Week 1 Quiz

5/10 points earned (50%)

You haven't passed yet. You need at least 80% to pass.
Review the material and try again! You have 3 attempts every 8 hours.

Review Related Lesson

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1 / 1
points

1.
You draw two balls from one of three possible large urns, labelled A, B, and C. Urn A has 1/2 blue balls, 1/3 green balls, and 1/6 red balls. Urn B has 1/6 blue balls, 1/2 green balls, and 1/3 red balls. Urn C has 1/3 blue balls, 1/6 green balls, and 1/2 red balls. With no prior information about which urn your are drawing from, you draw one red ball and one blue ball. What is the probability that you drew from urn C?

- 1/3
- 19/36
- 5/9
- 6/11

Correct Response
This question refers to the following learning objective(s):

- Work with the discrete form of Bayes' rule

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0 / 1
points

2.

Suppose ten people are sampled from the population and their heights are recorded. Further suppose their heights are distributed normally, with unknown mean μ and unknown variance σ^2 . Which of the following statements best describes the likelihood of the data Y in this situation?

- The probability of observing heights with a mean at least as extreme as $\bar{Y}$, given μ and σ^2.

- The probability of observing the data, given μ , σ^2, and the prior.

Incorrect Response

Recall the definition of likelihood, which is the probability of the data given the unknown parameters.

This question refers to the following learning objective(s):

- Define the concepts of prior, likelihood, and posterior probability and identify how they relate to one another

- The probability of observing the data, given the prior beliefs about the distribution of μ and σ^2 .

- The probability of observing the data, given μ, σ^2.

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1 / 1
points

3.

Recall the probability distribution of a Poisson random variable X:

$$P(X = x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

where λ is the rate parameter that equals the expected value of X .

John is analyzing traffic patterns on a country road. He believes that the number of cars that come during a given hour follows a Poisson distribution with rate λ. Further, he believes that either $\lambda = 1$, $\lambda = 2$, or $\lambda = 4$ and assigns equiprobable beliefs to each of the possible values of λ. He observes traffic for one hour and records a total of three cars passing.

Consider the following hypotheses:

H0: $\lambda < 2$

H1: $\lambda = 2$

H2: $\lambda > 2$

Which of the hypotheses has the greatest posterior probability?

- H_2

Correct Response
This question refers to the following learning objective(s):

- Use Bayes' rule to compare multiple hypotheses about a discrete random variable: Work with the discrete form of Bayes' rule.

- H_1
- H_0

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1 / 1
points

4.
Suppose you are given a coin and told that it is either a fair coin or a trick coin. You do not know whether the coin is fair (p = 0.5) or whether it always comes up heads (p = 1) and assign an initial prior probability q that your coin is a trick coin. In terms of q and assuming q < 0.95, how many heads in a row N need to come up for the posterior probability of a trick coin to be greater than 0.95?

- $N > -\log_2(\frac{q}{19(1-q)})$

Correct Response

This question refers to the following learning objective(s):

- Update prior probabilities through an iterative process of data collection

○ $N > -\log_2(\frac{1-q}{19q})$

○ $N > -\log_2(\frac{q}{20(1-q)})$

○ $N > -\log_2(\frac{1-q}{20q})$

✖ 0 / 1 points

5.

Which of the following corresponds to a Bayesian interpretation of the statement “the probability of Liverpool defeating Swansea City tomorrow is 90 percent”?

○ Liverpool would beat Swansea City nine times out of ten.

○ We would be indifferent to betting on Liverpool to win at 1:9 odds.

○ Liverpool is a heavy favorite to beat Swansea City.

Incorrect Response

In the Bayesian paradigm, probability is a degree of belief, which can be quantified in terms of wager preference and/or indifference.

This question refers to the following learning objective(s):

- Understand the differences between Frequentist and Bayesian definitions of probability and how they apply to inference

○ Teams as good as Liverpool have historically beaten teams as good as Swansea City 90 percent of the time.

✖ 0 / 1 points

6.

Which of the following statements can be used to describe a 95 percent Bayesian credible interval for a parameter μ, but not a 95 percent Frequentist confidence interval?

- The probability that μ falls within the interval is .95
- μ is in this interval 95 percent of the time.
- If we ran an infinite number of experiments, 95 percent of our intervals generated this way would contain the true value of μ .

Incorrect Response

An advantage of a credible interval, rather than a confidence interval, is that it allows us to express our uncertainty in terms of probabilities.

This question refers to the following learning objective(s):

- Understand the differences between Frequentist and Bayesian definitions of probability and how they apply to inference

- μ is either in the interval, or it is not. More data can increase or decrease our uncertainty that μ is in the interval.

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0 / 1
points

7.

Hearing about your brilliant success in working with M&Ms, Mars Inc. transfers you over to the Skittles department. They recently have had complaints about tropical Skittles being mixed in with original Skittles. You decide to conduct a frequentist analysis. Although you are confident that the quality control measures result in less than 1% of all regular Skittles accidentally being tropical Skittles, you understand that things need to change if the complaints are true, so you set the significance level $\alpha = 0.1$. Randomly sampling 300 supposedly original Skittles, you find that five of them are tropical. What are your findings? Hint- $H_0 : p \leq 0.01$ and $H_1 : p > 0.01$.

- Fail to reject H_0, since the p-value is equal to 0.184, which is greater than $\alpha = 0.1$
- Fail to reject H_0, since the p-value is equal to 0.101, which is greater than $\alpha = 0.1$
- Reject H_0, since the p-value is equal to 0.027, which is less than $\alpha = 0.1$

Incorrect Response

In this case, the p-value is the probability of observing at least 5 tropical Skittles in 300 trials, given that the null hypothesis (H_0) of less than 1\% tropical Skittles is true.

This question refers to the following learning objective(s):

- Conduct both a Bayesian and Frequentist analysis of data to make inferences about a proportion

- Fail to reject H_0, since the p-value is equal to 0.245, which is greater than $\alpha = 0.1$

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0 / 1
points

8.
You decide to conduct a statistical analysis of a lottery to determine how many possible lottery combinations there were. If there are N possible lottery combinations, each person has a 1/N chance of winning. Suppose that 413,271,201 people played the lottery and three people won. You are told that the number of lottery combinations is a multiple of 100 million and less than 1 billion, but have no other prior information to go on. What is the posterior probability that there were **fewer** than 600 million lottery combinations?

- 0.269

- 0.390

Incorrect Response
For each value of N from 100 million to 900 million, in increments of 100 million, calculate the probability of observing 3 winners, where the probability of success is 1/N. Use the likelihood and a uniform prior to calculate the posterior.

This question refers to the following learning objective(s):

- Conduct both a Bayesian and Frequentist analysis of data to make inferences about a proportion

- 0.511

- 0.894

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1 / 1

points

9.
You are testing dice for a casino to make sure that sixes do not come up more frequently than expected. Because you do not want to manually roll dice all day, you design a machine to roll a die repeatedly and record the number of sixes that come face up. In order to do a Bayesian analysis to test the hypothesis that p = 1/6 versus p = .175 , you set the machine to roll the die 6000 times. When you come back at the end of the day, you discover to your horror that the machine was unable to count higher than 999. The machine says that 999 sixes occurred. Given a prior probability of 0.8 placed on the hypothesis p = 1/6 , what is the posterior probability that the die is fair, given the censored data? Hint - to find the probability that at least x sixes occurred in N trials with proportion p (which is the likelihood in this problem), use the R command :

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1-pbinom(x-1,N,p)
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- 0.500
- 0.684

Correct Response
This question refers to the following learning objective(s):

- Use Bayes' rule to compare multiple hypotheses about a discrete random variable
- Work with the discrete form of Bayes' rule

- 0.800
- 0.881

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1 / 1
points

10.
True or False: As long as the prior places non-zero probability on all possible values of a proportion, the posterior of the proportion is guaranteed to converge to the true proportion as the sample size approaches infinity.

- True

Correct Response

This question refers to the following learning objective(s):

- Define the concepts of prior, likelihood, and posterior probability and identify how they relate to one another

False