Quiz 1 Study Guide: CS 1 to CS 5

Let’s explore each topic in detail. Imagine I’m your teacher, walking you through every concept step-by-step, explaining it like a story, and helping you solve each example.

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1. Basic Statistics

Let’s start with the building blocks of statistics!

1.1 Mean (Average)

What is the Mean?

The mean is just the **average**. Imagine you have a basket of candies, and you want to share them equally among your friends. The number each person gets is the **mean**.

Step-by-Step Example

Scenario: You and 4 friends go out for snacks over 5 days. Here’s how much you spent each day:

- Day 1: $50
- Day 2: $30
- Day 3: $70
- Day 4: $40

- Day 5: $60

Let's calculate the mean!

1. **Step 1: Add the total spending**
   Add up all the amounts:

$$50 + 30 + 70 + 40 + 60 = 250$$

   Total spending = $250.
2. **Step 2: Count the number of days**
   There are 5 days.
3. **Step 3: Divide the total spending by the number of days**

$$\text{Mean} = \frac{250}{5} = 50$$

Answer: On average, you spent **$50 per day**.

1.2 Median

What is the Median?

The median is the **middle value** when the numbers are arranged in order. Think of it like lining up in height order and picking the person in the middle.

Step-by-Step Example

Scenario: The heights of 5 students are: [160 cm, 150 cm, 170 cm, 155 cm, 165 cm].

Let's find the median!

1. **Step 1: Arrange the heights in ascending order**
   [150 cm, 155 cm, 160 cm, 165 cm, 170 cm]
2. **Step 2: Pick the middle value**
   The middle value is **160 cm**.

Answer: The median height is **160 cm**.

When the Dataset Has an Even Number of Values

Scenario: Add another student with a height of 175 cm. The dataset becomes:
[150, 155, 160, 165, 170, 175].

1. **Step 1: Arrange in ascending order** (already done).
2. **Step 2: Find the two middle values (160 and 165)**.
3. **Step 3: Take their average**:

$$\text{Median} = \frac{160 + 165}{2} = 162.5$$

Answer: The median is **162.5 cm**.

1.3 Mode

What is the Mode?

The mode is the value that occurs the most. Think about your favorite ice cream flavor. If most of your friends like chocolate, that's the **mode**!

Step-by-Step Example

Scenario: In a class survey, students chose their favorite fruit:

- Apple: 5 students
- Banana: 8 students
- Mango: 8 students
- Orange: 3 students

Let's find the mode!

1. **Step 1: Count the votes for each fruit**
   - Apple: 5
   - Banana: 8
   - Mango: 8
   - Orange: 3
2. **Step 2: Identify the fruit with the highest votes**
   Both Banana and Mango have 8 votes.

Answer: The mode is **Banana and Mango**.

1.4 Range

What is the Range?

The range shows the **difference between the highest and lowest values**. Think of it like the tallest and shortest players in a basketball team.

Step-by-Step Example

Scenario: The ages of students in a class are: [12, 14, 15, 16, 18].

Let's find the range!

1. **Step 1: Identify the highest and lowest ages**
   - Highest = 18
   - Lowest = 12
2. **Step 2: Subtract the lowest from the highest**

$$\text{Range} = 18 - 12 = 6$$

Answer: The range is **6 years**.

1.5 Variance and Standard Deviation

What is Variance?

Variance measures **how spread out the data is**. It's like asking: "How far are the test scores from the average?"

What is Standard Deviation?

The standard deviation tells you the **average distance** of each data point from the mean. It's like saying, "On average, how different are the scores?"

Step-by-Step Example

Scenario: Test scores are: [50, 60, 70, 80, 90].

1. **Step 1: Find the mean**

$$\text{Mean} = \frac{50 + 60 + 70 + 80 + 90}{5} = 70$$

2. **Step 2: Subtract the mean from each score and square the result**
   - (50 - 70)^2 = 400
   - (60 - 70)^2 = 100
   - (70 - 70)^2 = 0
   - (80 - 70)^2 = 100
   - (90 - 70)^2 = 400
3. **Step 3: Compute the variance**

$$\text{Variance} = \frac{400 + 100 + 0 + 100 + 400}{5} = 200$$

4. **Step 4: Compute the standard deviation**

$$\text{Standard Deviation} = \sqrt{200} \approx 14.14$$

Answer: Variance = **200**, Standard Deviation = **14.14**.

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2. Probability of Events and Axioms

2.1 Basics

What is Probability?

Probability is the chance that something will happen. Think of it like predicting whether it will rain tomorrow.

Step-by-Step Example

Scenario: You flip a coin. What's the probability of getting heads?

1. **Step 1: Total outcomes**
   - Heads or Tails → 2 outcomes.
2. **Step 2: Favorable outcomes**
   - Heads → 1 favorable outcome.
3. **Step 3: Calculate probability**

$$P(\text{Heads}) = \frac{\text{Favorable outcomes}}{\text{Total outcomes}} = \frac{1}{2}$$

Answer: The probability of heads is $\frac{1}{2}$.

2.2 Complement Rule

What is the Complement Rule?

The complement rule helps you find the probability of something **not happening**. If the chance of rain is 30%, the chance of no rain is 70%.

Step-by-Step Example

Scenario: The chance of winning a lottery is 0.05 (5%). What's the chance of not winning?

1. **Step 1: Use the complement rule**

$$P(\text{Not Winning}) = 1 - P(\text{Winning}) = 1 - 0.05 = 0.95$$

Answer: The chance of not winning is **95%**.