

Sample Question Set

- Explain the derivation of Bayes' Theorem and its historical significance in probability theory.
- In a medical diagnosis scenario, if the probability of having a certain disease given a positive test result is 0.95, but the probability of having a positive test result given not having the disease is 0.10, what is the probability of having the disease?
- Discuss the concept of class imbalance in the context of Bayesian classification. How does it affect the performance of classifiers based on Bayes' Theorem?
- Can you explain how Bayes' Theorem is used in spam filtering algorithms? Provide a step-by-step explanation.
- Compare and contrast Bayesian inference and frequentist inference approaches. What are the advantages and disadvantages of each?
- Provide a real-world example of the application of Bayes' Theorem outside of the fields of statistics and machine learning.
- Explain the concept of a prior distribution in Bayesian statistics. How does it influence posterior inference?
- How does Bayes' Theorem extend to the case of multiple hypotheses or classes?
- Discuss the role of likelihood functions in Bayesian inference. How are they related to the posterior distribution?
- Consider a scenario where you have two diagnostic tests for a disease, each with different sensitivities and specificities. How would you combine the results of these tests using Bayes' Theorem?
- Explain the concept of conditional probability and provide a real-world example.
- Suppose you roll two fair six-sided dice. What is the probability that the sum of the numbers rolled is 7?
- Discuss the Law of Large Numbers and its significance in probability theory.
- Explain the concept of expected value and variance of a random variable. How are they calculated?
- Consider a fair coin flipped three times. What is the probability of getting exactly two heads?
- Discuss the relationship between probability distributions and probability density functions.

- Explain the concept of joint probability distributions and provide an example.
- What is the difference between discrete and continuous probability distributions? Give examples of each.
- Discuss the concept of a probability mass function (PMF) and a probability density function (PDF).
- Consider a binomial distribution with parameters n and p . What does this distribution represent, and how is it calculated?
- Explain the concept of conditional expectation and its application in probability theory.
- Discuss the central limit theorem and its significance in probability theory.
- Consider a normal distribution with mean μ and standard deviation σ . What is the probability that a randomly selected observation falls within one standard deviation of the mean?
- What is the difference between a cumulative distribution function (CDF) and a probability density function (PDF)?
- Discuss the concept of statistical independence between random variables. How is it related to conditional probability?
- In a bag of 50 marbles, 20 are red and the rest are blue. If 10 marbles are drawn randomly from the bag, what is the probability of drawing exactly 3 red marbles?
- A box contains 4 red balls, 3 green balls, and 5 blue balls. If 2 balls are drawn at random without replacement, what is the probability that both balls are blue?
- In a class, 40% of students study Mathematics, 30% study Physics, and 20% study both Mathematics and Physics. If a student is chosen at random, what is the probability that they study at least one of the subjects?
- An online store has three types of memberships: gold, silver, and bronze. 20% of customers have gold membership, 30% have silver, and 50% have bronze. If a randomly selected customer has a gold membership, what is the probability that they also have a silver membership?
- A company has two factories producing a certain product. Factory A produces 60% of the total output, and factory B produces 40%. The defect rate at factory A is 5%, while at factory B it's 8%. What is the probability that a defective product comes from factory B?
- A company received 100 job applications for a position. 60% of the applicants have relevant work experience, while 40% have a relevant degree. If 25% have both, what is the probability that an applicant selected at random has either work experience or a degree?
- A bag contains 5 red balls, 4 green balls, and 3 blue balls. If two balls are drawn at random without replacement, what is the probability that both balls are green?

- In a group of 50 people, 25 are female and 30 are over 40 years old. If 15 people are female and over 40, what is the probability that a randomly chosen person is either female or over 40?
- A multiple-choice test has 10 questions with 4 choices each. If a student guesses randomly on each question, what is the probability that they get exactly 3 correct answers?
- A box contains 8 blue, 5 red, and 3 green balls. If 2 balls are drawn at random without replacement, what is the probability that both are red?
- In a group of 80 students, 40 study French, 30 study German, and 20 study both languages. If a student is chosen randomly, what is the probability that they study at least one of the languages?
- A jar contains 30 black balls and 20 white balls. If 3 balls are drawn at random without replacement, what is the probability that all 3 balls are black?
- In a deck of 52 playing cards, what is the probability of drawing a face card (jack, queen, or king)?
- A box contains 6 blue, 4 green, and 5 yellow balls. If 3 balls are drawn at random with replacement, what is the probability that all are green?
- Suppose you have a set of observations $\{2, 4, 6, 8, 10\}$ assumed to be drawn from a normal distribution with unknown mean and variance. Compute the Maximum Likelihood Estimators for the mean and variance of the distribution.
- Consider a coin flipping experiment where you observe heads with probability p . Given 10 independent trials resulting in 7 heads, what is the Maximum Likelihood Estimator for the parameter p ?
- You have a dataset of observations $\{3, 5, 7, 9, 11\}$ assumed to be drawn from an exponential distribution with unknown rate parameter λ . Calculate the Maximum Likelihood Estimator for λ .
- A manufacturer produces light bulbs with a lifetime following an exponential distribution with mean 1000 hours. If a sample of 20 bulbs has an average lifetime of 900 hours, what is the Maximum Likelihood Estimator for the mean lifetime of the bulbs?
- Suppose you have a dataset of observations $\{10, 20, 30, 40, 50\}$ assumed to be drawn from a uniform distribution on the interval $[a, b]$. Compute the Maximum Likelihood Estimators for the parameters a and b .
- ***** Just some sample questions*****