Math 2E03- Introduction to Modelling

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Problem 1

A cardiology reasearch unit performs an experiment in which a dye is injected at a constant rate into the vein theat empties directly into the heart. Small samples of blood are withdrawn at regular intervals from the artery that carries blood directly out of the heart. Given information- $r_{in} = 5mL/s$, $c_1 = 1g/mL$ and $r_2 = 100mL/s$. You have to devise a way to estimate the volume of the patient's heart, given the following two sets of data.

Concentartion	Time
0	0
.0141	1

Problem 2

A Vm^3 storage tank contains methane. It must be emptied for a safety inspection. Nitrogen is available to pump into one end of the tank, forcing gas out the other side (assume that there is stirring mechanism within the tank). Suppose we added nitrogen three times then what will be the amount of remaining methane.

Problem 3

There is a line of trees L long, with a space of Δx between each tree. Unfortunately these trees are infested with those annoying fruit flies. Let r represent the probability that a particular fly will jump to the tree to the right in a given time interval, let l be the that a particular fly will jump to the tree to the left, and let $(1 - r - l)$ be the probability of staying out. Create the differential equation to model this system and investigate the solution in following cases.

1. $L = 50$, $\Delta x = .1$, $r = l = \frac{1}{2}$ $v(0, x) = x$
2. $L = 20$, $\Delta x = .05$, $r = .5, l = .5$ $v(0, x) = \sin(\pi x/L)$

where $v(x, t)$ is the probability of finding a fly on the tree at x at a given time t.