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CS109

Section #3
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Section #3 Warmup

Based on the work of many CS109 staffs

1 Lecture 8, 4-22-20: Poisson and More

1. (a) Cite the probability mass function for the Negative Binomial distribution, $X \sim NegBin(r, p)$. Recall this is the number of independent flips up to and including the r^{th} head, when $P(head) = p$.

   (b) Recall the PMF for $Y \sim Poi(\lambda)$: $p_Y(k) = e^{-\lambda}\lambda^k/k!$ for k in the range of Y. If $Z \sim Poi(2.3)$, then $P(Z = 2.3) = ?$

2. How many emails will I expect to receive in the next seven minutes if on average I receive w per minute?

1. (a)
$$P(X = k) = \binom{k-1}{r-1} p^r (1-p)^{k-r}$$

   (b) 0. The fact that 2.3 is used for both λ and for k is a coincidence.

2.
$$7w$$

2 Lecture 9, 4-24-20: Continuous Random Variables

1. **True or False**.

   (a) If X is a continuous RV, then $0 \leq f_X(x) \leq 1$ for all $x \in \mathbb{R}$. Recall f_X denotes the PDF of X.

   (b) If X is a continuous RV, then $0 \leq F_X(x) \leq 1$ for all $x \in \mathbb{R}$. Recall F_X denotes the CDF of X.

2. **Short Answer**. Let $X \sim \text{Uni}(\alpha, \beta) = \text{Uni}(12, 17)$

   (a) $P(X < 13) = ?$

   (b) $P(X \leq 13) = ?$

   (c) $P(X = 13) = ?$

1. (a) False.

   (b) True.

2. (a) 0.2 - The chunk between 12 and 13 contains one-fifth of all the probability

   (b) 0.2 - Including the number 13 itself is an infinitesimal change to the probability.

   (c) 0 - Continuous RV's equate to particular values with zero probability

3 Lecture 10, 4-27-20: The Normal Distribution

True or False. Let $X \sim \mathcal{N}(\mu, \sigma^2)$.

1. $(X - \mu)/\sigma^2 \sim \mathcal{N}(0, 1)$.
2. For all $w \in \mathbb{R}$, $P(X < \mu - w) = P(X > \mu + w)$
3. Mean(X) = Median(X) = Mode(X) = μ
4. $f_X(\mu) = 1$
5. $F_X(\mu) = 0.5$

1. False. Should be $(X - \mu)/\sigma$.
2. True. The normal distribution is symmetric, so the area under the curve before a certain value will match the area under the curve after that value's reflection across the mean of the distribution.
3. True. The mean of a distribution is the x value marking the "center of mass" on which it would balance if there was a fulcrum beneath it. The median of a distribution is the x value at which there is 50% mass on each side. The mode of a distribution is the x value at which the highest y value occurs. If the distribution is normal, that is sufficient for mean = median = mode.
4. False. The peak of a normal distribution can be any positive number. The variance determines the height.
5. True. The area under the curve up until the midpoint always accounts for half of the probability.