Math 3   Name _____
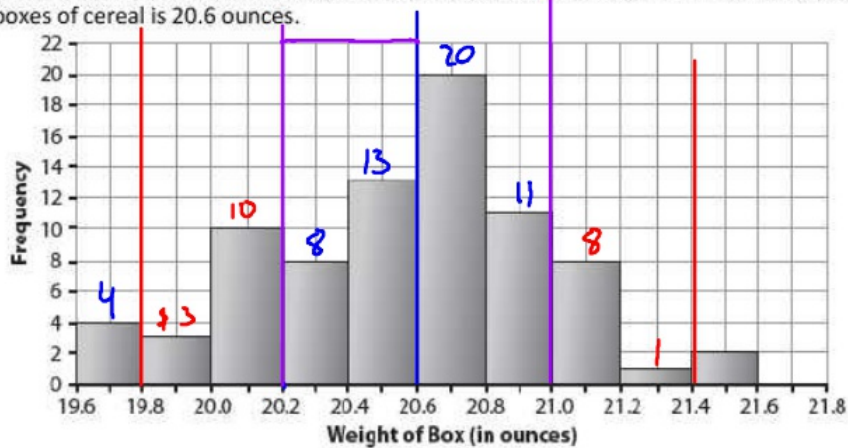
Practice Normal Distributions

1. Assume that the distribution of weights of cereal boxes is approximately normal. The histogram
    below shows the actual weights (in ounces) of 80 boxes of cereal. The mean weight of these
    boxes of cereal is 20.6 ounces.

$(80)(.68)$
54

a. Estimate the Standard deviation of the histogram.

.4 oz

b. Using your estimate of standard deviation from Part a, what percentage of the weights are
    at least two standard deviations from the mean? $\frac{74}{80} = .925$ 92.5%

c. The labeling on the boxes of cereal indicates that the weight of each box should be 20
    ounces. What percentage of these boxes weigh less than 20 ounces?

$\frac{7}{80} = .0875$
8.75%

2. In 2006, PISA (Programmer for International Students Assessment) conducted an international
    study of science learning. The scores for U.S. students on the test of Living Systems were
    approximately normal with mean 487 and standard deviation 117.

a. Paul, a U.S. student, got a score of 587 on this test.
    i. How many standard deviations above the mean was his score?

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

$z = \frac{587 - 487}{117} = .85$

    ii. What was his percentile?

.8023   80.23 percentile

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

b. The standardized value for Mary's score on the Living Systems test was -1.27. What was Mary's score on this test?

$$117 \,(-1.27) = \left(\frac{x - 487}{117}\right)^{117}$$

$$-148.59 = x - 487$$
$$+487 \qquad\qquad +487$$

$$x = 338.41$$

c. Sally scored in the 95th percentile for U.S. students. What was Sally's score?

$$1.64 = \frac{x - 487}{117}$$

$$x = 678.88$$

3. National results for the SAT test show that for college-bound seniors the average combined SAT Writing, Math and Verbal score is 1500 and the standard deviation is 250. National results for the ACT test show that for college-bound seniors the average composite ACT score is 20.8 and the standard deviation is 4.8. Your SAT score: 1860. Your neighbor's ACT: 29.

Who did better on their respective test?

Me (SAT)

$$z = \frac{1860 - 1500}{250}$$

$$z = 1.44 \ (.9251)$$

Neighbor (ACT)

$$z = \frac{29 - 20.8}{4.8}$$

$$z = 1.71 \ (.9564)$$

Neighbor Did better because of the higher z score.

4. Cholesterol levels in American women can be described by a Normal model with mean =188 mg/dL and a standard deviation of 24 mg/dL. A family physician decides to prescribe a cholesterol reducing drug to female patients who are above the 90th percentile of the cholesterol level for American women. Above what cholesterol level will the physician prescribe the drug? Show your work OR explain your reasoning in the box below:

$$1.28 = \frac{x - 188}{24}$$
$$x = 218.72 \ ^{mg}/_{dL}$$

Any cholesterol level above 218.72 will get a prescription.

5. Let x be the time required for a college student to complete a standardized exam. Suppose that for the population of students at a particular university, the distribution of x is well approximated by a normal curve with mean 45 minutes and standard deviation 5 minutes.

a. If 50 minutes is allowed for the exam, what proportion of students at this university would be unable to finish the exam?

$$z = \frac{50 - 45}{5} = 1$$

.84
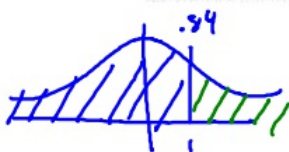
16% would be unable to finish

b. How much time should be allowed for the exam if we wanted 90% of the students taking the exam to finish in the allotted time?

$$1.28 = \frac{X - 45}{5}$$

$$= 51.4 \text{ min}$$

$\rightarrow 75^{th}$

c. How much time is required for the fastest 25% of all students to complete the exam?

$$.67 = \frac{X - 45}{5}$$

$$X = 48.35 \text{ min}$$

6. IQ tests are normally distributed with a mean score of 100 and a standard deviation of 15.

a. If someone has a IQ of 125, what is their percentile rank?

$$Z = \frac{125 - 100}{15}$$

95.25 percentile

$$Z = 1.67$$

.9525

b. What percentage of IQ's lie between scores of 118 and 88? Sketch a graph to help.
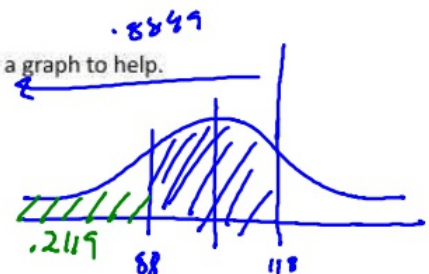
.8849

$$Z = \frac{118 - 100}{15}$$

$$Z = \frac{88 - 100}{15}$$

$$= 1.2$$

$$= -.80$$

$$(.8849)$$

$$(.2119)$$

.2119   88   118

.8849 - .2119
.673

c. What would a person's IQ score be if they were in the top 5% of all scores?

$$1.64 = \frac{X - 100}{15}$$

$$X = 124.6$$

7. Acupuncture is an important part of traditional Chinese medicine. This treatment is becoming more widely available through the United States.

In England, a study was conducted to determine if acupuncture was an effective means of reducing chorionic headache pain. In the study, 401 adults were randomly assigned to receive acupuncture treatments or to continue with their usual treatment for headaches. Acupuncture treatment was found to be more effective that usual care in decreasing headaches severely. (Source: American Family Physician, Vol. 70, No 3, August 1, 2004, pp 574-5.)

a. Does the study have the three characteristics of an experiment? Explain your reasoning.

Yes → Randomly selected who received what treatment
401 subjects is enough
Control group - continued usual treatment

b. Was the experiment subject blind? Explain your reasoning.

No Subjects Knew if the were

Receiving the treatment.

c. What were the treatments?

Acupuncture
Normal treatment.

d. What was the response?

Headaches Severity

8. Alzheimer's disease is a disease that affects older people. One of the early symptoms of Alzheimer's disease is memory loss. A diet that is rich in fruits, vegetables, grains, olive oil, and fish is called a Mediterranean Diet and may help prevent Alzheimer's disease.

Over a four-year period, researchers examined the health and diet of more than 2,000 people. The group of people had an average age of 76, and none of them had Alzheimer's disease at the beginning of the study. During the study, the researchers evaluated how closely each participant followed the Mediterranean diet. By the end of the study 260 participants had been diagnosed with Alzheimer's disease. They found that participants who most closely followed the diet were less likely to develop Alzheimer's that were participants who did not follow the diet. (Source: www.mayclinic.com/health/mediterranian-diet/AN01475)

a. What type of study was this? Explain your reasoning.

Observational Study

No randomization

b. Can you conclude from this study that eating a Mediterranean diet will cause a decrease in a person's chances of developing Alzheimer's disease? Explain your answer.

No. You can only conclude that for these people, there is an association between how closely the person followed the mediterranian diet and the likelihood of developing Alzheimer's disease. But you cannot conclude a cause-and-effect relationship. One possible lurking variable is that people who had difficulty following a healthy diet were more likey to develop Alzheimer's disease.