Homework #5a: Z-scores (Part I)

note: M equals x_{bar} – the mean of a sample

1. Define standard deviation:

The distance a typical score falls from the mean in a given distribution.

2. Define z-score for your mother and relate it to standard deviation:

The distance a specific score (x) falls from the mean (μ), expressed as standard-deviation (σ) units.

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

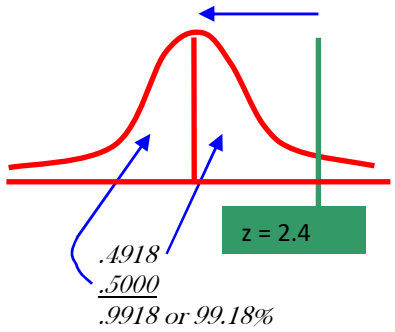
3. On the Whiznoodle Depression Inventory the average score is 50 (i.e., μ=50) with a standard deviation of 5 (σ=5).

a. What's Bob's standard score (z-score) if Bob scored a 62?

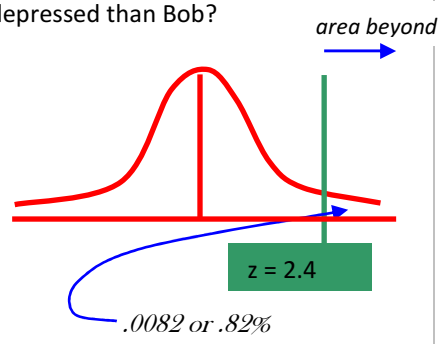
μ = 50
σ = 5
x = 62
z = ?

$$z = \frac{x - \mu}{\sigma_x}$$
$$z = \frac{62 - 50}{5}$$
$$z = 2.4$$

b. What percent of people are less depressed than Bob?



c. What percent of people are more depressed than Bob?



d. What's Rolanda's standard score if she had a raw score of 37?

μ =
σ =
x =
z =

e. What percent of people are less depressed than Rolanda?

.0047 or .47%

f. What percent of people are more depressed than Rolanda?

.9953 or 99.53%

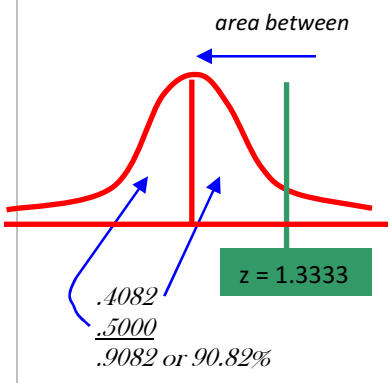
4. Most IQ tests are normed to have an average score of 100 with a standard deviation of 15.

a. What's Shanta's z-score if she scores 120 on the IQ test?

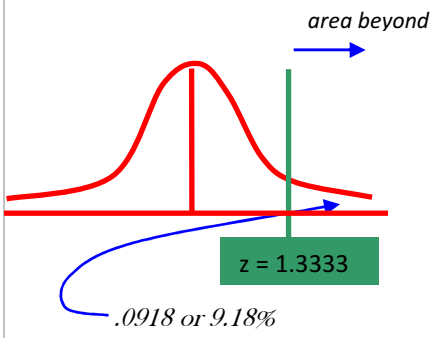
μ = 100
σ = 15
x = 120
z = ?

$$z = \frac{x - \mu}{\sigma_x}$$
$$z = \frac{120 - 100}{15}$$
$$z = 1.3333$$

b. What percent of people score **lower**?



c. What percent of people score **higher**?



5. A teacher administered the Ceespautrun reading ability test where students typically average 40 points with a standard deviation of 4.

a. Shanta scored a 50. What's her z-score?

b. What percent of people have a **lower** reading ability than Shanta?

.9938 or 99.38%

c. What percent of people have a **higher** reading ability than Shanta?

.0062 or .62%

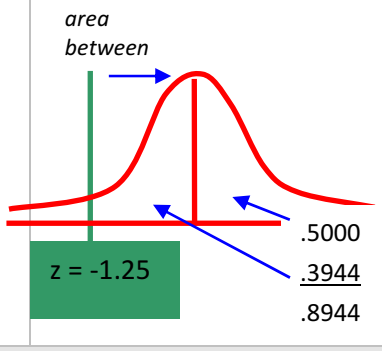
d. Kelly scored a 35. What's her z-score?

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

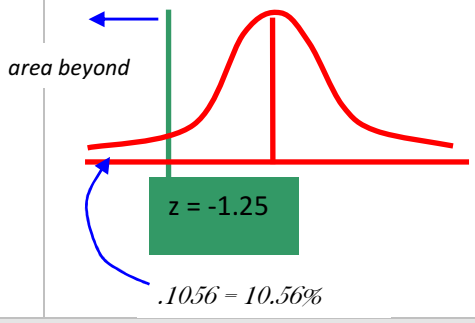
$$z = \frac{35 - 40}{4}$$

$$z = -1.25$$

e. What percent of students will score **higher** than Kelly?



f. What percent of students will score **lower** than Kelly?



.1056 = 10.56%

Part II: z-scores for Sample Means and Sampling Error

6. A researcher tests whether teachers with masters' degrees have classes that do better on the end of grade tests. His sample of 16 teachers averaged 79 on these tests. Teachers in the district averaged 78 (σ = 10)

$n = 16$

$\bar{x} = 79$

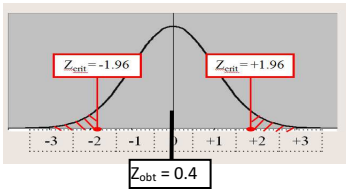
$\mu = 78$

$\sigma_x = 10$

$$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{10}{\sqrt{16}} = 2.5$$

$$z = \frac{\bar{x} - \mu}{\sigma_{\bar{x}}} = \frac{79 - 78}{2.5} = 0.4$$

Do these teachers seem more or less successful than normal? ($z_{crit} = \pm 1.96$). Show sketch. ***Circle**: Reject or Retain H_0*



7. Do students in the Sigma Digma Wigma fraternity have GPAs (M=2.4, n=16) different from those of normal students (μ=2.7, σ = 0.3)

Do the fraternity have lower/higher GPAs than normal? ($z_{crit} = \pm 1.96$). Show sketch.

Zobt = -4.0

8. A school psychologist tests whether 9 teachers trained in classroom management report fewer disciplinary problems (an average of 5) compared to district-wide norms (μ=11, σ = 6).

$n = 9$

$\bar{x} = 5$

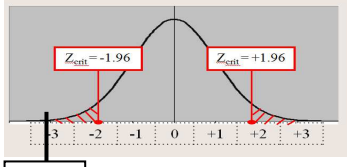
$\mu = 11$

$\sigma_x = 6$

$$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{6}{\sqrt{9}} =$$

$$z = \frac{\bar{x} - \mu}{\sigma_{\bar{x}}} = \frac{5 - 11}{2} = -3$$

Do these teachers have fewer/more disciplinary problems than normal? ($z_{crit} = \pm 1.96$). Show sketch. *Reject or Retain H_0*



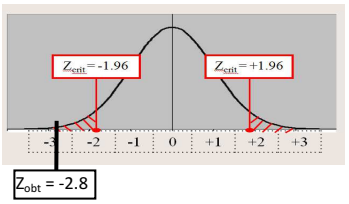
9. A researcher tested whether rats on diet pills differed in weight from normal rats (μ=410, σ =25). The four "dieting" rats averaged 375 ounces.

$\mu = 410$
$\sigma_x = 25$
$n = 4$
$\bar{x} = 375$

$$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{25}{\sqrt{4}} = 12.5$$

$$z = \frac{\bar{x} - \mu}{\sigma_{\bar{x}}} = \frac{375 - 410}{12.5} = -2.8$$

Do these rats seem lighter or heavier than normal? (z_{crit} = ± 1.96). Show sketch. ***Circle:*** *Reject or Retain H_0*



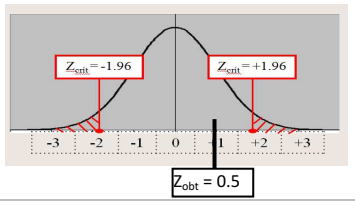
10. A researcher examined whether 9 people with social phobias were more likely to be depressed (M=51) than normal people (who average 50 with a standard deviation of 6).

$\mu = 50$
$\sigma_x = 6$
$n = 9$
$\bar{x} = 51$

$$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{6}{\sqrt{9}} = 2$$

$$z = \frac{\bar{x} - \mu}{\sigma_{\bar{x}}} = \frac{51 - 50}{2} = 0.5$$

Do these people seem less or more depressed than normal? (z_{crit} = ± 1.96). Show sketch. ***Circle:*** *Reject or Retain H_0*

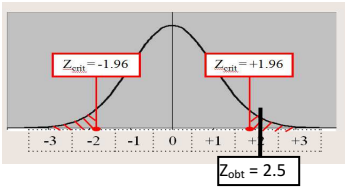


11. Do people who've completed a memory enhancement course do better on a test of working memory? The twenty-five memory course students scored 8 on average. People in general average 7 with a standard deviation of 2.

[redacted]

$\sigma_{\bar{x}}$ 0.4

Do these people seem to do worse or better than normal? (z_{crit} = ± 1.96). Show sketch. ***Circle:*** *Reject or Retain H_0*



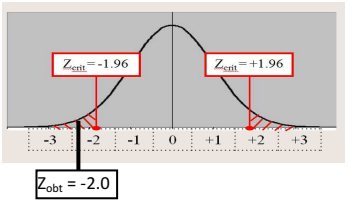
12. You administer a measure of depression to a group of 25 students deprived of studying for an entire weekend. This sample of students scores 44 on average. Higher scores indicate more depression, and normal people score 50 with a standard deviation of 15.

$\mu = 50$
$\sigma_x = 15$
$n = 25$
$\bar{x} = 44$

$$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{15}{\sqrt{25}} = 3$$

$$z = \frac{\bar{x} - \mu}{\sigma_{\bar{x}}} = \frac{44 - 50}{3} = -2$$

Do these students seem less or more depressed than normal? (z_{crit} = ± 1.96). Show sketch. ***Circle:*** *Reject or Retain H_0*



13. For the following, indicate whether it's a **frequency distribution (FD)** or a **sampling distribution (SD)**

FD **SD** a. A teacher administered the Ceespautrun reading ability test where students typically average 40 points with a standard deviation of 4. Her 16 students score 45 on average.

FD SD b. Adian scored 650 on the SAT. If people in general score at 500 with a standard deviation of 100, what percent of people score higher than this?

FD **SD** c. The 13 ROTC students averaged a score of 23 on the ACT when normal students score 20 with a standard deviation of 5. Do ROTC students appear to be above average?

FD SD d. The girl who received the tutoring scored 89 on the test. What percent of people did better than this, assume the average score overall was 75 with a standard deviation of 7?