L2 Probability Practice #4

1. A fluorescent tube manufacturer is thinking of improving its basic model. It tests 1,000 each of two new models and compares them with the basic model. It has two criteria
   - that there is no major flaw, so that the tube at least starts working.
   - that it lasts at least 20,000 hours.

	Flawed at start	Under 20,000 hours	Over 20,000 hours
Old Model	11	147	842
New Model A	9	191	800
New Model B	23	88	889

   a) What is the risk a randomly selected tube of Model A is flawed?

   b) If 150 bulbs of Model A were installed, how many would you predict to last at least 20,000 hours?

   c) What is the relative risk a tube of Model B will be flawed, compared to the old model?

2. A new brand on the market states that its fluorescent tubes have a mean life of 24,520 hours, with a standard deviation of 4,410 hours.

   a) What is the probability a tube will last over 30,000 hours?

   b) The supermarket replaces all its lights at the same time once 5% have failed. Predict how long that would take if they used this manufacturer's fluorescent tubes.

   c) If 100 tubes were installed, predict when the first one would fail.

3. Three fluorescent tubes are wired in a series – that is, one after another. The first tube is more likely to fail than the others, because it gets a sharper spike in voltage each time it is turned on.
   - There is a 10% chance the first tube will fail inside three years.
   - There is an 8% chance the second or third tube will fail inside three years.

   a) What is the probability they will all still be going after three years?

   b) What is the probability that more than one tube will fail inside three years?

   c) What is the probability that, given one of them fails, that it will not be the first one?

Answers: L2 Probability Practice #4

1.

	Flawed	Under 20,000 hours	Over 20,000 hours
Old Model	11	147	842
New Model A	9	191	800
New Model B	23	88	889

a) P(Model A flawed) = 9/1000 = **0.009**

b) P(Model A last) = 800/1000 = 0.8
Expected value = 150 × 0.8 = **120 tubes**

c) P(Model B flawed) = 23/1000 and P(old model flawed) = 11/1000
Therefore relative risk of Model B cf old model = 0.023/0.011 = **2.09**

2.

a) Graphics: Ncd: lower =30000, upper = 999999, σ = 4410, μ = 24520
P(x > 30000) = **0.1483**

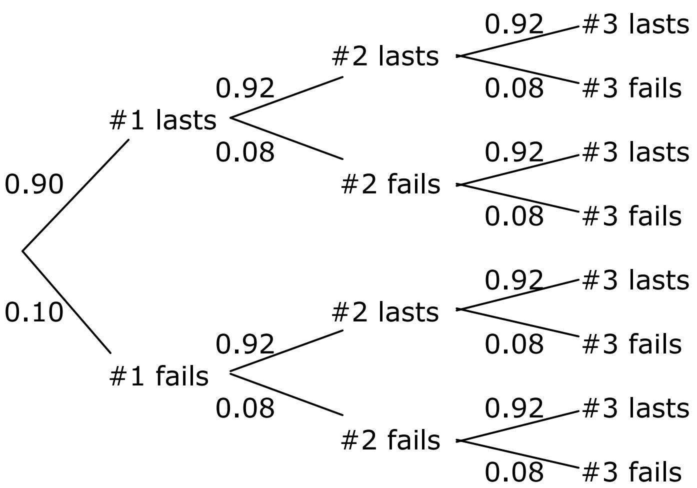
b) Graphics: InvN: tail =left, area = 0.05, σ = 4410, μ = 24520
limit = **17,266.2 hours**

c) We need the point when the expected value for the number of failures becomes more than ½ a tube. Since there are 100 tubes that can fail we need the probability of individual failure to be more than 0.005.

Graphics: InvN: tail =left, area = 0.005, σ = σ = 4410, μ = 24520
Expect first to have failed by **13,160 hours**

3.

a) P(all still going) = 0.9 × 0.92 × 0.92 = **0.762**



0.9 × 0.92 × 0.92 = 0.76176
0.9 × 0.92 × 0.08 = 0.06624
0.9 × 0.08 × 0.92 = 0.06624
0.9 × 0.08 × 0.08 = 0.00576
0.1 × 0.92 × 0.92 = 0.08464
0.1 × 0.92 × 0.08 = 0.00736
0.1 × 0.08 × 0.92 = 0.00736
0.1 × 0.08 × 0.08 = 0.00064

b) P(x > 1) = P(1 + 2 fail) + P(1 + 3 fail) + P(2 + 3 fail) + P(1 + 2 + 3 fail)
= 0.00736 + 0.00736 + 0.00576 + 0.00064 = **0.02112**

c) P(at least one fail) = 1 – P(no fails) = 1 – 0.76176 = 0.23824
P(2 or 3 fail, 1 lasts) = 0.06624 + 0.06624 + 0.00576 = 0.13824
P(at least one gone, but not #1) = (only #2 or #3 gone) out of (any gone)
= 0.13824/0.23824 = **0.580**