Vinothini Pushparaja

Assignment - 1

1.2.1 What would be the number of suspected pairs if the following changes were made to the data?

(a) The number of days of observation was raised to 2000.

(b) The number lier of people observed was raised to 2 billion (& there were therefore 200,000 hotels)

(c) The reported pair as suspect if they were at the same hotel at the same time on three different days.

P(Visiting a hotel on any given day) = 0.01

P(Any Two people deciding to visit a hotel on any given day) = 0.0001

Chance that they will visit the same hotel on one given day } $= \frac{0.0001}{2 \times 10^5} = 2^{-1} \times 10^{-9}$

Chance that they will visit the same hotel on three different days } $= (2^{-1} \times 10^{-9})^3 = 8^{-1} \times 10^{-27}$

No. of pairs of people $= \binom{2 \times 10^9}{2} = \frac{(2 \times 10^9)^3}{2} = \cancel{4} \times 10^{27} = 2 \times 10^{18}$

No. of days (3 diff days) $= \binom{2000}{3} = \frac{(2000)^3}{2} = \frac{8 \times 10^9}{2} = \cancel{4 \times 10^9}$

$= 1{,}331{,}334{,}000$

Expected no. of events that look like evil doing } $= \cancel{\frac{4 \times 10^{27} \times 4 \times 10^9 \times 10^{-27}}{8}}$

$= \cancel{2 \times 10^9}$

$= \cancel{2{,}000{,}000{,}000}$

$= 2.6 \times 10^{27} \times \frac{10^{-27}}{8} = 0.33$

Which is very very small

1.2.2. Suppose that we have info. about the supermarket purchases of 100 million people. Each person goes to the supermarket 100 times in a year & buys 10 of the 1000 items that the supermarket sells. We believe that a pair of terrorists will buy exactly the same set of 10 items. at some time during the year. If we search for pairs of people who have bought the same set of items, would we expect that any such people found were truly terrorists?

No. of pairs of people $= 100\binom{10^6}{2} = \frac{100 \times 10^{12}}{2} = 5 \times 10^{13}$

~~P(Any two people purchasing the same items)~~ $= \cancel{\frac{1}{\binom{1000}{10}}} \; \cancel{\binom{1000}{10}} = \cancel{\frac{1}{(1000)^2}}$

Expected pairs of people buying the same set of items $\Big\} = \frac{5 \times 10^{13}}{\binom{1000}{10}}$

$$= \frac{5 \times 10^{13}}{\binom{10^3}{10}}$$

$$\approx 1.89 \times 10^{-10}$$

Which is also very very small.