MXB107 Assessment 2

Gentry White 578490

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Question 1

Each time a player throws a dart at a dartboard, they have a 0.05 probability of hitting the bulls-eye. How many throws must a player make to have the probability of hitting the bulls-eye at least once is 0.5?

Question 2

Suppose that the probability of living to 70 years or more is 0.6 and the probability of living to 80 years or older is 0.2. If a person reaches their 70th birthday what is the probability, they will reach their 80th?

Question 3

Show that if A, B, and C are mutually independent then $A \cap B$ and C and independent, and $A \cup B$ and C are independent.

Question 4

If two teams A and B play in a championship series, and assume that each game outcome is independent, and team A has a chance of winning any game is 0.4 is it in team A's best interest to play a best of five series or a best of seven series?

Question 5

Suppose that a rare disease affects a population at a rate of 1 in 1000, find the probability of k cases in a population of size 100,000 for $k = 1, 2, 3$. Compute your results, assuming a Binomial distribution and a Poisson distribution. Compare your results.

Question 6

Show that Poisson probabilities can be computed recursively by noting that $p_0 = \exp(-\lambda)$ and

$$p_k = \frac{\lambda}{k} p_{k-1},\ k = 1, 2, 3, \ldots$$

Use this formula to compute $Pr(X \leq 4)$ for $X \sim Pois(4.5)$.

Question 7

Phone calls are received at my residence (land-line) at a rate of two per hour.

a. If I take a ten-minute walk around my neighbourhood, what is the probability that someone will try to call my house while I am out?
b. How long could I leave my house if I want the probability I miss a phone call to be less than 0.5?

Question 8

What is the difference between simple random sampling, stratified random sampling, and weighted sampling?

Question 9

If we assume that the time between a person receives an alert on their phone follows an exponential distribution with mean 4.3 minutes, then if I take a sample of 90 people and record that they report the time between one alert and the next. What is the probability that the average of these times will exceed 4.5 minutes?

Question 10

A sample of 1387 individuals asked if they approved of the Queensland Government's handling of COVID-19. 697 individuals responded "yes", and the remainder responded "no".

a. Is it reasonable to assume that the sampling distribution of the sample proportion of respondents who replied "yes" is approximately Gaussian?
b. What is the mean and standard error of the sampling distribution of the proportion of respondents who replied "yes"?