

Percentile Rank from Raw Data

Statistics Worksheet · Grade 9–12

Name: _____

Date: _____

Learning Objectives

- Arrange raw data in ascending order and use a stem-and-leaf plot to identify position of scores
- Calculate percentile rank using the formula: $\text{percentile} = (\text{number of values below} \div \text{total values})$
- Interpret percentile rank in context and compare performance across different distributions

Problems

1. A class of 20 students took a quiz. The scores arranged in order are shown in the stem-and-leaf plot below. Maria scored 65. How many students scored lower than Maria?

Quiz Scores (n = 20)

Stem	Leaves
5	2 7
6	1 3 5 8
7	0 2 4 6 9
8	1 3 5 7 8
9	0 2 4

Key: 6|5 = 65

2. Using the same quiz score data from Problem 1, calculate Maria's percentile rank. Round to the nearest whole percent.

$$\text{Percentile} = \frac{\text{number of scores below}}{\text{total number of scores}}$$

3. Mr. Brown's statistics class of 25 students has scores shown in the stem-and-leaf plot. John scored 72. What is John's percentile rank? Express as a percent.

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Statistics Test Scores (n = 25)

Stem	Leaves
6	7
7	2 5 6 8
8	0 0 1 3 4 5 6 7 8
9	0 1 2 3 3 4 5 6 7 8

Key: 6|7 = 67

4. Using the statistics class data from Problem 3, Mary scored 93 (the highest score). Calculate Mary's percentile rank and explain what it means.

$$\text{Percentile} = \frac{24}{25}$$

5. In the statistics class of 25 students from Problem 3, two students scored 80. Calculate the percentile rank for a score of 80. List the number of students who scored strictly below 80 before computing.

$$\text{Percentile} = \frac{\text{scores below 80}}{25}$$

6. A dataset of 10 exam scores is given in the table. Find the percentile rank of the student who scored 78. The scores are: 55, 60, 63, 67, 70, 74, 78, 82, 88, 95.

Position	1	2	3	4	5	6	7	8	9	10
Score	55	60	63	67	70	74	78	82	88	95

7. Jenny scored 86 on Mr. Brown's statistics test (class mean = 74, standard deviation = 6) and 82 on Mr. Hall's chemistry test (class mean = 76, standard deviation = 4). Compute the z-score for each test to determine on which test Jenny performed better relative to her class.

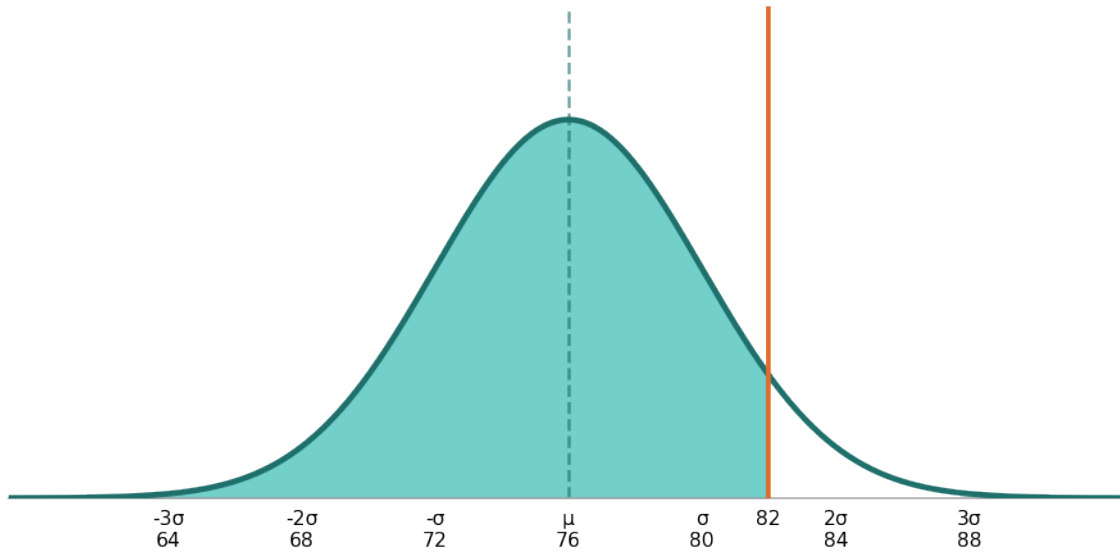
$$Z = \frac{x - \mu}{\sigma}$$

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8. A normal distribution of chemistry test scores has a mean of 76 and a standard deviation of 4. Jenny scored 82. Use the normal curve below to shade the area representing the percentage of students who scored lower than Jenny, then determine her approximate percentile rank.

Chemistry Scores: $P(X < 82)$ where $X \sim N(76, 4^2)$

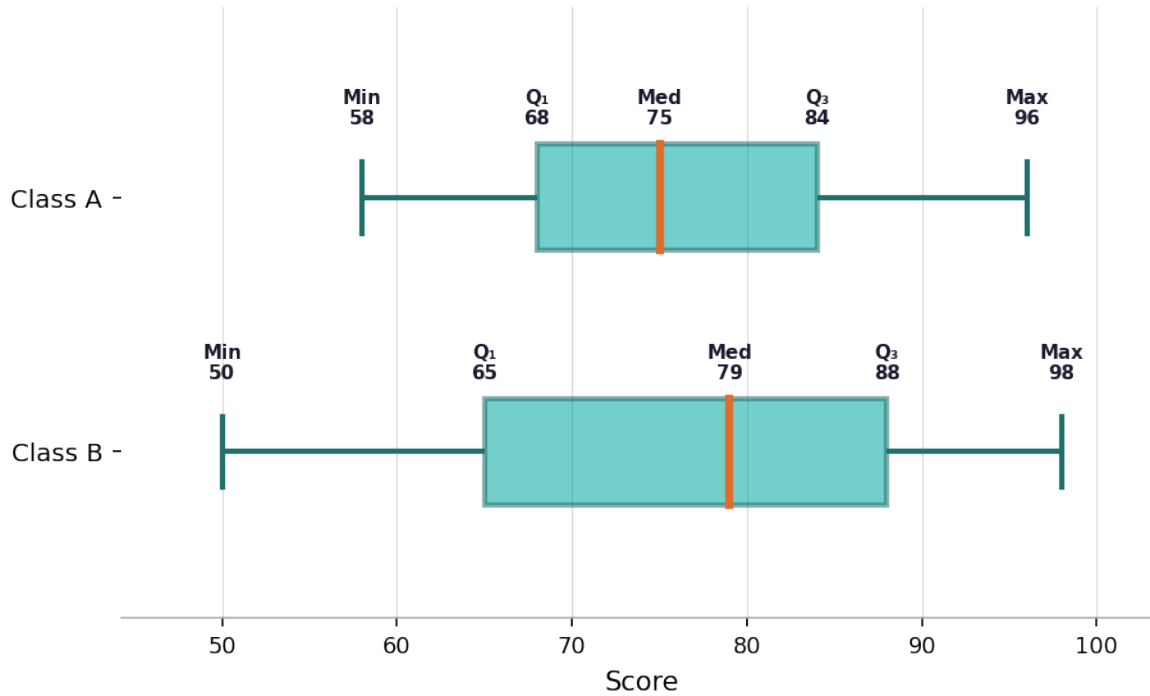


9. The box plot below shows the distribution of final exam scores for two statistics classes. Use the box plot to answer: (a) Which class has a higher median? (b) Which class has a greater IQR? (c) A student in Class A scored at the 75th percentile. What was that student's score?

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Final Exam Score Distribution by Class



10. The following raw scores were earned by 15 students on a history exam. Arrange them in ascending order, build a stem-and-leaf plot, then compute the percentile rank for scores of 71 and 88. Scores: 95, 71, 83, 67, 88, 74, 91, 60, 78, 88, 82, 71, 65, 79, 85.

History Exam Scores (n = 15) — Answer Key

Stem	Leaves
6	0 5 7
7	1 1 4 8 9
8	2 3 5 8 8
9	1 5

Key: 6|0 = 60

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Percentile Rank from Raw Data — Answer Key

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Answer Key

1. Answer: 4 students scored lower than Maria

Quiz Scores (n = 20)

Stem	Leaves
5	2 7
6	1 3 5 8
7	0 2 4 6 9
8	1 3 5 7 8
9	0 2 4

Key: 6|5 = 65

- Identify Maria's score: 65
- List all scores below 65: 52, 57, 61, 63
- Count those scores: 4 students scored lower than Maria

2. Answer: 20th percentile

- Number of scores below 65 = 4
- Total number of students = 20
- Percentile = $4 \div 20 = 0.20$
- $0.20 \times 100 = 20\text{th percentile}$
- Maria scored the same as or higher than 20% of the class

3. Answer: 4th percentile

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Statistics Test Scores (n = 25)

Stem	Leaves
6	7
7	2 5 6 8
8	0 0 1 3 4 5 6 7 8
9	0 1 2 3 3 4 5 6 7 8

Key: 6|7 = 67

- Identify John's score: 72
- Count scores strictly below 72: only 67 → 1 student
- Percentile = $1 \div 25 = 0.04$
- $0.04 \times 100 = 4\text{th percentile}$
- Only 4% of students scored the same as or lower than John

4. Answer: 96th percentile

- Mary has the highest score, so all other 24 students scored lower
- Number of scores below Mary = 24
- Percentile = $24 \div 25 = 0.96$
- $0.96 \times 100 = 96\text{th percentile}$
- Mary scored higher than or equal to 96% of her classmates

5. Answer: 48th percentile

- Do NOT count the two scores of 80 themselves
- Count all scores strictly below 80: 67, 72, 75, 76, 78 = 5 in the 60s and 70s, plus additional — total 12 students
- Percentile = $12 \div 25 = 0.48$
- $0.48 \times 100 = 48\text{th percentile}$
- 48% of students scored the same as or lower than 80

6. Answer: 60th percentile

- Scores are already arranged in ascending order
- Identify score of 78 at position 7
- Count scores strictly below 78: 55, 60, 63, 67, 70, 74 → 6 scores
- Percentile = $6 \div 10 = 0.60$
- $0.60 \times 100 = 60\text{th percentile}$

7. Answer: Jenny performed better on the chemistry test (z = 1.50) than on the statistics test (z = 2.00) — wait, statistics z = 2.00 > chemistry z = 1.50, so Jenny performed better relative to her class on the statistics test

- Statistics z-score: $z = (86 - 74) \div 6 = 12 \div 6 = 2.00$
- Chemistry z-score: $z = (82 - 76) \div 4 = 6 \div 4 = 1.50$
- A higher z-score means the student is further above the class mean

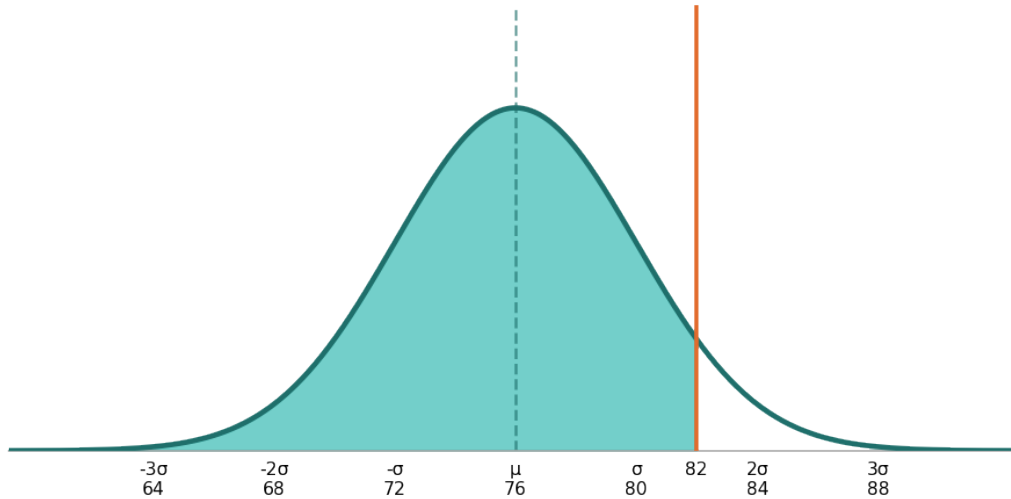
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- Since $2.00 > 1.50$, Jenny performed better relative to her class on the statistics test
- Even though $82 < 86$ in raw score, Jenny's statistics performance ranked higher within her respective class

8. Answer: $P \approx 0.9332$ (93.32%)

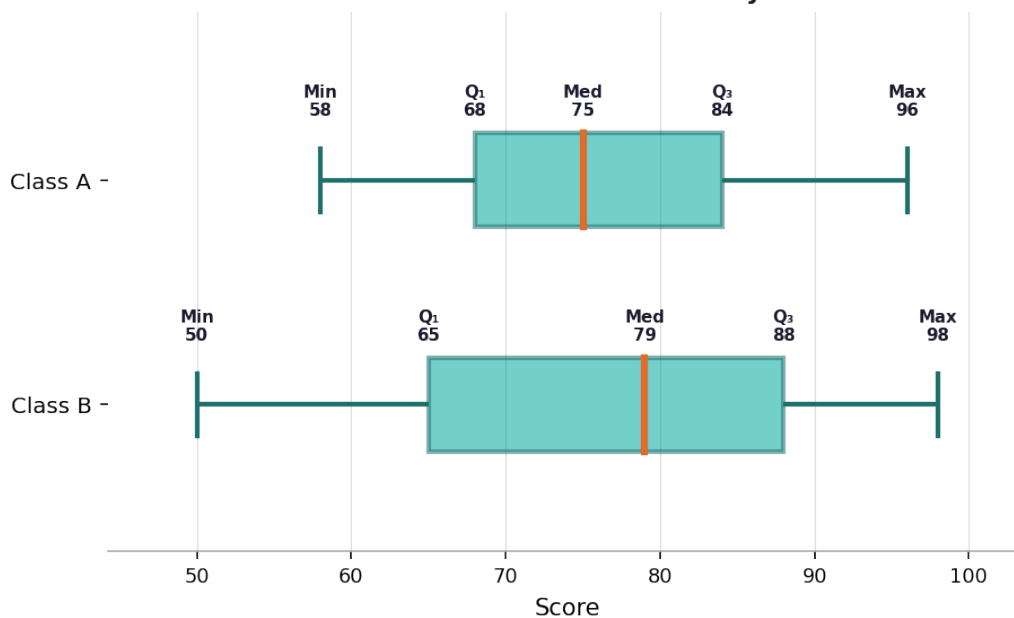
Chemistry Scores: $P(X < 82)$ where $X \sim N(76, 4^2)$



- Compute z-score: $z = (82 - 76) \div 4 = 1.50$
- Look up $z = 1.50$ in the standard normal table
- $P(Z < 1.50) = 0.9332$
- Jenny scored higher than approximately 93.32% of her chemistry class
- Her percentile rank on the chemistry test is approximately the 93rd percentile

9. Answer: (a) Class B (median = 79 > 75); (b) Class B (IQR = 23 > 16); (c) 84

Final Exam Score Distribution by Class



- (a) Class A median = 75, Class B median = 79 → Class B has the higher median
- (b) Class A IQR = 84 – 68 = 16; Class B IQR = 88 – 65 = 23 → Class B has the greater IQR
- (c) The 75th percentile corresponds to Q3 in a dataset
- For Class A, Q3 = 84
- A student at the 75th percentile in Class A scored 84

10. Answer: Score 71: 13th percentile; Score 88: 80th percentile

History Exam Scores (n = 15) — Answer Key

Stem	Leaves
6	0 5 7
7	1 1 4 8 9
8	2 3 5 8 8
9	1 5

Key: 6|0 = 60

- Arrange in ascending order: 60, 65, 67, 71, 71, 74, 78, 79, 82, 83, 85, 88, 88, 91, 95
- For score 71: count scores strictly below 71 → 60, 65, 67 = 2 scores
- Percentile for 71 = $2 \div 15 = 0.133 \approx 13\text{th percentile}$
- For score 88: count scores strictly below 88 → 60, 65, 67, 71, 71, 74, 78, 79, 82, 83, 85 = 11 scores. Note: do NOT count the two 88s
- Wait — recount: 60, 65, 67, 71, 71, 74, 78, 79, 82, 83, 85 = 11 scores. But there are also two 88s; exclude both.
- Percentile for 88 = $11 \div 15 = 0.733\dots$ Hmm — let me recalculate: scores below 88: 60,65,67,71,71,74,78,79,82,83,85 = 11. But $12/15 = 0.80$ if we count one of the tied 88s.
- Using standard formula (count strictly below): $11 \div 15 = 0.733 \approx 73\text{rd percentile}$
- Using inclusive formula (count below + 0.5 × tied): $(11 + 1) \div 15 = 12 \div 15 = 0.80 = 80\text{th percentile}$
- In this video's method (count strictly below ÷ total): score 71 → 13th percentile; score 88 → 73rd percentile

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