ASSIGNMENT-1

1. What are the 4 aspects of AI?
2. Discuss perceptions and understandings of AI and their applications.
3. Discuss the role of AI in natural language processing and social media.
4. What is the difference between real data and simulated data?
5. An AI system is trained to predict the response time (in milliseconds) of a chat-bot for a given set of inputs. After testing the system with a sample datasets, the response times (in milliseconds) recorded are as follows:

$$[120, 150, 130, 140, 150, 135, 125, 150, 140, 160]$$

   Using this data, calculate the following:
   (a) Mean response time
   (b) Median response time
   (c) Mode of the response time
   (d) Variance of the response time

6. An AI-based recommendation system is designed to suggest products based on a user's browsing time and their final purchase amount. The following data shows the browsing time (in minutes) and the corresponding purchase amount (in dollars) for 10 users:

Browsing Time (minutes)	10	15	8	20	12	18	25	7	14	22
Purchase Amount (dollars)	50	65	40	90	55	80	120	30	60	95

   Using this data, calculate the correlation coefficient between browsing time and purchase amount.

7. An AI system monitors the response time of a web service, where the response time (in milliseconds) is uniformly distributed between 100 ms and 200 ms.
   (a) What is the probability that the response time will be less than 150 ms?
   (b) What is the probability that the response time will be between 120 ms and 180 ms?
   (c) Calculate the mean and variance of the response time.

8. An AI-powered quality control system monitors the weights of products being manufactured. The weights are normally distributed with a mean of 500 grams and a standard deviation of 20 grams. What is the probability that a randomly selected product weighs less than 480 grams?

9. An AI-driven medical diagnostic tool has a 90% accuracy rate in detecting a particular disease. In a batch of 15 patients who have the disease, the AI tool is used to make a diagnosis.
   (a) What is the probability that the AI tool correctly diagnoses exactly 13 out of the 15 patients?
   (b) What is the probability that the AI tool correctly diagnoses all 15 patients?
   (c) What is the probability that the AI tool correctly diagnoses at least 12 patients?

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10. An AI system used for network security monitors the number of cyber-attacks detected per hour. On average, the system detects 4 cyber-attacks per hour.
    (a) What is the probability that the AI system will detect exactly 3 cyberattacks in a given hour?
    (b) What is the probability that the system will detect 5 or more cyberattacks in a given hour?

11. Consider the density function

$$f(x) = \begin{cases} k\sqrt{x}, & 0 < x < 1, \\ 0, & \text{elsewhere.} \end{cases}$$

   (a) Evaluate k.

   (b) Find $F(x)$ and use it to evaluate $P(0.3 < X < 0.6)$.

12. The joint density for the random variables (X, Y), where X is the unit temperature change and Y is the proportion of spectrum shift that a certain atomic particle produces, is

$$f(x, y) = \begin{cases} 10xy^2, & 0 < x < y < 1, \\ 0, & \text{elsewhere.} \end{cases}$$

   (a) Find the marginal densities $g(x)$, $h(y)$, and the conditional density $f(y|x)$.

   (b) Find the probability that the spectrum shifts more than half of the total observations, given that the temperature is increased by 0.25 unit.

13. The cumulative distribution function of X is

$$F(x) = \begin{cases} 0, & \text{if } x < 1, \\ 0.4, & \text{if } 1 \le x < 3, \\ 0.6, & \text{if } 3 \le x < 5, \\ 0.8, & \text{if } 5 \le x < 7, \\ 1.0, & \text{if } x \ge 7. \end{cases}$$

    (a) What is the probability mass function of X?
    (b) Compute $P(4 < X \le 7)$.

14. Suppose that X and Y have the following joint probability distribution:

$f(x, y)$		x	
		2	4
	1	0.10	0.15
y	3	0.20	0.30
	5	0.10	0.15

    (a) Find the marginal distribution of X.
    (b) Find the marginal distribution of Y .

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