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section: 35

Brain storming problems.

(1) uniform Distribution:-

Problem 1:-

Conside a parking lot with 100 spaces. arrive at random times and park in a random available space model the number of employ spaces in the parking lot as a uniform distribution. Discuss the implications of this model and calculate the probability of having fewer than 20 empty spaces

Sol:- Given

total no. of spaces in the parking lot = 100

Probability density function for a uniform distribution is $f(x) = \frac{1}{b-a}$

$a = 0$

$b = 100$

$f(x) = \frac{1}{100-0} = \frac{1}{100}$.

$P(x<20) = \int_0^{20} \frac{1}{100} dx$

$= \frac{1}{100}(20-0)$

$= \frac{20}{100} = 0.2$

Problem 2:-

Sol:- Given that the ages of respondents between 20 & 50 years are uniformly distributed

mean age $\Rightarrow \frac{\text{min age} + \text{max age}}{2} = \frac{20+50}{2} = 35$.

median $= \frac{20+50}{2} = 35$

$\Rightarrow$ 20 years
50 years.

Range $= 50 - 20 = 30$.

exponential Distribution:-

Problem-3:-

sol: The probability density function (pdf) of the exponential distribution is

$$f(x) = \beta e^{-\beta x}$$

$$\beta = 1/\mu$$

$$\beta = \frac{1}{100} = 0.01$$

$$P(x < 50) = \int_0^{50} \beta e^{-\beta x} dx$$

$$\Rightarrow -e^{-0.01 \cdot 50} + e^{0.}$$

$$\Rightarrow -e^{-0.5} + 1$$

$$= 1 - 0.6065 \Rightarrow 0.3935.$$

Problem-4:-

Sol: Given,

the average Completion time (μ) is 15 minutes

$$\beta = 1/\mu$$

$$\beta = \frac{1}{15} = 0.0667$$

Probability that a Customer takes more the domain

$$P(x > 20) = \int_{20}^{\infty} \beta e^{-\beta x} dx$$

$$P(x > 20) = \int_{20}^{\infty} 0.066 + e^{-0.0667x} dx$$

$$\Rightarrow 1 - P(20)$$

$$P(20) = 1 - e^{-1.334}$$

$$P(20) \Rightarrow 0.736.$$

$$P(x > 20) = 1 - 0.7367 = 0.2633.$$

(3) Normal Distribution:

Problems:

Sol:- Given that IQ Score are normally distributed

with mean (μ) = 100

standard deviation = 15

$$z = \frac{x-\mu}{\sigma}$$

$$z_{85} = \frac{85-100}{15} = -1$$

$$z_{115} = \frac{115-100}{15} = 1$$

$P(x<85) = P(z<-1)$

$P(x<115) = P(z<1)$.

by normal distribution

$P(z<-1) = P(z<-1)$

$P(x<115) = P(z<1)$

$P(z<1) = 0.8413$

$P(85<x<115) = P(z<1) - P(z<-1)$

$\Rightarrow 0.6826$

$\therefore$ approximately 68.26 % of population has an IQ score between 85 & 115.

Problem 6:-

Standard deviation (σ) = 20.

$$z = \frac{x-\mu}{\sigma}$$

$$z_{170} = \frac{170-150}{10} = 1$$

$P(x>170) = 1 - P(z<1)$

using distribution table

$P(z < 1) = 0.8413$.

$P(x > 140) = 1 - 0.8413$

$\Rightarrow 0.1587$

∴ The Probability that a randomly selected bird weight not mor than 140 grams is 0.1587

ii) Comparative Analysis:-

Problem 7.

* uniform distribution:-

→ Assume all waiting times with a given range are equally likely.

* exponential Distribution:-

→ Describe waiting time b/w event in a random process.

* scenarios:-

→ Use uniform distribution when buses arrive predictably like on a fixed schedule

Problem 8:-

Normal distribution:-

Advantages:- Represents how heights typically vary in a Population.

Limitations:- Assume a bell-shaped Curve.

Comparison:-

normal distribution:- Better modelling student heights as it reflects real world variation.

Interactive exploration:-

CLT:- It states that as you take larger and larger samples from any population

Impact of samplesize:-

* for small sample sizes the sampling distribution of the mean may not look perfectly normal.

Practical implication:-

* CLT allows us to use the properties of the normal distribution to make satistical interences, even when the population distribution is not normal.

Critical thinking scenario:-

Problem 10:-

uniform distribution:- unlikely as it assumes all lifespans are equally likely with in range.

Normal distribution:- Not ideal, as it's not typical used for modelling finite process like light bulb lifespans.

Exponential distribution:- Best choice, It represents the Constant and random failure rate of light bulbs overtime

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