LESSON MAKER PRO

Beyond the Average

Estimate chances with normal distributions.

HIGH SCHOOL · A2S.DSP.A.23

A2S.DSP.A.23 "Use mathematical and statistical reasoning about normal distributions to draw conclusions and assess risk; limit to informal arguments."

NAME _____ DATE _____

USE THE EMPIRICAL RULE

For roughly normal data, about 68% of values are within 1 standard deviation (SD) of the mean, and about 95% are within 2 SDs. The distribution is symmetric, so each tail gets half the percentage outside a range.

WORKED EXAMPLE

The data are roughly normal. About what percent of values are above 78?

DISTRIBUTION

Mean	SD
72	6

1. 78 is 1 SD above 72.
2. 100% - 68% = 32% lie outside 1 SD.
3. Half are above 78: 32% / 2 = 16%.

Answer: About 16%.

PRACTICE 4 problems

1 Roughly normal data have mean 50 and SD 10. About what percent are below 40?

ANSWER _____

2 Roughly normal data have mean 100 and SD 20. About what percent are above 140?

ANSWER _____

3 Roughly normal data have mean 30 and SD 4. About what percent are between 26 and 34?

ANSWER _____

4 Roughly normal data have mean 200 and SD 25. About what percent are between 225 and 250?

ANSWER _____

APPLY IT Show your work

1 Concert entry waits are roughly normal, with mean 24 minutes and SD 3 minutes. About what percent of fans wait longer than 30 minutes? Is that rare, meaning under 5%?

WORK SPACE

ANSWER _____

2 Game matches last a roughly normal amount of time, with mean 18 minutes and SD 2 minutes. About what percent last 16 to 20 minutes? About how many is that in 100 matches?

WORK SPACE

ANSWER _____

CHALLENGE One step up

Travel times on both routes are roughly normal. You must arrive within 40 minutes. Which route has the smaller risk of taking longer? Give both risks.

TRAVEL TIMES IN MINUTES

Route	Mean	SD
A	30	5
B	33	7

WORK SPACE AND ANSWER

ANSWER KEY

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Roughly normal data have mean 50 and SD 10. About what percent are below 40?	**About 16%.**
2	Roughly normal data have mean 100 and SD 20. About what percent are above 140?	**About 2.5%.**
3	Roughly normal data have mean 30 and SD 4. About what percent are between 26 and 34?	**About 68%.**
4	Roughly normal data have mean 200 and SD 25. About what percent are between 225 and 250?	**About 13.5%.**

PART 2 · APPLY IT

1. **About 2.5%; yes, it is rare.** 30 minutes is 2 SDs above the mean. Half of the 5% outside 2 SDs is above 30 minutes.
2. **About 68%; about 68 matches.** The interval is within 1 SD of the mean, so it includes about 68% of matches. That is about 68 out of 100.

CHALLENGE

Route A. Its risk is about 2.5%, since 40 is 2 SDs above its mean. Route B's risk is about 16%, since 40 is 1 SD above its mean.

Accept estimates based on the empirical rule. The percentages are approximate, not exact probabilities.