Week 2 Quiz

8/10 points (80%)

Quiz, 10 questions

Congratulations! You passed!

Next Item

1 / 1 points

1. An obesity researcher is trying to estimate the probability that a random male between the ages of 35 and 44 weighs more than 270 pounds. In this analysis, weight is:

- A continuous random variable, since weight can theoretically take on any non-negative value in an interval.

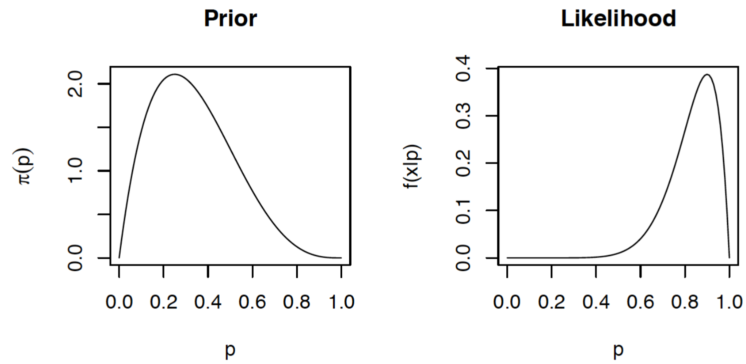
Correct
This question refers to the following learning objective(s):

- Identify the difference between a discrete and continuous random variable and define their corresponding probability functions

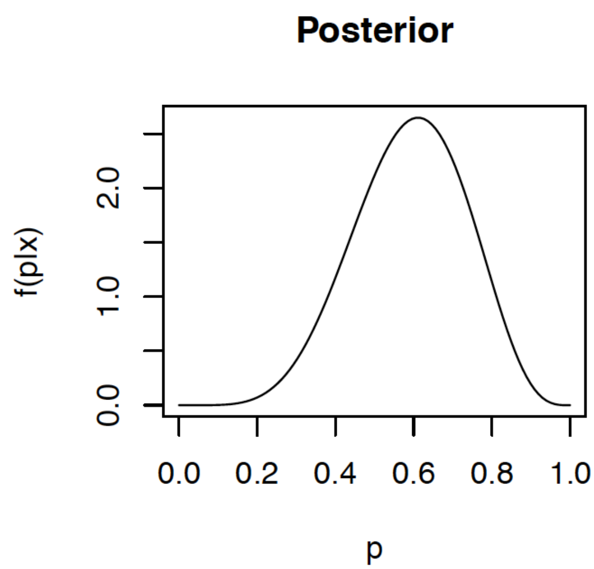
- A discrete random varible, since weights are often measured to the nearest pound.
- A continuous random variable, since the prior probability that a random male between the ages of 35 and 44 weighs more than 270 pounds gives non-zero probability to all values between 0 and 1.
- A discrete random variable, since the number of men who weigh more than 270 pounds can take on only integer values.

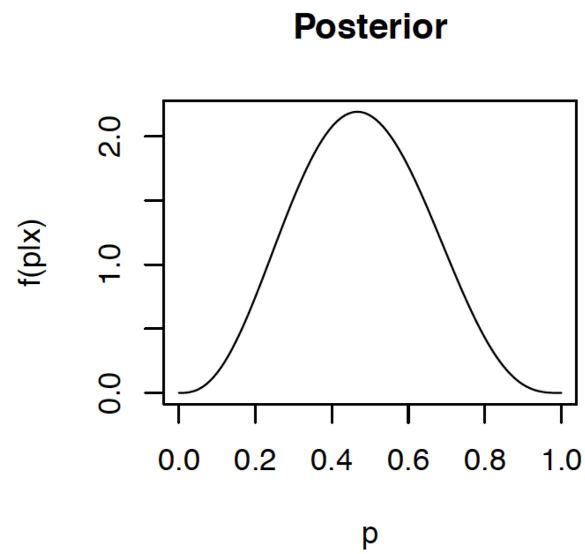
1 / 1
points

2. Below are plots of the prior distribution for a proportion p and the likelihood as a function of p based on 10 observed data points.

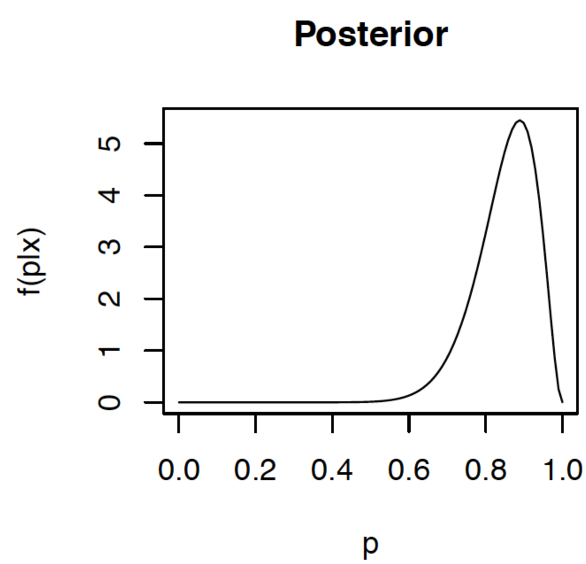


which of the following is most likely to be the posterior distribution of θ?

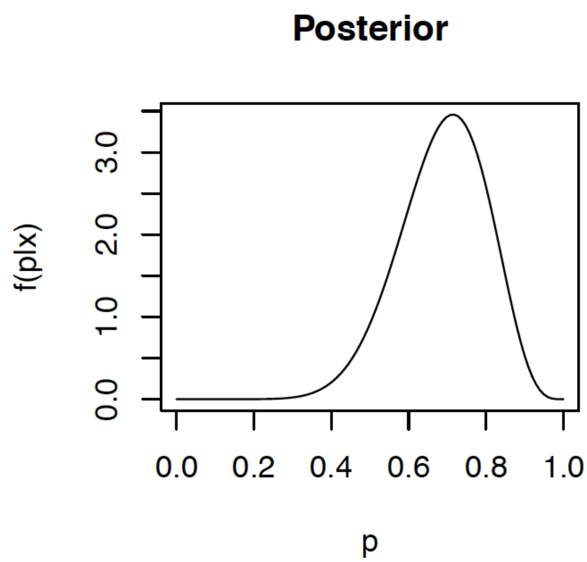




Posterior
f(p|x)
2.0
1.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
p



Posterior
f(p|x)
5
4
3
2
1
0
0.0
0.2
0.4
0.6
0.8
1.0
p



Correct
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

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1 / 1 points

3. Which of the following distributions would be a good choice of prior to use if you wanted to determine if a coin is fair when you have a **strong** belief that the coin is biased towards heads? (Assume a model where we call heads a success and tails a failure).

- Beta(90, 10)

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

- Elicit prior beliefs about a parameter in terms of a Beta, Gamma, or Normal distribution

- Beta(9, 1)

- Beta(10, 90)
- Beta(50, 50)
- Beta(1, 9)

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1 / 1 points

4. If John is trying to perform a Bayesian analysis to make inferences about the proportion of defective electric toothbrushes, which of the following distributions represents the a conjugate prior for the proportion p ?

- Gamma
- Normal
- Beta

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

- Understand the concept of conjugacy and know the Beta-Binomial, Poisson-Gamma, and Normal-Normal conjugate families

- Poisson

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1 / 1 points

5. You are hired as a data analyst by politician A. She wants to know the proportion of people in Metrocity who favor her over politician B. From previous poll numbers, you place a Beta(40,60) prior on the proportion. From polling 200 randomly sampled people in Metrocity, you find that 103 people prefer politician A to politician B. What is the posterior distribution of the proportion of voters who favor politician A?

- Beta(143, 157)

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

- Make inferences about a proportion using a conjugate Beta prior

- Beta(163, 137)
- Beta(103, 97)
- Beta(142, 156)

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1 / 1 points

6. A young meteorologist is trying to estimate the expected number of tropical cyclones that occur in a given year. He assumes that the number of observed tropical cyclones in a year follows a Poisson distribution with rate λ that is consistent across years. Because the meteorologist is inexperienced, he assigns a relatively uninformative $Gamma(k = .5, \theta = 2)$ prior distribution to λ. During his first five years, he observes a total of 49 cyclones. If he were to collect more data about tropical cyclones in future years, what should his prior be?

- $Gamma(k = 49, \theta = 7)$
- $Gamma(k = 49.5, \theta = 2/11)$

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

- Make inferences about a proportion using a conjugate Beta prior
- Make inferences about a rate of arrival using a conjugate Gamma prior

- Update prior probabilities through an iterative process of data collection

- $Gamma(k = 49.5, \theta = 7)$
- $Gamma(k = 49.5, \theta = 2/21)$

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1 / 1 points

7. Suppose that the number of fish that Hans catches in an hour follows a Poisson distribution with rate λ. If the prior on λ is Gamma(1,1) and Hans catches no fish in five hours, what is the posterior distribution for λ?

- $Gamma(k = 2, \theta = 1/5)$
- $Gamma(k = 1, \theta = 1/6)$

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

- Make inferences about a rate of arrival using a conjugate Gamma prior

- $Gamma(k = 1, \theta = 1/5)$
- $Gamma(k = 2, \theta = 1/6)$

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0 / 1 points

8. The posterior distribution for a mean of a normal likelihood, with a known variance σ^2 and data $x_1, x_2, \ldots, x_n$, and a normal prior with mean μ_0 and variance σ_0^2 has the following distribution:

$$\mu \sim N\left(\left(\frac{\mu_0}{\sigma_0^2} + \frac{\sum_{i=1}^n x_i}{\sigma^2}\right) \Big/ \left(\frac{1}{\sigma_0^2} + \frac{n}{\sigma^2}\right), \left(\frac{1}{\sigma_0^2} + \frac{n}{\sigma^2}\right)^{-1}\right).$$

If you were to collect a large amount of data, how can you simplify the formulas given above? Hint - both n and $\sum_{i=1}^{n} x_i$ are very large relative to μ_0 and σ_0^2.

- $\mu \sim N\left(\mu_0, \frac{\sigma_0^2}{n}\right)$
- $\mu \sim N\left(\frac{\sum_{i=1}^{n} x_i}{n}, \sigma^2\right)$
- $\mu \sim N\left(\frac{\sum_{i=1}^{n} x_i}{n}, \frac{\sigma^2}{n}\right)$
- $\mu \sim N\left(\mu_0, \sigma_0^2\right)$

This should not be selected

For a large amount of data, $\frac{\mu_0}{\sigma_0^2}$ makes a negligible contribution to the term $\frac{\mu_0}{\sigma_0^2} + \frac{\sum_{i=1}^{n} x_i}{\sigma^2}$ and $\frac{1}{\sigma_0^2}$ similarly makes a negligible contribution to $\frac{1}{\sigma_0^2} + \frac{n}{\sigma^2}$

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

- Make inferences about the mean of a normal distribution when the variance is known

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1 / 1 points

9. A scientist is interested in estimating the average weight of male golden hamsters. They decide to use a Bayesian approach to estimate μ by creating a credible interval using a weakly informative prior. The posterior distribution gives a 95% credible interval spanning 3.3 - 4.0 oz. According to this model, what is the probability that μ does **not** fall within this range?

- 2.5%
- 5%

Correct

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

- Articulate the differences between a Frequentist confidence interval and a Bayesian credible interval

- 95%
- Either 0 or 1 since μ is fixed, and must either be inside or outside the interval

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✖

0 / 1 points

10. Suppose you are given a coin and told that the die is either biased towards heads (p = 0.75) or biased towards tails (p = 0.25). Since you have no prior knowledge abou the bias of the coin, you place a prior probability of 0.5 on the outcome that the coin is biased towards heads. You flip the coin twice and it comes up tails both times. What is the posterior probability that your next flip will be heads?

- 1/3
- 3/10
- 3/8
- 2/5

This should not be selected
Use the discrete form of Bayes' rule to find the posterior probability that the coin is biased toward heads. Then find the probability that the next flip is heads for each of the two possibilities (heads-bias or tails-bias) to find the posterior predictive probability.

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

- Derive the posterior predictive distribution for very simple experiments
- Work with the discrete form of Bayes' rule