DATA 335 - Winter 2026 - Quiz 1

February 11, 2026

Name: _____

Student ID: _____

Question	Points	Score
1	4	
2	3	
3	4	
4	4	
Total:	15	

Instructions

- Complete all four problems in this booklet.
- Justify your answers fully, transcribing Python code where appropriate.
- You may use a computer to run Python code, search package documentation, and refer to any relevant course materials (Jupyter notebooks, textbooks, etc.).
- Use of AI chatbots/agents is prohibited.
- The time limit is 50 minutes.

1. Each bag in a large box contains 25 tulip bulbs. It is known that 60% of the bags contain bulbs for 5 red and 20 yellow tulips, while the remaining 40% of the bags contain bulbs for 15 red and 10 yellow tulips. A bag is selected at random and a bulb taken at random from this bag is planted.

   (a) (2 points) What is the probability that a yellow tulip will grow?

   (b) (2 points) Given that the tulip is yellow, what is the probability that it came from a bag containing 5 red and 20 yellow bulbs?

2. (3 points) On average, a grocer sells three of a certain article per week. What is the smallest number these articles that the grocer must have in stock so that the chance of running out within a week is less than 0.01? Assume a Poisson distribution.

3. Let random variable θ represent the rate at which people receive text messages, measured in messages per hour. At first, you believe that the typical number of messages per hour is 5 with a standard deviation of 0.25.

   (a) (2 points) Tune an appropriate Gamma(s, r) prior model for θ.

   (b) (2 points) What is the prior probability that the rate of text messages per hour is larger than 10?

4. In a study of water quality, $n = 176$ samples were taken from streams having a high environmental impact from sheep farming. Of these, $y = 44$ had a high Campylobacter (a kind of bacteria) level. Let θ be the probability that a sample of water from this type of stream has a high Campylobacter level.

   (a) (2 points) Using a Beta$(1, 10)$, calculate the posterior distribution for θ.

   (b) (2 points) Perform a Bayesian hypothesis test of

   $$H_0 : \theta \leq 0.15 \qquad \text{versus} \qquad H_1 : \theta > 0.15$$

   at the 0.05 level of significance.

Extra sheet