

**Chapter 2 - Frequency Distributions and Graphs**

**EXERCISE SET 2-1**

1. Frequency distributions are used to organize data in a meaningful way, to determine the shape of the distribution, to facilitate computational procedures for statistics, to make it easier to draw charts and graphs, and to make comparisons among different sets of data.

2. Categorical distributions are used with nominal or ordinal data, ungrouped distributions are used with data having a small range, and grouped distributions are used when the range of the data is large.

3. Five to twenty classes. Width should be an odd number so that the midpoint will have the same place value as the data.

4. An open-ended frequency distribution has either a first class with no lower limit or a last class with no upper limit. They are necessary to accomodate all the data.

5.  
Boundaries: 42.5 – 47.5  
Midpoint: 45  
Width: 5

6.  
Boundaries: 124.5 – 131.5  
Midpoint: 128  
Width: 7

7.  
Boundaries: 8.235 – 11.365  
Midpoint: 9.8  
Width: 3.13

8.  
Boundaries: 16.25 – 18.55  
Midpoint: 17.4  
Width: 2.3

9.  
Class width is not uniform.

10.  
Class limits overlap, and class width is not uniform.

11.  
A class has been omitted.

12.  
Class width is not uniform.

13.

| <i>Class</i> | <i>f</i> | <i>Percent</i> |
|--------------|----------|----------------|
| F            | 19       | 38             |
| C            | 14       | 28             |
| B            | 10       | 20             |
| A            | <u>7</u> | <u>14</u>      |
|              | 50       | 100            |

The class with the most data values is professional football. The class with the least number of data values is auto racing.

14.

| <i>Class</i> | <i>f</i> | <i>Percent</i> |
|--------------|----------|----------------|
| A            | 4        | 10%            |
| M            | 28       | 70%            |
| H            | 6        | 15%            |
| S            | 2        | <u>5%</u>      |
|              | 40       | 100%           |

15.

| <i>Limits</i> | <i>Boundaries</i> | <i>f</i> |
|---------------|-------------------|----------|
| 0             | -0.5 - 0.5        | 2        |
| 1             | 0.5 - 1.5         | 5        |
| 2             | 1.5 - 2.5         | 24       |
| 3             | 2.5 - 3.5         | 8        |
| 4             | 3.5 - 4.5         | 6        |
| 5             | 4.5 - 5.5         | 4        |
| 6             | 5.5 - 6.5         | 0        |
| 7             | 6.5 - 7.5         | <u>1</u> |
|               |                   | 50       |

|                | <i>cf</i> |
|----------------|-----------|
| Less than -0.5 | 0         |
| Less than 0.5  | 2         |
| Less than 1.5  | 7         |
| Less than 2.5  | 31        |
| Less than 3.5  | 39        |
| Less than 4.5  | 45        |
| Less than 5.5  | 49        |
| Less than 6.5  | 49        |
| Less than 7.5  | 50        |

The category "twice a week" has more values than any other category.

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16.

| <i>Limits</i> | <i>Boundaries</i> | <i>f</i> |
|---------------|-------------------|----------|
| 3             | 2.5 - 3.5         | 2        |
| 4             | 3.5 - 4.5         | 4        |
| 5             | 4.5 - 5.5         | 4        |
| 6             | 5.5 - 6.5         | 1        |
| 7             | 6.5 - 7.5         | 4        |
| 8             | 7.5 - 8.5         | 3        |
| 9             | 8.5 - 9.5         | <u>2</u> |
|               |                   | 20       |

|               | <i>cf</i> |
|---------------|-----------|
| Less than 2.5 | 0         |
| Less than 3.5 | 2         |
| Less than 4.5 | 6         |
| Less than 5.5 | 10        |
| Less than 6.5 | 11        |
| Less than 7.5 | 15        |
| Less than 8.5 | 18        |
| Less than 9.5 | 20        |

17.

$$H = 514 \quad L = 465$$

$$\text{Range} = 514 - 465 = 49$$

$$\text{Width} = 49 \div 6 = 8.2 \text{ round up to } 9$$

| <i>Limits</i> | <i>Boundaries</i> | <i>f</i> |
|---------------|-------------------|----------|
| 465 - 473     | 464.5 - 473.5     | 9        |
| 474 - 482     | 473.5 - 482.5     | 7        |
| 483 - 491     | 482.5 - 491.5     | 7        |
| 492 - 500     | 491.5 - 500.5     | 6        |
| 501 - 509     | 500.5 - 509.5     | 7        |
| 510 - 518     | 509.5 - 518.5     | <u>4</u> |
|               |                   | 40       |

|                 | <i>cf</i> |
|-----------------|-----------|
| Less than 464.5 | 0         |
| Less than 473.5 | 9         |
| Less than 482.5 | 16        |
| Less than 491.5 | 23        |
| Less than 500.5 | 29        |
| Less than 509.5 | 36        |
| Less than 518.5 | 40        |

18.

$$H = 110 \quad L = 54$$

$$\text{Range} = 110 - 54 = 56$$

$$\text{Width} = 56 \div 7 = 8 \text{ round up to } 9$$

18. continued

| <i>Limits</i> | <i>Boundaries</i> | <i>f</i> |
|---------------|-------------------|----------|
| 54 - 62       | 53.5 - 62.5       | 7        |
| 63 - 71       | 62.5 - 71.5       | 6        |
| 72 - 80       | 71.5 - 80.5       | 8        |
| 81 - 89       | 80.5 - 89.5       | 4        |
| 90 - 98       | 89.5 - 98.5       | 1        |
| 99 - 107      | 98.5 - 107.5      | 3        |
| 108 - 116     | 107.5 - 116.5     | <u>1</u> |
|               |                   | 30       |

|                 | <i>cf</i> |
|-----------------|-----------|
| Less than 53.5  | 0         |
| Less than 62.5  | 7         |
| Less than 71.5  | 13        |
| Less than 80.5  | 21        |
| Less than 89.5  | 25        |
| Less than 98.5  | 26        |
| Less than 107.5 | 29        |
| Less than 116.5 | 30        |

19.

$$H = 70 \quad L = 27$$

$$\text{Range} = 70 - 27 = 43$$

$$\text{Width} = 43 \div 7 = 6.1 \text{ or } 7$$

| <i>Limits</i> | <i>Boundaries</i> | <i>f</i> |
|---------------|-------------------|----------|
| 27 - 33       | 26.5 - 33.5       | 7        |
| 34 - 40       | 33.5 - 40.5       | 14       |
| 41 - 47       | 40.5 - 47.5       | 15       |
| 48 - 54       | 47.5 - 54.5       | 11       |
| 55 - 61       | 54.5 - 61.5       | 3        |
| 62 - 68       | 61.5 - 68.5       | 3        |
| 69 - 75       | 68.5 - 75.5       | <u>2</u> |
|               |                   | 55       |

|                | <i>cf</i> |
|----------------|-----------|
| Less than 26.5 | 0         |
| Less than 33.5 | 7         |
| Less than 40.5 | 21        |
| Less than 47.5 | 36        |
| Less than 54.5 | 47        |
| Less than 61.5 | 50        |
| Less than 68.5 | 53        |
| Less than 75.5 | 55        |

20.

$$H = 177,500 \quad L = 70,000$$

$$\text{Range} = 177,500 - 70,000 = 107,500$$

$$\text{Width} = 107,500 \div 6 = 17,916.67$$

round up to 17,917

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20. continued

| <i>Limits</i>     | <i>Boundaries</i>     | <i>f</i> |
|-------------------|-----------------------|----------|
| 70,000 - 87,916   | 69,999.5 - 87,916.5   | 1        |
| 87,917 - 105,833  | 87,916.5 - 105,833.5  | 3        |
| 105,834 - 123,750 | 105,833.5 - 123,750.5 | 7        |
| 123,751 - 141,667 | 123,750.5 - 141,667.5 | 6        |
| 141,668 - 159,584 | 141,667.5 - 159,584.5 | 5        |
| 159,585 - 177,502 | 159,584.5 - 177,502.5 | <u>3</u> |
|                   |                       | 25       |

|                     | <i>cf</i> |
|---------------------|-----------|
| Less than 69,999.5  | 0         |
| Less than 87,916.5  | 1         |
| Less than 105,833.5 | 4         |
| Less than 123,750.5 | 11        |
| Less than 141,667.5 | 17        |
| Less than 159,584.5 | 22        |
| Less than 177,502.5 | 25        |

21.

$$H = 88 \quad L = 12$$

$$\text{Range} = 88 - 12 = 76$$

$$\text{Width} = 76 \div 9 = 8.4 \text{ round up to } 9$$

| <i>Limits</i> | <i>Boundaries</i> | <i>f</i> |
|---------------|-------------------|----------|
| 12 - 20       | 11.5 - 20.5       | 7        |
| 21 - 29       | 20.5 - 29.5       | 7        |
| 30 - 38       | 29.5 - 38.5       | 3        |
| 39 - 47       | 38.5 - 47.5       | 3        |
| 48 - 56       | 47.5 - 56.5       | 4        |
| 57 - 65       | 56.5 - 65.5       | 3        |
| 66 - 74       | 65.5 - 74.5       | 0        |
| 75 - 83       | 74.5 - 83.5       | 2        |
| 84 - 92       | 83.5 - 92.5       | <u>1</u> |
|               |                   | 30       |

|                | <i>cf</i> |
|----------------|-----------|
| Less than 11.5 | 0         |
| Less than 20.5 | 7         |
| Less than 29.5 | 14        |
| Less than 38.5 | 17        |
| Less than 47.5 | 20        |
| Less than 56.5 | 24        |
| Less than 65.5 | 27        |
| Less than 74.5 | 27        |
| Less than 83.5 | 29        |
| Less than 92.5 | 30        |

22.

$$H = 51.7 \quad L = 1.2$$

$$\text{Range} = 51.7 - 1.2 = 50.5$$

$$\text{Width} = 50.5 \div 5 = 10.1 \text{ round up to } 11$$

22. continued

| <i>Limits</i> | <i>Boundaries</i> | <i>f</i> |
|---------------|-------------------|----------|
| 0 - 10        | -0.5 - 10.5       | 7        |
| 11 - 21       | 10.5 - 21.5       | 6        |
| 22 - 32       | 21.5 - 32.5       | 2        |
| 33 - 43       | 32.5 - 43.5       | 0        |
| 44 - 54       | 43.5 - 54.5       | <u>1</u> |
|               |                   | 16       |

|                | <i>cf</i> |
|----------------|-----------|
| Less than -0.5 | 0         |
| Less than 10.5 | 7         |
| Less than 21.5 | 13        |
| Less than 32.5 | 15        |
| Less than 43.5 | 15        |
| Less than 54.5 | 16        |

23.

$$H = 123 \quad L = 77$$

$$\text{Range} = 123 - 77 = 46$$

$$\text{Width} = 46 \div 7 = 6.6 \text{ or } 7$$

| <i>Limits</i> | <i>Boundaries</i> | <i>f</i> |
|---------------|-------------------|----------|
| 77 - 83       | 76.5 - 83.5       | 1        |
| 84 - 90       | 83.5 - 90.5       | 1        |
| 91 - 97       | 90.5 - 97.5       | 6        |
| 98 - 104      | 97.5 - 104.5      | 14       |
| 105 - 111     | 104.5 - 111.5     | 8        |
| 112 - 118     | 111.5 - 118.5     | 1        |
| 119 - 125     | 118.5 - 125.5     | <u>1</u> |
|               |                   | 32       |

|                 | <i>cf</i> |
|-----------------|-----------|
| Less than 76.5  | 0         |
| Less than 83.5  | 1         |
| Less than 90.5  | 2         |
| Less than 97.5  | 8         |
| Less than 104.5 | 22        |
| Less than 111.5 | 30        |
| Less than 118.5 | 31        |
| Less than 125.5 | 32        |

24.

$$H = 3462 \quad L = 3$$

$$\text{Range} = 3462 - 3 = 3459$$

$$\text{Width} = 3459 \div 9 = 384.3$$

round up to 385

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24. continued

| Limits      | Boundaries      | f        |
|-------------|-----------------|----------|
| 3 - 387     | 2.5 - 387.5     | 33       |
| 388 - 772   | 387.5 - 772.5   | 11       |
| 773 - 1157  | 772.5 - 1157.5  | 3        |
| 1158 - 1542 | 1157.5 - 1542.5 | 2        |
| 1543 - 1923 | 1542.5 - 1923.5 | 0        |
| 1924 - 2312 | 1923.5 - 2312.5 | 0        |
| 2313 - 2697 | 2312.5 - 2697.5 | 1        |
| 2698 - 3082 | 2697.5 - 3082.5 | 0        |
| 3083 - 3467 | 3082.5 - 3467.5 | <u>1</u> |
|             |                 | 51       |

|                  | cf |
|------------------|----|
| Less than 2.5    | 0  |
| Less than 387.5  | 33 |
| Less than 772.5  | 44 |
| Less than 1157.5 | 47 |
| Less than 1542.5 | 49 |
| Less than 1923.5 | 49 |
| Less than 2312.5 | 49 |
| Less than 2697.5 | 50 |
| Less than 3082.5 | 50 |
| Less than 3467.5 | 51 |

25.

$$H = 12.3 \quad L = 6.2$$

$$\text{Range} = 12.3 - 6.2 = 6.1$$

$$\text{Width} = 6.1 \div 7 = 0.87 \text{ round up to } 0.9$$

| Limits      | Boundaries    | f        |
|-------------|---------------|----------|
| 6.2 - 7.0   | 6.15 - 7.05   | 1        |
| 7.1 - 7.9   | 7.05 - 7.95   | 7        |
| 8.0 - 8.8   | 7.95 - 8.85   | 9        |
| 8.9 - 9.7   | 8.85 - 9.75   | 7        |
| 9.8 - 10.6  | 9.75 - 10.65  | 8        |
| 10.7 - 11.5 | 10.65 - 11.55 | 4        |
| 11.6 - 12.4 | 11.55 - 12.45 | <u>4</u> |
|             |               | 40       |

|                 | cf |
|-----------------|----|
| Less than 6.15  | 0  |
| Less than 7.05  | 1  |
| Less than 7.95  | 8  |
| Less than 8.85  | 17 |
| Less than 9.75  | 24 |
| Less than 10.65 | 32 |
| Less than 11.55 | 36 |
| Less than 12.45 | 40 |

26.

$$H = 37.9 \quad L = 17.3$$

$$\text{Range} = 37.9 - 17.3 = 20.6$$

26. continued

$$\text{Width} = 20.6 \div 6 = 3.43 \text{ round up to } 3.5$$

| Limits      | Boundaries    | f        |
|-------------|---------------|----------|
| 17.3 - 20.2 | 17.25 - 20.25 | 4        |
| 20.3 - 23.2 | 20.25 - 23.25 | 6        |
| 23.3 - 26.2 | 23.25 - 26.25 | 18       |
| 26.3 - 29.2 | 26.25 - 29.25 | 8        |
| 29.3 - 32.2 | 29.25 - 32.25 | 6        |
| 32.3 - 35.2 | 32.25 - 35.25 | 7        |
| 35.3 - 38.2 | 35.25 - 38.25 | <u>1</u> |
|             |               | 50       |

|                 | cf |
|-----------------|----|
| Less than 17.25 | 0  |
| Less than 20.25 | 4  |
| Less than 23.25 | 10 |
| Less than 26.25 | 28 |
| Less than 29.25 | 36 |
| Less than 32.25 | 42 |
| Less than 35.25 | 49 |
| Less than 38.25 | 50 |

27. The percents add up to 101%. They should total 100% unless rounding was used.

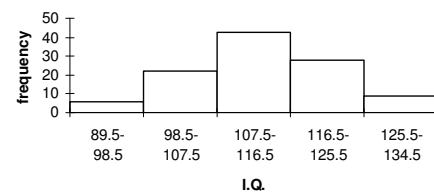
28.

| Class | f |
|-------|---|
| 0     | 1 |
| 1     | 4 |
| 2     | 5 |
| 3     | 7 |
| 4     | 4 |
| 5     | 4 |
| 6     | 3 |
| 7     | 3 |
| 8     | 5 |
| 9     | 5 |

No. Zero appears only once and 3 appears 7 times.

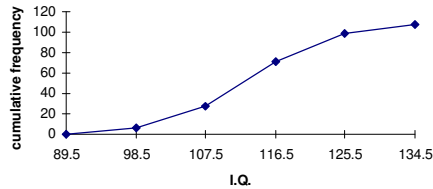
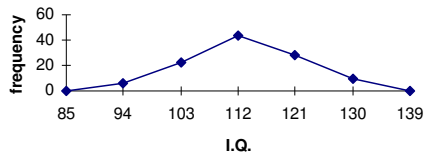
### EXERCISE SET 2-2

1.



## Chapter 2 - Frequency Distributions and Graphs

1. continued



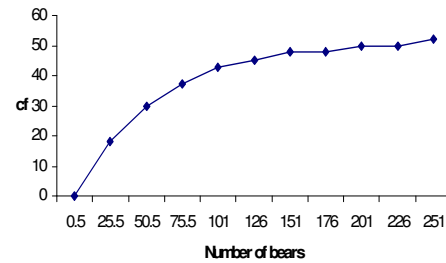
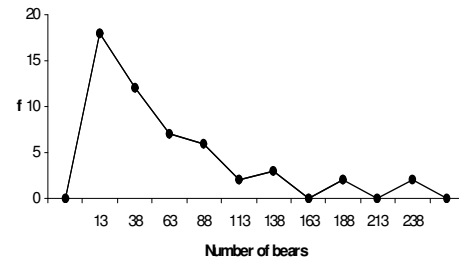
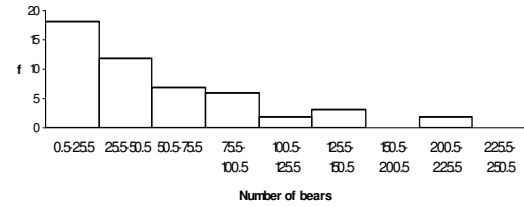
Eighty applicants do not need to enroll in the summer programs.

2.

| Limits    | Boundaries    | $X_m$ | $f$      |
|-----------|---------------|-------|----------|
| 1 - 25    | 0.5 - 25.5    | 13    | 18       |
| 26 - 50   | 25.5 - 50.5   | 38    | 12       |
| 51 - 75   | 50.5 - 75.5   | 63    | 7        |
| 76 - 100  | 75.5 - 100.5  | 88    | 6        |
| 101 - 125 | 100.5 - 125.5 | 113   | 2        |
| 126 - 150 | 125.5 - 150.5 | 138   | 3        |
| 151 - 175 | 150.5 - 175.5 | 163   | 0        |
| 176 - 200 | 175.5 - 200.5 | 188   | 2        |
| 201 - 225 | 200.5 - 225.5 | 213   | 0        |
| 226 - 250 | 225.5 - 250.5 | 238   | <u>2</u> |
|           |               |       | 52       |

|                 | $cf$ |
|-----------------|------|
| Less than 0.5   | 0    |
| Less than 25.5  | 18   |
| Less than 50.5  | 30   |
| Less than 75.5  | 37   |
| Less than 100.5 | 43   |
| Less than 125.5 | 45   |
| Less than 150.5 | 48   |
| Less than 175.5 | 48   |
| Less than 200.5 | 50   |
| Less than 225.5 | 50   |
| Less than 250.5 | 52   |

2. continued



Thirty-seven counties had 75 or fewer bears killed.

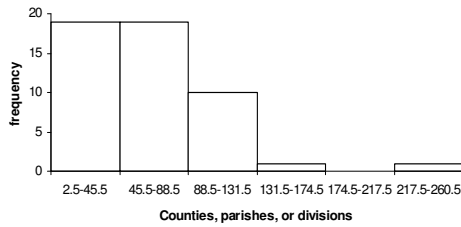
3.

| Limits    | Boundaries    | $X_m$ | $f$      |
|-----------|---------------|-------|----------|
| 3 - 45    | 2.5 - 45.5    | 24    | 19       |
| 46 - 88   | 45.5 - 88.5   | 67    | 19       |
| 89 - 131  | 88.5 - 131.5  | 110   | 10       |
| 132 - 174 | 131.5 - 174.5 | 153   | 1        |
| 175 - 217 | 174.5 - 217.5 | 196   | 0        |
| 218 - 260 | 217.5 - 260.5 | 239   | <u>1</u> |
|           |               |       | 50       |

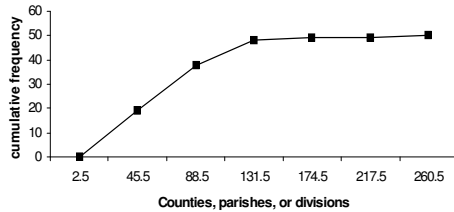
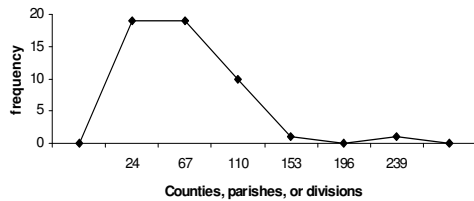
|                 | $cf$ |
|-----------------|------|
| Less than 2.5   | 0    |
| Less than 45.5  | 19   |
| Less than 88.5  | 38   |
| Less than 131.5 | 48   |
| Less than 174.5 | 49   |
| Less than 217.5 | 49   |
| Less than 260.5 | 50   |

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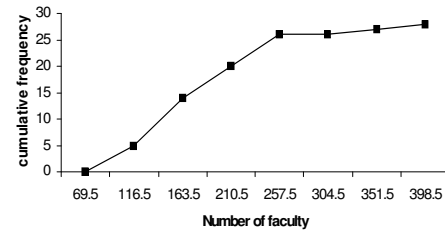
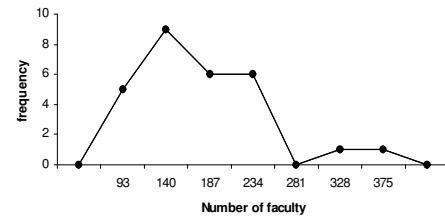
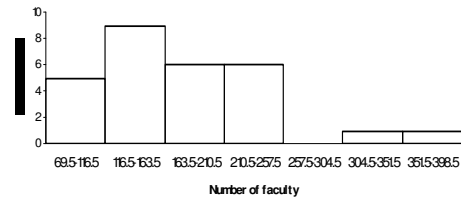
3. continued



The distribution is positively skewed.



4. continued



$\frac{12}{28} = 0.429$  or 42.9% have 180 or more.  
The histogram and frequency polygon are positively skewed.

4.

| Limits    | Boundaries    | $X_m$ | $f$            |
|-----------|---------------|-------|----------------|
| 70 - 116  | 69.5 - 116.5  | 93    | 5              |
| 117 - 163 | 116.5 - 163.5 | 140   | 9              |
| 164 - 210 | 163.5 - 210.5 | 187   | 6              |
| 211 - 257 | 210.5 - 257.5 | 234   | 6              |
| 258 - 304 | 257.5 - 304.5 | 281   | 0              |
| 305 - 351 | 304.5 - 351.5 | 328   | 1              |
| 352 - 398 | 351.5 - 398.5 | 375   | $\frac{1}{28}$ |

|                 | $cf$ |
|-----------------|------|
| Less than 69.5  | 0    |
| Less than 116.5 | 5    |
| Less than 163.5 | 14   |
| Less than 210.5 | 20   |
| Less than 257.5 | 26   |
| Less than 304.5 | 26   |
| Less than 351.5 | 27   |
| Less than 398.5 | 28   |

5.

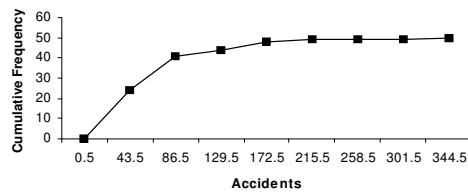
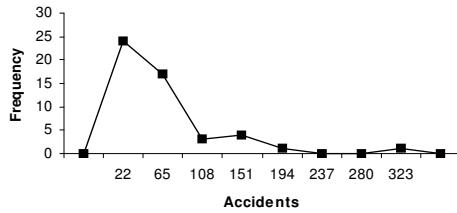
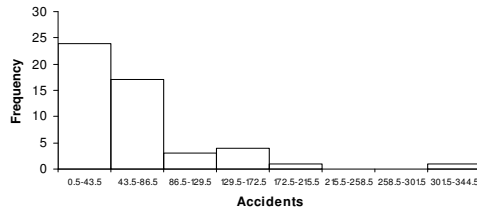
| Limits    | Boundaries    | $X_m$ | $f$            |
|-----------|---------------|-------|----------------|
| 1 - 43    | 0.5 - 43.5    | 22    | 24             |
| 44 - 86   | 43.5 - 86.5   | 65    | 17             |
| 87 - 129  | 86.5 - 129.5  | 108   | 3              |
| 130 - 172 | 129.5 - 172.5 | 151   | 4              |
| 173 - 215 | 172.5 - 215.5 | 194   | 1              |
| 216 - 258 | 215.5 - 258.5 | 237   | 0              |
| 259 - 301 | 258.5 - 301.5 | 280   | 0              |
| 302 - 344 | 301.5 - 344.5 | 323   | $\frac{1}{50}$ |

|                 | $cf$ |
|-----------------|------|
| Less than 0.5   | 0    |
| Less than 43.5  | 24   |
| Less than 86.5  | 41   |
| Less than 129.5 | 44   |
| Less than 172.5 | 48   |
| Less than 215.5 | 49   |
| Less than 258.5 | 49   |
| Less than 301.5 | 49   |
| Less than 344.5 | 50   |

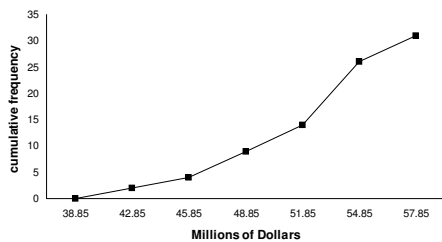
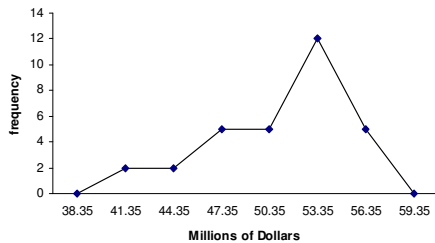
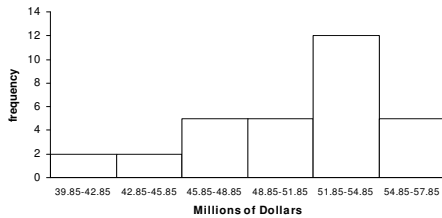
## Chapter 2 - Frequency Distributions and Graphs

5. continued

The distribution is positively skewed.



6.



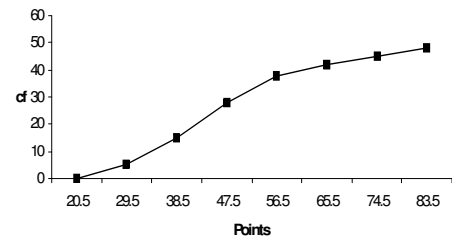
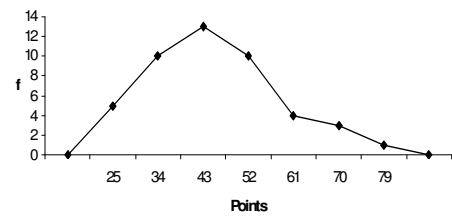
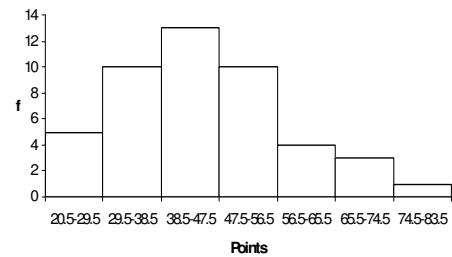
6. continued

The distribution is left skewed or negatively skewed.

7.

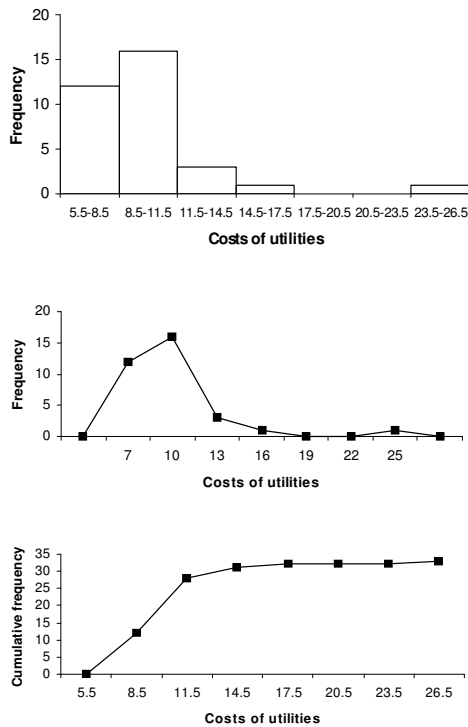
| Limits  | Boundaries  | $X_m$ | $f$            |
|---------|-------------|-------|----------------|
| 21 - 29 | 20.5 - 29.5 | 25    | 5              |
| 30 - 38 | 29.5 - 38.5 | 34    | 10             |
| 39 - 47 | 38.5 - 47.5 | 43    | 13             |
| 48 - 56 | 47.5 - 56.5 | 52    | 10             |
| 57 - 65 | 56.5 - 65.5 | 61    | 4              |
| 66 - 74 | 65.5 - 74.5 | 70    | 3              |
| 75 - 83 | 74.5 - 83.5 | 79    | $\frac{1}{46}$ |

|                | $cf$ |
|----------------|------|
| Less than 20.5 | 0    |
| Less than 29.5 | 5    |
| Less than 38.5 | 15   |
| Less than 47.5 | 28   |
| Less than 56.5 | 38   |
| Less than 65.5 | 42   |
| Less than 74.5 | 45   |
| Less than 83.5 | 46   |



## Chapter 2 - Frequency Distributions and Graphs

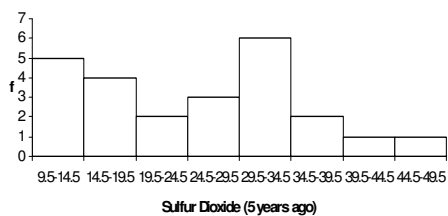
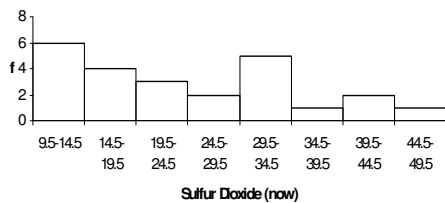
8.



The distribution is positively skewed.

9.

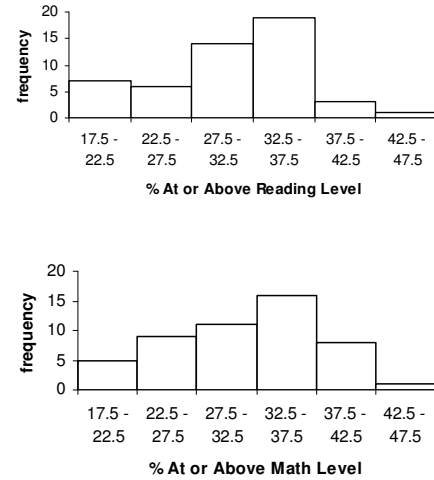
| Limits  | Boundaries  | $f(\text{now})$ | $f(5 \text{ years ago})$ |
|---------|-------------|-----------------|--------------------------|
| 10 - 14 | 9.5 - 14.5  | 6               | 5                        |
| 15 - 19 | 14.5 - 19.5 | 4               | 4                        |
| 20 - 24 | 19.5 - 24.5 | 3               | 2                        |
| 25 - 29 | 24.5 - 29.5 | 2               | 3                        |
| 30 - 34 | 29.5 - 34.5 | 5               | 6                        |
| 35 - 39 | 34.5 - 39.5 | 1               | 2                        |
| 40 - 44 | 39.5 - 44.5 | 2               | 1                        |
| 45 - 49 | 44.5 - 49.5 | 1               | 1                        |
| Total   |             | 24              | 24                       |



9. continued

With minor differences, the histograms are fairly similar.

10.



The distribution of math percentages is more bell-shaped than the distribution of reading percentages, and its peak in the class of 32.5 – 37.5 is not as high as the peak of the reading percentages.

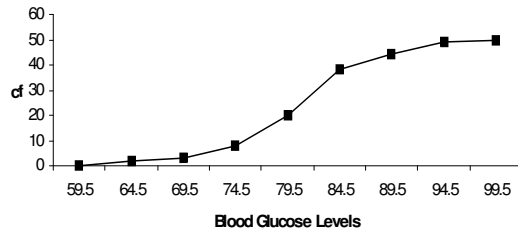
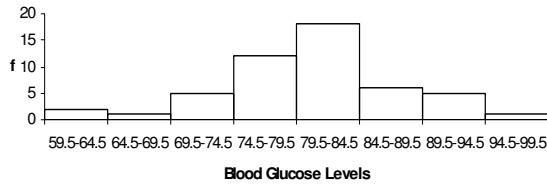
11.

| Limits  | Boundaries  | $X_m$ | $f$ |
|---------|-------------|-------|-----|
| 60 - 64 | 59.5 - 64.5 | 62    | 2   |
| 65 - 69 | 64.5 - 69.5 | 67    | 1   |
| 70 - 74 | 69.5 - 74.5 | 72    | 5   |
| 75 - 79 | 74.5 - 79.5 | 77    | 12  |
| 80 - 84 | 79.5 - 84.5 | 82    | 18  |
| 85 - 89 | 84.5 - 89.5 | 87    | 6   |
| 90 - 94 | 89.5 - 94.5 | 92    | 5   |
| 95 - 99 | 94.5 - 99.5 | 97    | 1   |
|         |             |       | 50  |

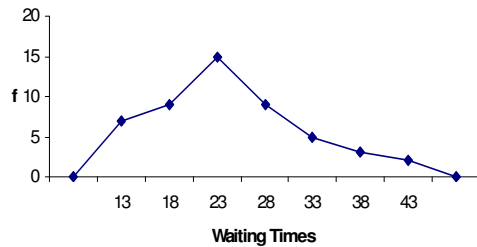
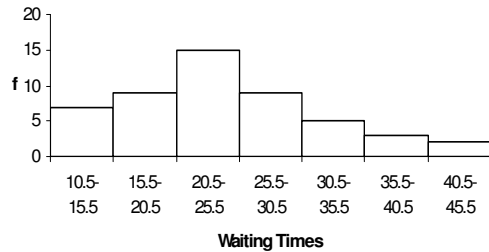
|                | $cf$ |
|----------------|------|
| Less than 59.5 | 0    |
| Less than 64.5 | 2    |
| Less than 69.5 | 3    |
| Less than 74.5 | 8    |
| Less than 79.5 | 20   |
| Less than 84.5 | 38   |
| Less than 89.5 | 44   |
| Less than 94.5 | 49   |
| Less than 99.5 | 50   |

## Chapter 2 - Frequency Distributions and Graphs

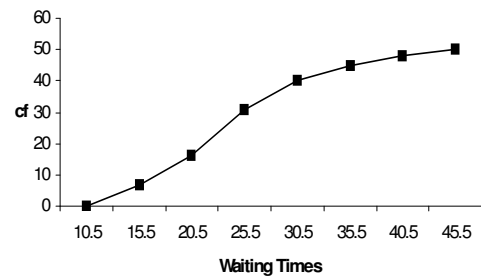
11. continued



12.

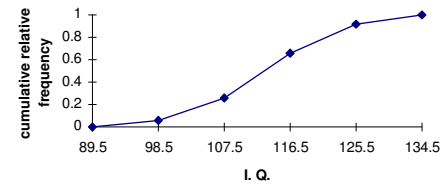
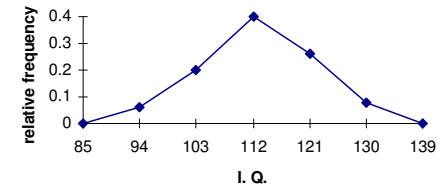
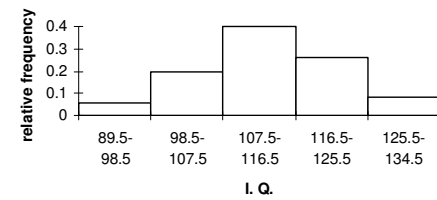


12. continued



Ten patients waited longer than 30 minutes.

13.



The proportion of applicants who need to enroll in a summer program is 0.26 or 26%.

14.

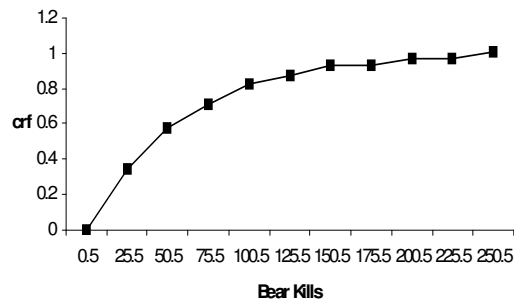
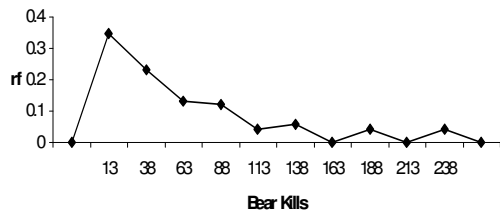
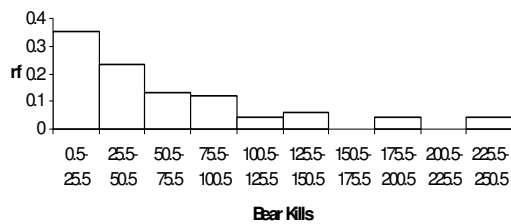
| Boundaries    | $X_m$ | $rf$        |
|---------------|-------|-------------|
| 0.5 - 25.5    | 13    | 0.35        |
| 25.5 - 50.5   | 38    | 0.23        |
| 50.5 - 75.5   | 63    | 0.13        |
| 75.5 - 100.5  | 88    | 0.12        |
| 100.5 - 125.5 | 113   | 0.04        |
| 125.5 - 150.5 | 138   | 0.06        |
| 150.5 - 175.5 | 163   | 0.00        |
| 175.5 - 200.5 | 188   | 0.04        |
| 200.5 - 225.5 | 213   | 0.00        |
| 225.5 - 250.5 | 238   | <u>0.04</u> |
|               |       | 1.01        |

## Chapter 2 - Frequency Distributions and Graphs

14. continued

|                 | <i>crf</i> |
|-----------------|------------|
| Less than 0.5   | 0          |
| Less than 25.5  | 0.35       |
| Less than 50.5  | 0.58       |
| Less than 75.5  | 0.71       |
| Less than 100.5 | 0.83       |
| Less than 125.5 | 0.87       |
| Less than 150.5 | 0.93       |
| Less than 175.5 | 0.93       |
| Less than 200.5 | 0.97       |
| Less than 225.5 | 0.97       |
| Less than 250.5 | 1.01       |

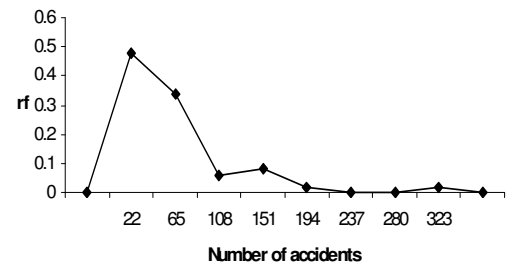
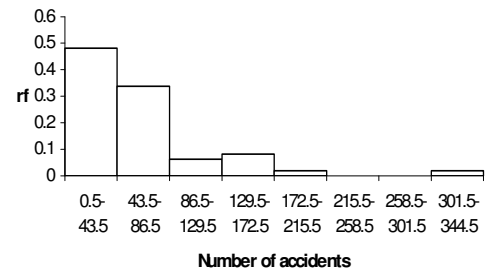
(differences in totals are due to rounding)



15.

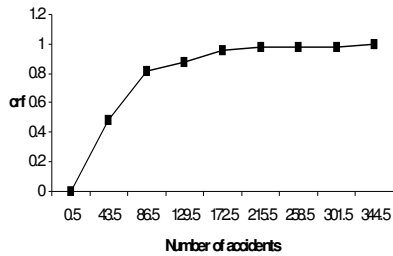
| <i>Boundaries</i> | $X_m$ | <i>rf</i>   |
|-------------------|-------|-------------|
| 0.5 - 43.5        | 22    | 0.48        |
| 43.5 - 86.5       | 65    | 0.34        |
| 86.5 - 129.5      | 108   | 0.06        |
| 129.5 - 172.5     | 151   | 0.08        |
| 172.5 - 215.5     | 194   | 0.02        |
| 215.5 - 258.5     | 237   | 0.00        |
| 258.5 - 301.5     | 280   | 0.00        |
| 301.5 - 344.5     | 323   | <u>0.02</u> |
|                   |       | 1.00        |

|                 | <i>crf</i> |
|-----------------|------------|
| Less than 0.5   | 0          |
| Less than 43.5  | 0.48       |
| Less than 86.5  | 0.82       |
| Less than 129.5 | 0.88       |
| Less than 172.5 | 0.96       |
| Less than 215.5 | 0.98       |
| Less than 258.5 | 0.98       |
| Less than 301.5 | 0.98       |
| Less than 344.5 | 1.00       |



## Chapter 2 - Frequency Distributions and Graphs

15. continued

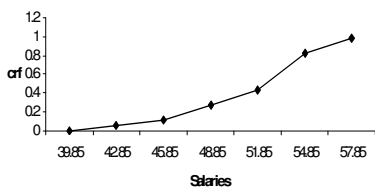
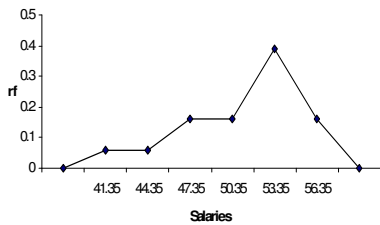
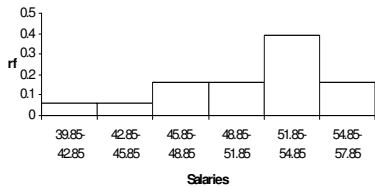


16.

| Boundaries    | $X_m$ | $rf$        |
|---------------|-------|-------------|
| 39.85 - 42.85 | 41.35 | 0.06        |
| 42.85 - 45.85 | 44.35 | 0.06        |
| 45.85 - 48.85 | 47.35 | 0.16        |
| 48.85 - 51.85 | 50.35 | 0.16        |
| 51.85 - 54.85 | 53.35 | 0.39        |
| 54.85 - 57.85 | 56.35 | <u>0.16</u> |
|               |       | 0.99        |

(difference is due to rounding)

|                 | $crf$ |
|-----------------|-------|
| Less than 39.85 | 0     |
| Less than 42.85 | 0.13  |
| Less than 45.85 | 0.13  |
| Less than 48.85 | 0.29  |
| Less than 51.85 | 0.45  |
| Less than 54.85 | 0.84  |
| Less than 57.85 | 1.00  |

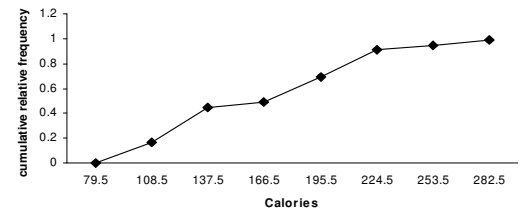
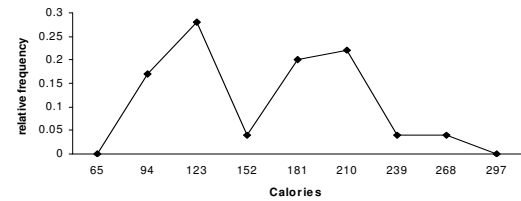
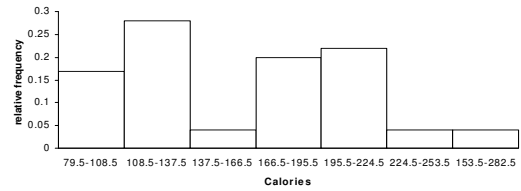


17.

| Boundaries    | $X_m$ | $rf$        |
|---------------|-------|-------------|
| 79.5 - 108.5  | 94    | 0.17        |
| 108.5 - 137.5 | 123   | 0.28        |
| 137.5 - 166.5 | 152   | 0.04        |
| 166.5 - 195.5 | 181   | 0.20        |
| 195.5 - 224.5 | 210   | 0.22        |
| 224.5 - 253.5 | 239   | 0.04        |
| 253.5 - 282.5 | 268   | <u>0.04</u> |
|               |       | 0.99*       |

\*due to rounding

|                 | $crf$ |
|-----------------|-------|
| Less than 79.5  | 0.00  |
| Less than 108.5 | 0.17  |
| Less than 137.5 | 0.45  |
| Less than 166.5 | 0.49  |
| Less than 195.5 | 0.69  |
| Less than 224.5 | 0.91  |
| Less than 253.5 | 0.95  |
| Less than 282.5 | 0.99  |



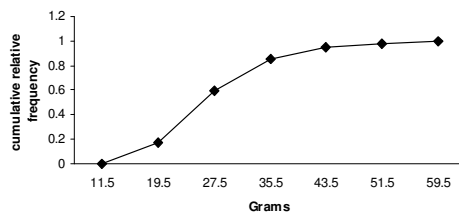
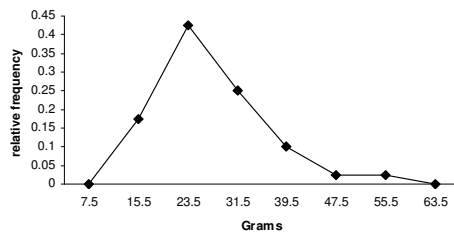
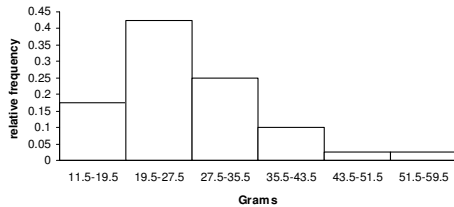
The histogram has two peaks.

## Chapter 2 - Frequency Distributions and Graphs

18.

| <i>Boundaries</i> | $X_m$ | <i>rf</i>    |
|-------------------|-------|--------------|
| 11.5 - 19.5       | 15.5  | 0.175        |
| 19.5 - 27.5       | 23.5  | 0.425        |
| 27.5 - 35.5       | 31.5  | 0.25         |
| 35.5 - 43.5       | 39.5  | 0.10         |
| 43.5 - 51.5       | 47.5  | 0.025        |
| 51.5 - 59.5       | 55.5  | <u>0.025</u> |
|                   |       | 1.000        |

|                | <i>crf</i> |
|----------------|------------|
| Less than 11.5 | 0.000      |
| Less than 19.5 | 0.175      |
| Less than 27.5 | 0.600      |
| Less than 35.5 | 0.850      |
| Less than 43.5 | 0.950      |
| Less than 51.5 | 0.975      |
| Less than 59.5 | 1.000      |

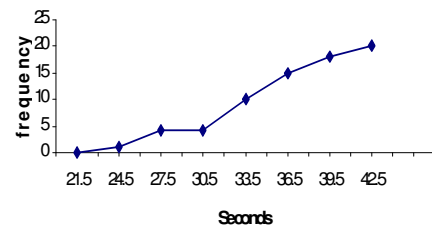
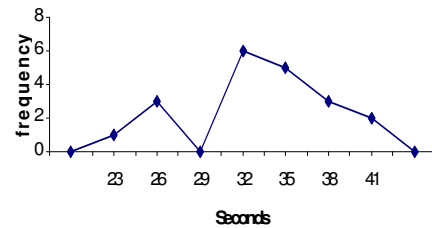


The histogram is positively skewed.

19.

| <i>Limits</i> | <i>Boundaries</i> | $X_m$ | <i>f</i> |
|---------------|-------------------|-------|----------|
| 22 - 24       | 21.5 - 24.5       | 23    | 1        |
| 25 - 27       | 24.5 - 27.5       | 26    | 3        |
| 28 - 30       | 27.5 - 30.5       | 29    | 0        |
| 31 - 33       | 30.5 - 33.5       | 32    | 6        |
| 34 - 36       | 33.5 - 36.5       | 35    | 5        |
| 37 - 39       | 36.5 - 39.5       | 38    | 3        |
| 40 - 42       | 39.5 - 42.5       | 41    | <u>2</u> |
|               |                   |       | 20       |

|                | <i>cf</i> |
|----------------|-----------|
| Less than 21.5 | 0         |
| Less than 24.5 | 1         |
| Less than 27.5 | 4         |
| Less than 30.5 | 4         |
| Less than 33.5 | 10        |
| Less than 36.5 | 15        |
| Less than 39.5 | 18        |
| Less than 42.5 | 20        |



20.

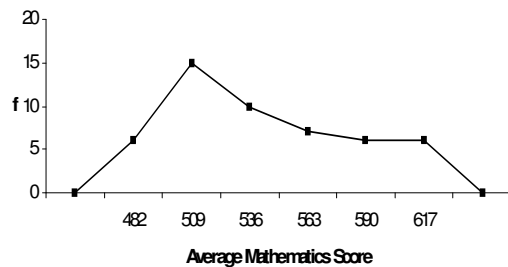
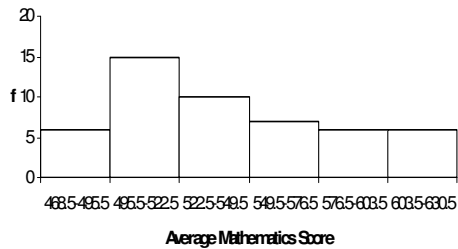
- a. 0
- b. 14
- c. 10
- d. 16

## Chapter 2 - Frequency Distributions and Graphs

21.

| <i>Boundaries</i> | $X_m$ | $f$      |
|-------------------|-------|----------|
| 468.5 - 495.5     | 482   | 6        |
| 495.5 - 522.5     | 509   | 15       |
| 522.5 - 549.5     | 536   | 10       |
| 549.5 - 576.5     | 563   | 7        |
| 576.5 - 603.5     | 590   | 6        |
| 603.5 - 630.5     | 617   | <u>6</u> |
|                   |       | 50       |

|                 | $f$ |
|-----------------|-----|
| Less than 468.5 | 0   |
| Less than 495.5 | 6   |
| Less than 522.5 | 21  |
| Less than 549.5 | 31  |
| Less than 576.5 | 38  |
| Less than 603.5 | 44  |
| Less than 630.5 | 50  |

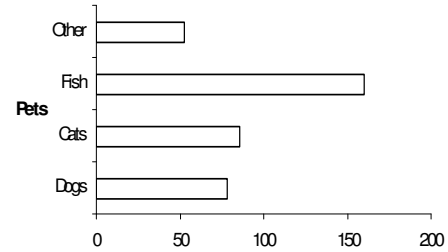
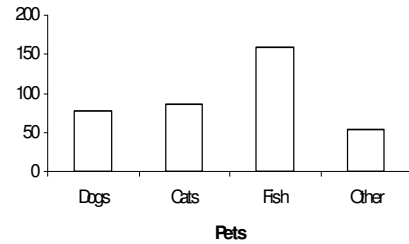


### EXERCISE SET 2-3

1.

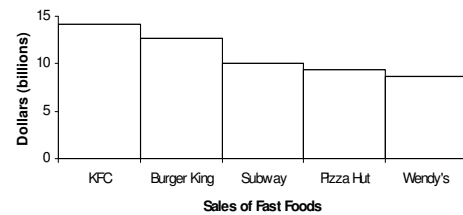
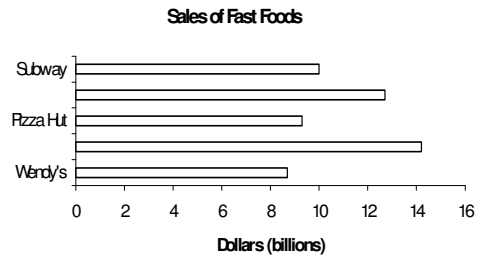
|       | $f$ |
|-------|-----|
| Dogs  | 78  |
| Cats  | 86  |
| Fish  | 160 |
| Other | 53  |

1. continued



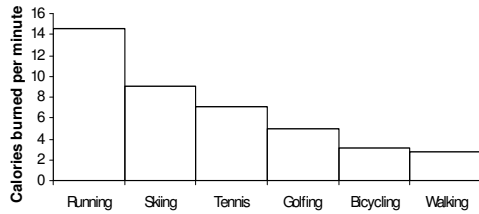
2.

|             | $f$   |
|-------------|-------|
| Wendy's     | \$8.7 |
| KFC         | 14.2  |
| Pizza Hut   | 9.3   |
| Burger King | 12.7  |
| Subway      | 10.0  |

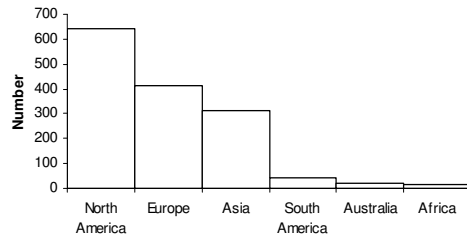


## Chapter 2 - Frequency Distributions and Graphs

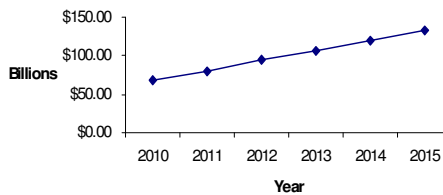
3.



4.

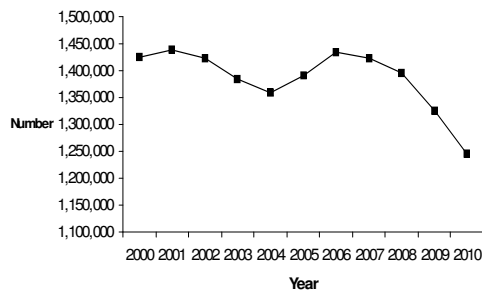


5.



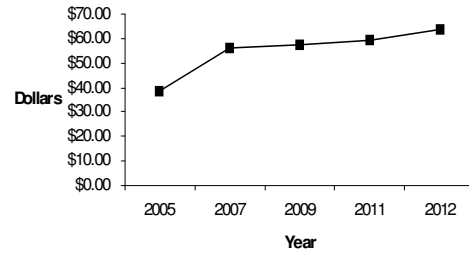
There is a steady increase over the years.

6.



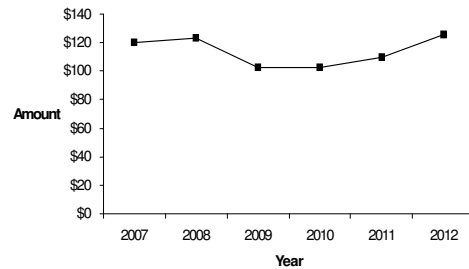
Crime decreased between 2001 and 2004, increased between 2004 and 2006, then decreased steadily from 2007 to 2010.

7.



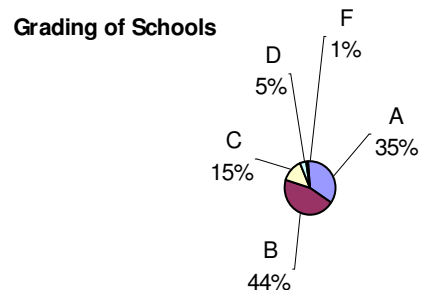
There was a considerable increase between 2005 and 2007, then small increases after 2007.

8.



There was an increase in spending between 2007 and 2008 followed by a decrease in spending between 2008 and 2009. Spending showed slight increases in 2010, 2011, and 2012.

9.

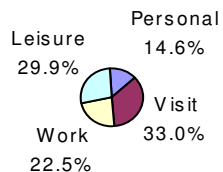


More people graded their child's school as B than any other grade. Very few people graded the schools as D or F.

## Chapter 2 - Frequency Distributions and Graphs

10.

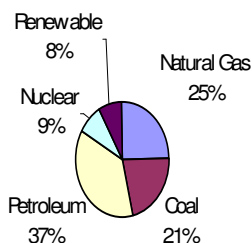
|                         |      |       |         |
|-------------------------|------|-------|---------|
| Personal Business       | 146  | 14.6% | 52.56°  |
| Visit friends or family | 330  | 33.0% | 118.8°  |
| Work-related            | 225  | 22.5% | 81.0°   |
| Leisure                 | 299  | 29.9% | 107.64° |
|                         | 1000 | 100%  | 360°    |



About  $\frac{1}{3}$  of the travelers visit friends or relatives, with the fewest travelling for personal business.

11.

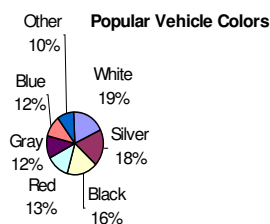
**Energy Consumption**



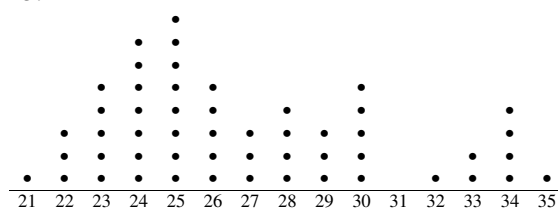
Fossil fuels accounted for 83% of total usage.

12.

|        |     |       |
|--------|-----|-------|
| White  | 19% | 68.4° |
| Silver | 18% | 64.8° |
| Black  | 16% | 57.6° |
| Red    | 13% | 46.8° |
| Gray   | 12% | 43.2° |
| Blue   | 12% | 43.2° |
| Other  | 10% | 36.0° |

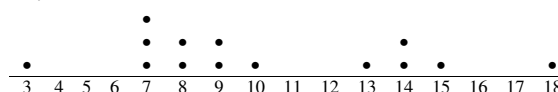


13.



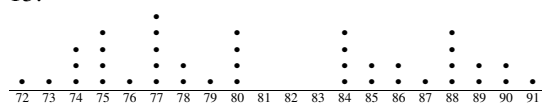
The dotplot is somewhat positively skewed and shows that the majority of the players are between 21 and 30 years old. There are 2 peaks at 24 years old, with 7 players, and at 25 years old, with 8 players.

14.



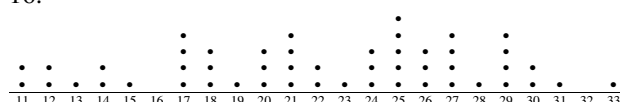
The number of teacher strikes ranges from 3 strikes to 18 strikes. The data clusters between 7 and 10 strikes and between 13 and 15 strikes.

15.



The data peaks at age 77 and gaps between the ages of 80 and 84. The data clusters between ages 72 to 80 and between ages 84 to 91.

16.



The commuting times range from 11 minutes to 33 minutes. The data clusters between 17 and 31 minutes and gaps at 16 and 32 minutes.

17.

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 4 |
| 6 | 6 | 6 | 7 | 7 | 8 | 8 | 8 | 8 | 9 |   |   |   |   |   |   |   |   |   |   |
| 7 | 0 | 1 | 3 | 4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 8 | 5 | 6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 9 | 0 | 3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Most of the players have 50 to 54 home runs. The greatest number of home runs is 73.

## Chapter 2 - Frequency Distributions and Graphs

18.

|    |   |   |   |   |       |
|----|---|---|---|---|-------|
| 10 | 0 | 0 | 0 | 0 | 0     |
| 11 | 0 | 0 | 5 |   |       |
| 12 | 0 | 0 | 0 | 0 | 0     |
| 13 | 0 | 0 | 0 | 0 | 0     |
| 14 | 0 | 0 | 0 | 0 | 5 5 5 |
| 15 | 0 | 0 | 0 |   |       |
| 16 | 0 | 0 | 0 | 0 | 0     |
| 17 | 0 |   |   |   |       |
| 18 | 0 | 0 |   |   |       |
| 19 | 0 |   |   |   |       |

19.

| South America |   |   |   |   |   |   |   |   |   | Europe |    |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|---|--------|----|---|---|---|---|---|---|---|---|
| 4             | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2      | 0  | 3 | 4 | 4 |   |   |   |   |   |
|               |   |   |   |   |   |   |   |   |   | 0      | 5  | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 7 |
|               |   |   |   |   |   |   |   |   |   | 1      | .1 | 2 | 3 | 4 |   |   |   |   |   |
|               |   |   |   |   |   |   |   |   |   | 1      | 2  |   |   |   |   |   |   |   |   |
|               |   |   |   |   |   |   |   |   |   | 5      | 2  |   |   |   |   |   |   |   |   |
|               |   |   |   |   |   |   |   |   |   | 3      |    |   |   |   |   |   |   |   |   |
|               |   |   |   |   |   |   |   |   |   | 9      | 3  |   |   |   |   |   |   |   |   |

The majority of the South American rivers are longer than those in Europe.

20.

| Math |   |   |   |   |   |   |  |  |  | Reading |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|--|--|--|---------|---|---|---|---|---|---|---|---|---|
| 9    | 9 | 9 | 7 | 5 | 5 | 2 |  |  |  | 5       |   |   |   |   |   |   |   |   |   |
|      | 9 | 8 | 6 | 3 | 2 | 1 |  |  |  | 6       | 1 | 1 | 5 | 6 | 6 | 7 | 9 |   |   |
|      |   | 6 | 4 | 3 | 3 | 2 |  |  |  | 7       | 0 | 0 | 1 | 6 | 6 | 6 | 7 | 7 | 8 |
|      |   |   |   |   |   |   |  |  |  | 8       | 0 |   |   |   |   |   |   |   |   |

The reading scores are somewhat higher than the math scores.

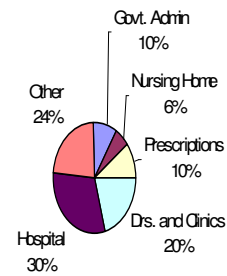
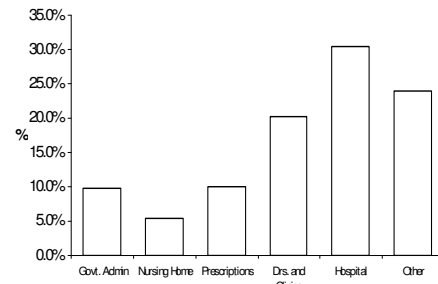
21.

- Pareto chart
- Pareto chart
- Pie graph
- Pie graph
- Pareto chart
- Time series graph

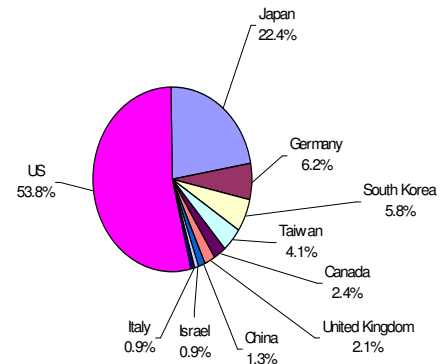
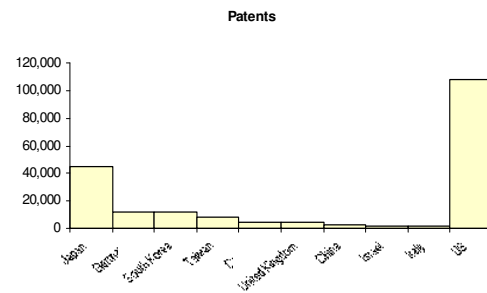
22.

- Time series graph
- Pie graph
- Pareto chart
- Pie graph
- Time series graph
- Pareto chart

23.



24.

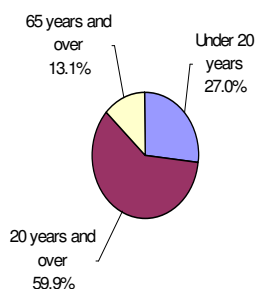


The bar graph is better since there are too many categories for the pie graph.

## Chapter 2 - Frequency Distributions and Graphs

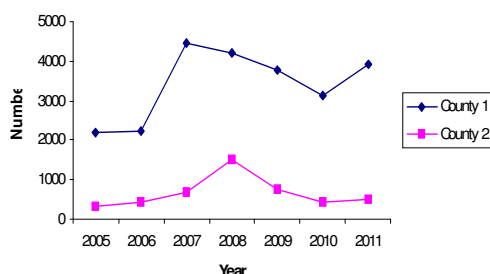
25. The bottle for 2011 is much bigger in area than the bottle for 1988. This causes the eye to see a much bigger difference than the actual difference.

26.



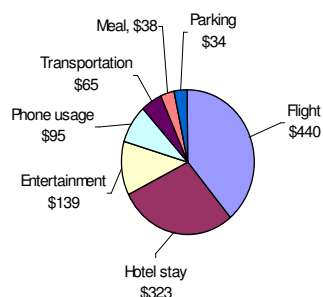
Yes. The percentages add up to more than 100%. Since the category "20 years and over" also includes the category "65 years and over", subtract 13.1% from 73% to obtain the percentage for "20 years and over".

27.



There is no way to tell if the crime rate is decreasing by looking at the graph.

28.



Note: Other graphs could be drawn to illustrate this data.

### REVIEW EXERCISES - CHAPTER 2

1.

| Class      | f         | Percent   |
|------------|-----------|-----------|
| Newspaper  | 10        | 20        |
| Television | 16        | 32        |
| Radio      | 12        | 24        |
| Internet   | <u>12</u> | <u>24</u> |
|            | 50        | 100       |

2.

| Class          | f        | Percent    |
|----------------|----------|------------|
| Czech Republic | 7        | 25.0       |
| Sweden         | 6        | 21.4       |
| Canada         | 5        | 17.9       |
| USSR           | 4        | 14.3       |
| Russia         | 3        | 10.7       |
| Finland        | 2        | 7.1        |
| Slovakia       | <u>1</u> | <u>3.6</u> |
| Total          | 28       | 100        |

Omit the years when no games were held.

3.

| Class | f        |
|-------|----------|
| 11    | 1        |
| 12    | 2        |
| 13    | 2        |
| 14    | 2        |
| 15    | 1        |
| 16    | 2        |
| 17    | 4        |
| 18    | 2        |
| 19    | 2        |
| 20    | 1        |
| 21    | 0        |
| 22    | <u>1</u> |
|       | 20       |

|                | cf |
|----------------|----|
| less than 10.5 | 0  |
| less than 11.5 | 1  |
| less than 12.5 | 3  |
| less than 13.5 | 5  |
| less than 14.5 | 7  |
| less than 15.5 | 8  |
| less than 16.5 | 10 |
| less than 17.5 | 14 |
| less than 18.5 | 16 |
| less than 19.5 | 18 |
| less than 20.5 | 19 |
| less than 21.5 | 19 |
| less than 22.5 | 20 |

## Chapter 2 - Frequency Distributions and Graphs

4.

| Limits | Boundaries  | f        |
|--------|-------------|----------|
| 8      | 7.5 - 8.5   | 11       |
| 9      | 8.5 - 9.5   | 10       |
| 10     | 9.5 - 10.5  | 4        |
| 11     | 10.5 - 11.5 | 2        |
| 12     | 11.5 - 12.5 | 2        |
| 13     | 12.5 - 13.5 | 4        |
| 14     | 13.5 - 14.5 | 2        |
| 15     | 14.5 - 15.5 | <u>1</u> |
|        |             | 36       |

|                | cf |
|----------------|----|
| less than 7.5  | 0  |
| less than 8.5  | 11 |
| less than 9.5  | 21 |
| less than 10.5 | 25 |
| less than 11.5 | 27 |
| less than 12.5 | 29 |
| less than 13.5 | 33 |
| less than 14.5 | 35 |
| less than 15.5 | 36 |

5.

| Limits  | Boundaries  | f        |
|---------|-------------|----------|
| 15 - 19 | 14.5 - 19.5 | 3        |
| 20 - 24 | 19.5 - 24.5 | 18       |
| 25 - 29 | 24.5 - 29.5 | 18       |
| 30 - 34 | 29.5 - 34.5 | 8        |
| 35 - 39 | 34.5 - 39.5 | <u>3</u> |
|         |             | 50       |

|                | cf |
|----------------|----|
| Less than 14.5 | 0  |
| Less than 19.5 | 3  |
| Less than 24.5 | 21 |
| Less than 29.5 | 39 |
| Less than 34.5 | 47 |
| Less than 39.5 | 50 |

6.

| Limits   | Boundaries   | f        |
|----------|--------------|----------|
| 51 - 59  | 50.5 - 59.5  | 5        |
| 60 - 68  | 59.5 - 68.5  | 12       |
| 69 - 77  | 68.5 - 77.5  | 11       |
| 78 - 86  | 77.5 - 86.5  | 8        |
| 87 - 95  | 86.5 - 95.5  | 3        |
| 96 - 104 | 95.5 - 104.5 | <u>2</u> |
|          |              | 41       |

6. continued

|                 | cf |
|-----------------|----|
| Less than 50.5  | 0  |
| Less than 59.5  | 5  |
| Less than 68.5  | 17 |
| Less than 77.5  | 28 |
| Less than 86.5  | 36 |
| Less than 95.5  | 39 |
| Less than 104.5 | 41 |

7.

| Limits  | Boundaries  | rf          |
|---------|-------------|-------------|
| 15 - 19 | 14.5 - 19.5 | 0.06        |
| 20 - 24 | 19.5 - 24.5 | 0.36        |
| 25 - 29 | 24.5 - 29.5 | 0.36        |
| 30 - 34 | 29.5 - 34.5 | 0.16        |
| 35 - 39 | 34.5 - 39.5 | <u>0.06</u> |
|         |             | 1.00        |

|                | crf  |
|----------------|------|
| Less than 14.5 | 0.00 |
| Less than 19.5 | 0.06 |
| Less than 24.5 | 0.42 |
| Less than 29.5 | 0.78 |
| Less than 34.5 | 0.94 |
| Less than 39.5 | 1.00 |

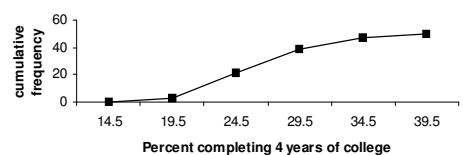
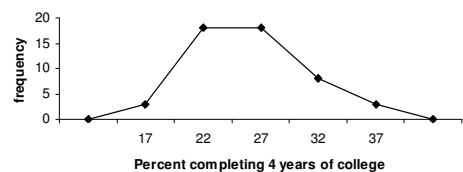
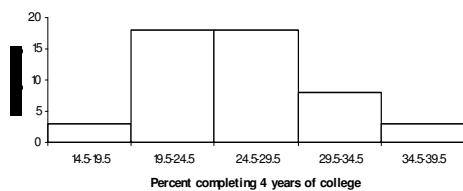
8.

| Limits   | Boundaries   | rf           |
|----------|--------------|--------------|
| 51 - 59  | 50.5 - 59.5  | 0.122        |
| 60 - 68  | 59.5 - 68.5  | 0.293        |
| 69 - 77  | 68.5 - 77.5  | 0.268        |
| 78 - 86  | 77.5 - 86.5  | 0.195        |
| 87 - 95  | 86.5 - 95.5  | 0.073        |
| 96 - 104 | 95.5 - 104.5 | <u>0.049</u> |
|          |              | 1.000        |

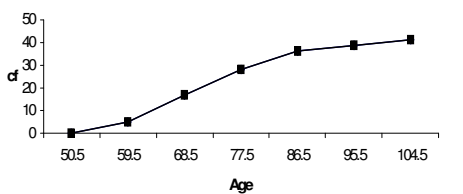
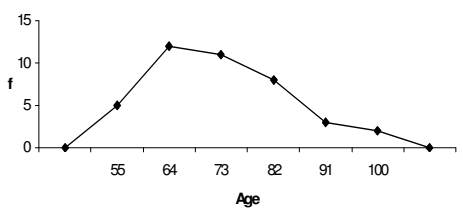
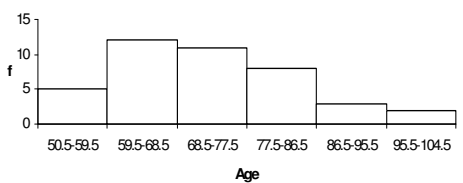
|                 | crf   |
|-----------------|-------|
| Less than 50.5  | 0.000 |
| Less than 59.5  | 0.122 |
| Less than 68.5  | 0.415 |
| Less than 77.5  | 0.683 |
| Less than 86.5  | 0.878 |
| Less than 95.5  | 0.951 |
| Less than 104.5 | 1.000 |

## Chapter 2 - Frequency Distributions and Graphs

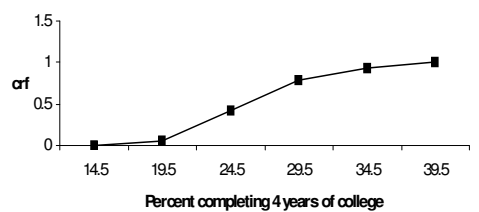
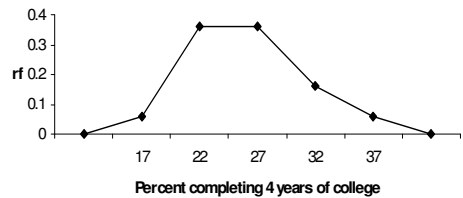
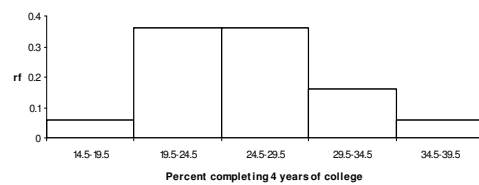
9.



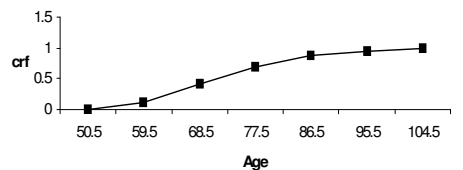
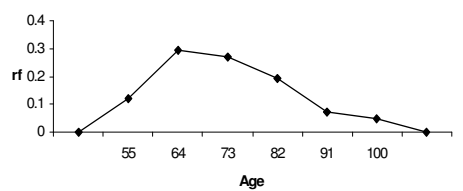
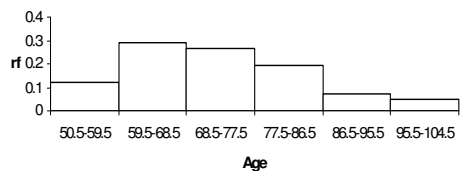
10.



11.

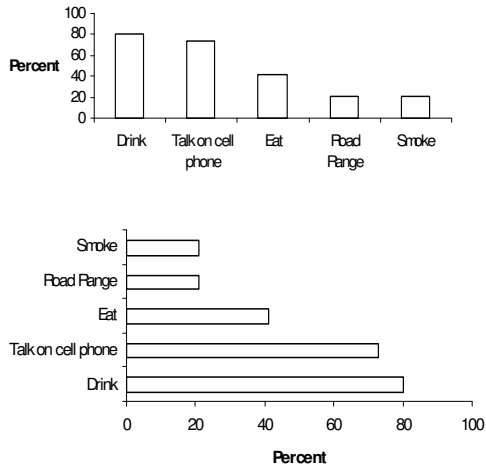


12.

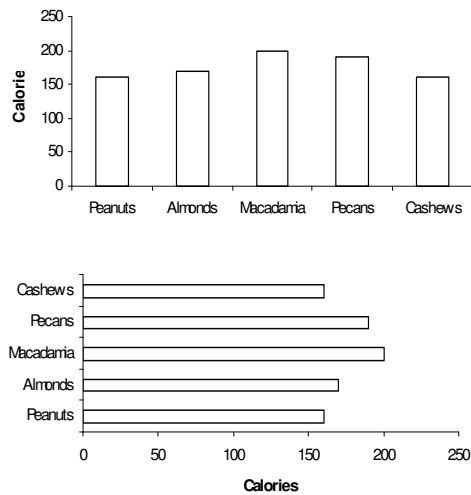


## Chapter 2 - Frequency Distributions and Graphs

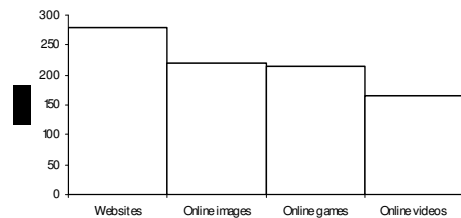
13.



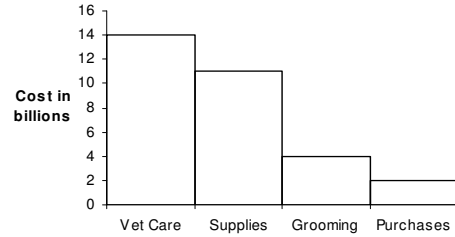
14.



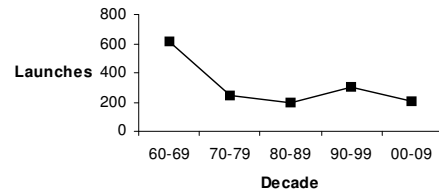
15.



16.

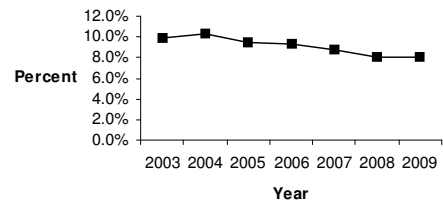


17.



Launches declined steadily from the 1960s through the 1970s and 1980s. Launches increased in the 1990s then decreased in the 2000s.

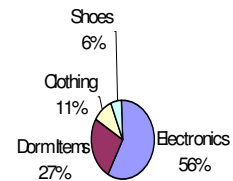
18.



The dropout rate increased slightly from 2003 to 2004, then decreased slightly each year until 2008. There was a slight increase in 2009.

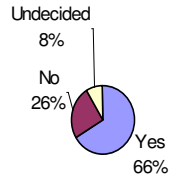
19.

Spending of College Freshmen

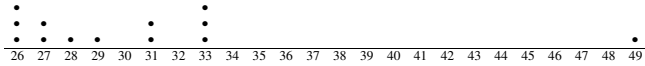


## Chapter 2 - Frequency Distributions and Graphs

20.

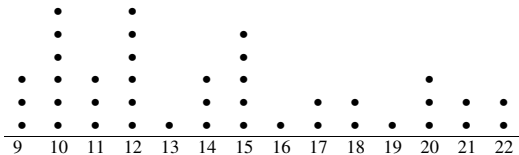


21.



The graph shows almost all but one of the touchdowns per season for Manning's career were between 26 and 33.

22.



The distribution is somewhat positively skewed, and the majority of the CDs (27) had between 9 and 15 songs on them.

23.

|   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|
| 2 | 9 | 9 |   |   |   |   |
| 3 | 2 | 4 | 5 | 6 | 8 | 8 |
| 4 | 1 | 2 | 3 | 7 | 7 |   |
| 5 | 1 | 3 | 5 | 8 |   |   |
| 6 | 2 | 2 | 2 | 3 | 7 |   |
| 7 | 2 | 3 |   |   |   |   |

24.

|    |   |   |   |
|----|---|---|---|
| 10 | 2 | 8 | 8 |
| 11 | 3 |   |   |
| 12 |   |   |   |
| 13 |   |   |   |
| 14 | 2 | 4 |   |
| 15 |   |   |   |
| 16 |   |   |   |
| 17 | 6 | 6 | 6 |
| 18 | 4 | 9 |   |
| 19 | 2 |   |   |
| 20 | 5 | 9 |   |
| 21 | 0 |   |   |

25.

The graphs are misleading because no scale is used on the  $x$  and  $y$  axes.

26.

The difference between payoffs appears large, but is only 3%. The scale on the  $y$  axis may be truncated.

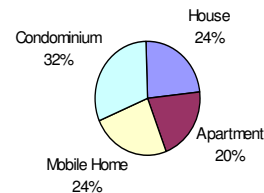
### CHAPTER 2 QUIZ

- False
- False
- False
- True
- True
- False
- False
- c
- c
- b
- b
- Categorical, ungrouped, grouped
- 5, 20
- Categorical
- Time series
- Stem and leaf plot
- Vertical or y

18.

| Class | f  | cf |
|-------|----|----|
| H     | 6  | 6  |
| A     | 5  | 11 |
| M     | 6  | 17 |
| C     | 8  | 25 |
|       | 25 |    |

19.



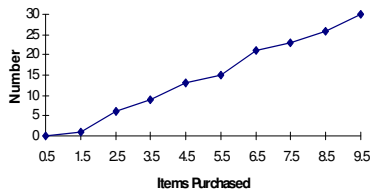
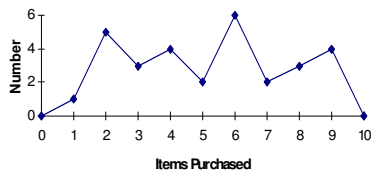
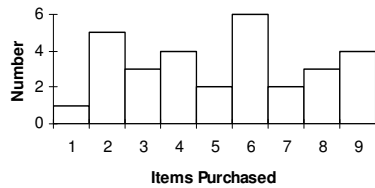
## Chapter 2 - Frequency Distributions and Graphs

20.

| Limits | Boundaries | f  |
|--------|------------|----|
| 1      | 0.5 – 1.5  | 1  |
| 2      | 1.5 – 2.5  | 5  |
| 3      | 2.5 – 3.5  | 3  |
| 4      | 3.5 – 4.5  | 4  |
| 5      | 4.5 – 5.5  | 2  |
| 6      | 5.5 – 6.5  | 6  |
| 7      | 6.5 – 7.5  | 2  |
| 8      | 7.5 – 8.5  | 3  |
| 9      | 8.5 – 9.5  | 4  |
|        |            | 30 |

|               | cf |
|---------------|----|
| less than 0.5 | 0  |
| less than 1.5 | 1  |
| less than 2.5 | 6  |
| less than 3.5 | 9  |
| less than 4.5 | 13 |
| less than 5.5 | 15 |
| less than 6.5 | 21 |
| less than 7.5 | 23 |
| less than 8.5 | 26 |
| less than 9.5 | 30 |

21.

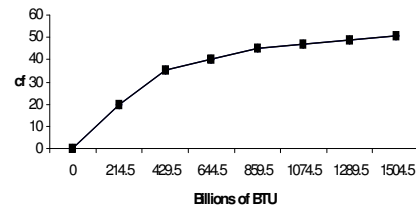
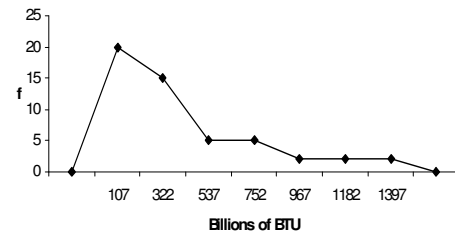
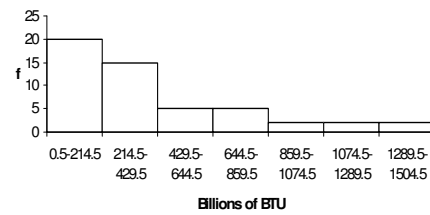


22.

| Limits      | $X_m$ | Boundaries      | f  | rf   |
|-------------|-------|-----------------|----|------|
| 0 - 214     | 107   | -0.5 - 214.5    | 20 | 0.39 |
| 215 - 429   | 322   | 214.5 - 429.5   | 15 | 0.29 |
| 430 - 644   | 537   | 429.5 - 644.5   | 5  | 0.10 |
| 645 - 859   | 752   | 644.5 - 859.5   | 5  | 0.10 |
| 860 - 1074  | 967   | 859.5 - 1074.5  | 2  | 0.04 |
| 1075 - 1289 | 1182  | 1074.5 - 1289.5 | 2  | 0.04 |
| 1290 - 1504 | 1397  | 1289.5 - 1504.5 | 2  | 0.04 |
|             |       |                 | 51 | 1.00 |

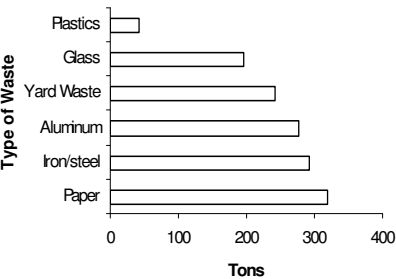
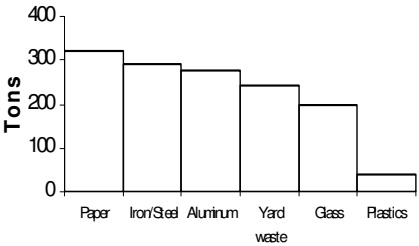
|                  | cf | crf  |
|------------------|----|------|
| Less than 0      | 0  | 0    |
| Less than 214.5  | 20 | 0.39 |
| Less than 429.5  | 35 | 0.68 |
| Less than 644.5  | 40 | 0.78 |
| Less than 859.5  | 45 | 0.88 |
| Less than 1074.5 | 47 | 0.92 |
| Less than 1289.5 | 49 | 0.96 |
| Less than 1504.5 | 51 | 1.00 |

23.

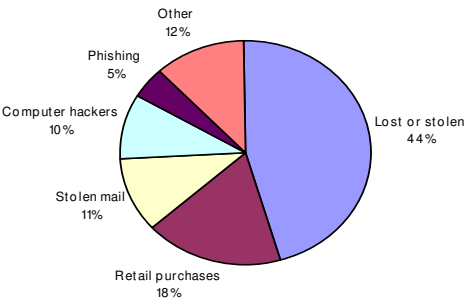


Chapter 2 - Frequency Distributions and Graphs

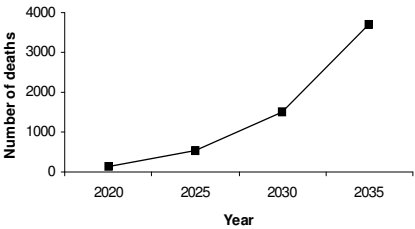
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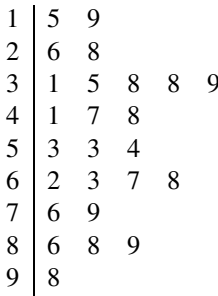
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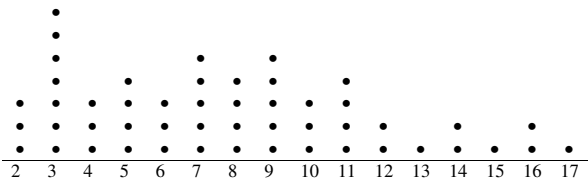
26.



27.



28.



29.

The bottles have different areas, so your eyes will compare areas instead of heights.