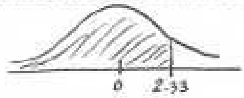
Name:
Date:

PBHL 5013/BIOM 5013 – Collected Homework
Chapter 6

1. Answer to 6.6.

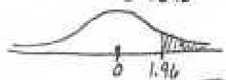
Find the probabilities for the standard normal random variable Z:

a. $P(Z < 2.33) =$ 0.9901

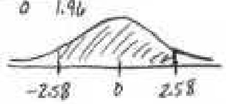


b. $P(Z < 1.645) =$ 0.95

c. $P(Z > 1.96) =$ 0.025



d. $P(-2.58 < Z < 2.58) =$ 0.9902



2. Answer to 6.11.

Find the following percentiles for the standard normal random variable Z:

a. 90th percentile = 1.28

b. 95th percentile = 1.645

c. 98th percentile = 2.05

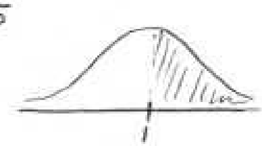
d. 99th percentile = 2.33

3. Answer to 6.18.

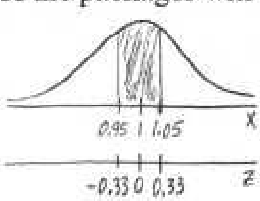
Suppose that the weights of these "1-pound" packages are normally distributed with a mean of 1.00 pound and a standard deviation of .15 pound. $\mu = 1.00$, $\sigma = 0.15$

Let X = weight of ground beef package

a. What proportion of the packages will weigh more than 1 pound? = 0.5000

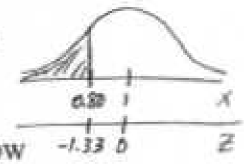


b. What proportion of the packages will weigh between .95 and 1.05 pounds? =
0.2586



$$P(0.95 < X < 1.05)$$
$$= P\left(\frac{0.95-1}{0.15} < Z < \frac{1.05-1}{0.15}\right)$$
$$= P(-0.33 < Z < 0.33)$$
$$= P(Z < 0.33) - P(Z < -0.33) = 0.6293 - 0.3707 = 0.2586$$

c. What is the probability that a randomly selected package of ground beef will weigh less than .80 pound? = 0.0918 $P(X< 0.80) = P\left(Z< \frac{0.80-1}{0.15}\right)$
$\cong P(Z<-1.33) = 0.0918$



d. Would it be unusual to find a package of ground beef that weighs 1.45 pounds? How would you explain such a large package? The probability that a package of ground beef weighs at least 1.45 pounds is 0.0013. So, it would be unusual to find a package of ground beef that weighs 1.45 pounds. Also, a weight of 1.45 pounds is 3 standard deviations above the mean. One explanation is to conclude that the mean of the distribution of "1-pound" packages is greater than 1.00 pound.

$P(X\geq 1.45) = P\left(Z \geq \frac{1.45-1}{0.15}\right)$
$= P(Z \geq 3)$
$= 1-P(Z<3)$
$= 1-0.9987 = 0.0013$

4. **Answer to 6.25.**

Suppose that the unsupported stem diameters at the base of a particular species of sunflower plant have a normal distribution with an average diameter of 35 millimeters (mm) and a standard deviation of 3 mm. Let X = unsupported stem diameter at the base of a particular species of sunflower plant
$\mu = 35$, $\sigma = 3$

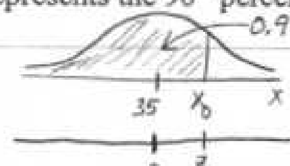
a. What is the probability that a sunflower plant will have a basal diameter of more than 40 mm? = 0.0475 $P(X>40) = P\left(Z> \frac{40-35}{3}\right) \cong P(Z>1.67)$
$= 1-P(Z\leq 1.67) = 1-0.9525 = 0.0475$

b. If two sunflower plants are randomly selected, what is the probability that both plants will have a basal diameter of more than 40 mm? = 0.00226
Remember the multiplication rule for independent events A and B: $P(A\cap B) = P(A)P(B)$. Let $A = X_1 > 40$ mm and $B = X_2 > 40$ mm.
So, $P(A\cap B) = P(A)P(B)$
$= P(X_1>40)P(X_2>40)$
$= (0.0475)(0.0475)$
$= 0.00225625$

c. Within what limits would you expect the basal diameter to lie, with probability .95? = 29.12 mm to 40.88 mm

$X_L = \mu + z_L\sigma$ $X_U = \mu + z_U\sigma$
$X_L = 35 + (-1.96)(3)$ $X_U = 35 + 1.96(3)$
$X_L = 29.12$ $X_U = 40.88$

d. What diameter represents the 90[th] percentile of the distribution of diameters? 38.84 mm



$X_0 = \mu + z_0\sigma$
$X_0 = 35 + 1.28(3)$
$X_0 = 38.84$

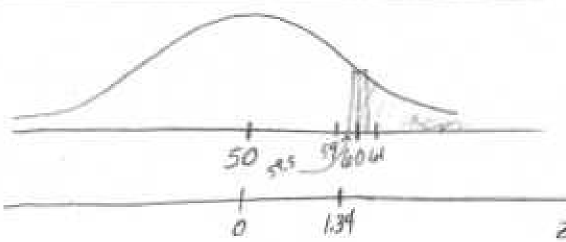
5. **Answer to 6.46.**

If the 50,000 children were a random sample from the population of children represented by past records, what is the probability of observing a value of x equal to 60 or more? $\cong 0.0901$

Let X = # of children with the particular genetic defect out of 50000
Treat X as binomial with $n = 50{,}000$ and $p = 0.001$.
$\mu = np = 50$, $\sigma = \sqrt{npq} = \sqrt{50000(0.001)(0.999)} = \sqrt{49.95} \cong 7.068$

Would you say that the observation of x = 60 children with genetic defects represents a rare event? No, this does not represent a rare event because the probability of observing a value of x equal to 60 or more is approximately 0.0901, which is larger than 0.05. Also, x = 60 is only $\cong$ 1.41 standard deviations above the mean.

$P(X\geq 60) = P(X \geq 59.5)$
$\cong P\left(Z \geq \frac{59.5-50}{7.067531394}\right)$
$\cong P(Z\geq 1.34)$
$= 1-P(Z<1.34)$
$= 1-0.9099 = 0.0901$



6. Answer to 6.53.

a. What is the average number of women who put in more than 40 hours a week on the job? = 31 $\mu = np = 50(0.62) = 31$

b. What is the standard deviation for the number of women who put in more than 40 hours a week on the job? $\cong$ 3.432 $\sigma = \sqrt{npq} = \sqrt{50(0.62)(0.38)} = \sqrt{11.78} = 3.43220046$

c. Suppose that in our sample of 50 working women, there are 25 who work more than 40 hours a week. Would you consider this to be an unusual occurrence? Explain.
No, this would not be considered an unusual occurrence because the probability of observing a value of 25 or less is approximately 0.0548.
Also, $x=25$ is only ≈ 1.75 standard deviations below the mean.

$$P(X \le 25) = P(X \le 25.5)$$
$$\cong P\left(Z \le \frac{25.5-31}{3.43220046}\right)$$
$$\cong P(Z \le -1.60)$$
$$= 0.0548$$