12. $\frac{\sum(x-\bar{x})^2}{n} = \frac{\sum(x^2-2x\bar{x}+\bar{x}^2)}{n} = \frac{\sum x^2-\sum(2x\bar{x})+\sum\bar{x}^2}{n}$

$= \frac{\sum x^2}{n} - \frac{2\bar{x}\sum x}{n} + \frac{n\bar{x}^2}{n} = \frac{\sum x^2}{n} - 2\bar{x}^2 + \bar{x}^2 = \frac{\sum x^2 - n\bar{x}^2}{n}$

13. Yes. If one student's mark is a lot lower on one test and a lot higher on another test, the average could be the same, but the standard deviation would be higher. The other student could have almost the same mark every test and have a low standard deviation.

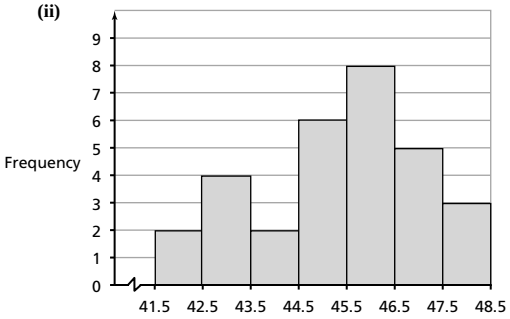
14. Yes. Answers may vary; for example: 162, 167, 168, 169, 170, 171.5 and 163, 165, 167, 168, 169, 172.5

3.4 Exercises, page 176

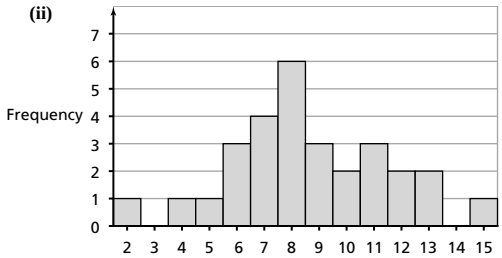
1. **(a)** yes
(b) No, 68% of the values fall within 1 standard deviation.
(c) yes **(d)** yes **(e)** depends on $\bar{x}$ **(f)** yes

2. The standard deviation can be analyzed mathematically and it takes into account all of the data values.

3. **(a)** **(i)** mean: 45.19, median: 45.5, standard deviation: 1.70
(ii)



(b) **(i)** mean: 8.62, median: 8, standard deviation: 2.85
(ii)



4. **(a)** (c)

5. **(a)** 12 **(c)** 16.3

6. 135; standard deviation = 15

7. **(a)** Yes, for normal distributions, since 99.7% of the data are within 3σ of the mean; 6σ = 99.7% of the data, which is very close to 100% of the data.
(b) **(a)** 1.07 **(b)** 2.17

8. 180.7 cm and taller

9. **(a)** 9.6 oz to 10.8 oz
(c) No. There is a 0.15% chance of the cup overflowing, which is not significant.

10. 6.9 years

11. **(a)** might be symmetrical and bell-shaped
(b) varies
(c) more symmetrical, more bell-shaped

12. **(a)** Kate: mean: 103.4, standard deviation: 19.86; Bernie: mean: 104.2, standard deviation: 15.37
(b) Kate: 60%; Bernie: 80%
(c) Kate: 163; Bernie: 150

14. **(a)** No, that is more than 3 standard deviations from the mean.
(b) at most 83

3.5 Exercises, page 186

1. **(a)** **(i)** –0.4 **(ii)** 0.6 **(iii)** 2.0 **(iv)** –2.6
(b) **(i)** –2.4 **(ii)** 0.7 **(iii)** 2.8 **(iv)** –1.1
(c) **(i)** –0.5 **(ii)** –2.3 **(iii)** 1.7 **(iv)** –2.0
(d) **(i)** 0.6 **(ii)** –2.8 **(iii)** 1.6 **(iv)** 0.0

2. **(a)** No. The area is 1. **(b)** Yes.
(c) No. They are all exactly equal to 0.
(d) Yes. (or N(0, 1^2))

3. 760

4. **(a)** 67th percentile **(b)** 99th percentile
(c) 20th percentile **(d)** 3rd percentile

5. **(a)** –0.13 **(b)** 0.61 **(c)** –1.48 **(d)** 2.05

6. **(a)** 60 **(b)** 40 **(c)** 75 **(d)** 45
(e) 31.9 **(f)** 52 **(g)** 66.2 **(h)** 27.6

7. **(a)** **(i)** 0.17 **(ii)** 2.57
(b) 74.2%; 25.7% **(c)** (z = 1.28) 185 points

8. 0.38%

9. **(a)** 0.38% **(b)** 37.8% **(c)** 5.30

10. **(a)** 94th percentile **(b)** 640.8

11. **(a)** 428.4g **(b)** 0.35%

12. **(a)** 12 **(b)** 0 **(c)** 68

13. No. There is only a 0.37% chance that the temperature could be over 30ºC on any given day.

14. 63.6, 78.4

15. mean = 1.95 m; standard deviation = 0.82 m

3.6 Exercises, page 193

1. **(a)** **(i)** 29.38 **(ii)** 24.22 **(iii)** 22.03 **(iv)** 20.41 **(v)** 21.63
(b) (iv), (v), (iii), (ii), (i)
(c) No relationship

2. **(a)** 45 **(b)** 68 **(c)** 58 **(d)** 80

3. **(a)** 1.80 m **(b)** 2.00 m **(c)** 1.94 m **(d)** 1.66 m

4. Bush: 0.387, Cruz Jr.: 0.530, Delgado: 0.540, Gonzalez: 0.388, Stewart: 0.463, Team Total: 0.430

7. **(a)** Index = cost $\times \frac{1000}{\text{speed}} \times \frac{100}{\text{seats}}$
(b) L1011–100/200: \$2424, B767–300: \$2525, B747–100: \$2773, B757–200: \$3092, B747–400: \$3219, DC–10–10: \$3654, B767–200: \$3832, DC–10–30: \$4410, A300–600: \$4447

8. **(a)** Index = 2 × adult + 2 × child + parking + 2 × cap + 4 × drink + 4 × hot dog
(b) Montreal: \$79.76, Florida: \$91.89, Detroit: \$98.04, Colorado: \$123.60, Toronto: \$125.81, Ottawa: \$127.22, Atlanta: \$131.60, Baltimore: \$132.05, New York: \$143.11, Boston: \$156.12