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Week 1 Quiz

✖ **2/10** points earned (20%)

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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0 / 1
points

1.
A New York City cab was involved in a hit-and-run accident last night. Five witnesses reported the incident, four of whom said that the cab was green and one of whom said that the cab was yellow. Assume each witness correctly identifies the color of a cab with probability 2/3. It is known that 85% of registered cabs in New York City are yellow and 15% are green. Based on this information, what is the probability that the cab was green?

- 58.5%
- 41.5%

Incorrect Response
We are trying to find the probability that the cab was green, not yellow.

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

- Work with the discrete form of Bayes' rule

- 88.9%
- 15.0%

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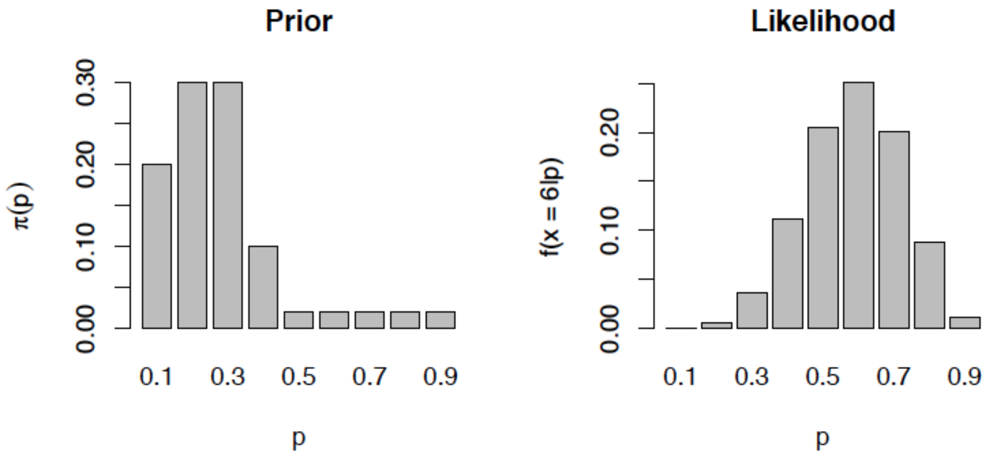
1 / 1

points

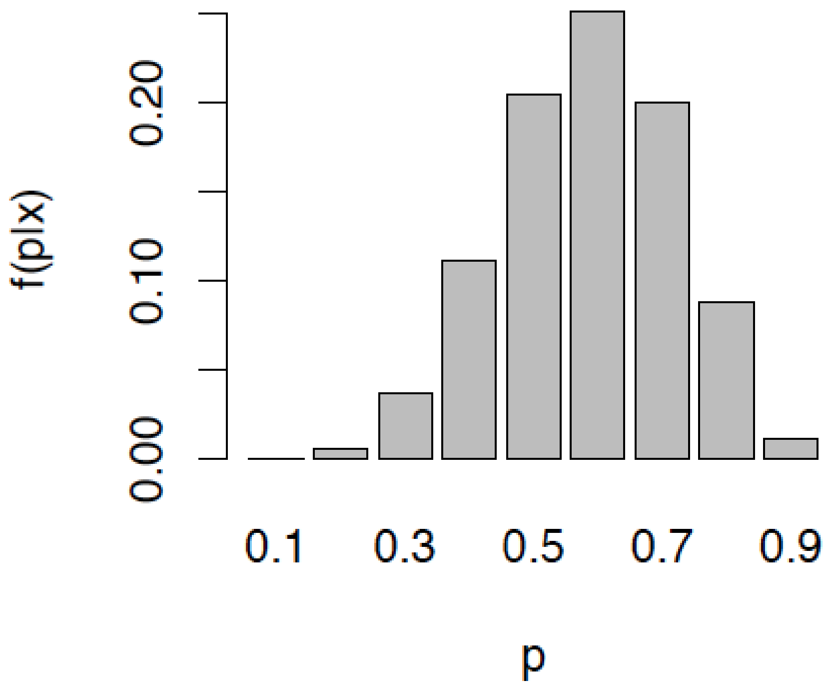
2.

Below are plots of the prior distribution for a success probability p and the likelihood as a function of p, where six successes were observed in ten trials.



Which of the following is most likely to be the posterior distribution for the proportion p?

○



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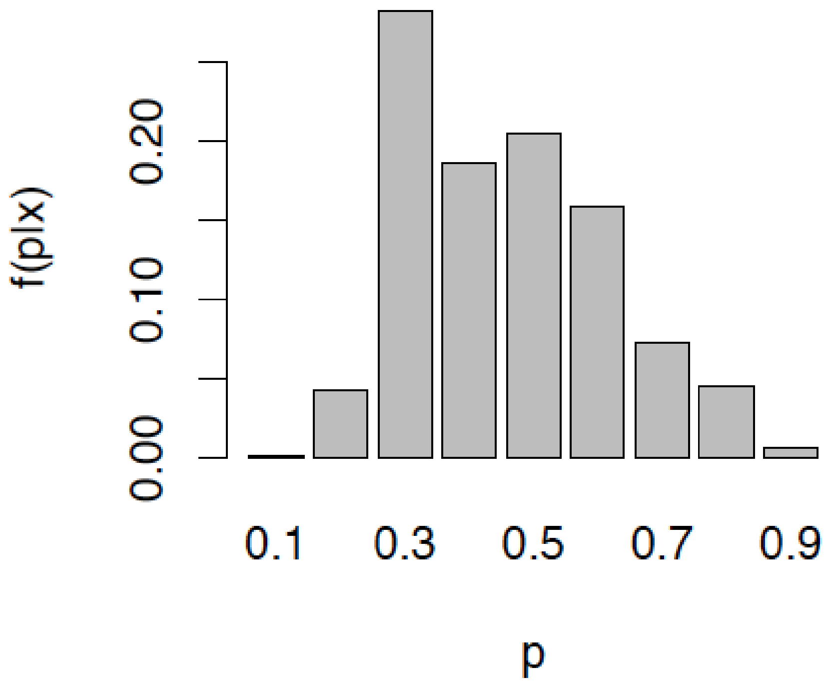
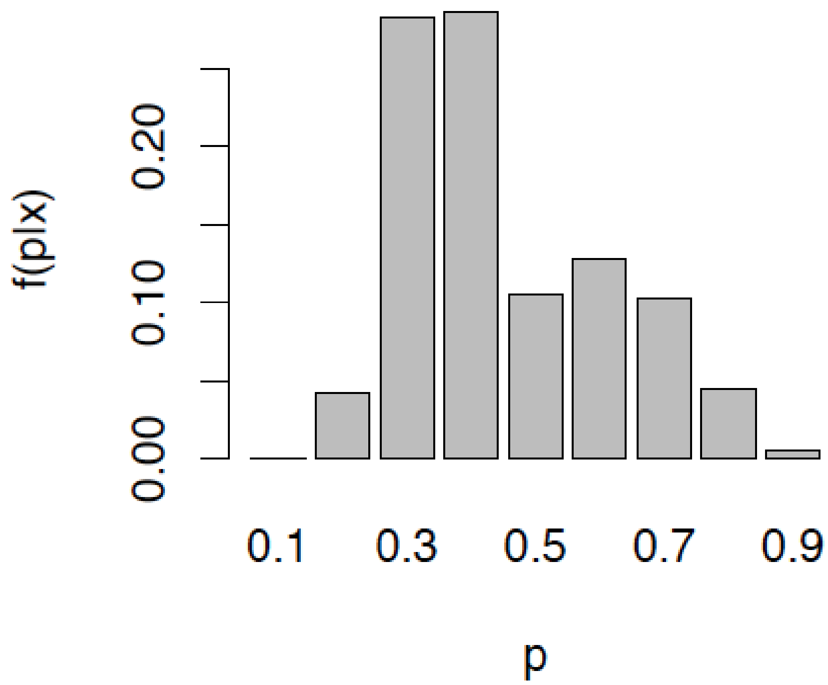
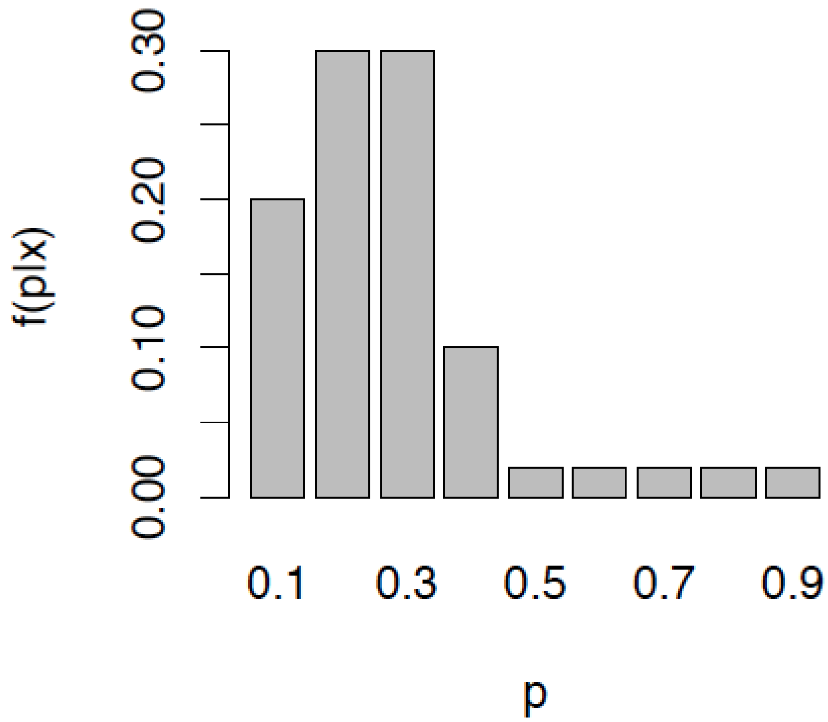




Correct Response

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



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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

H_1

H_0

Incorrect Response

Since each value of _ is equiprobable, the prior probability that λ takes on each of the three values is 1/3. Use the probability mass function of the Poisson distribution as the likelihood.

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

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0 / 1 points

4.

The posterior distribution after running two identical experiments is the same as that after running the second experiment with the posterior of the first experiment as the prior.

True

False

Incorrect Response

A feature of Bayesian statistics is that our posterior beliefs update after each new data point comes in. Our posterior after seeing some data becomes our new prior before we acquire more data

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

- Update prior probabilities through an iterative process of data collection

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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"?

- We would be indifferent to betting on Liverpool to win at 1:9 odds.
- Teams as good as Liverpool have historically beaten teams as good as Swansea City 90 percent of the time.

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

- Liverpool would beat Swansea City nine times out of ten.
- Liverpool is a heavy favorite to beat Swansea City.

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0 / 1 points

6.

Sander runs a controlled experiment to test the hypothesis that rats treated with 10 mg of Vitamin A have higher mortality rates than rats not given Vitamin A. After every death, he checks to see whether the p-value under the null hypothesis of no difference is below 0.05. If the p-value is greater than 0.05, he keeps collecting data. Otherwise, he stops collecting data and reports his results. If, after 10,000 deaths, he does not get significant results, he stops. Under a **Bayesian** framework, what is the problem with Sander's experimental design?

- There is no problem with Sander's design; the posterior only depends on the entirety of the data and the prior beliefs before the experiment.
- By making a stopping rule that was dependent on his results, he made it more probable that he would get results suggesting Vitamin A increases rat mortality rates.

Incorrect Response

As long as the data are collected in the same way, with Bayesian inference, we iteratively update our beliefs as new data come in. It does not matter when we stop collecting data; our beliefs are based only on the data and the prior, not on possible future observations that we could have collected.

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

- The posterior distribution will be biased, since Sander was intent on getting a specific result before the experiment began

- Sander excluded the possibility of getting a p-value larger than 0.05 by stopping the experiment prematurely

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points

7.
A new breast cancer screening method is tested to see if it performs better than existing methods in detecting breast cancer. To measure the sensitivity of the test, a total of 10,000 patients known to have various stages of breast cancer are testing using the new method. Of those 10,000 patients, 9,942 are diagnosed by the new method to have breast cancer. Given that the best current methods have 99.3% sensitivity, is there significant evidence at the $\alpha = 0.05$ level to conclude that the new method has higher sensitivity than existing methods? Hint - $H_0 : p \leq 0.993$ and $H_1 : p > .993$

- Yes, since the p-value under H_0 of no difference is approximately equal to 0.048, which is less than $\alpha = 0.05$

- Yes, since the p-value under H_0 of no difference is approximately equal to 0.033, which is less than $\alpha = 0.05$

Incorrect Response
Remember, the p-value under H_0 in this case is the probability of observing at least 9942 out of 10,000 correct diagnoses, given that the true rate is 99.3%

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

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

- No, since the p-value under H_0 of no difference is approximately equal to 0.063, which is greater than $\alpha = 0.05$

- No, since the p-value under H_0 of no difference is approximately equal to 0.081, which is greater than $\alpha = 0.05$

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points

8.
In the NFL, a professional American football league, there are 32 teams, of which 12 make the playoffs. In a typical season, 20 teams (the ones that don't make the playoffs) play 16 games, 4 teams play 17 games, 6 teams play 18 games, and 2 teams play 19 games. At the beginning of each game, a coin is flipped to determine who gets the football first. You are told that an unknown team won ten of its coin flips last season. Given this information, what is the posterior probability that the team did not make the playoffs (i.e. played 16 games)?

- 0.556
- 0.589
- 0.612

Incorrect Response
The number of coin flips a team wins follows a Binomial distribution with p = 0.5 and N unknown. Place a prior on N corresponding to the number of teams that play the respective number of games in a given season divided by the total number of teams.

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

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

- 0.625

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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)
```

- 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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0 / 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
- False

Incorrect Response

As N increases, the likelihood washes out the prior and the likelihood approaches the true parameter value by the law of large numbers.

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