8.6 Estimated mean time is \( \bar{x} = 3.8 \) minutes.

Estimated standard error is \( \frac{s}{\sqrt{n}} = \frac{1.2}{\sqrt{40}} = 0.1897 \).

90% error margin is \( 1.645 \times \frac{s}{\sqrt{n}} = 1.645(0.1897) = 0.31 \) minutes.

8.10 We have \( d = 1.4, \sigma = 3.2, \) and \( z_{0.05} = z_{0.025} = 2.58. \) Hence,
\[
\left[ \frac{2.58(3.2)}{1.4} \right]^2 = 34.78.
\]
So, the required sample size is \( n = 35 \).

8.14 Since the sample size is 108, the 90% error margin \( 1.645 \times \frac{\sigma}{\sqrt{n}} = 2.9 \), so that solving for \( \sigma \) yields \( \sigma = 18.321 \). Now, to determine the required sample size \( n \) for the case where \( d = 1.8, \sigma = 18.321 \) and \( z_{0.05} = z_{0.025} = 1.96 \), we calculate
\[
\left[ \frac{1.96\sigma^2}{1.8} \right]^2 = 397.98. \text{ So, the required sample size is } n = 398.
\]

8.22 (a) For large \( n \), a 95% confidence interval for \( \mu \) is given by \( \bar{X} \pm z_{0.025} \frac{s}{\sqrt{n}} \). Using \( z_{0.025} = 1.96, n = 39, \) and the summary statistics \( \bar{x} = 4.7, s = 3.2, \) the 95% confidence interval for \( \mu \) is given by
\[
4.7 \pm 1.96 \times \frac{3.2}{\sqrt{39}} = 4.7 \pm 1.004 \text{ or } (3.696, 5.704) \text{ songs.}
\]

(b) This is uncertain. We only know that in the long run, 95% of all confidence intervals would contain the value of the true parameter \( \mu \).

(c) 95% of all confidence intervals would contain \( \mu \) by the interpretation provided in the text.

8.30 For large \( n \), a 90% confidence interval for \( \mu \) is given by \( \bar{X} \pm z_{0.05} \frac{s}{\sqrt{n}} \). Using \( z_{0.05} = 1.645, n = 30 \) and the summary statistics \( \bar{x} = 8.12, s = 1.78 \) the 90% confidence interval for \( \mu \) is given by
\[
8.12 \pm 1.645 \times \frac{1.78}{\sqrt{30}} = 8.12 \pm 0.535 \text{ or } (7.585, 8.655).
8.42 (a) Using $\bar{x} = 30.54$, the observed value of the test statistic is
\[ z = \frac{30.54 - 30}{2/\sqrt{55}} = \frac{0.54}{0.2697} = 2.00. \]
Since the observed $z = 2.00$ lies in the rejection region $R : z \geq 1.645$, the null hypothesis is rejected with $\alpha = 0.05$.

(b) Using $\bar{x} = 0.136$, the observed value of the test statistic is
\[ z = \frac{0.136 - 0.15}{0.085/\sqrt{125}} = \frac{-0.014}{0.0076} = -1.84. \]
Since the observed $z = -1.84$ does not lie in the rejection region $R : z \leq -1.96$, the null hypothesis is not rejected with $\alpha = 0.025$.

(c) Using $\bar{x} = 77.35$, the observed value of the test statistic is
\[ z = \frac{77.35 - 80}{8.6/\sqrt{38}} = \frac{-2.65}{1.395} = -1.90. \]
Since the observed $z = -1.90$ does not lie in the rejection region $R : |z| \geq 2.58$, the null hypothesis is not rejected with $\alpha = 0.01$.

(d) Using $\bar{x} = -0.59$, the observed value of the test statistic is
\[ z = \frac{-0.59 - 0}{1.23/\sqrt{40}} = \frac{-0.59}{0.1945} = -3.03. \]
Since the observed $z = -3.03$ lies in the rejection region $R : |z| \geq 1.88$, the null hypothesis is rejected with $\alpha = 0.06$.

8.54 Let $\mu$ denote the true mean content (in percent-weight) of cashews in the mixed-nut cans. Since the inspector wants to substantiate the belief that $\mu < 25$, we formulate the following hypotheses: $H_0 : \mu = 25$, $H_1 : \mu < 25$.

Now, to run the test with sample size $n = 35$, we use the test statistic $Z = \frac{\bar{x} - 25}{S/\sqrt{35}}$.
Since $H_1$ is left-sided, the rejection region should have the form $R : Z \leq z_{\alpha}$. The observed value of the test statistic is
\[ z = \frac{23.5 - 25}{3.1/\sqrt{35}} = -2.86, \]
Note that the $p$-value is $P(Z \leq -2.86) = 0.0021$. So, the null hypothesis would be rejected with $\alpha$ as small as 0.0021. This extremely small $p$-value is strong evidence in support of the inspector’s belief.

8.86 (a) To test the hypotheses: $H_0 : \mu = 3.7$, $H_1 : \mu < 3.7$
we use the test statistic $\frac{\bar{x} - 3.7}{S/\sqrt{n}}$. Since $H_1$ is left-sided, the rejection region should have the form $R : Z \leq z_{\alpha}$. Since $z_{0.05} = 1.645$, the rejection region is $R : Z \leq -1.645$. Since the value of the test statistic, namely
\[ \frac{3.6 - 3.7}{0.5/\sqrt{40}} = -1.265, \]
is not in $R$, we do not reject $H_0$ at $\alpha = 0.05$.

(b) Since we do not reject $H_0$, we could be making a Type II error.