



Algebra 2 – Year 2

Lesson 11.9 – Normal Distributions
Notes & Examples (Day 1)

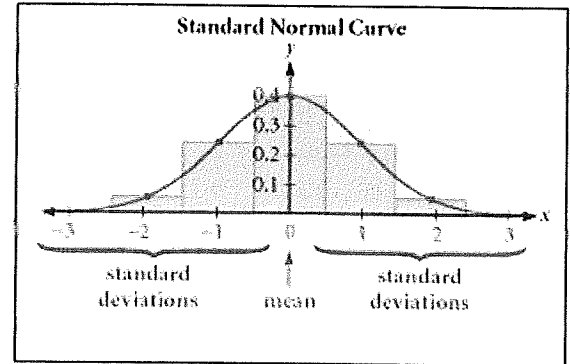
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Many common statistics (such as human height, weight, or blood pressure) gathered from samples in the natural world tend to have a *normal distribution*.

A **normal distribution** of data varies randomly from the mean, creating a mound-shape pattern that is symmetric about the mean.

→ Graph of a normal distribution

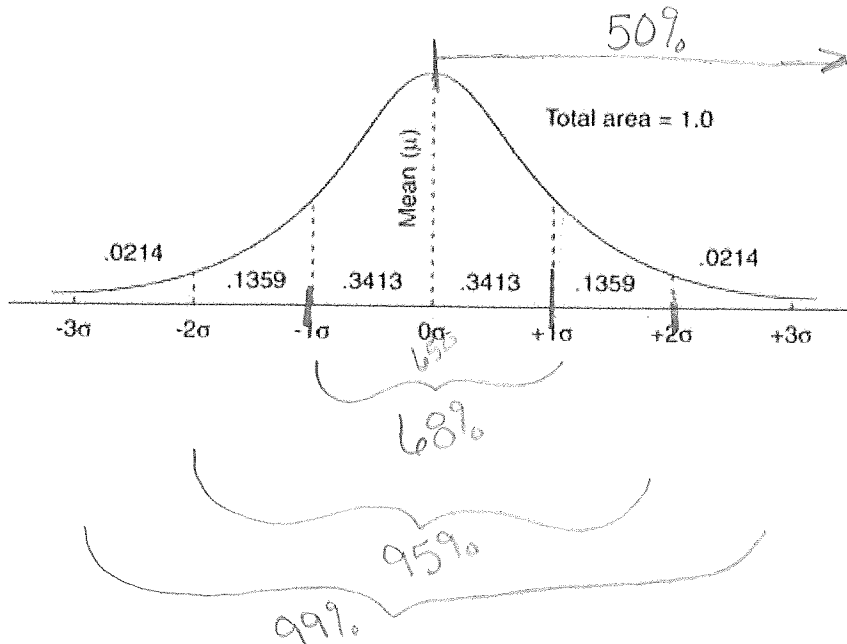
A **normal curve** is obtained by drawing a curve through the midpoints of the tops of the bars in a histogram of normally distributed data. It is defined by the mean and standard deviation.



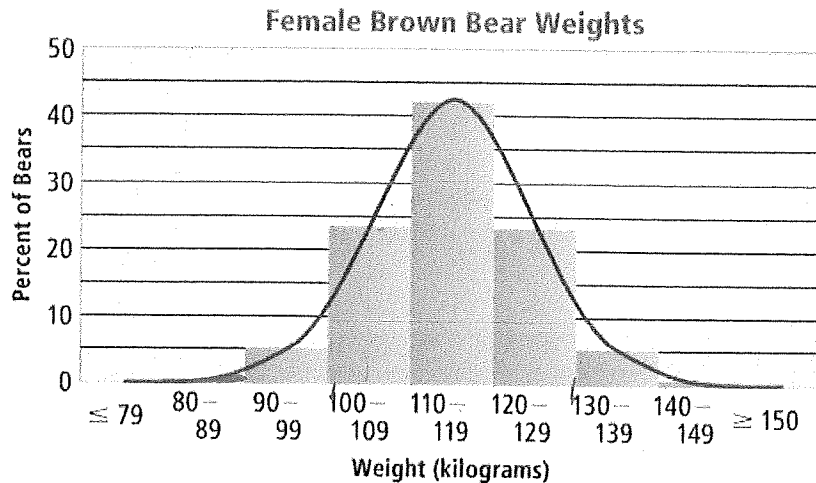
A **standard normal curve** is a normal curve with a mean of 0 and a standard deviation of 1. It is defined by the **mean** and **standard deviation**.

Properties of Normal Distributions

- The curve is symmetric about the mean.
- Total area under the curve is 1
- Mean, median, and mode are about equal.
- About 68% of area is within 1 standard deviation of mean.
- About 95% of area is within 2 standard deviations of mean.
- About 99% of area is within 3 standard deviations of mean.



Example 1: The bar graph gives the weights of a population of female brown bears. The curve shows how the weights are normally distributed about the mean, 115 kg, and the standard deviation is 10 kg.



a. Approximately what percent of female brown bears weigh between 100 and 129 kg?

Estimate percents $23 + 42 + 23 = 88$
 Add percents $88\% \rightarrow$ between 100-129 kg

b. Approximately what percent of female brown bears weigh less than 120 kg?

$42 + 23 + 5 + 1 = 71$
 $71\% \rightarrow$ less than 120 kg

Example 2: Scores for a certain professional exam are approximately normally distributed with a mean of 650 and a standard deviation of 100.

a. What is the probability that a randomly selected test score is between 450 and 850?

$P(450 \leq x \leq 850) = .1359 + .3413 + .3413 + .1359$
 $= .9544 \rightarrow 95.44\%$

$650 - 100 = 550$
 $550 - 100 = 450$
 $650 + 100 = 750$
 $750 + 100 = 850$

b. Out of 1000 randomly selected test scores, how many would you expect to be between 450 and 850?

$1000 \cdot .9544 = 954.4 = 954$

Example 3: The heights of adult American males are approximately normally distributed with a mean of 69.5 in. and a standard deviation of 2.5 in.

a. What percent of adult American males are between 67 in. and 74.5 in. tall?

$P(67 \leq x \leq 74.5) = .3413 + .3413 + .1359$

$= .8185 \rightarrow 81.85\%$ between 67 in - 74.5 in tall

$69.5 - 2.5 = 67$
 $69.5 + 2.5 = 72$
 $72 + 2.5 = 74.5$

b. In a group of 2000 adult American males, about how many would you expect to be taller than 6 ft.?

(72 in) $P(x > 72) = .50 - .3413 = .1587 \rightarrow 15.87\%$

$2000 \cdot .1587 = 317.4 \approx 317$ over 6 ft. tall

11-9 Practice

Normal Distributions

Form G

The actual weights of bags of pet food are normally distributed about the mean. Use the graph at the right for Exercises 1-3.

1. About what percent of bags of pet food weigh 49.9 lb-50.1 lb?

$$17 + 20 + 18 = 55 \quad 55\%$$

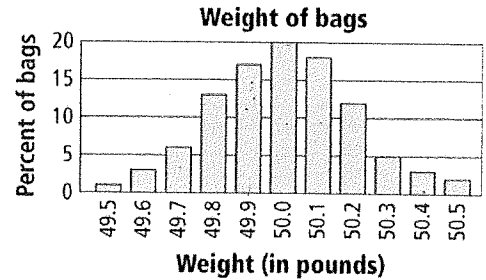
2. About what percent of bags weigh less than 49.8 lb?

$$6 + 3 + 1 = 10 \quad 10\%$$

3. In a group of 250 bags, how many would you expect to weigh more than 50.4 lb?

$$2 \rightarrow 2\%$$

$$250 \cdot .02 = 5 \text{ bags}$$



A set of data has a normal distribution with a mean of 5.1 and a standard deviation of 0.9. Find the percent of data within each interval.

4. from 4.2 to 5.1

$$5.1 - 0.9 = 4.2$$

$$.3413$$

$$34.13\%$$

5. greater than 6.9

$$5.1 + 0.9 = 6.0$$

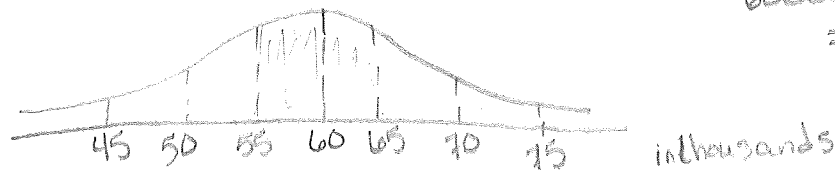
$$6.0 + 0.9 = 6.9$$

$$.5 - (.3413 + .1359)$$

$$= .0228 \rightarrow 2.28\%$$

6. The number of miles on a car when a certain part fails is normally distributed, with a mean of 60,000 and a standard deviation of 5000.

- a. Sketch the normal curve for the distribution. Label the x-axis values at one, two, and three standard deviations from the mean.



- b. What is the probability that the part will NOT fail between 55,000 and 65,000 miles?

$$1 - (.3413 + .3413) = .3174$$

$$31.74\%$$

7. A college only accepts students who score in the top 16% on the entrance exam. The exam scores are normally distributed, with a mean of 25 and a standard deviation of 3.8. To the nearest whole number, what is the least score you could earn and still be accepted to the college?

$$.5 - .3413 \approx .16 \quad 16\% \rightarrow \text{greater than 1 standard deviation}$$

$$25 + 3.8 = 28.8 \rightarrow 29$$

A normal distribution has a mean of 50 and a standard deviation of 6. Find the probability that a value selected at random is in the given interval.

8. from 44 to 50 $50 - 6 = 44$

$$.3413$$

$$34.13\%$$

9. from 38 to 56 $44 - 6 = 38$

$$50 + 6 = 56$$

$$.1359 + .3413 + .3413$$

$$= .8185$$

$$81.85\%$$

10. at least 50

$$x \geq 50$$

$$.5$$

$$50\%$$

11. at most 56

$$x \leq 56$$

$$.5 + .3413 = .8413$$

$$84.13\%$$

Draw a normal curve to solve the following problems.

12. A local bakery makes chocolate chip cookies. The number of chocolate chips in the cookies is approximately normally distributed, with mean 11.4 and standard deviation 1.3. What percent of the cookies have between 8.8 and 14 chocolate chips?

$$.1359 + .3413 + .3413 + .1359$$

$$= .9544$$

$$95.44\%$$

$$11.4 - 1.3 = 10.1$$

$$10.1 - 1.3 = 8.8$$

$$11.4 + 1.3 = 12.7$$

$$12.7 + 1.3 = 14$$

13. The bakery described in Exercise 12 sold 200 chocolate chip cookies. How many of the cookies had less than 8.8 chocolate chips?

$$.5 - (.1359 + .3413) = .0228 \rightarrow 2.28\%$$

$$200 \cdot .0228 = 4.56 \approx 5 \text{ cookies}$$



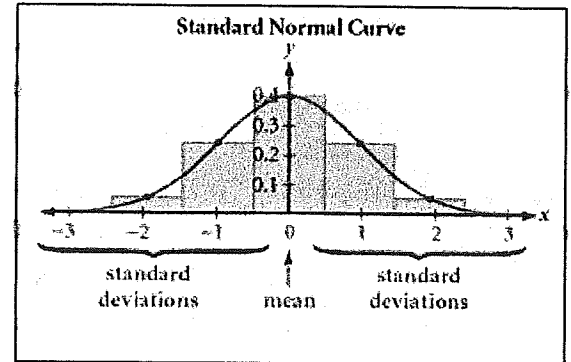
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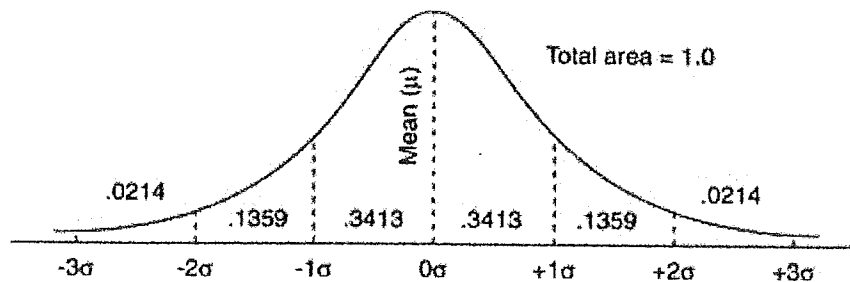


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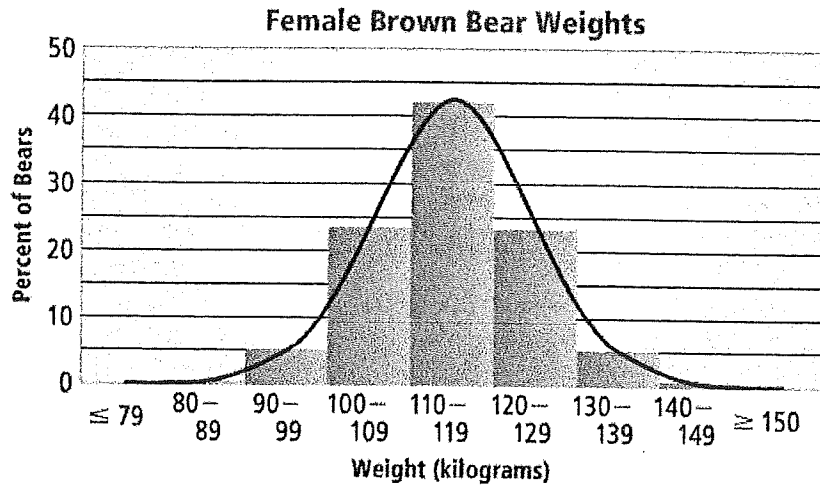
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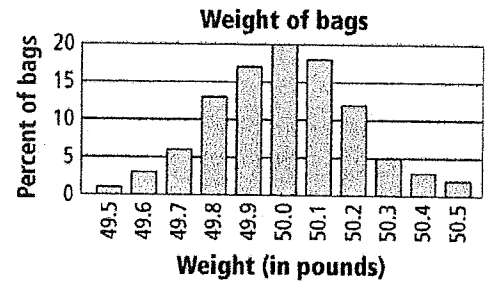
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