1. (a) Let $X_1, \ldots, X_{50}$ be the weights of the 50 bags.
Then $\bar{X}$ is approximately normally distributed with mean $\mu_{\bar{X}} = 100$ and $\sigma_{\bar{X}} = 0.5/\sqrt{50} = 0.0707$.
The z-score of 99.9 is $(99.9 - 100)/0.0707 = -1.41$.
The area to the left of $z = -1.41$ is 0.0793.
$P(\bar{X} < 99.9) = 0.0793$.

(b) $\bar{X}$ is approximately normally distributed with mean $\mu_{\bar{X}} = 100.15$, and $\sigma_{\bar{X}} = 0.5/\sqrt{50} = 0.0707$.
The z-score of 100 is $(100 - 100.15)/0.0707 = -2.12$.
The area to the left of $z = -2.12$ is 0.0170.
$P(\bar{X} < 100) = 0.0170$.

3. Let $X_1, \ldots, X_{100}$ be the heights of the 100 men.
Then $\bar{X}$ is approximately normally distributed with mean $\mu_{\bar{X}} = 70$ and $\sigma_{\bar{X}} = 2.5/\sqrt{100} = 0.25$.
The z-score of 69.5 is $(69.5 - 70)/0.25 = -2.00$.
The area to the right of $z = -2.00$ is $1 - 0.0228 = 0.9772$.
$P(\bar{X} > 69.5) = 0.9772$.

11. (a) If the claim is true, then $X \sim \text{Bin}(1000, 0.05)$, so $X$ is approximately normal with mean $\mu_X = 1000(0.05) = 50$
and $\sigma_X = \sqrt{1000(0.05)(0.95)} = 6.89202$.
To find $P(X \geq 75)$, use the continuity correction and find the z-score of 74.5.
The z-score of 74.5 is $(74.5 - 50)/6.89202 = 3.55$.
The area to the right of $z = 3.55$ is $1 - 0.9998 = 0.0002$.
$P(X \geq 75) = 0.0002$.

(b) Yes. Only about 2 in 10,000 samples of size 1000 will have 75 or more nonconforming tiles if the goal has been reached.

(c) No, because 75 nonconforming tiles in a sample of 1000 is an unusually large number if the goal has been reached.

(d) If the claim is true, then $X \sim \text{Bin}(1000, 0.05)$, so $X$ is approximately normal with mean $\mu_X = 1000(0.05) = 50$
and $\sigma_X = \sqrt{1000(0.05)(0.95)} = 6.89202$.
To find $P(X \geq 53)$, use the continuity correction and find the z-score of 52.5.
The z-score of 52.5 is $(52.5 - 50)/6.89202 = 0.36$.
The area to the right of $z = 0.36$ is $1 - 0.6406 = 0.3594$.
$P(X \geq 53) = 0.3594$.

(e) No. More than 1/3 of the samples of size 1000 will have 53 or more nonconforming tiles if the goal has been reached.

(f) Yes, because 53 nonconforming tiles in a sample of 1000 is an unusually large number if the goal has been reached.
Minitab Homework

(a) Find mean, standard deviation, maximum, and minimum for each data set. [Hint: Use Descriptive statistics option.]

Descriptive Statistics: C1, C2, C3, C4, C5

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>N*</th>
<th>Mean</th>
<th>StDev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>500</td>
<td>0</td>
<td>4.77049E-18</td>
<td>1.0000</td>
<td>-1.7424</td>
<td>1.6649</td>
</tr>
<tr>
<td>C2</td>
<td>500</td>
<td>0</td>
<td>1.07423E-15</td>
<td>1.0000</td>
<td>-0.9418</td>
<td>7.6325</td>
</tr>
<tr>
<td>C3</td>
<td>500</td>
<td>0</td>
<td>7.81276E-16</td>
<td>1.0000</td>
<td>-1.3596</td>
<td>5.2107</td>
</tr>
<tr>
<td>C4</td>
<td>500</td>
<td>0</td>
<td>2.28523E-16</td>
<td>1.0000</td>
<td>-0.7194</td>
<td>11.8294</td>
</tr>
<tr>
<td>C5</td>
<td>500</td>
<td>0</td>
<td>1.47451E-17</td>
<td>1.0000</td>
<td>-2.7233</td>
<td>2.8191</td>
</tr>
</tbody>
</table>

(b) Use Normal probability plots to decide what column(s) can be described by Normal distribution.

By the five normal probability plots, the probability plot of C5 lie much closer to a straight line. Therefore, the data from the column 5 can be described by Normal distribution.
Solution for Section 5.1

1. (a) 1.645

(b) 1.37

(c) 2.81

(d) 1.15

5. (a) $\bar{X} = 150$, $s = 25$, $n = 100$, $z_{0.025} = 1.96$.

The confidence interval is $150 \pm 1.96(25/\sqrt{100})$, or $(145.10, 154.90)$.

(b) $\bar{X} = 150$, $s = 25$, $n = 100$, $z_{0.05} = 2.58$.

The confidence interval is $150 \pm 2.58(25/\sqrt{100})$, or $(143.55, 156.45)$.

(c) $\bar{X} = 150$, $s = 25$, $n = 100$, so the upper confidence bound 153 satisfies $153 = 150 + z_{\alpha/2}(25/\sqrt{n})$.

Solving for $z_{\alpha/2}$ yields $z_{\alpha/2} = 1.20$.

The area to the right of $z = 1.20$ is $1 - 0.8849 = 0.1151$, so $\alpha/2 = 0.1151$.

The level is $1 - \alpha = 1 - 2(0.1151) = 0.7698$, or 76.98%.

(d) $z_{0.025} = 1.96$. $1.96(25/\sqrt{n}) = 2$, so $n = 601$.

(e) $z_{0.05} = 2.58$. $2.58(25/\sqrt{n}) = 2$, so $n = 1041$.

Solution for Section 5.2

3. (a) $X = 52$, $n = 70$, $\hat{p} = (52 + 2)/(70 + 4) = 0.72973$, $z_{0.025} = 1.96$.

The confidence interval is $0.72973 \pm 1.96 \sqrt{0.72973(1 - 0.72973)/(70 + 4)}$, or $(0.629, 0.831)$.

(b) $X = 52$, $n = 70$, $\hat{p} = (52 + 2)/(70 + 4) = 0.72973$, $z_{0.05} = 1.645$.

The confidence interval is $0.72973 \pm 1.645 \sqrt{0.72973(1 - 0.72973)/(70 + 4)}$, or $(0.645, 0.815)$.

(c) Let $n$ be the required sample size.

Then $n$ satisfies the equation $0.05 = 1.96\sqrt{\hat{p}(1 - \hat{p})/(n + 4)}$.

Replacing $\hat{p}$ with $\hat{p} = 0.72973$ and solving for $n$ yields $n = 300$.

(d) Let $n$ be the required sample size.

Then $n$ satisfies the equation $0.05 = 1.645\sqrt{\hat{p}(1 - \hat{p})/(n + 4)}$.

Replacing $\hat{p}$ with $\hat{p} = 0.72973$ and solving for $n$ yields $n = 210$. 