Week 3 Quiz

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10/10 points earned (100%)

Quiz passed!

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1 / 1 points

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

- Your prediction as to whether it will rain tomorrow.
- Your prediction for the number of bikes sold this year by a local bike shop.
- 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.

- Your answer choice on a Coursera multiple choice quiz.

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1 / 1 points

2.
Fill in the blank: Under a **quadratic loss function**, the summary statistic that minimizes the posterior expected loss is the ________ of the posterior.

Mean

Correct

Correct Answer. The mean is the summary statistic that minimizes the posterior expected loss under the quadratic 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

Median

Mode

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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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1 / 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?

- $\frac{1}{4}$
- $\frac{2}{5}$
- $\frac{1}{3}$
- $\frac{2}{7}$

Correct
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.

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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 strong prior (Beta(500,500)) on the proportion, 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

0.29

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.

0.30

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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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1 / 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 **with** 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?

- There is no problem with the experimental design.

Correct

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

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1 / 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
- 0.5

Correct
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.

- 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