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## Solutions

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### Solutions to Chapter 2 Exercise

1. Graph 2.9 contains:
  - (a) 13 vertices
  - (b) 17 edges
  - (c) 5 multiple edges
  - (d) 2 loops
  - (e) 3 vertices adjacent to vertex  $a$
  - (f) 8 vertices connected to vertex  $a$
2. The graph induced by...
  - (a) vertices  $\{a, b, c, d, e\}$  should contain vertices  $\{a, b, c, d, e\}$  and edges  $\{(a, b), (a, c), (a, d), (c, c), (b, e)\}$ .
  - (b) edges  $\{x, y, z\}$  should contain vertices  $\{g, j, k, l\}$  and edges  $\{(g, j), (g, k), (j, l)\}$ .
3. Graphs  $Y$  and  $Z$  are isomorphic. One possible isomorphism is given in Table 13.2. Graphs  $Y$  and  $Z$  are not automorphic.
4. A planar clique of size...
  - (a) 4 can exist.
  - (b) 5 cannot exist.

TABLE 13.2: One possible isomorphism of graphs  $Y$  and  $Z$ .

$V(A)$	$V(B)$
$a$	$d$
$b$	$b$
$c$	$f$
$d$	$a$
$e$	$e$
$f$	$c$

- (c) 6 cannot exist.
5. Given an undirected tree...
- (a) it is possible to draw a directed tree with the same number of vertices and edges.
- (b) it is not possible to draw a new undirected tree with the same number of vertices but a different number of edges.
- (c) it is not possible to add an edge to the tree without creating a cycle.
- (d) it is not possible to remove an edge from the tree without disconnecting at least one vertex.

### Solutions to Chapter 3 Exercises

1. 

```
1 > library(stats)
2 > summary(m.age)
3   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
4  15.70  17.20   20.60   21.51  24.90   30.40
5 > sd(m.age)
6 [1] 4.83385
7 > var(m.age)
8 [1] 23.36610
```
2. Figure 13.20 displays the solution.
3. (a)  $4 + y$   
 (b)  $y - x$   
 (c)  $sum(y)$   
 (d)  $x * y$   
 (e)  $y[1 : 5]$
4. (a)  $seq(1, 10, by = 2)$   
 (b)  $seq(2, 10, by = 2)$   
 (c)  $seq(10, 1, by = -1)$   
 (d)  $seq(1, 10, by = 2)^3$
5. (a)  $\mathbf{A} + \mathbf{B} = \begin{pmatrix} 9 & 11 \\ 10 & 7 \end{pmatrix}$   
 (b)  $\mathbf{A} + 3*\mathbf{B} = \begin{pmatrix} 23 & 23 \\ 14 & 13 \end{pmatrix}$

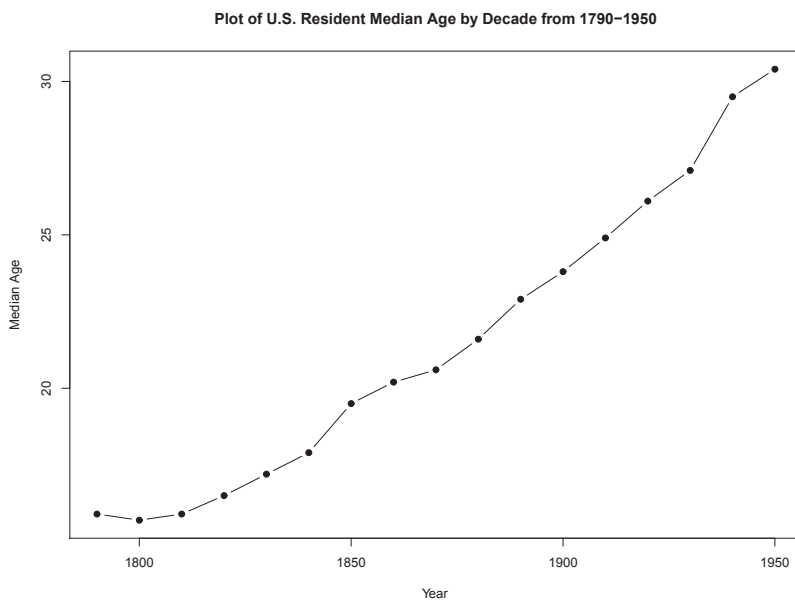


FIGURE 13.20: The output of the plot command `plot(year, m.age, type="b", col="black", xlab="Year", ylab="Median Age", main="Plot of U.S. Resident Median Age by Decade from 1790-1950", font.main=2, font.lab=1, pch=19)`

(c)  $\det(\mathbf{A}) = -32$

(d)  $\mathbf{A} \%*\% \mathbf{B} = \begin{pmatrix} 24 & 27 \\ 64 & 60 \end{pmatrix}$

(e)  $t(\mathbf{B}) = \begin{pmatrix} 7 & 2 \\ 6 & 3 \end{pmatrix}$

6. `1 > cube = function(x){x^3}`

7. `1 > randomNumbers(n=100,min=1,max=25,col=10)`

```

2      V1 V2 V3 V4 V5 V6 V7 V8 V9 V10
3 [1,]  3 20  9 22 17  2 23 12  9  13
4 [2,]  3  4 21  8 25 15 24 10  7  4
5 [3,] 18 23 25  4 10 22  1 15  3  2
6 [4,]  9  3 22  7 12  9 15 21 14 24
7 [5,] 11  3 16 20 13  2  9  8 25  4
8 [6,] 19  3 13  9  6 20  8 14 22  1
9 [7,] 25  6  9 11 11 21 17 15 23  6

```

```
10 [8,] 9 22 21 19 5 13 16 5 1 6
11 [9,] 4 11 7 11 24 20 3 3 23 20
12 [10,] 15 9 5 16 4 13 11 16 19 14
```

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## Solutions to Chapter 4 Exercises

1 1a **A** is symmetric, **B** is not.

$$\begin{bmatrix} & 1 \\ & \end{bmatrix}$$