt{1+p}}$$

(a) Find the elasticity of demand function $E(p)$.

(b) When $p = 10$, how will an increase in price affect the profit?

4. In a petri dish, the number of bacteria increase at an exponential rate. After 10 minutes, there are 10,000 bacteria, and after 20 minutes, there are 100,000.

   (a) How many bacteria were there initially?

   (b) Write a function which gives the population of the bacteria at time t.

   (c) If penicillin is added at $t = 30$ minutes, causing the population to decay exponentially so that at $t = 60$ minutes the population is 5000, then at what time has the population returned to its initial amount?