

Normal Distributions:

- Calculate z-score ranking.
- Use z-scores to determine percentage of graph below, above or between.
- Use percentage of population below a data value to determine the z-score.

1. Review properties of a normal population:

Score	Frequency
10	2
11	4
12	6
most 13	8
14	6
15	3
16	1

Sketch: Histogram & Frequency Polygon.

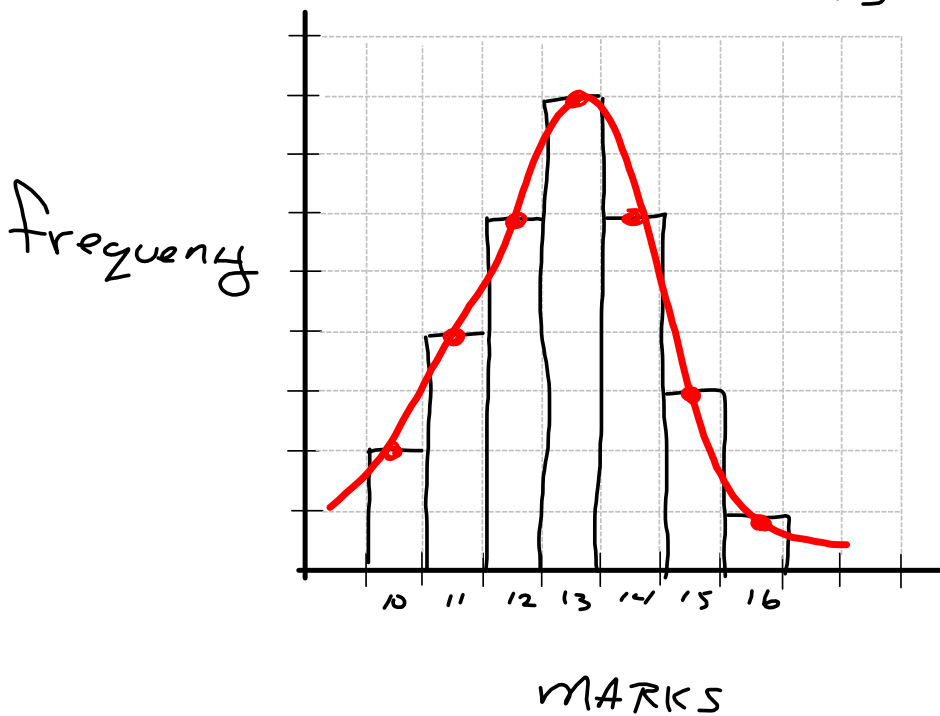
Calculate: Mean, Median, Mode, Standard Deviation

$\bar{x}$  middle most  $\sigma$   
Normal Distribution, justify?

$$\bar{x} = 12.8 \quad \sigma = 1.5$$

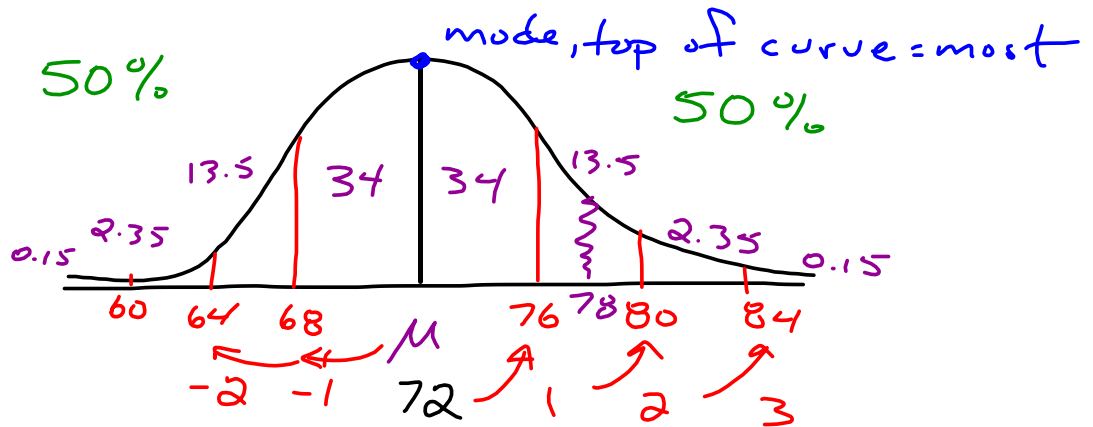
$$\text{med} = 13$$

$$\text{mode} = 13$$



NORMAL / yes ... mean = median = mode = 13  
 \ no ... mean = 12.8  $\neq$  13 = median = mode

2. Populations: Marks for a quiz generated a normal curve (bell curve) with an average of 72 (mean) and a standard deviation of 4.0.
- a) Sketch the curve and label properties: mode, median, mean, standard deviations, percentage of population in each section.



- b) Ranking of scores: z-score (number of standard deviations from the mean).

$$\sigma = 4$$

Score of 72 ... equal to average  $Z = 0$

Score of 64 ... two  $\times 4$  below,  $Z = -2$

Score of 84 ... three  $\times 4$  above average,  $Z = 3$

Score of 78: between 1 and 2 above,  $Z = 1.5$

FIND  
RANK

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

example  $x = 78$   $\mu = 72$   $\sigma = 4$

$$Z = \frac{78 - 72}{4}$$

$$Z = \frac{6}{4}$$

$$Z = 1.5$$

Find the area between each z-score using your calculator (normalcdf function)

lower z = 1.25 and upper z = 2.5



$$A = 0.0994$$

$$A = 9.9\%$$

$$= 0.9537$$

$$= 95.4\%$$

lower z = -2.5 and upper z = 1.75



lower z = -5 and upper z = 5

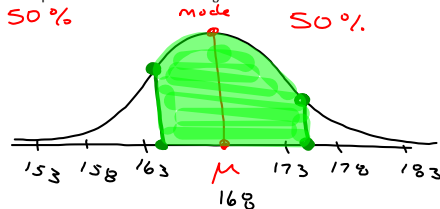


$$0.999999 = 1.0 \text{ or } 100\%$$

When you know where you rank on the normal curve (bell curve) you can also determine your percentage rank in the population. We will learn to use Normalcdf on our calculators.

3. Populations: Heights of students at LCHS are normally distributed with a mean height of 168 cm and a standard deviation of 5.0 cm.

- Sketch the curve and label properties: mode, median, mean,  $\pm 3$  standard deviations.
- Determine the z-score (ranking) for a person with a height of 175 cm.
- Determine the z-score for a person with a height of 164 cm.
- Shade the normal curve to show the heights from 164 cm to 175 cm. Use your calculator to determine the percentage of students who have a height between 164 cm and 175 cm.
- Draw a new bell curve and shade the region to show heights 175 cm or more. Determine the percent of students have a height 175 cm or more.



$$b) x=175 \quad \mu=168 \quad \sigma=5 \quad z = \frac{x-\mu}{\sigma}$$

$$z = \frac{175-168}{5} = \frac{7}{5} = 1.4$$

$$c) x=164 \quad \mu=168 \quad \sigma=5$$

$$z = \frac{164-168}{5} = \frac{-4}{5} = -0.8$$

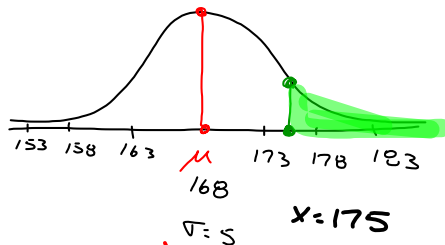
$$d) \text{normalcdf}(\text{lower } z, \text{upper } z)$$

$$\text{normalcdf}(-0.8, 1.4)$$

$$= 0.7074$$

$$= 71\%$$

e)



$$z = \frac{175-168}{5} = \frac{7}{5} = 1.4$$

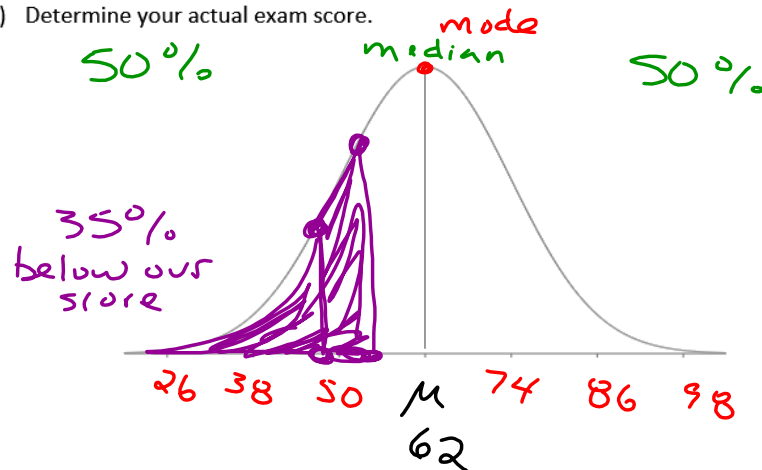
$$\text{normalcdf}(\text{lower } z, \text{upper } z)$$

$$\text{normalcdf}(1.4, 5) = 0.0808$$

$$= 8\%$$

When you know where you rank based on percentages on the normal curve (bell curve) you can also determine your z-score rank in the population. We will learn to use **InvNorm** on our calculators.

4. Population: Exam scores of students at LCHS are normally distributed with a **mean score of 62** and a standard **deviation of 12**.
- Sketch the curve and label properties: mode, median, mean,  $\pm 3$  standard deviations.
  - You scored better than 35% of the students on this exam. Shade the normal curve to represent your ranking. Use your calculator to determine your z-score.
  - Determine your actual exam score.



$\text{InvNorm}(\text{area left})$  or  $(\text{area below})$

$$\text{InvNorm}(0.35) = -0.39$$

"two decimals"

c)  $x = ?$      $\mu = 62$      $\sigma = 12$      $Z = -0.39$

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

$$-0.39 = \frac{x - 62}{12}$$

$$-4.32 = x - 62$$

mult 12

$$57.68 = x$$

add 62

$$x = 58$$