Week 1 Quiz

4/10 points earned (40%)

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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1 / 1
points

1.
You draw two balls from one of three possible large urns, labelled A, B, and C. Urn A has 1/2 blue balls, 1/3 green balls, and 1/6 red balls. Urn B has 1/6 blue balls, 1/2 green balls, and 1/3 red balls. Urn C has 1/3 blue balls, 1/6 green balls, and 1/2 red balls. With no prior information about which urn your are drawing from, you draw one red ball and one blue ball. What is the probability that you drew from urn C?

- 6/11

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

- Work with the discrete form of Bayes' rule

- 1/3
- 5/9
- 19/36

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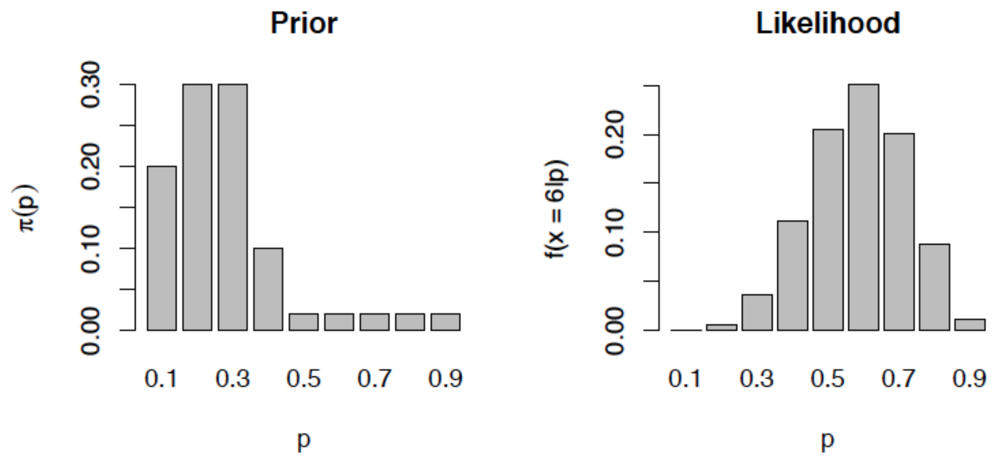
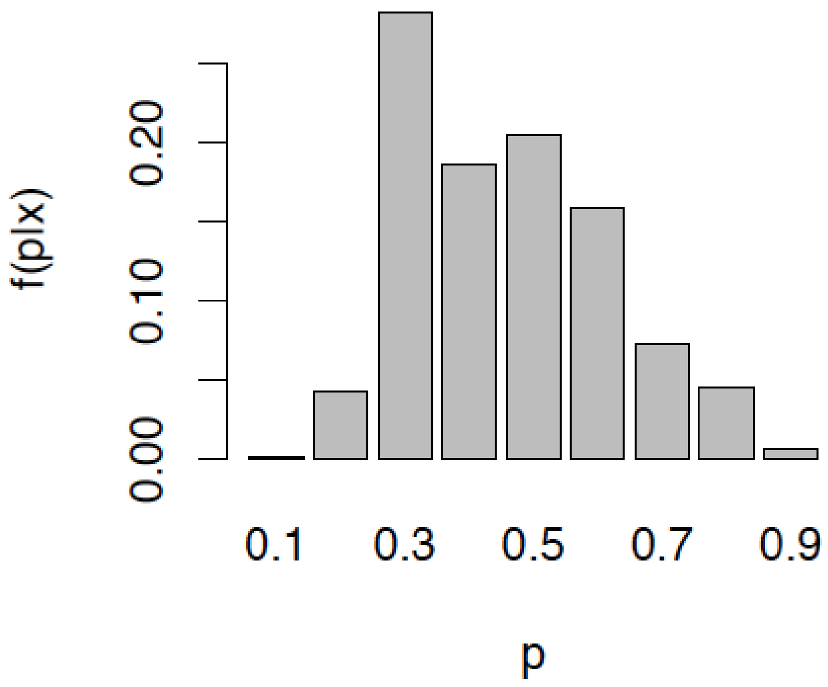
0 / 1
points

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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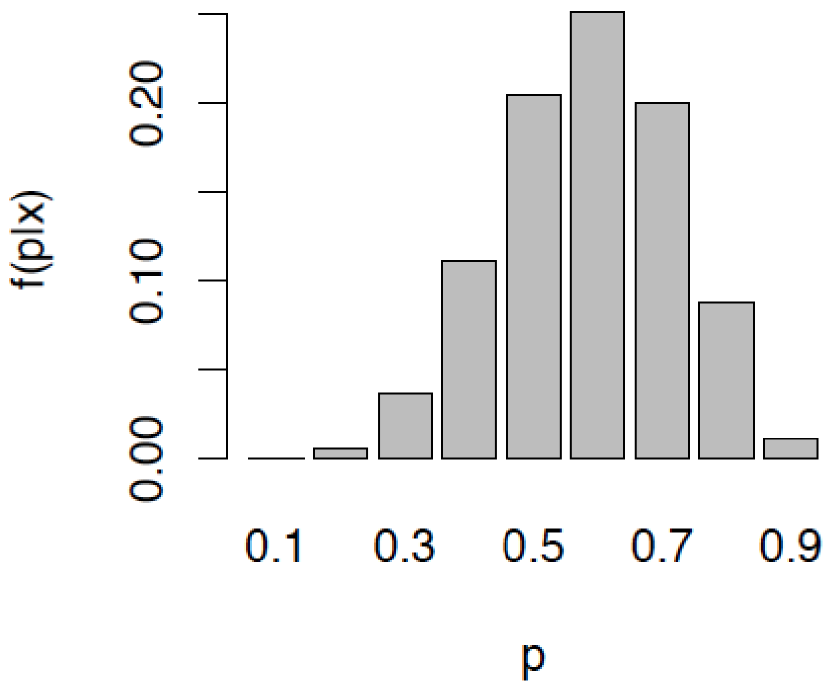
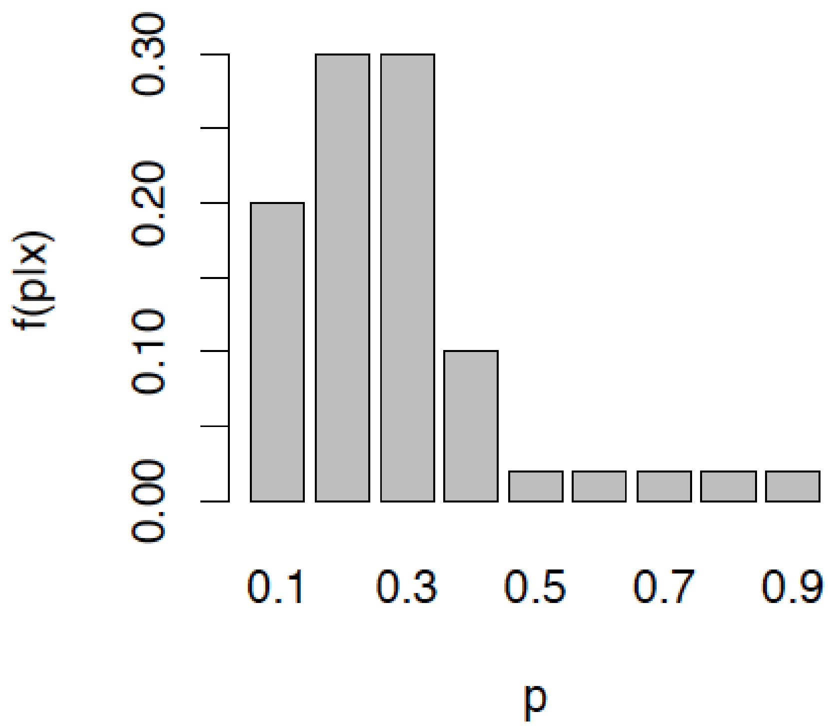


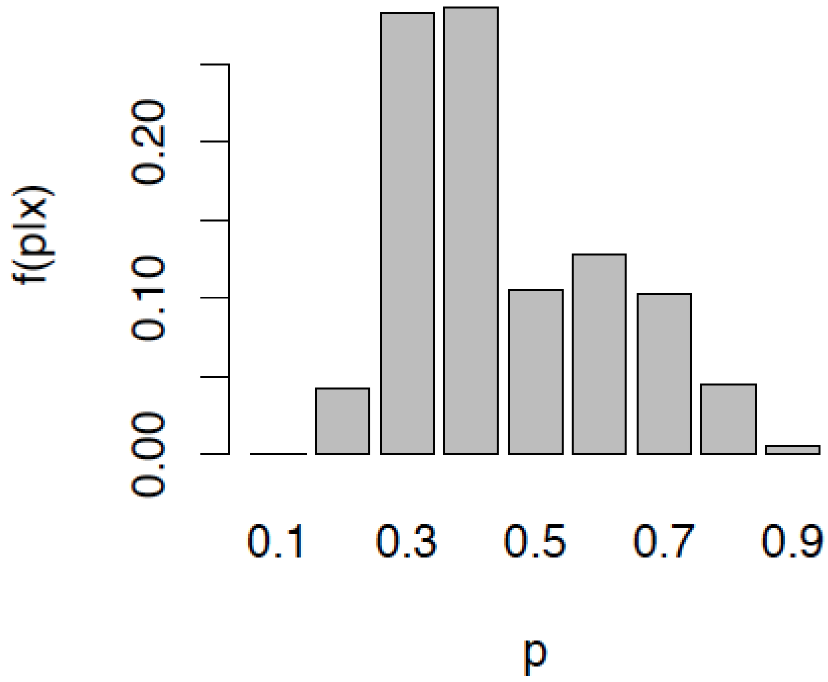


Incorrect Response

The posterior is a mixture of the likelihood and the prior. The more data there is, the more the likelihood outweighs the prior.

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



0 / 1
points

3.
You go to Las Vegas and sit down at a slot machine. You are told by a highly reliable source that, for each spin, the probability of hitting the jackpot is either 1 in 1,000 or 1 in 1,000,000, but you have no prior information to tell you which of the two it is. You play ten times, but do not win the jackpot. What is the posterior probability that the true odds of hitting the jackpot are 1 in 1,000?

- 0.269
- 0.475
- 0.498
- 0.500

Incorrect Response
Use the binomial distribution to calculate the likelihood. It is important to note that much more data is needed to become certain about the value of p when successes are rare.

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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1 / 1
points

4.
Suppose you are given a coin and told that it is either a fair coin or a trick coin. You do not know whether the coin is fair (p = 0.5) or whether it always comes up heads (p = 1) and assign an initial prior probability q that your coin is a trick coin. In terms of q and assuming q < 0.95, how many heads in a row N need to come up for the posterior probability of a trick coin to be greater than 0.95?

- $N > -\log_2(\frac{q}{20(1-q)})$
- $N > -\log_2(\frac{1-q}{19q})$
- $N > -\log_2(\frac{1-q}{20q})$
- $N > -\log_2(\frac{q}{19(1-q)})$

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

- Update prior probabilities through an iterative process of data collection

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1 / 1
points

5.
Which of the following corresponds to a Frequentist interpretation of the statement "the probability of rain tomorrow is 30 percent"?

- If conditions identical to tomorrow occurred an infinite number of times, we would observe rain on 30 percent of those days.

Correct Response
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

- A degree of belief of 0.3, where 0 means rain is impossible and 1 means rain is certain.
- Under similar conditions, it has rained 30 percent of the time in the past.
- If we predicted rain tomorrow, we would be 30% confident in our prediction.

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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?

- Sander excluded the possibility of getting a p-value larger than 0.05 by stopping the experiment prematurely
- 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.
- The posterior distribution will be biased, since Sander was intent on getting a specific result before the experiment began

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

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.

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0 / 1
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 $\alpha = 0.05$

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

- Yes, since the p-value under H_0 of no difference is approximately equal to 0.033, which is less than $\alpha = 0.05$
- 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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0 / 1
points

8.

You decide to conduct a statistical analysis of a lottery to determine how many possible lottery combinations there were. If there are N possible lottery combinations, each person has a 1/N chance of winning. Suppose that 413,271,201 people played the lottery and three people won. You are told that the number of lottery combinations is a multiple of 100 million and less than 1 billion, but have no other prior information to go on. What is the posterior probability that there were **fewer** than 600 million lottery combinations?

- 0.269

Incorrect Response
For each value of N from 100 million to 900 million, in increments of 100 million, calculate the probability of observing 3 winners, where the probability of success is 1/N. Use the likelihood and a uniform prior to calculate the posterior.

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

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

- 0.390
- 0.511
- 0.894

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0 / 1
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 1-pbinom(x-1,N,p)
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- 0.500
- 0.684
- 0.800

Incorrect Response

Our likelihood under a given hypothesis is the probability that we observe at least 999 sixes in 6000 trials, given that the hypothesis is true. Use prior probability p = 0.8 and the likelihood to find the posterior probability.

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

- 0.881

1 / 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

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

False