Chapter 6 Selected Problem Solutions

Sections 6-1and 6-2

6-1. Sample average:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{592.035}{8} = 74.0044 \text{ mm}$$

Sample variance:

$$\sum_{i=1}^{8} x_i = 592.035$$

$$\sum_{i=1}^{8} x_i^2 = 43813.18031$$

$$s^2 = \frac{\sum_{i=1}^{n} x_i^2 - \frac{\left(\sum_{i=1}^{n} x_i\right)^2}{n}}{n-1} = \frac{43813.18031 - \frac{(592.035)^2}{8}}{8-1}$$

$$= \frac{0.0001569}{7} = 0.000022414 \quad (\text{mm})^2$$

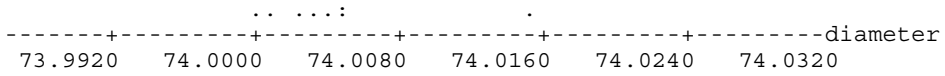
Sample standard deviation:

$$s = \sqrt{0.000022414} = 0.00473 \quad \text{mm}$$

The sample standard deviation could also be found using

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} \quad \text{where} \quad \sum_{i=1}^{8}(x_i - \bar{x})^2 = 0.0001569$$

Dot Diagram:



There appears to be a possible outlier in the data set.

6-11. a) $\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{5747}{8} = 7.184$

b) $s^2 = \dfrac{\sum_{i=1}^{n} x_i^2 - \dfrac{\left(\sum_{i=1}^{n} x_i\right)^2}{n}}{n-1} = \dfrac{412.853 - \dfrac{(57.47)^2}{8}}{8-1} = \dfrac{0.003}{7} = 0.000427$

$s = \sqrt{0.000427} = 0.02066$

c) Examples: repeatability of the test equipment, time lag between samples, during which the pH of the solution could change, and operator skill in drawing the sample or using the instrument.

6-13. a) $\bar{x} = 65.85$
$s = 12.16$

b) Dot Diagram

```
                                                 :   :
   .          .     .    .   ..    .: .: .   .:..: .. :: .... ..
 -+---------+---------+---------+---------+---------+---------+-----temp
 30         40        50         60        70         80
```

c) Removing the smallest observation (31), the sample mean and standard deviation become
$\bar{x} = 66.86$
$s = 10.74$

Section 6-3

6-15 a.) Stem-and-leaf display for Problem 6-15 cycles: unit = 100 1|2 represents 1200

```
  1    0T|3
  1    0F|
  5    0S|7777
 10    0o|88899
 22    1*|000000011111
 33    1T|22222223333
(15)   1F|444445555555555
 22    1S|66667777777
 11    1o|888899
  5    2*|011
  2    2T|22
```

b) No, only 5 out of 70 coupons survived beyond 2000 cycles.

6-19. Descriptive Statistics

```
Variable        N  Median    Q1       Q3
cycles         70  1436.5  1097.8   1735.0
```

6-25 Stem-and-leaf display for Problem 6-25. Yard: unit = 1.0
Note: Minitab has dropped the value to the right of the decimal to make this display.

```
  4   23*|2334
  7   23o|677
 15   24*|00112444
 19   24o|5578
 32   25*|0111122334444
 45   25o|5555556677899
(15)  26*|000011123334444
 40   26o|566677888
 31   27*|0000112222233333444
 12   27o|66788999
  4   28*|003
```

```
1    28o|5
```

Sample Mean $\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{\sum_{i=1}^{100} x_i}{100} = \frac{26070}{100} = 260.7 \quad yards$

Sample Standard Deviation

$\sum_{i=1}^{100} x_i = 26070$ and $\sum_{i=1}^{100} x_i^2 = 6813256$

$$s^2 = \frac{\sum_{i=1}^{n} x_i^2 - \frac{\left(\sum_{i=1}^{n} x_i\right)^2}{n}}{n-1} = \frac{6813256 - \frac{(26070)^2}{100}}{100-1} = \frac{16807}{99}$$

$$= 169.7677 \quad yards^2$$

and

$$s = \sqrt{169.7677} = 13.03 \quad yards$$

Sample Median

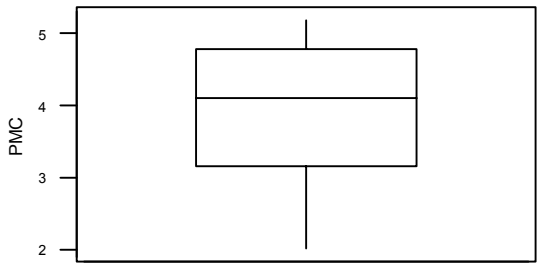
```
Variable             N     Median
yards              100     261.15
```

Section 6-5

6-43. Descriptive Statistics

```
Variable         N      Mean    Median  Tr Mean     StDev  SE Mean
PMC             20     4.000     4.100     4.044     0.931    0.208
Variable       Min       Max        Q1        Q3
PMC          2.000     5.200     3.150     4.800
```

a) Sample Mean: 4
b) Sample Variance: 0.867
Sample Standard Deviation: 0.931
c)



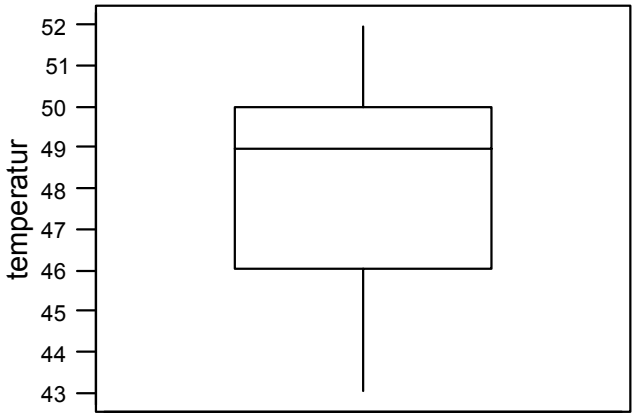
6-47.

Descriptive Statistics

```
Variable         N      Mean    Median  Tr Mean     StDev  SE Mean
temperat        24    48.125    49.000    48.182     2.692    0.549
Variable       Min       Max        Q1        Q3
```

```
temperat   43.000   52.000   46.000   50.000
```

a) Sample Mean: 48.125
   Sample Median: 49
b) Sample Variance: 7.246
   Sample Standard Deviation: 2.692
c)



The data appear to be slightly skewed.

Supplemental

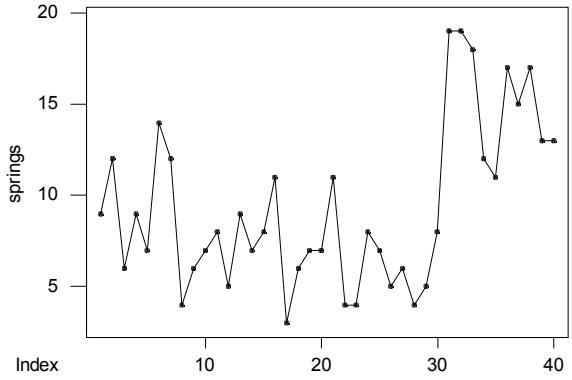
6-75 a) Sample 1 Range = 4
   Sample 2 Range = 4
   Yes, the two appear to exhibit the same variability
b) Sample 1 s = 1.604
   Sample 2 s = 1.852
   No, sample 2 has a larger standard deviation.
c) The sample range is a relatively crude measure of the sample variability as compared to the sample standard deviation since the standard deviation uses the information from every data point in the sample whereas the range uses the information contained in only two data points - the minimum and maximum.

6-79 a)`Stem-and-leaf display for Problem 6-79: unit = 1    1|2  represents 12`

```
 1    0T|3
 8    0F|4444555
18    0S|6666777777
(7)   0o|8888999
15    1*|111
12    1T|22233
 7    1F|45
 5    1S|77
 3    1o|899
```

b) Sample Average = 9.325
   Sample Standard Deviation = 4.4858

c)



The time series plot indicates there was an increase in the average number of nonconforming springs made during the 40 days. In particular, the increase occurs during the last 10 days.