

IVA'S CALCULUS I: Homework based on Tuesday 4/1 – Tuesday 4/8 lectures

Purpose

The main purpose of this assignment is to have you practice ideas central to integral calculus and the subject called differential equations.

Due date

Thursday 4/10/2014, by 5pm.

Problems

1. Fish population of a lake, without any external influences, grows at the rate of 10% per year. A fishing operation is about to start at the lake; it is planned to harvest 40 000 fish from the lake each year. Currently, the fish population is estimated at 200 000.
 - (a) Write down the differential equation and the initial value problem describing the above situation.
 - (b) Predict the fish population in five years. Do put effort into getting a relatively accurate answer; indicate how your prediction can be further improved.
2. On their own, weeds in Iva's back yard would be growing at the rate of 50% per year. Iva estimates that she puts about 15 kilograms of weeds into the yard waste each year. On the other hand, neighbor's goat Bella eats 30% of the weeds each year. Currently, there is about 100 kilograms of weeds in the back yard.
 - (a) Write down the differential equation and the initial value problem describing the above situation.
 - (b) Predict the amount of weeds in three years. Do put effort into getting a relatively accurate answer; indicate how your prediction can be further improved.
3. Iva's neighbor Bella the Goat eats blackberries from Iva's yard. The rate at which she eats them, however, depends on time of the year. If t variable denotes time measured in years with $t = 0$ corresponding to the New Years Day, then the rate at which Bella eats blackberries is given by

$$r(t) = 250 (1 - \cos^2(\pi t)) \text{ kilograms per year.}$$

- (a) Graph the function $r(t)$. At what time of the year is Bella eating the most blackberries? At what time of the year is Bella eating the least amount of blackberries?

- (b) Predict the amount of blackberries Bella consumes between
- i. January 1st and March 31st.
 - ii. June 1st and August 31st.

Do put effort into getting a relatively accurate answer; indicate how your prediction can be further improved.

4. The vine on Iva's front porch is growing at different rates at different times of the year. If t variable denotes time measured in years with $t = 0$ corresponding to the New Years Day, then the rate at which the vine is growing is given by

$$r(t) = 2 \sin^4\left(\pi t + \frac{\pi}{6}\right) \text{ feet per year.}$$

- (a) Graph the function $r(t)$. At what time of the year is the vine growing the fastest?
- (b) Predict the length of the vine on July 1st of 2016, if on Jan 1st of 2014 the vine was 12 feet long. Do put effort into getting a relatively accurate answer; indicate how your prediction can be further improved.