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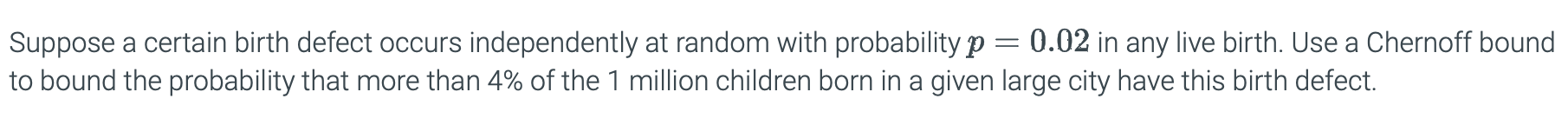
CS / CPE 600

Prof. Reza Peyrovian

Homework Assignment 10

Submission Date: 12 / 04 / 2022

Q1. No. 19.8.3



Sol.

For i = 1, …, 106, Compute 𝜇

μ = E[X]= ∑(i=1)^1000000 E[xi] = ∑(i=1)^1000000 0.02 = 20000

4% of 1 million children would be = 0.04 \* 1000000 = 40000

By Chernoff bounds, for 𝛿 = 1, upper bound is

𝑃𝑟(𝑋 ≥ (1+𝛿)𝜇) = 𝑃(𝑋≥ 40000) < [ [e^ ] / (1+)^(1+) ] ^ = [e / 4]^20000

Q2. No. 19.8.18

Text

Description automatically generated

Sol.

There are nn possibilities how this algorithm chooses random numbers.

There is n! permutations, it is not possible to divide nn by n!

This algorithm does not generate every permutation with equal probability.

For example, when n = 4, the permutation (1, 2, 3 ,4) is twice as likely to be generated as the permutation (1, 4, 3, 2).

Let us take an example,

n = 4, nn = 44 = 256 possible choices for random numbers.

n! = 4! = 24 possible permutations.

256/24 = 10.67 which is not possible.

The possibility of permutations to be more likely is more.

Q3. No. 19.8.35

Text

Description automatically generated

Sol.

a.

For implementing probabilistic packet marking strategy, a router R with some probability (p <= (1 / 2)).

The probability of the packet received by the recipient i.e. marked by the ith (1<= i <= d) router along the attack path is = p (1 – p)(d - i) where d is total number of routers.

b.

Above problem is same as coupon collector problem. The recipient must collect d routers by visiting series of routers.

Let X be the random variable representing number of times to visit for d routers:

X can be written as

X = X1 + X2 + X3 + … Xd

Let Xi be the number of trips recipient must made in order to go from having i-1 distinct routers. Got i-1 distinct coupons, probability of getting new router will be

pi = (d - (i - 1)) / d

Since there are d routers, and d - (i - 1) we don’t have. By the linearity of expectation

E[X] = E[X1] + E[X2] + E[X3] + … E[Xd]

= 1/p1 + 1/p2 + 1/p3+ … + 1/pd

= dHd (computed in book)

where Hd is the harmonic number and can be approximated as ln d < Hd < ln d+1

Now according to tail estimate, recipient must make more than d ln d traceback to get all d routers.