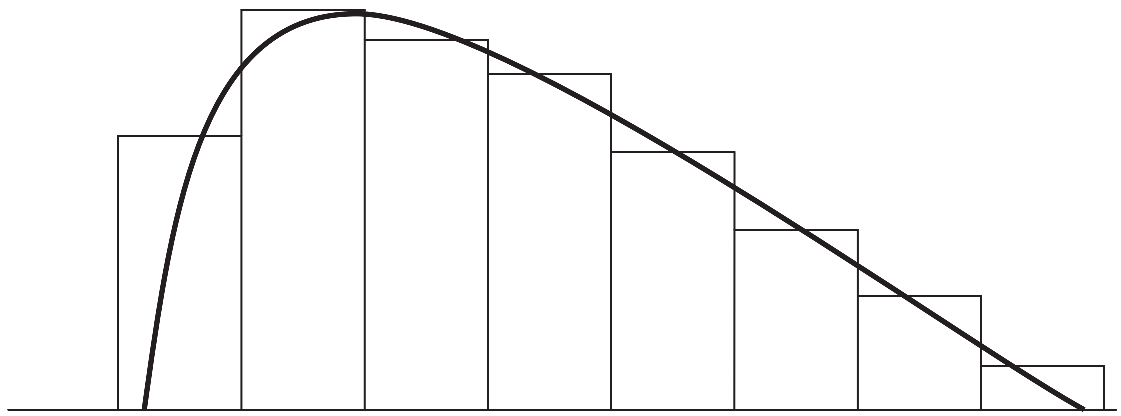
Probability & Statistics Solutions – Chapter 7

Problem Set 7.1 **Exercises** **Pages 301-305**

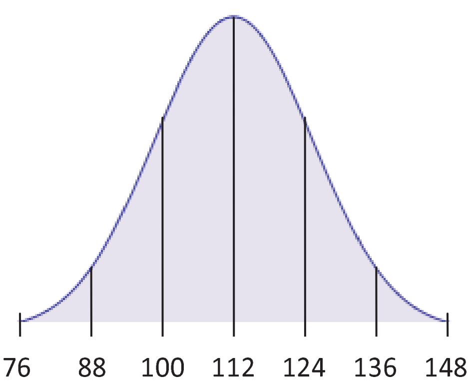
1) a) An approximate sketch for the density curve is given below.



b) 1 (All density curves have an area of 1.)

c) Skewed right

2) a)



b) 50%

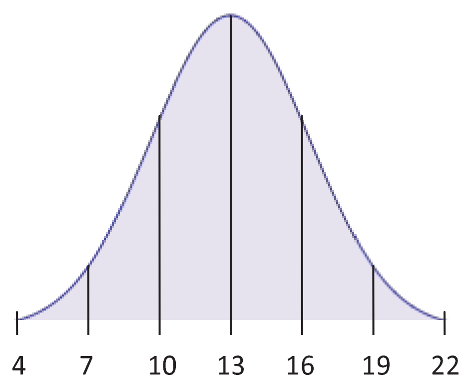
c) 68%

d) 34%

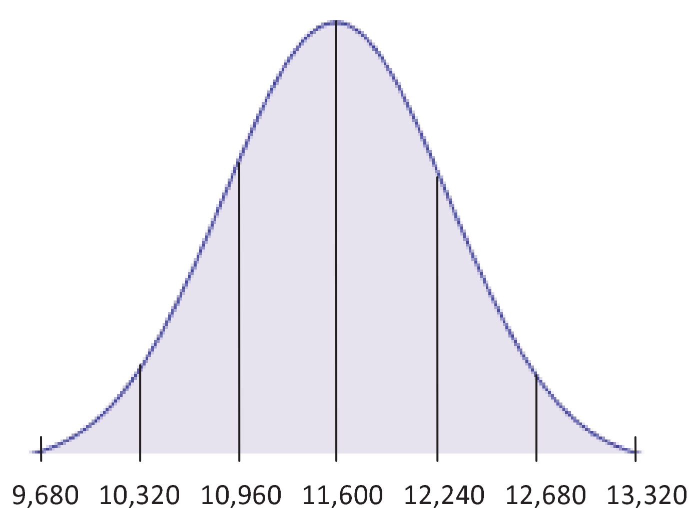
e) 50% - 34% = 16%

f) 50% - 34% - 13.5% = 2.5%

3) a)



4) a) 11.85 & 12.15
   b) 11.70 & 12.30
   c) 11.55 & 12.45
5) The mean of a normal distribution is in the middle and it appears to be 15 fish. The standard deviation is the distance from the mean to an inflection point. This appears to be about 3 fish
6) a)



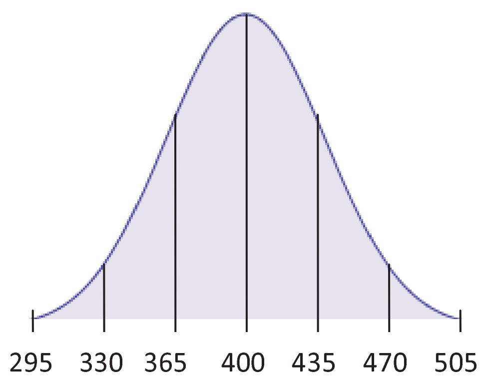
   b) 2.5%
   c) 9,680 and 13,320
   d) 13.5% + 68% = 81.5%

7) Situation i) is not likely to be normally distributed. This would include males and females so we would likely have a situation with many short hair lengths and many long hair lengths but not many in the middle.

Situation ii) is not likely to be normally distributed. It is likely that most all of the Ipod touches sold in Minnesota this week were all priced the same.

Situation iii) is most likely normally distributed. It is reasonable to think that there would be an average time and that most of the 4^{th} grade boys would be fairly close to that average. Nonetheless, we would expect that there would be some boys who were significantly slower and some who were significantly faster than the average. As we move further from the average, there would be fewer and fewer results recorded.

8) a)



b) 50%

c) 16% should last 435 hours or more and 2.5% should last 470 hours or more.

d) We would expect 34% + 50% = 84% to last 365 hours or more. 84% of 5000 is 4200 bulbs.

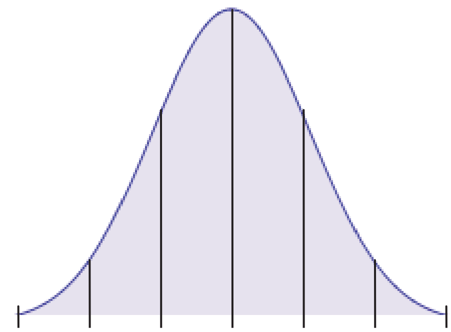
9) a) 97.5% popped means that only 2.5% did not pop so we are 2 standard deviations above the mean which would be 145 + 13 + 13 = 171 seconds.

b) It would be between 132 seconds and 158 seconds.

10) a) First of all, 34% + 50 % = 84% must wait more than 5 minutes. Now take 84% of 400 to find that 336 students need to wait more than 5 minutes.

b) Only 2.5% of students have to wait longer than 11 minutes. Now take 2.5% of 400 to get that only 10 students have to wait more than 11 minutes.

11) a)



b) They must be able to solve the puzzle in 13.0 minutes or less.

c) Only 16% of the students can solve it in 16.1 minutes or less. Take 16% of 400 to get that only 64 students can solve the puzzle in 16.1 minutes or less.

12) The top 16% of all scores begin 1 standard deviation to the right of the mean. In this case, this score would be at 60 + 10 = 70.

Review Exercises

13) Mean $\approx$ 5.45, Standard Deviation $\approx$ 1.51

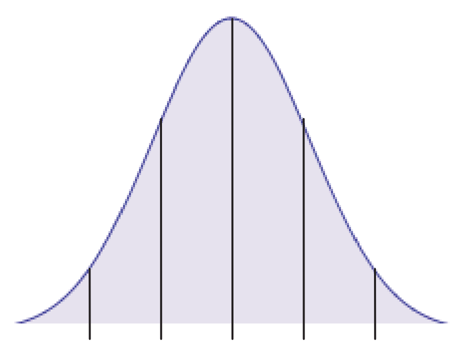
14) The key is that we need 2 dogs **and** 2 cats. There is no indication that order of selection matters, so we have ${}_{16}C_2 \cdot {}_{12}C_2 = 120 \cdot 66 = 7{,}920$ ways this can be done.

15) Five-Number Summary = 3, 8, 12.5, 15, 20

16) It will be biased because it is a voluntary response survey.

Problem Set 7.2 Exercises Pages 311-313

1)



2) $z = \frac{165-125}{40} = \frac{40}{40} = 1$

3) $z = \frac{85-125}{40} = \frac{-40}{40} = -1$

4) $z = \frac{171-125}{40} = \frac{46}{40} = 1.15$

5) Using the Normal Distribution Table, $z = \frac{135-125}{40} = \frac{10}{40} = 0.25$. This gives a corresponding value of 0.5987 so our observation is at about the 60th percentile.
On a calculator, NormalCdf(-1000, 135, 125, 40) = 0.5987 or the 60th percentile.

6) Using the Normal Distribution Table, $z = \frac{70-125}{40} = \frac{-55}{40} = -1.375 \approx -1.38$. This gives a corresponding value of 0.0838 so our observation is at about the 8th percentile.
On a calculator, NormalCdf(-1000, 70, 125, 40) = 0.0846 or the 9th percentile.
Note: These two answers are different due to the rounding that occurs when using the Normal Distribution Table.

7) Since 125 is at the mean, it is at the 50th percentile.

8) Using the Normal Distribution Table, $z = \frac{145-125}{40} = \frac{20}{40} = 0.5$. This gives a corresponding value of 0.6915 so our observation is at the 69th percentile. However, we want the probability of being greater than this so we get P($\geq$145) = 1 – 0.6915 = 0.3085 or there is a 31% chance of observing at least 145 cars.
On a calculator, NormalCdf(145, 1000, 125, 40) = 0.3085 or a 31% chance.

9) Using the Normal Distribution Table, $z = \frac{100-125}{40} = \frac{-25}{40} = -0.625 \approx -0.63$ and $z = \frac{150-125}{40} = \frac{25}{40} = 0.625 \approx 0.63$. These gives corresponding values of 0.7357 and 0.2643. Subtracting gives 0.7357 – 0.2643 = 0.4714 so there is about a 47% chance of seeing between 100 and 150 cars on the road.
On a calculator, NormalCdf(100, 150, 125, 40) = 0.4680 or about a 47% chance.

10) Using the Normal Distribution Table, $z = \frac{140-125}{40} = \frac{15}{40} = 0.375 \approx 0.38$. This gives a corresponding value of 0.6480 so our observation is at about the 65th percentile.
On a calculator, NormalCdf(-1000, 140, 125, 40) = 0.6462 or the 65th percentile.

11) Using the Normal Distribution Table, $z = \frac{65-125}{40} = \frac{-60}{40} = -1.5$. This gives a corresponding value of 0.0668 so our observation is at about the 7th percentile.
On a calculator, NormalCdf(-1000, 65, 125, 40) = 0.0668 or the 7th percentile.

12) Using the Normal Distribution Table, $z = \frac{90-125}{40} = \frac{-35}{40} = -0.875 \approx -0.88$ and $z = \frac{130-125}{40} = \frac{5}{40} = 0.125 \approx 0.13$. This gives corresponding values of 0.1894 and 0.5517. Subtracting gives 0.5517 – 0.1894 = 0.3623 so there is about a 36% chance of seeing between 90 and 130 cars on the road.
On a calculator, NormalCdf(90, 130, 125, 40) = 0.3590 or about a 36% chance.

13) Using the Normal Distribution Table, $z = \frac{160-125}{40} = \frac{35}{40} = .875 \approx 0.88$. This gives a corresponding value of 0.8106. However, we want to know the probability of seeing more than 160 cars so P($\geq$160) = 1 – 0.8106 = 0.1894 or about a 19% chance.
On a calculator, NormalCdf(160, 1000, 125, 40) = 0.1908 or a 19% chance.

14) Using the Normal Distribution Table, $z = \frac{110-125}{40} = \frac{-15}{40} = -0.375 \approx -0.38$. This gives a corresponding value of 0.3520 so there is about a 35% chance of seeing no more than 110 cars on the road.
On a calculator, NormalCdf(-1000, 110, 125, 40) = 0.3538 or a 35% chance.

15) Using the Normal Distribution Table, $z = \frac{165-136}{14} = \frac{29}{14} = 2.07$. This gives a corresponding value of 0.9808 so our observation is at about the 98th percentile.
On a calculator, NormalCdf(-1000, 165, 136, 14) = 0.9808 or the 98th percentile.

16) $-1.35 = \frac{x-136}{14}$

$-18.9 = x - 136$

$117.1 = x - 136$

We would expect to find about 117 ants in this colony.

17) $z = \frac{131-136}{14} = \frac{-5}{14} \approx -.36$

18) Using the Normal Distribution Table, $z = \frac{160 - 136}{14} = \frac{24}{14} \approx 1.71$. This gives a corresponding value of 0.9564 so there is about a 96% chance of seeing no more than 160 ants in this colony.

On a calculator, NormalCdf(-1000, 160, 136, 14) = 0.9568 or a 96% chance.

19) Using the Normal Distribution Table, $z = \frac{150 - 136}{14} = \frac{14}{14} = 1$. This gives a corresponding value of 0.8413. However, we want the probability of finding 150 ants **or more**.

P($\geq$150) = 1 – 0.8413 = 0.1597 which is about a 16% chance.

On a calculator, NormalCdf(150, 1000, 136, 14) = 0.1587 or a 16% chance.

20) Using the Normal Distribution Table, $z = \frac{120 - 136}{14} = \frac{-16}{14} \approx -1.14$ and

$z = \frac{155 - 136}{14} = \frac{25}{40} \approx 1.36$. These give corresponding values of 0.1271 and 0.9131.

Subtracting gives 0.9131 – 0.1271 = 0.7860 so there is about a 79% chance of seeing between 120 and 155 ants in a colony.

On a calculator, NormalCdf(120, 155, 136, 14) = 0.7861 or about a 79% chance.

21) The best comparison here will be with regards to z –scores.

Ricky's z-score is $z = \frac{1140 - 1000}{200} = \frac{140}{200} = 0.70$.

Robbie's z-score is $z = \frac{22 - 18}{6} = \frac{4}{6} \approx 0.67$.

Ricky did better because his z-score was slightly higher.

22) Use z-scores to compare heights.

The male's z-score is $z = \frac{74 - 69.5}{2.5} = \frac{4.5}{2.5} = 1.80$.

The female's z-score is $z = \frac{68.5 - 64.5}{2.3} = \frac{4}{2.3} \approx 1.74$.

The male would be considered taller because his z-score was slightly higher.

23) Using the Normal Distribution Table, $z = \frac{345 - 315}{12} = \frac{30}{12} = 2.5$. This gives a corresponding value of 0.9938. This is beyond the 99^{th} percentile so it would be in his longest 1% of his drives.

On a calculator, NormalCdf(-1000, 345, 315, 12) = 0.9938 or just beyond the 99^{th} percentile.

Review Exercises

24) 1

25) $P(2\ Queens) = \frac{4}{52}\cdot\frac{3}{51} = \frac{12}{2,652} = \frac{1}{221} \approx 0.005$

26) Based upon the stem plot below, it is generally true that the overall times for the 12th graders were better than those for the 9th graders.

9th		12th
	10	6 6 9
8 8 5	11	2 4 6 6
7 6 1	12	1 2
4 1	13	3
0	14	

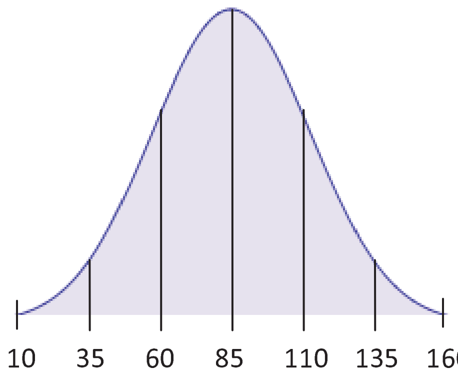
27) It is more likely that there is something else in play here. It is not logical that simply shipping computers to countries whose people have low life-expectancies would make them live longer. A reasonable explanation is that both the life-expectancy and the percentage of people who have computers is a common response to income. Countries with plenty of money probably have both better health care and also more money for computers.

28) $EV = 0\cdot 0.21 + 1\cdot 0.37 + 2\cdot 0.32 + 3\cdot 0.1 = 1.31$

Problem Set 7.3 Exercises Pages 317-319

1) a) From the table, the z-score that produces a result closest to 0.84 is between z = 0.99 and z = 1.00. Using the calculator, InvNorm(0.84, 0, 1) = 0.994 . Use z = 0.99 .
b) From the table, the z-score that produces a result closest to 0.16 is between z = -0.99 and z = -1.00 . Using the calculator, InvNorm(0.16, 0, 1) = -0.994 . Use z = -0.99 .
c) This suggests that we are at the 95th percentile. From the table, the z-score that produces a result closest to 0.95 is between z = 1.64 and z = 1.65 . Using the calculator, InvNorm(0.95, 0, 1) = 1.645. Use z = 1.65 .
d) From the table, the z-score that produces a result closest to 0.35 is between z = -0.38 and z = -0.39 . Using the calculator, InvNorm(0.35, 0, 1) = -0.385 . Use z = -0.39 .
e) This suggests that to look between the 25th percentile and 75th percentile. From the table, the z-score closest to the 25th percentile is between z = -0.67 and z = -0.68 . Likewise, the z-score closest to the 75th percentile is between z = 0.67 and z = 0.68 . Using the calculator, InvNorm(0.25, 0, 1) = -0.674 and InvNorm(0.75, 0, 1) = 0.674. The middle 50% of the data is between z = -0.67 and z = 0.67 .

2) a)



b) The middle 94% would be marked at the 3rd and 97th percentiles. From the table, the z-scores are z = -1.88 and z = 1.88 .

$$-1.88 = \frac{x-85}{25} \qquad 1.88 = \frac{x-85}{25}$$

$$-47 = x-85 \qquad 47 = x-85$$

$$x = 38 \qquad x = 132$$

The middle 94% of all patients will have blood glucose levels between 38 and 132.
On the calculator, InvNorm(0.03, 85, 25) = 37.98 and InvNorm(0.97, 85, 25) = 132.02 which also gives us results between 38 and 132.

c) Look at the 99th percentile. From the table, the z-score = 2.33 .

$$2.33 = \frac{x-85}{25}$$

$$58.25 = x-85$$

$$143.25 = x$$

The top 1% of blood glucose levels start at 143.
Using the calculator, InvNorm (0.99, 85, 25) = 143.16 or about 143.

d) Look at the 2nd percentile. From the table, the z-score = -2.05 .

$$-2.05 = \frac{x-85}{25}$$

$$-51.25 = x-85$$

$$33.75 = x$$

The marker for the lowest 2% of blood glucose levels is at about 34.
Using the calculator, InvNorm (0.02, 85, 25) = 33.66 or about 34.

3) a) The top 10% is at the 90th percentile. From the table, this gives z = 1.28 .

$$1.28 = \frac{x - 500}{100}$$

$$128 = x - 500$$

$$628 = x$$

From the calculator, InvNorm(0.90, 500, 100) = 628.2 so a student must score 628 or higher.

b) The top 40% is at the 60th percentile. From the table, this gives z = 0.25 .

$$0.25 = \frac{x - 18}{6}$$

$$1.5 = x - 18$$

$$19.5 = x$$

From the calculator, InvNorm(0.60, 18, 6) = 19.52 so a student must score about 20 or higher.

c) The middle 50% would be between the 25th and 75th percentiles. From the table, these give z = -0.67 and z = 0.67 .

$$-0.67 = \frac{x - 18}{6} \qquad 0.67 = \frac{x - 18}{6}$$

$$-4.02 = x - 18 \qquad 4.02 = x - 18$$

$$13.98 = x \qquad 22.02 = x$$

From the calculator, InvNorm(0.25, 18, 6) = 13.95 and InvNorm(0.75, 18, 6) = 22.05 so a student must score between 14 and 22 to be in the middle 50%.

d) Compare z-scores. From the table, the 85th percentile produces a z-score of 1.04 . To find z-scores only on the calculator, use a mean of 0 and a standard deviation of 1.
InvNorm (0.85, 0, 1) = 1.036.

Compare this to the z-score for an SAT result of 620 to get $z = \frac{620 - 500}{100} = \frac{120}{100} = 1.2$.

Since this z-score is better, the student who scored the 620 did better than the student at the 85th percentile.

4) The top 20% is at the **20th percentile!** This is because the lowest 20% of times will be the fastest times. From the table, this z-score is z = 1.04 .

$$-1.04 = \frac{x - 10.06}{0.07}$$

$$-0.0728 = x - 10.06$$

$$9.99 \approx x$$

From the calculator, InvNorm(0.20, 10.06, 0.07) = 10.001. A runner would have to complete the 100 meters in 10 seconds or less.
Note that the difference between the two results here is due to the rounding in the table.

5) The tallest 25% of boys will be at the 75th percentile or higher. From the table, the z-score is $z = 0.67$. Note that 5 feet, 9 inches is the same as 69 inches.

$$
\begin{aligned}
0.67 &= \frac{x-69}{2.5} \\
1.675 &= x - 69 \\
70.675 &= x
\end{aligned}
$$

From the calculator, InvNorm(0.75, 69, 2.5) = 70.69 inches. In order to try out for the team, a player must be a bit over 70.5 inches or 5 feet, 10 ½ inches tall.

6) If a student is in the top 90% of their class, this means that the student could be as low as the 10th percentile. In other words, for every 100 students, this particular student ranks above only about 10 students.

7) Considering that it only overfills 2% of the time, begin by finding where the 98th percentile is for the machine. From the table, the z-score is $z = 2.05$.

$$
\begin{aligned}
2.05 &= \frac{x-19}{0.6} \\
1.23 &= x - 19 \\
20.23 &= x
\end{aligned}
$$

From the calculator, InvNorm(0.98, 19, .6) = 20.23 . It appears that the 20 ounce cup is actually designed to be able to hold about 20 ¼ ounces of soda.

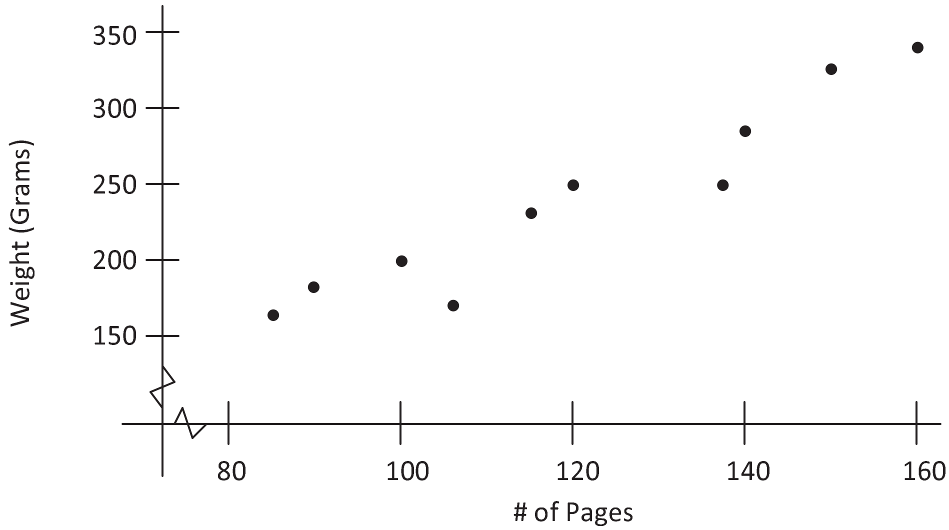
Review Exercises

8) Note that 7 feet is the same as 84 inches and our z-score is $z = \frac{84-79}{3.5} = \frac{5}{3.5} \approx 1.43$.

From the table, this corresponds to 0.9236 or about the 92nd percentile. This suggests that only 8% of these eagles will have wingspans longer than 7 feet.

From the calculator, NormalCdf(84, 1000, 79, 3.5) = 0.0766 or about 8%.

9) a)



b) From the calculator, r = 0.96 .

c) From the calculator, $y = 2.34x - 41.59$.

d) This book would weigh $y = 2.34 \cdot 130 - 41.59 = 262.61$ or about 263 grams.

e)

$$295 = 2.34 \cdot x - 41.59$$
$$336.59 = 2.34 \cdot x$$
$$143.8 \approx x$$

This book would have about 144 pages.

10) a) There are 4 pool balls that are both solid and odd so $P(Solid \text{ and } Odd) = \frac{4}{15} \approx 0.27$.

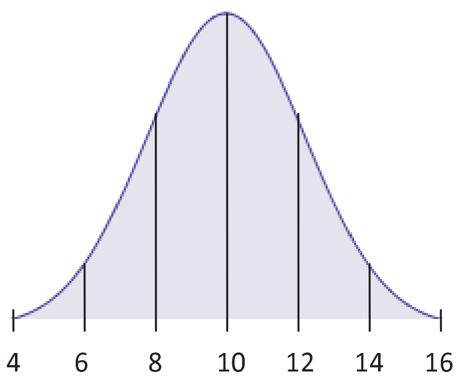
b) There are 8 solid pool balls to begin with plus there are 4 more (the 9, 11, 13, and 15) that are also odd for a total of 12 pool balls that are either solid or odd so $P(Solid \text{ or } Odd) = \frac{12}{15} = 0.8$.

c) In this case the two pool balls could either be solid & solid or striped & striped.

$$P(Solid, Solid \text{ or } Striped, Striped) = \frac{8}{15} \cdot \frac{7}{14} + \frac{7}{15} \cdot \frac{6}{14} = \frac{56}{210} + \frac{42}{210} = \frac{98}{210} = \frac{7}{15} \approx 0.47$$

Chapter 7 Review Exercises   Pages 320-323

1) a)



b) 95%

c) 34% + 34% + 13.5% + 2.35% = 83.85%

d) Start by finding the z-scores for 8 and 13. $z = \frac{8-10}{2} = -1$ and $z = \frac{13-10}{2} = 1.5$.

From the table, these z-scores correspond to 0.1587 and 0.9332. Subtracting these gives a result of 0.7745 or about 77.5% of scores are between 8 and 13.
From the calculator, NormalCdf(8, 13, 10, 2) = 0.7745 or about 77.5%.

e) $z = \frac{11-10}{2} = 0.5$ which corresponds to 0.6915 . To find the percentage that scored above 11, subtract 1 – 0.6915 = 0.3085 . About 31% of students scored at least 11.
From the calculator, NormalCdf(11, 1000, 10, 2) = 0.3085 or about 31%.

f) Start by finding the z-scores for 5 and 12. $z = \frac{5-10}{2} = -2.5$ and $z = \frac{12-10}{2} = 1$. From the table, these z-scores correspond to 0.0062 and 0.8413. Subtracting these gives a result of 0.8351 or about 83.5% of scores are between 5 and 12.
From the calculator, NormalCdf(8, 13, 10, 2) = 0.8351 or 83.5%.

g) The z-score from the table that is closest to the 90th percentile is z = 1.28 .

$$1.28 = \frac{x-10}{2}$$
$$2.56 = x-10$$
$$12.56 = x$$

From the calculator, InvNorm(0.90, 10, 2) = 12.56 or about 12 ½ points.

h) $z = \frac{13-10}{2} = 1.5$

i) $-1.5 = \frac{x-10}{2}$ or $-3 = x-10$ or $7 = x$ This student scored 7 points.

2) i) is not likely to be normal because there are many different types of trees in a forest.
ii) is also not likely to be normal because most kids probably cannot hit the golf ball very far(some probably not at all), but there will be some who have some experience golfing who can hit it significantly farther than the other kids.
iii) This is also not likely to be normal. There is probably an average number of siblings somewhere around 2. If it was normal, then we would expect to see equal numbers on each side of the mean. This cannot happen because while there certainly are some students with 5 siblings, there would not be any with a negative number of siblings.
iv) This could very well produce a normal distribution. We would expect that for this group that there would be an average time that the 6th grade boys could hold their breath and there would be fewer and fewer students with particular results as we move further and further away from the mean.

3) a) The middle 50% would be marked by the 25th and 75th percentiles. From the table, the z-scores that most closely correspond to these values are z = -0.67 and z = 0.67 .

$$-0.67 = \frac{x - 11{,}000}{900} \qquad 0.67 = \frac{x - 11{,}000}{900}$$
$$-603 = x - 11{,}000 \qquad 603 = x - 11{,}000$$
$$10{,}397 = x \qquad 11{,}603 = x$$

From the calculator, InvNorm(0.25, 11000, 900) = 10,393 and InvNorm (0.75, 11000, 900) = 11,607. The differences in the answers are due to the fact that the z-scores are only approximate.

b) From the table, $z = \frac{13{,}400 - 11{,}000}{900} = \frac{2{,}400}{900} \approx 2.67$ which corresponds to 0.9962 or just past the 99th percentile.

From the calculator, NormalCdf (0, 13400, 11000, 900) = 0.9962 or just past the 99th percentile.

c) From the table, the z-score associated with the 70th percentile is z = 0.52 .

$$0.52 = \frac{x - 11{,}000}{900}$$
$$468 = x - 11{,}000$$
$$11{,}468 = x$$

From the calculator, InvNorm(0.70, 11000, 900) = 11,472. The differences in answers are due to the fact that the z-scores are only approximate.

4) a) $z = \frac{125-100}{15} = \frac{25}{15} \approx 1.67$

b) The top 2.5% would mean we are at the 97.5th percentile. From the table, the z-score is z = 1.96.

$$\begin{aligned} 1.96 &= \frac{x-100}{15} \\ 29.4 &= x-100 \\ 129.4 &= x \end{aligned}$$

A person must get just over a 129 on their IQ test to qualify for MENSA.

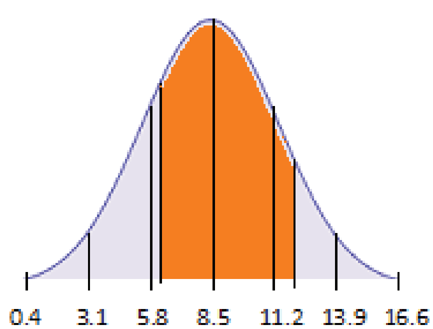
c) From part a), the z-score we are interested in is z = 1.67. From the table, a z-score of z= 1.67 is associated with 0.9525. Subtract 1 – 0.9525 = 0.0475 to find that just under 5% of all IQ scores are greater than 125.

From the calculator, NormalCdf(125, 1000, 100, 15) = 0.0478 or just under 5%.

d) Notice that 70 is exactly 2 standard deviations below the mean. Therefore, only about 2.5% of all IQ scores are below 70.

e) It makes most sense to compare z-scores. $z = \frac{143-100}{15} = \frac{43}{15} \approx 2.87$. From the table, this corresponds to 0.9979 which is past the 99th percentile. The person who scored 143 did better.From the calculator, NormalCdf(0, 143, 100, 15) = 0.9979 which is past the 99th percentile.

5) a)



b) The z-scores associated with 6 and 12 pounds are $z=\frac{6-8.5}{2.7}\approx -0.93$ and $z=\frac{12-8.5}{2.7}\approx 1.30$. The corresponding results from the table are 0.1762 and 0.9032 .

Subtracting gives 0.9032 – 0.1762 = 0.7270 or about 73%.

From the calculator, NormalCdf(6, 12, 8.5, 2.7) = 0.7253 or about 73%.

c) The middle 60% would be from the 20th percentile to the 80th percentile. From the table, the corresponding z-scores are z = -0.84 and z = 0.84.

$$-0.84=\frac{x-8.5}{2.7} \qquad 0.84=\frac{x-8.5}{2.7}$$

$$-2.268=x-8.5 \qquad 2.268=x-8.5$$

$$6.232=x \qquad 10.768=x$$

'Typical' households recycle between about 6.2 and 10.8 pounds of newspaper each month.

From the calculator, InvNorm(0.2, 8.5, 2.7) = 6.228 and InvNorm(0.8, 8.5, 2.7) = 10.772 or between 6.2 and 10.8 pounds per month.

6) a) Note that 3 feet is the same as 36 inches. $z=\frac{36-56}{11}=\frac{-20}{11}\approx -1.82$ From the table, z = -1.82 corresponds to 0.0344 or about 3% of all years have less than 3 feet of snow. normalcdf(-1000, 36, 56, 11) $\approx$ 3.5%.

b) Note that 6 feet is the same as 72 inches. $z=\frac{72-56}{11}=\frac{16}{11}\approx 1.45$ From the table,

z = 1.45 gives 0.9265 so about 100%-92.7% = 7.3% of all years have more than 6 feet of snow. normalcdf(72, 1000, 56, 11) $\approx$ 7.3%

c) $z=\frac{85-56}{11}=\frac{29}{11}\approx 2.64$ From the table, z = 2.64 corresponds to 0.9959. We want the percentage of the time that there is more than 85 inches so subtract 1 – 0.9959 = 0.0041 or about 0.4% of the time a winter will have more than 85 inches of snow. normalcdf(85, 1000, 56,11) $\approx$ 0.4%

d) From the table, the 10th percentile corresponds to a z-score of z = -1.28 .

$$-1.28 = \frac{x-56}{11}$$
$$-14.08 = x - 56$$
$$41.92 = x$$

A winter could be considered 'dry' if it receives less than about 42 inches of snow.

invnorm(.1, 56,11) $\approx$ 41.9 inches

7) Your z-score is $z = \frac{37-31}{4} = \frac{6}{4} = 1.5$. From the table, this corresponds to 0.9332 which is just beyond the 93rd percentile.
From the calculator, NormalCdf(-1000, 37, 31, 4) = 0.9332 which is just beyond the 93rd percentile.

Your brother's z-score is $z = \frac{56-40}{11} = \frac{16}{11} \approx 1.45$. From the table, this corresponds to 0.9265 which is not quite to the 93rd percentile. Since you scored at a higher percentile, your score is better.

From the calculator, NormalCdf(-1000, 56, 40, 11) = 0.9271 which is not quite to the 93rd percentile.

8) For Ted Williams, $z = \frac{0.406-0.260}{0.041} = \frac{0.146}{0.041} \approx 3.56$ which indicates that he was over 3 ½ standard deviations above the mean.
For Joe Mauer, $z = \frac{0.365-0.262}{0.035} = \frac{0.103}{0.041} \approx 2.94$ which indicates that he was just under 3 standard deviations above the mean.

Ted Williams did better because he had a better z-score.

9) The initial goal is to find the percentile that is equivalent to a score of 200. The z-score is $z = \frac{200-150}{22} = \frac{50}{22} \approx 2.27$. From the table, a z-score of 2.27 corresponds to 0.9884.
Only 1 – 0.9884 = 0.0116 or 1.16% of students will qualify for a medal. This translates into $456 \cdot 0.0116 \approx 5.29$ or just over 5 medals will be needed. Order 6 medals.
From the calculator, NormalCdf(200, 1000, 150, 22) = 0.0115 or 1.15% of students will qualify for a medal. This translates into $456 \cdot 0.0115 \approx 5.24$ or just over 5 medals. Order 6 medals.