8-4 a) 95% CI for μ, $n=10,\quad \sigma=20 \quad \bar{x}=1000,\quad z=1.96$

$$\bar{x}-z\sigma/\sqrt{n} \le \mu \le \bar{x}+z\sigma/\sqrt{n}$$
$$1000-1.96(20/\sqrt{10}) \le \mu \le 1000+1.96(20/\sqrt{10})$$
$$987.6 \le \mu \le 1012.4$$

b) .95% CI for μ, $n=25,\quad \sigma=20 \quad \bar{x}=1000,\quad z=1.96$

$$\bar{x}-z\sigma/\sqrt{n} \le \mu \le \bar{x}+z\sigma/\sqrt{n}$$
$$1000-1.96(20/\sqrt{25}) \le \mu \le 1000+1.96(20/\sqrt{25})$$
$$992.2 \le \mu \le 1007.8$$

c) 99% CI for μ, $n=10,\quad \sigma=20 \quad \bar{x}=1000,\quad z=2.58$

$$\bar{x}-z\sigma/\sqrt{n} \le \mu \le \bar{x}+z\sigma/\sqrt{n}$$
$$1000-2.58(20/\sqrt{10}) \le \mu \le 1000+2.58(20/\sqrt{10})$$
$$983.7 \le \mu \le 1016.3$$

d) 99% CI for μ, $n=25,\quad \sigma=20 \quad \bar{x}=1000,\quad z=2.58$

$$\bar{x}-z\sigma/\sqrt{n} \le \mu \le \bar{x}+z\sigma/\sqrt{n}$$
$$1000-2.58(20/\sqrt{25}) \le \mu \le 1000+2.58(20/\sqrt{25})$$
$$989.7 \le \mu \le 1010.3$$

e) When n is larger, the CI is narrower. The higher the confidence level, the wider the CI.

8-7 a) Find n for the length of the 95% CI to be 40. $Z_{a/2} = 1.96$

$$1/2\text{ length} = (1.96)(20)/\sqrt{n} = 20$$
$$39.2 = 20\sqrt{n}$$
$$n = \left(\frac{39.2}{20}\right)^2 = 3.84$$

Therefore, $n = 4$.

b) Find n for the length of the 99% CI to be 40. $Z_{a/2} = 2.58$

$$1/2\text{ length} = (2.58)(20)/\sqrt{n} = 20$$
$$51.6 = 20\sqrt{n}$$
$$n = \left(\frac{51.6}{20}\right)^2 = 6.66$$

Therefore, $n = 7$.

8-8 Interval (1): $3124.9 \le \mu \le 3215.7$ and Interval (2): $3110.5 \le \mu \le 3230.1$

Interval (1): half-length =90.8/2=45.4 and Interval (2): half-length =119.6/2=59.8

a) $\bar{x}_1 = 3124.9 + 45.4 = 3170.3$

$\bar{x}_2 = 3110.5 + 59.8 = 3170.3$ The sample means are the same.

b) Interval (1): $3124.9 \le \mu \le 3215.7$ was calculated with 95% confidence because it has a smaller half-length, and therefore a smaller confidence interval. The 99% confidence level widens the interval.

8-14 a) 95% Two-sided CI on the true mean life of a 75-watt light bulb

For $\alpha = 0.05$, $z_{\alpha/2} = z_{0.025} = 1.96$, and $\bar{x} = 1014$, $\sigma = 25$, $n=20$

$$\bar{x} - z_{0.025}\left(\frac{\sigma}{\sqrt{n}}\right) \le \mu \le \bar{x} + z_{0.025}\left(\frac{\sigma}{\sqrt{n}}\right)$$

$$1014 - 1.96\left(\frac{25}{\sqrt{20}}\right) \le \mu \le 1014 + 1.96\left(\frac{25}{\sqrt{20}}\right)$$

$$1003 \le \mu \le 1025$$

b) 95% one-sided CI on the true mean piston ring diameter

For $\alpha = 0.05$, $z_\alpha = z_{0.05} = 1.65$ and $\bar{x} = 1014$, $\sigma = 25$, $n=20$

$$\bar{x} - z_{0.05}\frac{\sigma}{\sqrt{n}} \le \mu$$

$$1014 - 1.65\left(\frac{25}{\sqrt{20}}\right) \le \mu$$

$$1005 \le \mu$$

The lower bound of the one-sided confidence interval is greater than the lower bound of the two-sided interval even though the level of significance is the same. This is because for a one-sided confidence interval the probability in the left tail (α) is greater than the probability in the left tail of the two-sided confidence interval ($\alpha/2$).

8-25 a) $t_{0.025,12} = 2.179$ b) $t_{0.025,24} = 2.064$ c) $t_{0.005,13} = 3.012$

d) $t_{0.0005,15} = 4.073$

8-26 a) $t_{0.05,14} = 1.761$ b) $t_{0.01,19} = 2.539$ c) $t_{0.001,24} = 3.467$

8-27 a) Mean $= \dfrac{sum}{N} = \dfrac{251.848}{10} = 25.1848$

$Variance = (stDev)^2 = 1.605^2 = 2.5760$

b) 95% confidence interval on mean

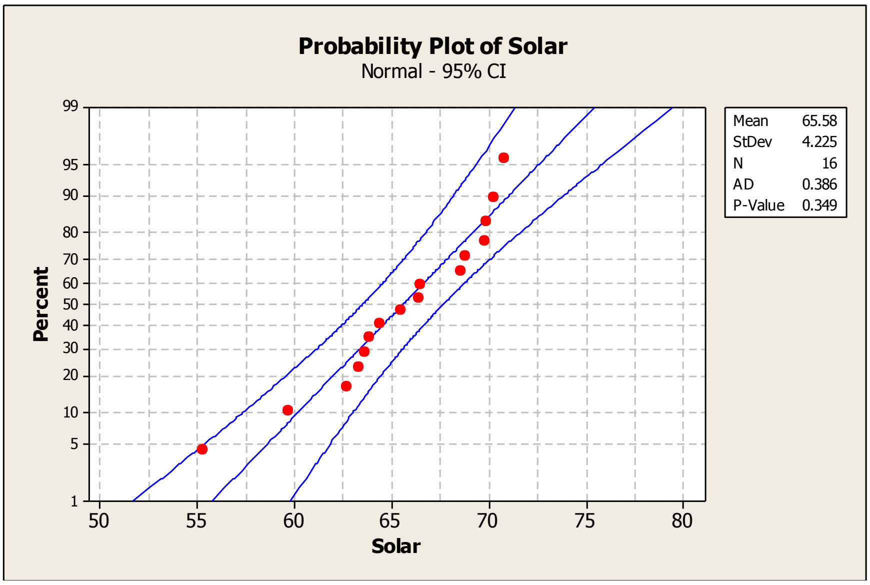
$n = 10 \quad \bar{x} = 25.1848 \quad s = 1.605 \qquad t_{0.025,9} = 2.262$

$$\bar{x} - t_{0.025,9}\left(\frac{s}{\sqrt{n}}\right) \le \mu \le \bar{x} + t_{0.025,9}\left(\frac{s}{\sqrt{n}}\right)$$

$$25.1848 - 2.262\left(\frac{1.605}{\sqrt{10}}\right) \le \mu \le 25.1848 + 2.262\left(\frac{1.605}{\sqrt{10}}\right)$$

$$24.037 \le \mu \le 26.333$$

8-36 The data appear to be normally distributed based on the normal probability plot below.



95% confidence interval on mean solar energy consumed

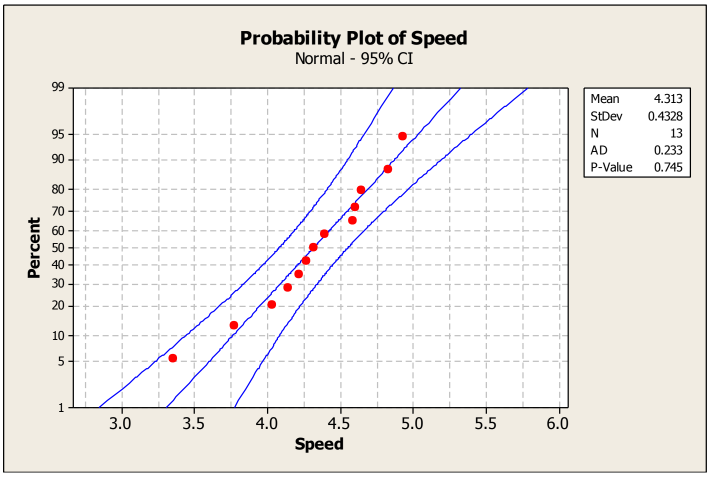
$n = 16 \quad \bar{x} = 65.58 \quad s = 4.225 \qquad t_{0.025,15} = 2.13$

$$\bar{x} - t_{0.025,15}\left(\frac{s}{\sqrt{n}}\right) \le \mu \le \bar{x} + t_{0.025,15}\left(\frac{s}{\sqrt{n}}\right)$$

$$65.58 - 2.131\left(\frac{4.225}{\sqrt{16}}\right) \le \mu \le 65.58 + 2.131\left(\frac{4.225}{\sqrt{16}}\right)$$

$$63.329 \le \mu \le 67.831$$

8-41. a) The data appear to be normally distributed based on examination of the normal probability plot below.



b) 95% confidence interval on mean speed-up

$$n = 13 \quad \bar{x} = 4.313 \quad s = 0.4328 \quad t_{0.025,12} = 2.179$$

$$\bar{x} - t_{0.025,12}\left(\frac{s}{\sqrt{n}}\right) \leq \mu \leq \bar{x} + t_{0.025,12}\left(\frac{s}{\sqrt{n}}\right)$$

$$4.313 - 2.179\left(\frac{0.4328}{\sqrt{13}}\right) \leq \mu \leq 4.313 + 2.179\left(\frac{0.4328}{\sqrt{13}}\right)$$

$$4.051 \leq \mu \leq 4.575$$

c) 95% lower confidence bound on mean speed-up

$$n = 13 \quad \bar{x} = 4.313 \quad s = 0.4328 \quad t_{0.05,12} = 1.782$$

$$\bar{x} - t_{0.05,12}\left(\frac{s}{\sqrt{n}}\right) \leq \mu$$

$$4.313 - 1.782\left(\frac{0.4328}{\sqrt{13}}\right) \leq \mu$$

$$4.099 \leq \mu$$