



q4

10/8/22, 5:48 AM

Quiz: Quiz 4: Probability Review

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Started: Oct 8 at 5:48am

Quiz Instructions

Question 1

1 pts

Which of the following is not always true for a discrete random variable X ?

☐ $\mathbb{E}[cX] = c\mathbb{E}[X]$

☐ If $X \geq 0$ then $\mathbb{E}[X] \geq 0$

☒ $\mathbb{E}[XY] = \mathbb{E}[X]\mathbb{E}[Y]$

☐ $\mathbb{E}[X + Y] = \mathbb{E}[X] + \mathbb{E}[Y]$

Question 2

1 pts

Consider the following PMFs

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X	$P(X)$	$Q(X)$
1	$1/2$	$1/4$
2	$1/4$	$1/2$
3	$1/4$	$1/4$

$D_{KL}(P||Q) - D_{KL}(Q||P)$
 $= -\sum p(x) \log_2 q(x) + \sum q(x) \log_2 p(x)$
 $= -\frac{1}{2} \times \log_2 \frac{1}{4} - \frac{1}{4} \times \log_2 \frac{1}{2} - \frac{1}{4} \log_2 \frac{1}{4} + \frac{1}{2} \log_2 \frac{1}{2} + \frac{1}{4} \log_2 \frac{1}{4}$
 $= 0$

Calculate $D_{KL}(P||Q) - D_{KL}(Q||P)$

Use \log_2 when calculating D_{KL}

☒ 0

☐ -1/2

☐ 3/4

☐ 1/2

Question 3

1 pts

Consider a random variable X which takes on the values $-1, 0$ and 1 with probabilities $P(-1)=1/4, P(0) = 1/2, P(1) = 1/4$. Find the entropy $H(X)$, in base 2.

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☐ -0.75

☒ 1.5

☐ 0.75

☐ 1

$H(X) = E(-\log_2 p(x)) = -\sum p(x) \log_2 p(x)$
 $H(X) = -\frac{1}{4} \log_2 \frac{1}{4} - \frac{1}{2} \log_2 \frac{1}{2} - \frac{1}{4} \log_2 \frac{1}{4}$
 $= -\frac{1}{4} \times (-2) - \frac{1}{2} \times (-1) - \frac{1}{4} \times (-2)$
 $= \frac{1}{2} + \frac{1}{2} + \frac{1}{2}$

Question 4

1 pts

A bag contains 5 blue balls and 10 white balls. A ball is drawn from the bag and its color is noted. Then this ball is put back into the bag with 3 more balls of the same color. A ball is then drawn again from the bag at random. The probability that the first ball drawn is blue, given that the second ball drawn is blue, is:

☒ 4/9

☐ 1/3

☐ 8/9

☐ 3/4

A : first blue-ball withdrawn
 B : first white-ball withdrawn
 E : second ball is blue
 $P(A) = \frac{5}{15}$ $P(B) = \frac{10}{15}$
 $P(E|A) = \frac{8}{18}$, $P(E|B) = \frac{5}{18}$
 $P(E) = P(A)P(E|A) + P(B)P(E|B)$
 $= \frac{5}{15} \times \frac{8}{18} + \frac{10}{15} \times \frac{5}{18}$
 $= \frac{4}{9}$

Question 5

1 pts

We have two machines A and B, which work independently. The probability that machine A breaks down is 0.1 and the probability that machine B breaks down is 0.2. We build a production line from these machines, where the output of machine A is fed into machine B as input. What is the probability that our production line stops working (i.e.: no output can be produced because either machine breaks down)?

☐ 0.2

☐ 0.1

☐ 0.72

☒ 0.28

$1 - (0.9 \times 0.8) = 1 - 0.72 = 0.28$

Question 6

1 pts

There are 67 students in a class, 32 of whom earned A+ on assignment 1, 10 of whom earned A+ on assignment 2, and 27 of whom did not earn A+ on either of them. What is the probability that a randomly selected student from the class earned A+'s on both assignments 1 and 2?

Question 7

1 pts

Which of the following statement is true?

☐ If X and Y are independent random variables, then $Cov(X, Y) \neq 0$.

☐ If $Cov(X, Y) = 0$, then X and Y are necessarily independent random variables.

☐ $Cov(X, Y) = 0$, if and only if X and Y are independent random variables.

☒ If X and Y are independent random variables, then $Cov(X, Y) = 0$.

Question 8

1 pts

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☐ 40/67

☐ 4/67

☒ 2/67

☐ 42/67

$42 - (67 - 2) = 2$

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Let X be a continuous random variable, with PDF:

$$f_X(x) = \begin{cases} 0 & x < 0 \\ 0.5 & 0 \leq x < 1 \\ e^{-x} & x \geq 1 \end{cases}$$

What is the conditional expectation of X , given $X < 1$?

☐ 1

☐ 0

☒ 0.5

☐ e^{-x}

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