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:

1 / 1 point

- ○ A discrete random variable, since the number of men who weigh more than 270 pounds can take on only integer values.
- ○ 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 continuous random variable, since weight can theoretically take on any non-negative value in an interval.
- ○ A discrete random varible, since weights are often measured to the nearest pound.

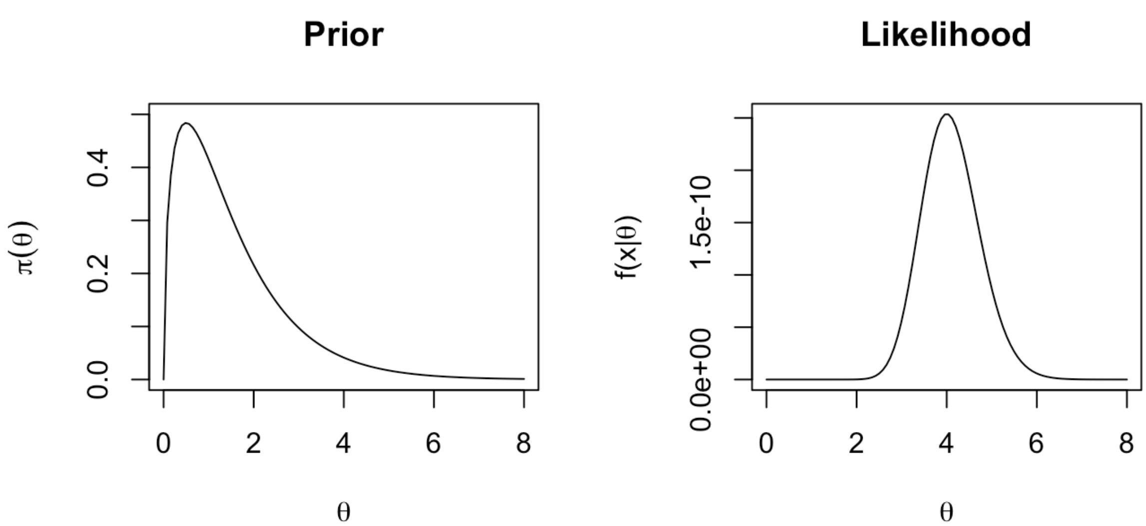
✓ **Correct**

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

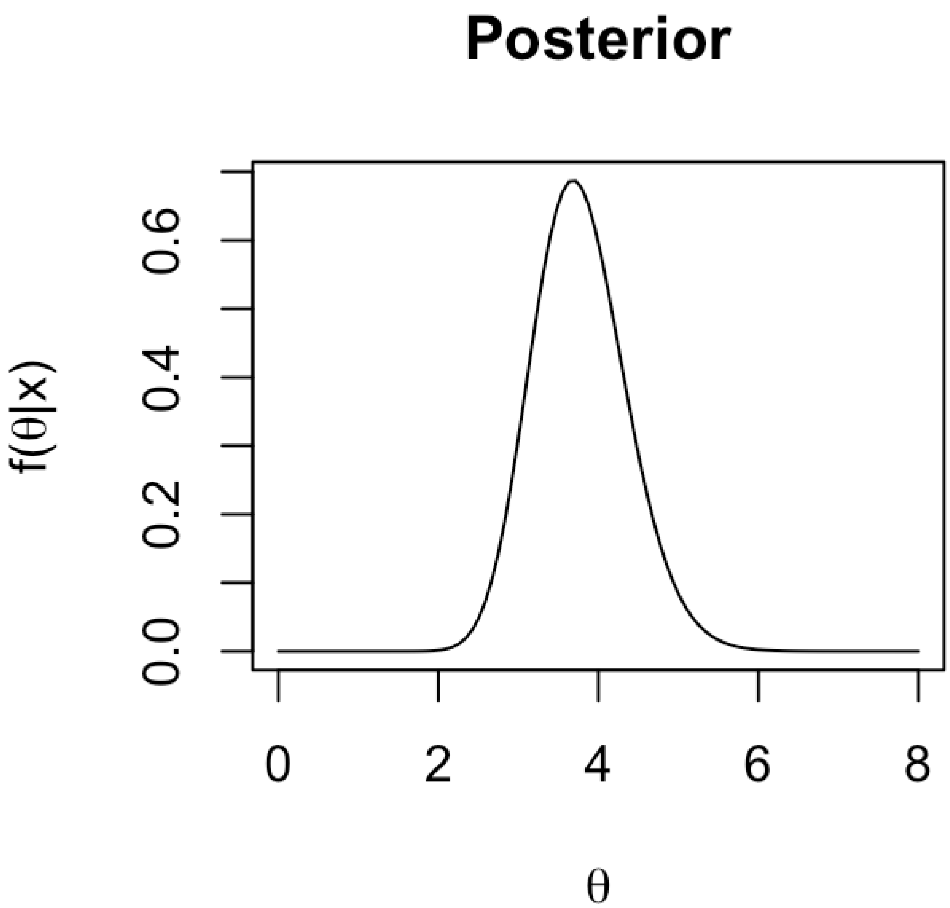
2. Below are plots of the prior distribution for a parameter θ and the likelihood as a function of θ based on 10 observed data points.

1 / 1 point

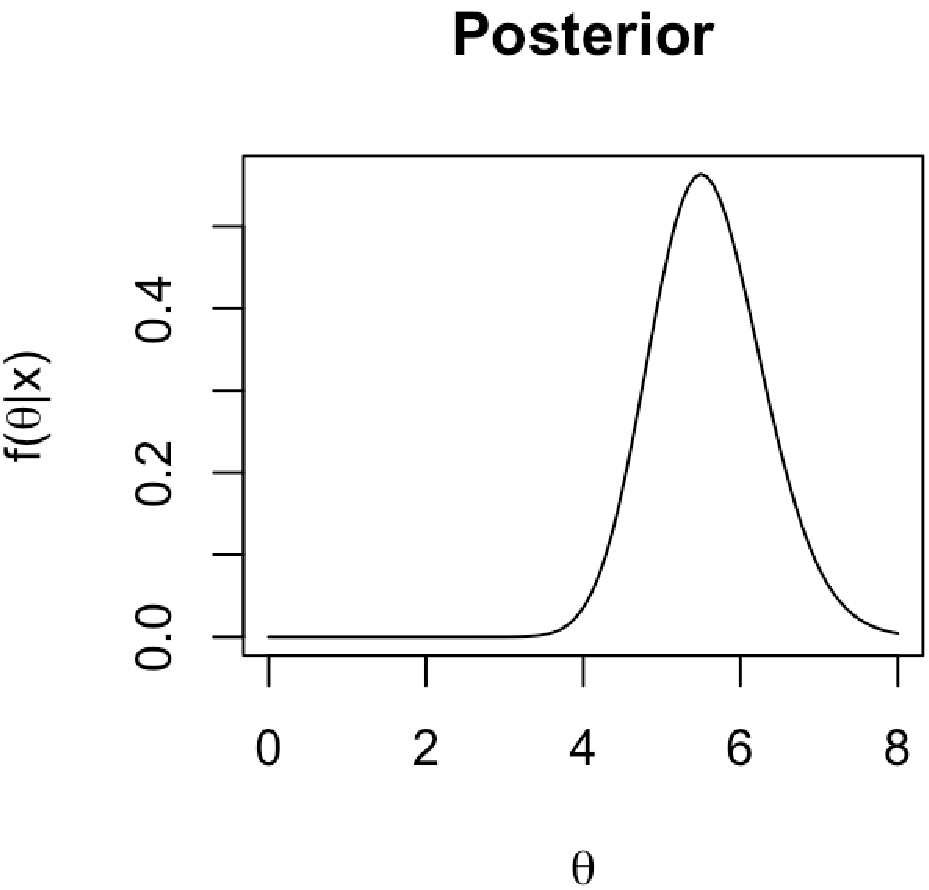


which of the following is most likely to be the posterior distribution of θ?

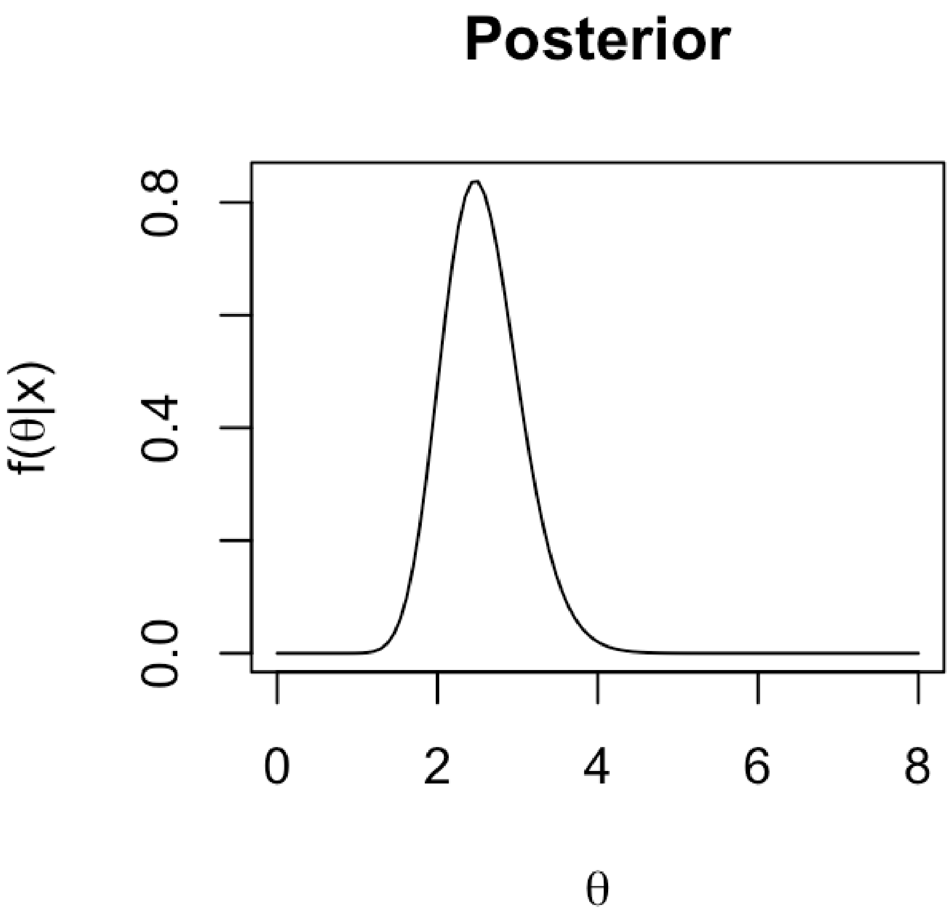
A.



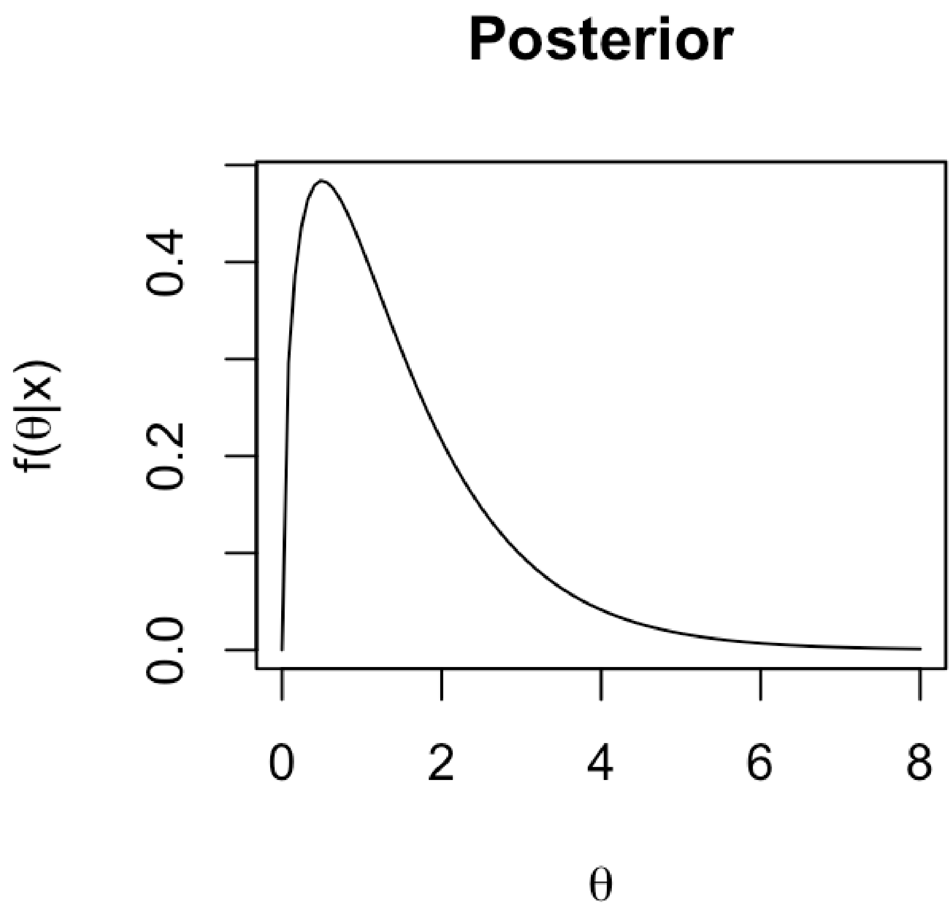
B.



C.



D.



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

3. Which of the following distributions would be the best 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).

1 / 1 point

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

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

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

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 ?

1 / 1 point

- ( ) Gamma
- ( ) Normal
- (•) Beta
- ( ) Poisson

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

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 probability that the majority of people prefer politician A to politican B (i.e. P(p>0.5|data))?

1 / 1 point

- ○ 0.198
- ◉ 0.209
- ○ 0.664
- ○ 0.934

Correct

Recall that if the prior is $Beta(\alpha, \beta)$, then the posterior with x successes in $n trials$ is $Beta(\alpha + x, \beta + n - x)$. Use the **pbeta** function in R to find the posterior probability that $p > 0.5$.

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

- Make inferences about a proportion using a conjugate Beta prior

6. An engineer has just finished building a new production line for manufacturing widgets. They have no idea how likely this process is to produce defective widgets so they plan to run two separate runs of 15 widgets each. The first run produces 3 defective widgets and the second 5 defective widgets.

1 / 1 point

We represent our lack of apriori knowledge of the probability of producing a defective widgets, *p*, using a flat, uninformative prior -*Beta*(1,1). What should the posterior distribution of *p* be after the first run is finished? And after the second?

- ○ After the first run, *Beta*(4,13). After the second run, *Beta*(6,11).
- ○ After the first run, *Beta*(3,12). After the second run, *Beta*(8,22).
- ○ After the first run, *Beta*(3,12). After the second run, *Beta*(5,10).
- ◉ After the first run, *Beta*(4,13). After the second run, *Beta*(9,23).

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

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?

0 / 1 point

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

Incorrect

Since the Gamma distribution is conjugate to the Poisson distribution, the posterior will be Gamma with parameter value $k + \sum x_i$ and $\theta/(n\theta + 1)$, where k and θ represent the parameters of the prior distribution.

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

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

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:

0 / 1 point

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

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.

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

Incorrect

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

9. True or False: When constructing a 95% credible interval, a good rule of thumb is to use the shortest of all such intervals.

1 / 1 point

- (selected) True
- False

Correct

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

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

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 / 1 point

- 1/3
- (selected) 3/10
- 2/5
- 3/8

Correct

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