9. $y = 0.1 - 0.4x + x^2$

11. $y = 1.6 + 2x$

13. 4.5 min

15. Let $t = x - c$, where $c = (\sum_{i=1}^{m} a_i)/m$. The data points $(a_1 - c, b_1), (a_2 - c, b_2), \ldots, (a_m - c, b_m)$ have the property that $\sum_{i=1}^{m} (a_i - c) = 0$. Exercise 14 then shows that these data points have least-squares linear fit given by $y = r_0 + r_1 t$, where r_0 and r_1 have the values given in Exercise 14. Making the substitution $t = x - c$, we see that the data points $(a_1, b_1), (a_2, b_2), \ldots, (a_m, b_m)$ have the least-squares linear fit given by $y = r_0 + r_1(x - c)$.

17. $\bar{x} = \begin{bmatrix} -\frac{1}{5} \\ \frac{3}{5} \end{bmatrix}$

19. $\bar{x} = \begin{bmatrix} 0 \\ 2 \\ -\frac{1}{4} \end{bmatrix}$

21. F F T T F F T T F F

23. See answer to Exercise 17.

25. See answer to Exercise 19.

27. The computer gave the fit $y = 0.7587548 + 1.311284x$ with a least-squares sum of 0.03891051.

29. We achieved a least-squares sum of 5.838961 with the expoential fit $y = 0.8e^{0.2x}$. The computer achieved a least-squares sum of 6.34004 with the exponential fit $y = 0.8874836e^{0.1960377x}$. The fit using logarithms tries to fit the smaller y-value data accurately at the expense of the larger y-value data, so that the *percent* accuracy of fit to the y-coordinates is as good as possible.

31. The computer gave the fit $y = 12.03846 - 1.526374x$ with a least-squares sum of 0.204176.

33. $y \approx 5.476 - 0.75x + 0.2738x^2$

35. $y \approx 5.632 - 1.139x + 0.1288x^2 + 0.05556x^3 + 0.01512x^4$

37. $y = -5 - 8x + 9x^2 - x^3$

HAPTER 7

ction 7.1

1. $[-1, 1]$

3. $[-4, -2, 1, 5]$

5. $[3, 5, 1, 1]$

7. $2x^2 + 6x + 2$

9. $\begin{bmatrix} -1 \\ -4 \\ -2 \end{bmatrix}$

11. a. $C_{B,B'} = \begin{bmatrix} 2 & 1 & 2 \\ 3 & 2 & 0 \\ 1 & 0 & 3 \end{bmatrix}$;

b. $C_{B',B} = \begin{bmatrix} -6 & 3 & 4 \\ 9 & -4 & -6 \\ 2 & -1 & -1 \end{bmatrix}$

13. a. $C_{B,B'} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$;

b. $C_{B',B} = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & -1 \\ 0 & 1 & -1 & 0 \\ 1 & -1 & 0 & 0 \end{bmatrix}$

15. $C_{B',B} = \begin{bmatrix} 1 & 2 & 1 \\ -1 & -2 & -2 \\ 0 & 1 & 0 \end{bmatrix}$

17. $C_{B',B} = \begin{bmatrix} 1 & 0 & 0 & 1 \\ -1 & 1 & 0 & 0 \\ 0 & -1 & 1 & 0 \\ 0 & 0 & -1 & 1 \end{bmatrix}$

19. $C_{B,B'} = \begin{bmatrix} 1 & 2 & 1 & 0 \\ 1 & -1 & 0 & 1 \\ 0 & 1 & -1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$

21. $C_{B,B'} = \begin{bmatrix} -1 & 1 \\ 1 & 1 \end{bmatrix}$

23. T F T F T F T F T T

25. $C_{B,B''} = C_{B',B''}C_{B,B'}$

Section 7.2

1. $R_B = \begin{bmatrix} 6 & 7 \\ -3 & -3 \end{bmatrix}$, $R_{B'} = \begin{bmatrix} 1 & -1 \\ 1 & 2 \end{bmatrix}$,
$C = \begin{bmatrix} -1 & 2 \\ 1 & -1 \end{bmatrix}$

3. $R_B = \begin{bmatrix} 0 & 1 & 0 \\ 2 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$, $R_{B'} = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & -1 \end{bmatrix}$,
$C = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & -1 \\ 1 & -1 & 0 \end{bmatrix}$

5. $R_B = \begin{bmatrix} \frac{13}{5} & \frac{4}{5} & 2 \\ -\frac{11}{5} & -\frac{3}{5} & -2 \\ -\frac{9}{5} & -\frac{2}{5} & -2 \end{bmatrix}$, $R_{B'} = \begin{bmatrix} -\frac{4}{3} & -\frac{1}{6} & -\frac{10}{3} \\ -\frac{4}{3} & -\frac{5}{3} & -\frac{16}{3} \\ 1 & \frac{1}{2} & 3 \end{bmatrix}$,

$C = \begin{bmatrix} 0 & -\frac{9}{5} & -\frac{8}{5} \\ 1 & \frac{13}{5} & \frac{21}{5} \\ 0 & \frac{12}{5} & \frac{14}{5} \end{bmatrix}$

7. $R_B = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$, $R_{B'} = \frac{1}{3}\begin{bmatrix} 1 & -2 & -2 \\ -2 & 1 & -2 \\ -2 & -2 & 1 \end{bmatrix}$,

$C = \frac{1}{3}\begin{bmatrix} 1 & 1 & -2 \\ 1 & -2 & 1 \\ 1 & 1 & 1 \end{bmatrix}$

9. $R_B = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, $R_{B'} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$,

$C = \frac{1}{2}\begin{bmatrix} 1 & 0 & 1 \\ 1 & 0 & -1 \\ 0 & 2 & 0 \end{bmatrix}$

11. $R_B = \begin{bmatrix} 2 & 0 & 0 \\ 2 & 2 & 0 \\ 1 & 1 & 2 \end{bmatrix}$, $R_{B'} = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 2 & 2 \\ 0 & 0 & 2 \end{bmatrix}$,

$C = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$

13. $R_B = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 3 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$, $R_{B'} = \begin{bmatrix} 0 & 1 & -2 & -3 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 3 \\ 0 & 0 & 0 & 0 \end{bmatrix}$,

$C = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 \end{bmatrix}$

15. $\begin{bmatrix} 2 & 1 & -3 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix}$

17. $\lambda_1 = -1$, $\lambda_2 = 5$; $E_{-1} = \mathrm{sp}\left(\begin{bmatrix} 1 \\ 1 \end{bmatrix}\right)$,

$E_5 = \mathrm{sp}\left(\begin{bmatrix} -1 \\ 1 \end{bmatrix}\right)$; diagonalizable

19. $\lambda_1 = 0$, $\lambda_2 = 1$, $\lambda_3 = 2$; $E_0 = \mathrm{sp}\left(\begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}\right)$,

$E_1 = \mathrm{sp}\left(\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}\right)$, $E_2 = \mathrm{sp}\left(\begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}\right)$; diagonalizable

21. $\lambda_1 = -2$, $\lambda_2 = \lambda_3 = 5$; $E_{-2} = \mathrm{sp}\left(\begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}\right)$,

$E_5 = \mathrm{sp}\left(\begin{bmatrix} 0 \\ -5 \\ 2 \end{bmatrix}\right)$; not diagonalizable

23. F T T F T T T F F T

CHAPTER 8

Section 8.1

1. $U = \begin{bmatrix} 3 & -6 \\ 0 & 1 \end{bmatrix}$, $A = \begin{bmatrix} 3 & -3 \\ -3 & 1 \end{bmatrix}$

3. $U = \begin{bmatrix} 1 & -4 & 3 \\ 0 & -1 & -8 \\ 0 & 0 & 0 \end{bmatrix}$, $A = \begin{bmatrix} 1 & -2 & \frac{3}{2} \\ -2 & -1 & -4 \\ \frac{3}{2} & -4 & 0 \end{bmatrix}$

5. $U = \begin{bmatrix} -2 & 8 \\ 0 & 3 \end{bmatrix}$, $A = \begin{bmatrix} -2 & 4 \\ 4 & 3 \end{bmatrix}$

7. $U = \begin{bmatrix} 8 & 5 & -4 \\ 0 & 1 & -2 \\ 0 & 0 & 10 \end{bmatrix}$, $A = \begin{bmatrix} 8 & \frac{5}{2} & -2 \\ \frac{5}{2} & 1 & -1 \\ -2 & -1 & 10 \end{bmatrix}$

9. $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -1/\sqrt{2} & 1/\sqrt{2} \\ 1/\sqrt{2} & 1/\sqrt{2} \end{bmatrix} \begin{bmatrix} t_1 \\ t_2 \end{bmatrix}$, $-t_1^2 + t_2^2$

11. $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 3/\sqrt{10} & -1/\sqrt{10} \\ 1/\sqrt{10} & 3/\sqrt{10} \end{bmatrix} \begin{bmatrix} t_1 \\ t_2 \end{bmatrix}$, $-t_1^2 +$

13. $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 1/\sqrt{2} & -1/\sqrt{2} \\ 1/\sqrt{2} & 1/\sqrt{2} \end{bmatrix} \begin{bmatrix} t_1 \\ t_2 \end{bmatrix}$, $t_1^2 + 5t_2^2$

15. $\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1/\sqrt{3} & -1/\sqrt{2} & -1/\sqrt{6} \\ 1/\sqrt{3} & 1/\sqrt{2} & -1/\sqrt{6} \\ 1/\sqrt{3} & 0 & 2/\sqrt{6} \end{bmatrix} \begin{bmatrix} t_1 \\ t_2 \\ t_3 \end{bmatrix}$,

$-t_1^2 + 2t_2^2 + 2t_3^2$

17. $a + c = k$, $ac = b^2$

19. $-5.472136t_1^2 + 3.472136t_2^2$

21. $-4.021597t_1^2 + 1.323057t_2^2 + 4.69854$

23. $-4t_1^2 + \frac{1}{2}t_2^2 + 4t_3^2 + \frac{11}{2}t_4^2$