Lab worksheet for Thursday, 25 March 2021

Practice: Applications of integration

Note: *All of the models in the exercises are entirely fictional. You should give units and express an exact form of your answers before giving a decimal form/approximation.*

Exercise 1:

a) The population of a town grows at a rate of r(t) people per year (where t is time in years). We consider in 2010, t = 0. At t = 3, the town's population was 1000 people. What does $1000 + \int_3^8 r(t)dt = 1500$ mean?

b) A water tank is filled at a rate of r =(t) liters per minute (where t is the time in minutes). What does $\int_1^7 r'(t)dt$ represent?

Exercise 2: The total expected revenue from selling tickets for a certain concert as a function of a single ticket's prices, x, changes at a rate of r(x) = 17 – 0.24x thousands of dollars per dollar. When x = 70, the total expected revenue is 128 thousand dollars. What is the total expected revenue when the ticket price is $80?

Exercise 3: An object is moving so that its speed after t minutes is $v(t) = 1 + 4t + 3t^2$ meters-per-minute. How far does the object travel during the 3rd minute?

Exercise 4: Find the function whose tangent has the slope $3x^2 + 6x - 2$ and whose graph passes through the point (0,6).

Exercise 5: A tree has been transplanted and after x years is growing at a rate of $1 + \frac{1}{(x+1)^2}$ meters-per-year. After 2 years, it has reached a height of 5 meters. How tall was it when it was planted?

Exercise 6: It is estimated that the population of a certain country is growing at a rate of $e^{0.002t}$ million people per year. If the current population is 50 million, what will the population be 10 years from now?

Exercise 7: It is estimated that x years from now the value of an acre of farmland will be increasing at a rate of $a(x) = \frac{0.4x^3}{\sqrt{0.2x^4+8000}}$ dollars per year. If the land is currently worth $500 per acre, how much will it be worth in 10 years?