Week 3 Quiz

7/10 points earned (70%)

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.

Back to Week 3

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points

1.
For which of the following situations would a quadratic loss function make the most sense?

- Your prediction for the number of bikes sold this year by a local bike shop.
- Your answer choice on a Coursera multiple choice quiz.
- Your prediction as to whether it will rain tomorrow.
- A doctor's estimate for the life expectancy of a terminally ill patient.

Correct
Correct Answer. Large mistakes in estimating life expectancy would particularly painful for both the patient and their family.

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

- Understand the concept of loss functions and how they relate to Bayesian decision making.

1 / 1
points

2.

Fill in the blank: Under a **linear loss function**, the summary statistic that minimizes the posterior expected loss is the ________ of the posterior.

- Mean
- Mode
- Median

Correct

Correct Answer. The median is the summary statistic that minimizes the posterior expected loss under the linear loss function.

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

- Understand the concept of loss functions and how they relate to Bayesian decision making.

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1 / 1 points

3.

You are employed in the Human Resources department of a company and are asked to predict the number of employees that will quit their jobs in the coming year. Based on a Bayesian analysis of historical data, you determine the posterior predictive distribution of the number of quitters to follow a Poisson($\lambda = 10$) distribution. Given a **quadratic** loss function, what is the prediction that minimizes posterior expected loss?

- a. 9
- b. 10

Correct

Correct Answer. 10 is the posterior mean of Poisson($\lambda = 10$). Since the loss function is quadratic, the mean of the posterior distribution minimizes the posterior expected loss.

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

- Make optimal decisions given a posterior distribution and a loss function.

- c. 11

d. Either a or b

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0 / 1
points

4.
Suppose you are testing a new drug to determine whether it is more effective than an existing drug. Let H_0 denote the hypothesis that the new drug is no more effective than the existing drug and H_1 denote the hypothesis that the new drug is more effective than the existing drug. If you accept H_1 when in fact H_0 is true, the loss is 100. If you accept H_0 when in fact H_1 is true, the loss is 40. Assume that no loss is incurred if you accept a true hypothesis. At what posterior probability of H_0 will you be indifferent between the two hypotheses?

$\frac{2}{5}$

$\frac{2}{7}$

$\frac{1}{4}$

This should not be selected
If p is the posterior probability that H_0 is true, then the expected loss under H_0 is $40(1-p)$ and the expected loss under H_1 is $100p$. Set the two equal and solve for p.

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

- Decide between hypotheses given a loss function: Make optimal decisions given a posterior distribution and a loss function.

$\frac{1}{3}$

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1 / 1
points

5.
You are testing a hypothesis H_1 against an alternative hypothesis H_2 using Bayes Factors. You calculate $BF[H_1 : H_2]$ to be 42.7. According to guidelines first given by Jeffreys (and presented in the lecture), what conclusion can be drawn from the data?

The data provides strong evidence against H_1.

- The data provides decisive evidence against H_1.
- The data provides strong evidence against H_2.

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

- Compare multiple hypotheses using Bayes Factors.

- The data provides decisive evidence against H_2.

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1 / 1
points

6.
Suppose that you are trying to estimate the true proportion p of male births in the United States. Starting with a uniform prior (Beta(1,1)) on p, you randomly sample 10,000 birth certificates, observing 5029 males and 4971 females. What is the posterior probability that p is less than or equal to 0.5? (Hint: use function(s) in R to answer this question)

- 0.27
- 0.28

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

- Conceptualize Lindley's paradox and how the Bayes Factor depends on prior elicitation
- Make inferences about a proportion using a conjugate Beta prior.

- 0.29
- 0.30

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1 / 1
points

7.

Suppose that you are trying to estimate the true proportion p of male births in the United States. You want to evaluate two hypotheses against each other: first the null hypothesis (H_0) that $p = 0.5$ and an alternative hypothesis (H_1) that $p \neq 0.5$. To do this, you assign a point-null prior to $p = 0.5$ under H_0 and a uniform $Beta(1, 1)$ prior to p under H_1. Then, if we define k to be the number of male births out of a total sample of n birth certificates,

$$P(k|H_0) = \binom{n}{k} 0.5^k (1 - 0.5)^{n-k}$$

$$P(k|H_1) = \int_0^1 \binom{n}{k} p^k (1-p)^{n-k} dp = \frac{1}{n+1}$$

Using the dbinom function in R calculate the Bayes Factor $BF[H_1 : H_0]$ if you observed 5029 male births out of 10,000 birth certificates.

- $BF[H_1 : H_0] = 67.44$
- $BF[H_1 : H_0] = 8.33$
- $BF[H_1 : H_0] = 0.12$
- $BF[H_1 : H_0] = 0.015$

Correct

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

- Conceptualize Lindley's paradox and how the Bayes Factor depends on prior elicitation
- Compare multiple hypotheses using Bayes Factors.

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0 / 1
points

8.

Suppose you are trying to infer the difference in the proportion of yellow M&Ms between two bags of M&Ms. Each bag is estimated to contain roughly 30 M&Ms. To make inferences about the proportion, you draw 10 M&Ms from each bag **without** replacement and record the number of yellow M&Ms in each bag.

Is there a problem with the experimental design? If so, what is it?

- Yes, the probability of drawing a yellow M&M is not independent within groups.
- There is no problem with the experimental design.

This should not be selected
Because we are sampling without replacement and the population size is small, for a given proportion p of yellow M&Ms, our draws are not independent and cannot be modeled b.

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

- Identify assumptions relating to a statistical inference.

Yes, the probability of drawing a yellow M&M is not independent between groups.

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0 / 1
points

9.
Suppose that when testing $H_0 : \mu = 0$ versus $H_1 : \mu \neq 0$ using Bayes Factors, we get the posterior probability $P(H_0 \mid \text{data}) = 0.6$. Conditional on H_1, the posterior mean of μ is 1.25. Under **quadratic** loss, what is the point estimate for μ that minimizes expected posterior loss?

0

This should not be selected
Under quadratic loss, the mean minimizes expected posterior loss. Use the posterior probabilities of each hypothesis to weight their respective means. Hint - if $H_0 : \mu = 0$ what is the posterior mean of μ under H_0?

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

- Create point estimates and credible intervals by averaging over multiple hypotheses
- Make optimal decisions given a posterior distribution and a loss function.

0.5

1

1.25

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1 / 1
points

10.
True or False: The use of the reference prior $Beta(1/2, 1/2)$ has little bearing on the posterior distribution of a proportion p, provided that the sample size is sufficiently large.

- True

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

- Conceptualize Lindley's paradox and how the Bayes Factor depends on prior elicitation.

- False