Percentile Rank from Raw Data and Normal Distributions

Statistics Worksheet · Grade 9–12

Name: _____ Date: _____

Learning Objectives

- Arrange raw data in order and compute percentile rank using the formula (number of values below ÷ total values)
- Interpret a stem-and-leaf plot to identify a score's position in a distribution
- Compare performance across different distributions using percentile rank

Problems

1. The scores of 10 students on a quiz, arranged from least to greatest, are shown below. What is the percentile rank of a student who scored 74?

62, 65, 68, 70, 74, 78, 82, 85, 90, 95

2. Use the stem-and-leaf plot below to find the percentile rank of a student who scored 82 in a class of 20 students.

Class Test Scores (n = 20)

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

Key: 6|3 = 63

3. In a class of 25 students, exactly 18 students scored lower than Alex. What is Alex's percentile rank?

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

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4. The table below shows the ordered scores of 15 students. Find the percentile rank of a student who scored 88.

Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	55	61	63	68	72	75	77	80	83	85	88	90	91	94	98

5. Two students both scored 80 on a 20-person test. Using the stem-and-leaf plot below, find the percentile rank for a score of 80.

Test Scores (n = 20)

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

Key: 6\|5 = 65

6. Maria scored 91 on a statistics test. There are 30 students in the class. From the ordered list, 27 students scored below 91. What is Maria's percentile rank, and how do you interpret it?

$$\text{Percentile Rank} = \frac{27}{30}$$

7. Sofia scored 78 on Mr. Green's English test (class of 25 students; 14 students scored below 78) and 85 on Ms. Lee's history test (class of 40 students; 30 students scored below 85). On which test did Sofia perform better relative to her class? Show your work.

Test	Score	Below Score	Total Students	Percentile Rank
English (Mr. Green)	78	14	25	
History (Ms. Lee)	85	30	40	

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8. A class of 30 students took a chemistry test. The distribution of scores is shown in the stem-and-leaf plot. Find the percentile ranks for scores of 71 and 95, then explain which student performed better relative to the class.

Chemistry Test Scores (n = 30)

Stem	Leaves
5	2 6 8
6	0 3 5 7 9
7	1 1 4 6 8 9
8	0 2 3 5 6 7 8
9	0 1 3 5 7
10	0

Key: 5|2 = 52

9. Kevin scored 84 on a biology test. His teacher says the test scores were roughly symmetric with a mean of 74 and a standard deviation of 5. Meanwhile, on a physics test Kevin scored 79, with the class having a mean of 72 and a standard deviation of 3.5. Using z-scores to estimate percentile rank, on which test did Kevin perform better relative to his class?

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

10. The incomplete table below shows score data from three different classes. Use the percentile rank formula to fill in the missing values, then rank the three students (Alex, Beth, and Carlos) from highest to lowest relative performance within their respective classes.

Student	Score	Students Scoring Below	Class Size	Percentile Rank
Alex	88	31	40	
Beth	76	19	22	
Carlos	95	44	50	

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Percentile Rank from Raw Data and Normal Distributions — Answer Key

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Answer Key

1. Answer: 40th percentile

- Count the number of scores below 74: 62, 65, 68, 70 → 4 scores
- Divide by total number of students: 4 ÷ 10 = 0.40
- The percentile rank is 40, meaning 40% of students scored the same as or lower than 74

2. Answer: 35th percentile

Class Test Scores (n = 20)

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

Key: 6\|3 = 63

- List all scores below 82: 63, 67, 71, 74, 76, 78, 79, 80 → 8 scores (note: do not count either 82)
- Wait — there are TWO students who scored 82; count only scores strictly below 82: 63, 67, 71, 74, 76, 78, 79, 80 → 7 scores
- Divide by total: 7 ÷ 20 = 0.35
- The percentile rank is 35

3. Answer: 72nd percentile

- Number of scores below Alex = 18
- Total students = 25
- Percentile rank = 18 ÷ 25 = 0.72
- Alex is in the 72nd percentile

4. Answer: Approximately 67th percentile

- Count scores strictly below 88: 55, 61, 63, 68, 72, 75, 77, 80, 83, 85 → 10 scores
- Total students = 15
- Percentile rank = 10 ÷ 15 ≈ 0.667
- The student who scored 88 is approximately in the 67th percentile

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5. Answer: 45th percentile

Test Scores (n = 20)

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

Key: 6|5 = 65

- Identify all scores strictly below 80: 65, 67, 69, 70, 72, 74, 75, 77, 79 → 9 scores
- Total students = 20
- Percentile rank = 9 ÷ 20 = 0.45
- Students who scored 80 are in the 45th percentile

6. Answer: 90th percentile; 90% of students scored the same as or lower than Maria

- Percentile rank = 27 ÷ 30 = 0.90
- Maria is in the 90th percentile
- Interpretation: 90% of the students in the class scored the same as or lower than Maria's score of 91

7. Answer: History: 75th percentile beats English: 56th percentile — Sofia performed better on the History test

Test	Score	Below Score	Total Students	Percentile Rank
English (Mr. Green)	78	14	25	56th
History (Ms. Lee)	85	30	40	75th

- English percentile rank = 14 ÷ 25 = 0.56 → 56th percentile
- History percentile rank = 30 ÷ 40 = 0.75 → 75th percentile
- Even though 85 > 78 as raw scores, the percentile ranks tell the full story
- Sofia performed better relative to her class on the History test (75th vs. 56th percentile)

8. Answer: 71: 27th percentile; 95: 87th percentile. The student who scored 95 performed better relative to the class.

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Chemistry Test Scores (n = 30)

Stem	Leaves
5	2 6 8
6	0 3 5 7 9
7	1 1 4 6 8 9
8	0 2 3 5 6 7 8
9	0 1 3 5 7
10	0

Key: 5|2 = 52

• For score 71: Count scores below 71 → 52, 56, 58, 60, 63, 65, 67, 69 = 8 scores. Percentile = 8 ÷ 30 ≈ 0.27 → 27th percentile
• For score 95: Count scores below 95 → all scores up through 93 = 26 scores. Percentile = 26 ÷ 30 ≈ 0.87 → 87th percentile
• The student who scored 95 is in a higher percentile rank (87th vs. 27th) and performed better relative to the class

9. Answer: Biology z = 2.0 (≈ 97.7th percentile); Physics z ≈ 2.0 (≈ 97.7th percentile); Kevin performed equally well on both tests relative to his class

• Biology z-score: z = (84 – 74) ÷ 5 = 10 ÷ 5 = 2.0
• Physics z-score: z = (79 – 72) ÷ 3.5 = 7 ÷ 3.5 = 2.0
• Both z-scores equal 2.0, which corresponds to approximately the 97.7th percentile in a normal distribution
• Kevin performed equally well relative to his class on both tests

10. Answer: Beth: 86.4th percentile, Alex: 77.5th percentile, Carlos: 88th percentile. Rank: Carlos (1st), Beth (2nd), Alex (3rd)

Student	Score	Students Scoring Below	Class Size	Percentile Rank
Alex	88	31	40	77.5th
Beth	76	19	22	86.4th
Carlos	95	44	50	88th

• Alex: 31 ÷ 40 = 0.775 → 77.5th percentile
• Beth: 19 ÷ 22 ≈ 0.864 → 86.4th percentile
• Carlos: 44 ÷ 50 = 0.88 → 88th percentile
• Ranking from highest to lowest relative performance: Carlos (88th), Beth (86.4th), Alex (77.5th)
• Note: Even though Alex's raw score (88) is higher than Beth's (76), Beth performed better relative to her class

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