15b The standard deviation is given by $\sigma = \sqrt{npq} = \sqrt{130 \cdot 0.75 \cdot 0.25} = 4.9371044 \to \mathbf{4.9}$.

15c First, $n \cdot p = 97.5$ and $n \cdot q = 32.5$ which are both greater than 5 (good). Now, $z = \frac{x-\mu}{\sigma} = \frac{85-97.5}{4.9} \approx -2.55$ which is less than -2. So, 85 is an **unusual** number of survivors in groups of 130. It might be worth checking to see if this particular hospital is doing as much as it can to help patients with this type of cancer.

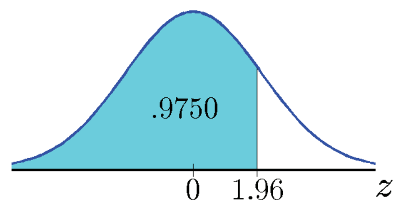
17a This is a binomial probability with $n = 124$ and $p = 0.05$. The mean from such a distribution would be $\mu = n \cdot p = 124 \cdot 0.05 = \mathbf{6.2}$ TV's.

17b First, $n \cdot p = 6.2$ and $n \cdot q = 117.8$ which are both greater than 5 (good).
To get the z-score of 16, we need the mean and standard deviation.
We have the mean. We need the standard deviation: $\sigma = \sqrt{n\,p\,q} = \sqrt{(124)(.05)(.95)} \approx 2.4$.
Now, $z = \frac{x-\mu}{\sigma} = \frac{16-6.2}{2.4} \approx 4.1$ which is way above 2.
So, this is **very unusual** if the 5% value that you got from the manufacturer is correct.

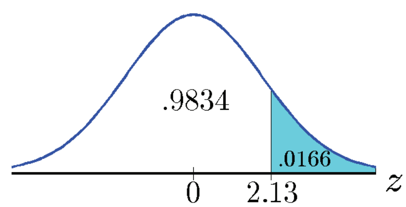
17c One, maybe you got very unlucky. Two, the 5% figure could be wrong. Maybe, the manufacturer can tell the good ones from the bad ones and sells all the bad ones to you.

Chapter 6

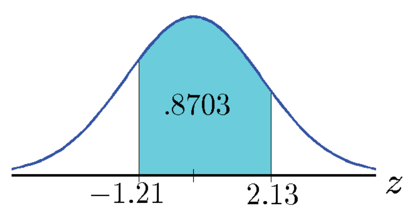
1a (i) $P(z < 1.96)$
Because of the $<$ (less than) sign, we are looking for the area to the left of 1.96. This is found straight from the z-table by using the row for 1.9 and the column for 0.06.
$\mathbf{P(z < 1.96) = 0.9750}$.



(ii) $P(z \geq 2.13)$
Because of the $\geq$ (greater than or equal to) sign, we are looking for area to the right of 2.13. This is found by getting the area to the left of 2.13 (from the z-table) and subtracting it from 1.
$\mathbf{P(z \geq 2.13) = 1 - P(z < 2.13) = 1 - 0.9834 = 0.0166}$

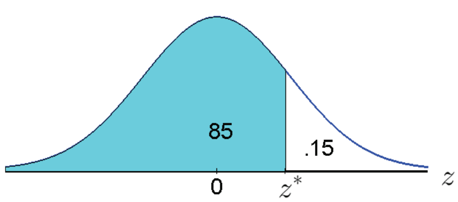


(iii) $P(-1.21 < z < 2.13)$
Because we are looking for the area between two z-scores we use
$P(z_1 < z < z_2) = P(z < z_2) - P(z < z_1)$
$P(-1.21 < z < 2.13) = P(z < 2.13) - P(z < -1.21)$
$P(-1.21 < z < 2.13) = 0.9834 - 0.1131 = \mathbf{0.8703}$



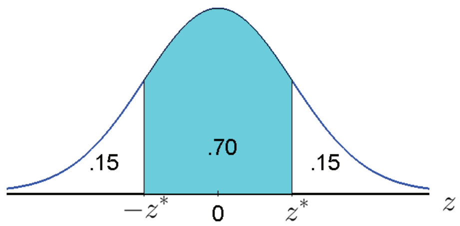
2a First, the area under a probability density curve = 1, so the area to the right of a given value is equal to one minus the area to the left. Second, since $z \leq z^*$ and $z > z^*$ are complementary events then the sum of the two probabilities must be one.

2b



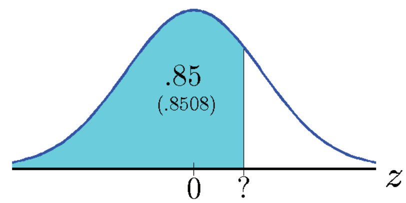
Since the mean of z-distribution = 0
then $P(z < 0) = 0.5$
Since $P(z < z^*) > 0.5$ then $z^* > 0$.
So, z^* is positive.

2c

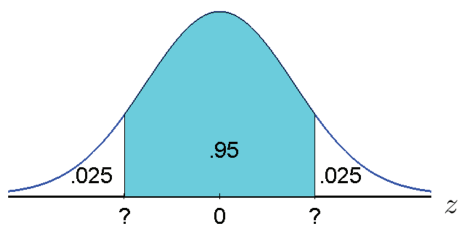


Since $P(z < z^*) = 0.85$ then $P(z > z^*) = 0.15$.
By symmetry $P(z < -z^*) = 0.15$.
So the area in the two tails combined is 0.30.
Therefore, the area between the two tails is **0.70**.

3a Here we are looking for a z-score so that the area below the curve to the left of this z-score is 0.85. So we look for 0.85 INSIDE the z-table. The closest value is 0.8508 corresponding to a z-score of **1.04**. (If you used software you should get 1.036.)



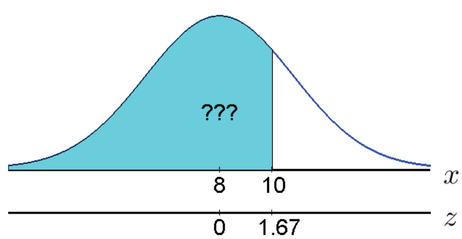
4a



Here we want the middle 95% or area = 0.95
So each tail contains half of 0.05 or 0.025.
Look for 0.025 INSIDE the z-table
Get a corresponding z-score of -1.96.
The left z-value is -1.96.
By symmetry, the right z-value is 1.96.

So the z-scores between **-1.96 and 1.96** constitute the middle 95% of the z-scores.

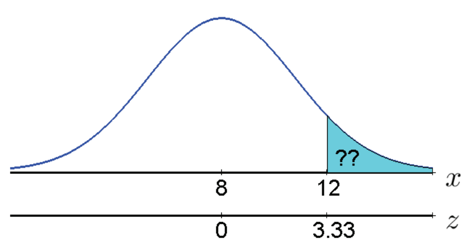
5a



If $x = 10$, then $z = \frac{x-\mu}{\sigma} = \frac{10-8}{1.2} \approx 1.67$

$$\begin{aligned} P(x < 10) &= P(z < 1.67) \\ &= \mathbf{0.9525} \quad \text{from } z\text{-table} \end{aligned}$$

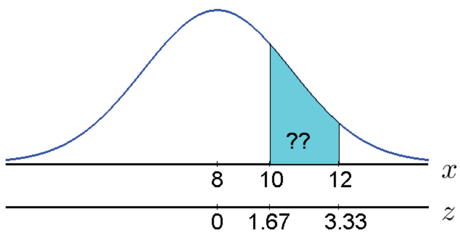
5b



If $x = 12$, then $z = \frac{x-\mu}{\sigma} = \frac{12-8}{1.2} \approx 3.33$

$$\begin{aligned} P(x > 12) &= 1 - P(x < 12) \\ &= 1 - P(z < 3.33) \\ &= 1 - .9996 \quad \text{from } z\text{-table} \\ &= \mathbf{0.0004} \end{aligned}$$

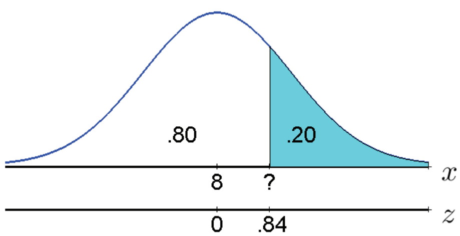
5c



If $x = 10$, then $z = \frac{x-\mu}{\sigma} = \frac{10-8}{1.2} \approx 1.67$
If $x = 12$, then $z = \frac{x-\mu}{\sigma} = \frac{12-8}{1.2} \approx 3.33$

$$
\begin{aligned}
P(10 < x < 12) &= P(x < 12) - P(x < 10) \\
&= P(z < 3.33) - P(z < 1.67) \\
&= 0.9996 - .9525 \quad \text{from } z\text{-table} \\
&= \mathbf{0.0471}
\end{aligned}
$$

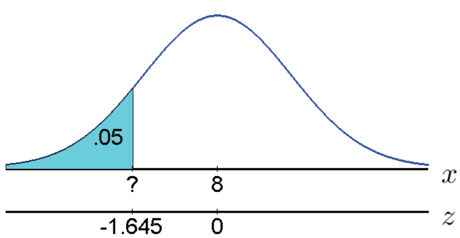
5d



We want 80% to the left and 20% right.
Look for 0.8000 INSIDE the z-table
The closest value is 0.7995
corresponding to $z = 0.84$.
x-value $= \mu + z\,\sigma = 8 + 0.84 \cdot 1.2 = \mathbf{9.008}$

So any potato that weigh more than about 9 ounces should be saved for the farmer's market.

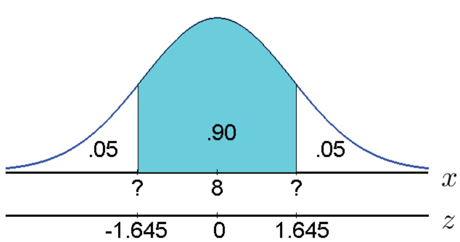
5e



We want 5% to the left and 95% right.
Look for 0.0500 INSIDE the z-table.
The corresponding z-value is z = -1.645.
x-value $= \mu + z\,\sigma = 8 - 1.645 \cdot 1.2 = \mathbf{6.026}$

So any potato that weighs less than about 6 ounces should be saved for the potato launcher.

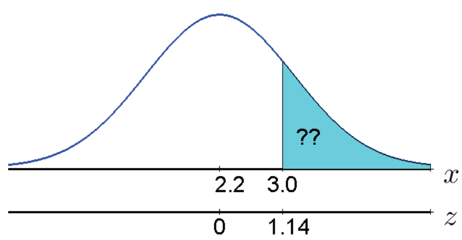
5f



Want 90% in the middle and 5% in each tail.
Look for 0.0500 INSIDE the z-table.
The left z-value is z = -1.645.
By symmetry, the right z-value is 1.645.
If $z = -1.645$, then
$x = \mu + z\,\sigma = 8 - 1.645 \cdot 1.2 = \mathbf{6.03}$
If $z = 1.645$, then
$x = \mu + z\,\sigma = 8 + 1.645 \cdot 1.2 = \mathbf{9.97}$

The weights of the middle 90% of the potatoes fall **between 6.03 ounces and 9.97** ounces.

7a

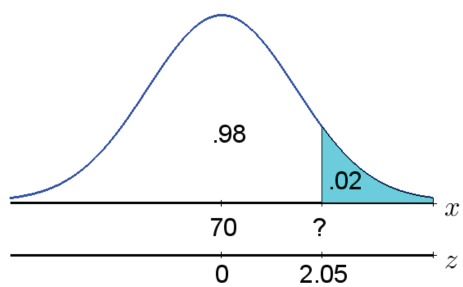


If $x = 76$, then $z = \frac{x-\mu}{\sigma} = \frac{76-70}{4} = 1.50$

$$\begin{aligned} P(x > 76) &= P(z > 1.50) \\ &= 1 - P(z < 1.50) \\ &= 1 - 0.9332 \quad \text{from } z\text{-table} \\ &= \mathbf{0.0668} \end{aligned}$$

So, about 6.68 or 7% of the cars are traveling faster than you.

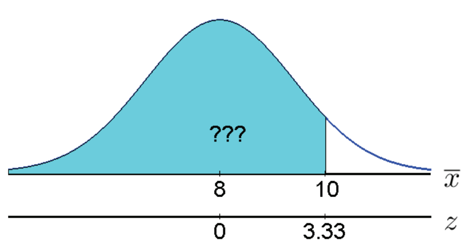
7b



You only want to ticket the top 2% (1/50)
You want 2% to the right and 98% to the left.
Look for 0.98 INSIDE the z-table.
The closest is 0.9798.
The corresponding z-value is $z = 2.05$.
x-value $= \mu + z\,\sigma = 70 + 2.05 \cdot 4 = \mathbf{78.2}$

Therefore, you should stop those cars traveling faster than 78.2 mph.

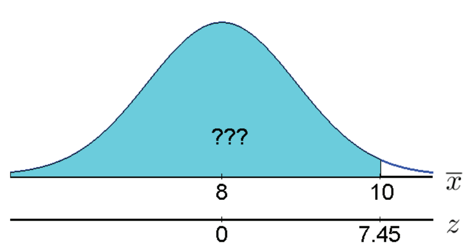
9a



If $\bar{x} = 10$, then $z = \frac{\bar{x}-\mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{10-8}{1.2/\sqrt{4}} \approx 3.33$

$$\begin{aligned} P(\bar{x} < 10) &= P(z < 3.33) \\ &= \mathbf{0.9996} \quad \text{from } z\text{-table} \end{aligned}$$

9b

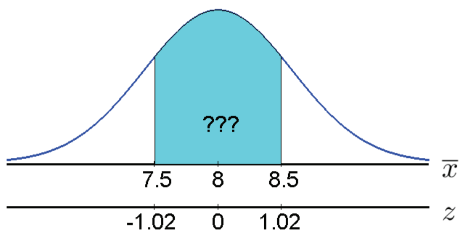


If $\bar{x} = 10$, then $z = \frac{\bar{x}-\mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{10-8}{1.2/\sqrt{20}} \approx 7.45$

$$\begin{aligned} P(\bar{x} < 10) &= P(z < 7.45) \\ &= \mathbf{0.9999} \quad \text{from } z\text{-table} \end{aligned}$$

In actuality the probability is greater than this but still < 1.

9c

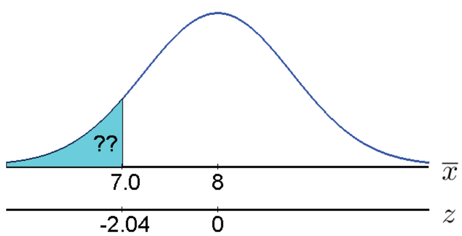


If $\bar{x} = 7.5$, then $z = \frac{\bar{x}-\mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{7.5-8}{1.2/\sqrt{6}} \approx -1.02$
If $\bar{x} = 8.5$, then $z = \frac{\bar{x}-\mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{8.5-8}{1.2/\sqrt{6}} \approx 1.02$

$$\begin{aligned} P(7.5 < \bar{x} < 8.5) &= P(-1.02 < z < 1.02) \\ &= P(z < 1.02) - P(z < -1.02) \\ &= 0.8461 - 0.1539 \quad \text{from } z\text{-table} \\ &= \mathbf{0.6922} \end{aligned}$$

Approximately 69% of these bags should have a mean potato weight of 7.5 to 8.5 ounces.

9d The mean weight of the potatoes in your bag is $42/6 = 7.0$ ounces. This is a mean weight of 1 ounce below the claimed mean. So I am already feeling a little cheated. How cheated? Find the probability of getting a mean less than the one I got.

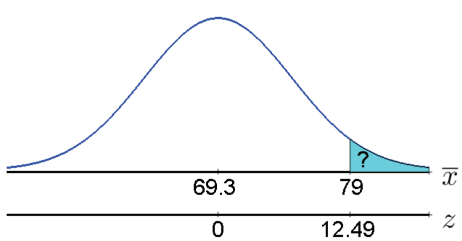


If $\bar{x} = 7.0$, then $z = \frac{\bar{x}-\mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{7-8}{1.2/\sqrt{6}} \approx -2.04$

$$\begin{aligned} P(\bar{x} < 7.0) &= P(z < -2.04) \\ &= \mathbf{0.0207} \quad \text{from } z\text{-table} \end{aligned}$$

As such, there is only a 2% chance of getting a randomly selected bag that weighs less than or equal to my bag. Now, I'm feeling extremely unlucky or cheated.

11a

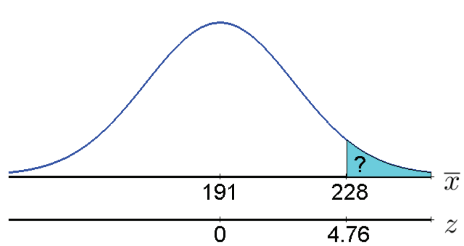


If $\bar{x} = 79.0$, then $z = \frac{\bar{x}-\mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{79.0-69.3}{2.8/\sqrt{13}} \approx 12.49$

$$\begin{aligned} P(\bar{x} > 79) &= P(z > 12.49) \\ &= 1 - P(z < 12.49) \\ &= 1 - 0.9999 \quad \text{from } z\text{-table} \\ &= \mathbf{0.0001} \end{aligned}$$

Actually, the probability is **much** smaller than this.

11b

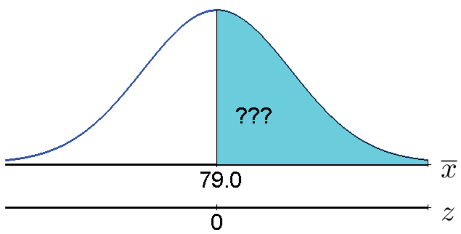


If $\bar{x} = 228$, then $z = \frac{\bar{x}-\mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{228-191}{28/\sqrt{13}} \approx 4.76$

$$\begin{aligned} P(\bar{x} > 228) &= P(z > 4.76) \\ &= 1 - P(z < 4.76) \\ &= 1 - 0.9999 \quad \text{from } z\text{-table} \\ &= \mathbf{0.0001} \end{aligned}$$

Actually, the probability is smaller than this.

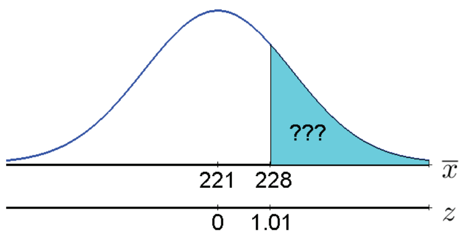
11c



If $\bar{x} = 79.0$, then $z = \frac{\bar{x}-\mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{79.0-79.0}{2.1/\sqrt{13}} = 0$

$$\begin{aligned} P(\bar{x} > 79) &= P(z > 0) \\ &= 1 - P(z < 0) \\ &= 1 - 0.5000 \quad \text{from } z\text{-table} \\ &= \mathbf{0.5000} \end{aligned}$$

11d



If $\bar{x} = 228$, then $z = \frac{\bar{x}-\mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{228-221}{25/\sqrt{13}} \approx 1.01$

$$\begin{aligned} P(\bar{x} > 228) &= P(z > 1.01) \\ &= 1 - P(z < 1.01) \\ &= 1 - 0.8438 \quad \text{from } z\text{-table} \\ &= \mathbf{0.1562} \end{aligned}$$

11e With respect to U.S. men, the team is crazy tall and very heavy. With respect to NBA players, the Lakers have a mean height that is perfectly normal (equal to the population mean) while the mean weight is somewhat high. If 13 NBA players were randomly selected, there is only about a 16% chance that the collection would have a mean weight greater than that of the L.A. Lakers.

13 If the actual satisfaction rate is 48%, you want to calculate the probability of getting a sample 220 employees with 85 or fewer satisfied.

1. If $p = .48$ and $n = 220$ then

$$\mu = n \cdot p = 220 \cdot (.48) = 105.6 \qquad \text{and} \qquad \sigma = \sqrt{n\,p\,q} = \sqrt{220(.48)(.52)} = 7.4$$

.

2. Now, let $z^* = \dfrac{x^* - \mu}{\sigma} = \dfrac{85 - 105.6}{7.4} \approx -2.78$
3. And then, $P(x \leq 85) \approx P(z < -2.78) = \mathbf{0.0027}$
4. **Conclusion:** This is a very unusual number of satisfied employees. In random samples of size 220 you can expect less than 0.3% of those samples to contain 85 or fewer satisfied employees. Your group fell into this category. Their unusually low satisfaction rate is probably not due to random variation but more likely some outside influence.

15 If the actual uninsured rate is 16.6%, you want to calculate the probability of getting a sample 250 patients with 50 or more of them uninsured.

1. If $p = .166$ and $n = 250$ then

$$\mu = n \cdot p = 250 \cdot (.166) = 41.5 \qquad \text{and} \qquad \sigma = \sqrt{n\,p\,q} = \sqrt{250(.166)(.834)} = 5.9$$

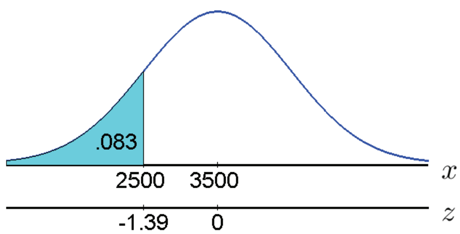
.

2. Now, let $z^* = \dfrac{x^* - \mu}{\sigma} = \dfrac{50 - 41.5}{5.9} \approx 1.44$

3. And then, $P(x \geq 50) \approx P(z \geq 1.44) = 1 - P(z \leq 1.44) = 1 - 0.9251 = \mathbf{0.0749}$

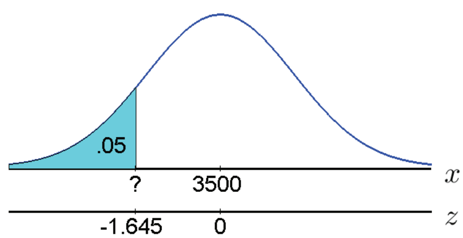
4. **Conclusion:** This is not particularly unusual. In random samples of size 250 you can expect about 7.5% of those samples would contain 50 or more uninsured. Your group fell into this category. Using the 5% cut-off rule for unusual, this is not an unusually large number of uninsured patients.

20a If the area to the left of 2500 is 8.3% or 0.083, find the z-score by looking for 0.083 INSIDE the z-table. The closest value is 0.0823 corresponding to a z-value of -1.39.



If $x = 2500$, then $z = \frac{\bar{x}-\mu}{\sigma} = \frac{2500-3500}{\sigma} \approx -1.39$
Now we solve this last equation for σ
$\sigma = \frac{2500-3500}{-1.39} = 719.42446 \approx \mathbf{719}$
So the standard deviation is approximately 719 grams.

20b



Want 0.05 inside the left tail.
Look for 0.0500 INSIDE the z-table.
The corresponding z-value is -1.645.
So, $x = \mu + z \cdot \sigma = 3500 - 1.645 \cdot 719 \approx \mathbf{2,317}$

So the new definition of a **low birth-weight** would be one that is less than **2,317** grams.

Chapter 7

1a The point estimate is the sample mean of 6.20 hours.

1b The margin of error is given by $E = z_{\alpha/2}\dfrac{\sigma}{\sqrt{n}}$ where $z_{\alpha/2} = 1.96$ (found in the z-table). With a population standard deviation $\sigma = 1.25$ and sample size $n = 50$, the margin of error is $E = 1.96\frac{1.25}{\sqrt{50}} = 0.3465$. The upper and lower bounds on μ are given by $\bar{x} \pm E$ which yields $\mathbf{5.85 < \mu < 6.55}$. **So, we are 95% confident that the mean number of hours of sleep for all college students is between 5.85 and 6.55 hours per day.**

1c Not Quite. Since 6.5 is in our confidence interval we can't be 95% confident that the true population mean is less than 6.5 hours.

1d Use the formula: $n = \left[\dfrac{z_{\alpha/2}\,\sigma}{E}\right]^2$. We want the margin of error to be no more than 0.2 hours so we set $E = 0.2$, and $z_{\alpha/2}$ at the 90% confidence level is 1.645. Now, $n = \left[\frac{1.645 \cdot 1.25}{0.2}\right]^2 = 105.7$. So we will need at least 106 college students in our survey.

1e Use the formula; $n = \left[\frac{z_{\alpha/2}\,\sigma}{E}\right]^2$. We want the margin of error to be no more than 0.1 hours so we set $E = 0.1$, and $z_{\alpha/2}$ at the 90% confidence level is 1.645. Now, $n = \left[\frac{1.645 \cdot 1.25}{0.1}\right]^2 = 422.8$. So we will need at least 423 college students in our survey.

1f Use the formula; $n = \left[\frac{z_{\alpha/2}\,\sigma}{E}\right]^2$. We want the margin of error to be no more than 0.1 hours so we set $E = 0.1$, and $z_{\alpha/2}$ at the 99% confidence level is 2.575. Now, $n = \left[\frac{2.575 \cdot 1.25}{0.1}\right]^2 = 1036.04$. So we will need at least 1037 college students in our survey.

3 Here we consider the middle 98% of the z-scores in a standard normal distribution. Therefore, there is 0.01 area in each tail (this equals $\alpha/2$ when $\alpha = 0.02$). Specifically, there is 0.01 area inside the upper tail and hence 0.99 to the left of the desired z-value. So, we look for 0.99 INSIDE the z-table. The closest value is 0.9901 corresponding to $z = 2.33$. So, $z_{\alpha/2} = \mathbf{2.33}$.

5a The point estimate is the sample proportion of $\hat{p} = 12/80 = \mathbf{0.15}$.

5b The margin of error is given by $E = z_{\alpha/2}\sqrt{\frac{\hat{p}\,\hat{q}}{n}}$ where $z_{\alpha/2} = 1.96$, $\hat{p} = 0.15$, $\hat{q} = 1 - \hat{p} = 0.85$, and $n = 80$. So, $E = 1.96\sqrt{\frac{.15\ .85}{80}} = 0.0782$ and the upper and lower bounds on p are given by $\hat{p} \pm E$ which yields $\mathbf{0.072 < p < 0.228}$. So, Carl can be 95% confident that the proportion of all ears of corn with worms is between 0.072 and 0.228.

5c The margin of error is given by $E = z_{\alpha/2}\sqrt{\frac{\hat{p}\,\hat{q}}{n}}$ where $z_{\alpha/2} = 2.575$, $\hat{p} = 0.15$, $\hat{q} = 1 - \hat{p} = 0.85$, and $n = 80$. So, $E = 2.575\sqrt{\frac{.15\ .85}{80}} = 0.1028$ and the upper and lower bounds on p are given by $\hat{p} \pm E$ which yields $\mathbf{0.047 < p < 0.253}$. So, Carl can be 99% confident that the proportion of all ears of corn with worms is between 0.047 and 0.253.

5d We want to use the formula $n = \frac{\left[z_{\alpha/2}\right]^2\ \hat{p}\,\hat{q}}{E^2}$. For a 99% confidence level, $z_{\alpha/2} = 2.575$. We use $\hat{p} = 0.15$ from the last problem. Finally if we want the estimate to be in error by no more than 2 percentage points, we set $E = 0.02$. Now, $n = \frac{[2.575]^2\ 0.15\ 0.85}{(0.02)^2} = 2113.5$, so he will need to sample at least **2114** ears of corn. That's a lot of corn.

5e We want to use the formula $n = \frac{\left[z_{\alpha/2}\right]^2\ 0.25}{E^2}$. For a 99% confidence level, $z_{\alpha/2} = 2.575$. If we want the estimate to be in error by no more than 2 percentage points, we set $E = 0.02$. Now, $n = \frac{[2.575]^2\ 0.25}{(0.02)^2} = 4144.1$, so he will need to sample at least **4145** ears of corn. That's even more corn.

7a The point estimate is the sample proportion of $\hat{p} = 59/100 = \mathbf{0.59}$.

7b The margin of error is given by $E = z_{\alpha/2}\sqrt{\frac{\hat{p}\,\hat{q}}{n}}$ where $z_{\alpha/2} = 2.575$, $\hat{p} = 0.59$, $\hat{q} = 1 - \hat{p} = 0.41$, and $n = 100$. So, $E = 2.575\sqrt{\frac{(.59)(.41)}{100}} = 0.1266$ and the upper and lower bounds on p are given by $\hat{p} \pm E$ which yields $\mathbf{0.4634 < p < 0.7166}$. So, we can be 99% confident that the proportion of heads in **all** tosses of this token is between 0.463 and 0.717.

7c No. Since 0.50 is within the confidence interval limits, you can't rule out the possibility that the true proportion is 0.50 which would mean the token is fair.

7d The margin of error is given by $E = z_{\alpha/2}\sqrt{\frac{\hat{p}\,\hat{q}}{n}}$ where $z_{\alpha/2} = 1.645$, $\hat{p} = 0.59$, $\hat{q} = 1 - \hat{p} = 0.41$, and $n = 100$. So, $E = 1.645\sqrt{\frac{(.59)(.41)}{100}} = 0.0809$ and the upper and lower bounds on p are given by $\hat{p} \pm E$ which yields $\mathbf{0.5091 < p < 0.6709}$. So, we can be 90% confident that the proportion of heads in **all** tosses of this token is between 0.509 and 0.671.

7e Yes. Since 0.50 is below the lower bound of the confidence interval you are 90% confident the true proportion of heads is above 0.50 and that the coin is not fair.

7f We want to use the formula $n = \frac{\left[z_{\alpha/2}\right]^2\ \hat{p}\,\hat{q}}{E^2}$. For a 99% confidence level, $z_{\alpha/2} = 2.575$. We use $\hat{p} = 0.59$ from the last problem. Finally if we want the estimate to be in error by no more 0.04, we set $E = 0.04$. Now, $n = \frac{[2.575]^2\ (0.59)\ (0.41)}{(0.04)^2} = 1002.47$, so I would need to toss this token at least **1003** times.

7g Now, use the formula $n = \frac{\left[z_{\alpha/2}\right]^2\ 0.25}{E^2}$. Now, $n = \frac{[2.575]^2\ 0.25}{(0.04)^2} = 1036.035$, so I would need to toss this token at least **1037** times.

9a The margin of error is given by $E = t_{\alpha/2}\frac{s}{\sqrt{n}}$ where $t_{\alpha/2} = 1.976$ (found in the t-table with 145 degrees of freedom because 149 is not in the table). With a sample standard deviation $s = 2,500$ and sample size $n = 150$, the margin of error is $E = 1.976\frac{2500}{\sqrt{150}} = 403$. The upper and lower bounds on μ are given by $\bar{x} \pm E$ which yields $\mathbf{23,597 < \mu < 24,403}$. **So, you are 95% confident that the mean debt for Vermont college students is between $23,597 and $24,403.**

9b Since we are 95% confident that the mean debt for Vermont students is greater than $23,597, we are at least 95% confident that the mean debt for Vermont students is greater than $21,000.

11a The point estimate for the population mean is the sample mean $\bar{x} = 25.2$ pounds.

11b The margin of error is given by $E = t_{\alpha/2}\frac{s}{\sqrt{n}}$ where $t_{\alpha/2} = 1.729$ (found in the t-table with degrees of freedom = 19 and a confidence level of 90%). With a sample standard deviation $s = 4.5$ and sample size $n = 20$, the margin of error is $E = 1.729\frac{4.5}{\sqrt{20}} = 1.740$. The upper and lower bounds on μ are given by $\bar{x} \pm E$ which yields $\mathbf{23.5 < \mu < 26.9}$. **So, we are 90% confident that the mean weight of all Chinook Salmon in the Columbia River is between 23.5 and 26.9 pounds.**

11c This confidence interval is calculated exactly like the previous one except that the critical value of t is given as $t_{\alpha/2} = 2.093$ (found in the t-table with degrees of freedom = 19 and a confidence level of 95%) which yields a margin of error of $E = 2.106$ and a confidence interval of $\mathbf{23.1 < \mu < 27.3}$. **So, we are 95% confident that the mean weight of all Chinook Salmon in the Columbia River is between 23.1 and 27.3 pounds.**

11d This is a close one. I am 95% confident that the mean weight of the salmon is is between 23.1 and 27.3 pounds but I am 99% confident that the mean weight is between 22.3 and 28.1 pounds. As such, **I am 95% confident that the mean weight is greater than 23 pounds but I am not 99% confident of this result.**

11e We can use the t-distribution if the sample size is greater than 30 or the population is normally distributed. We assumed the latter right from the start - though it is difficult to know for sure whether this is true.

13a Use the t-distribution. The sample size is small but the population distribution is normal. Since σ is unknown, use the t-distribution.

13b Neither. You would use the z-distribution (as for all population proportion confidence intervals) but the number of successes is too small, so you can't do anything with this.

13c Use the z-distribution. You can actually use either distribution because σ and s are known. However, the z-distribution gives you a better confidence interval.

13d Use the z-distribution. Always use the z-distributions for population proportions provided the number of successes and failures are both greater than 5.

13e Neither. Here the sample size is too small and the population distribution is not normal, so you can't use either distribution.

15 The sample mean will fall in the middle of the two given bounds. $\bar{x} = \frac{12.4+13.2}{2} = \mathbf{12.8}$. The margin of error E is the distance from the sample mean to either of the bounds. An easy way to find this is to take the upper bound minus the lower bound and divide this by 2. So, $E = \frac{13.2-12.4}{2} = \mathbf{0.4}$.

17a The margin of errors are given by given by

$$E = z_{\alpha/2}\frac{\sigma}{\sqrt{n}} \quad \text{or} \quad E = z_{\alpha/2}\sqrt{\frac{\hat{p}\,\hat{q}}{n}} \quad \text{or} \quad E = t_{\alpha/2}\frac{s}{\sqrt{n}}.$$

Regardless of the formula, if the confidence level increases the critical value of $z_{\alpha/2}$ or $t_{\alpha/2}$ will increase and **the margin of error will increase**. You should have observed this phenomenon in the answers to some of the problems in this homework set.

17b In this case, the critical values of $t_{\alpha/2}$ or $z_{\alpha/2}$ will decrease and **the margin of error will decrease**.

17c The margin of errors are given by given by

$$E = z_{\alpha/2}\frac{\sigma}{\sqrt{n}} \quad \text{or} \quad E = z_{\alpha/2}\sqrt{\frac{\hat{p}\,\hat{q}}{n}} \quad \text{or} \quad E = t_{\alpha/2}\frac{s}{\sqrt{n}}.$$

In all three cases, if n gets bigger, then E gets smaller so **the margin of error will decrease** (provided the confidence level and sample statistics do not change).

Chapter 8

1a (a) Claim: $\mu = 12$, $H_o : \mu = 12$, $H_1 : \mu \neq 12$. (b) μ is the mean volume of all 12 ounce cans of soda. (c) The null hypothesis supports the claim. (d) This would result in a two-tailed test.

1b (a) Claim: $\mu > 40,000$, $H_o : \mu = 40,000$, $H_1 : \mu > 40,000$. (b) μ is the mean daily flow rate of oil. (c) The alternate hypothesis supports the claim. (d) This would result in a right-tailed test.

1c (a) Claim: $p > 0.5$, $H_o : p = 0.5$, $H_1 : p > 0.5$. (b) p is the proportion of all people who have a strong dislike for statistics. (c) The alternate hypothesis supports the claim. (d) This would result in a right-tailed test.