Appendix C

Answers to Exercises

CHAPTER 2

2.1. b. $\Pr\{A \cup B\} = 0.7$
c. $\Pr\{A \cap \approx B^C\} = 0.1$
d. $\Pr\{A^C \cap B^C\} = 0.3$
2.2. b. $\Pr\{A\} = 9/31$, $\Pr\{B\} = 15/31$, $\Pr\{A,B\} = 9/31$
c. $\Pr\{A|B\} = 9/15$
d. No: $\Pr\{A\} \neq \Pr\{A|B\}$
2.3 a. 18/22
b. 22/31
2.4. b. $\Pr\{E_1, E_2, E_3\} = .000125$
c. $\Pr\{E_1^C, E_2^C, E_3^C\} = .857$
2.5. 0.20

CHAPTER 3

3.1. median = 2 mm, trimean = 2.75 mm, mean = 12.95 mm
3.2. MAD = 0.4 mb, IQR = 0.8 mb, $s = 0.88$ mb
3.4. $\gamma_{YK} = 0.273$, $\gamma = 0.877$
3.7. $\lambda = 0$
3.9. $z = 1.36$
3.10. $r_0 = 1.000$, $r_1 = 0.652$, $r_2 = 0.388$, $r_3 = 0.281$

3.12. Pearson: $\begin{bmatrix} 1.000 & 0.703 & -0.830 \\ 0.703 & 1.000 & -0.678 \\ -0.830 & -0.678 & 1.000 \end{bmatrix}$ Spearman : $\begin{bmatrix} 1.000 & 0.606 & -0.688 \\ 0.606 & 1.000 & -0.632 \\ -0.688 & -0.632 & 1.000 \end{bmatrix}$

CHAPTER 4

4.1. 0.168
4.2. a. 0.037
b. 0.331

4.3. a. $\mu_{\text{drought}} = 0.056$, $\mu_{\text{wet}} = 0.565$
b. 0.054
c. 0.432
4.4. \$280 million, \$2.825 billion
4.5. a. $\mu = 24.8°\text{C}$, $\sigma = 0.98°\text{C}$
b. $\mu = 76.6°\text{F}$, $\sigma = 1.76°\text{F}$
4.6. a. 0.00939
b. 22.9°C
4.7. a. $\alpha = 3.785$, $\beta = 0.934''$
b. $\alpha = 3.785$, $\beta = 23.7$ mm
4.8. a. $q_{30} = 2.41'' = 61.2$ mm; $q_{70} = 4.22'' = 107.2$ mm
b. $0.30''$, or 7.7 mm
c. $\cong 0.05$
4.9. a. $q_{30} = 2.30'' = 58.3$ mm; $q_{70} = 4.13'' = 104.9$ mm
b. $0.46''$, or 11.6 mm
c. $\cong 0.07$
4.10. a. $\beta = 35.1$ cm, $\zeta = 59.7$ cm
b. $x = \zeta - \beta \ln [-\ln(\text{F})]$; $\Pr\{X \leq 221 \text{ cm}\} = 0.99$
4.11. a. $\mu_{\max} = 31.8°\text{F}$, $\sigma_{\max} = 7.86°\text{F}$, $\mu_{\min} = 20.2°\text{F}$, $\sigma_{\min} = 8.81°\text{F}$, $\rho = 0.810$
b. 0.728
4.13. a. $\beta = \Sigma x/n$
b. $-\text{I}^{-1}(\hat{\beta}) = \hat{\beta}^2/n$
4.14. $x(u) = \beta [-\ln(1-u)]^{1/\alpha}$

CHAPTER 5

5.1. a. $z = 4.88$, reject H_0
b. [1.10°C, 2.56°C]
5.2. 6.53 days (Ithaca), 6.08 days (Canandaigua)
5.3. $z = -4.00$
a. $p = 0.000063$
b. $p = 0.000032$
5.4. $| r | \geq 0.366$
5.5. a. $D_{\text{n}} = 0.152$ (reject at 10%, not at 5% level)
b. For classes: [<2, 2–3, 3–4, 4–5, ≥5], $\chi^2 = 0.33$ (do not reject)
c. $r = 0.971$ (do not reject)
5.6. $\Lambda = 21.86$, reject ($p < .001$)
5.7. a. $U_1 = 1$, reject ($p < .005$)
b. $z = -3.18$, reject ($p = .0007$)
5.8. $\approx$ [1.02, 3.59]
5.9. a. Observed $(s^2_{\text{E–N}}/s^2_{\text{non-E–N}}) = 329.5$; permutation distribution critical value (1%, 2-tailed) $\approx$ 141, reject H_0 ($\text{p} < 0.01$)
b. 15/10000 members of bootstrap sampling distribution for $s^2_{\text{E–N}}/s^2_{\text{non-E–N}} \leq 1$; 2-tailed $\text{p} = 0.003$

5.10. a. Counting method, no (need ≥ 3 locally significant); FDR, yes
b. p=.007 and p=.009 significant according to FDR

CHAPTER 6

6.1. a. $\alpha = 14.8$, $\beta = 7.41$
b. Beta distribution, with $\alpha' = 29.8$, $\beta' = 17.4$
c. $\Pr\{X^+ = 0\} = .0094$, $\Pr\{X^+ = 1\} = .0656$, $\Pr\{X^+ = 2\} = .1982$, $\Pr\{X^+ = 3\} = .3248$ $\Pr\{X^+ = 4\} = .2895$, $\Pr\{X^+ = 5\} = .1125$,
6.2. a. $\beta = 190.8$, $\zeta = 162.3$
b. $\beta = 155.9$, $\zeta = 180.0$
c. 1040.0, 897.2
6.3. a. $\alpha = 1.5$, $\beta = 0.1$
b. .157
6.4. a. $\mu'_h = 455.6$, $\sigma'_h = 33.3$
b. $\mu_+ = 455.6$, $\sigma_+ = 60.1$
6.5. a. $\mu'_h = 427.4$, $\sigma'_h = 28.6$
b. $\mu_+ = 427.4$, $\sigma_+ = 57.6$
6.6. a. 462.3
b. 400
c. 450

CHAPTER 7

7.1. a. $a = 959.8$°C, $b. = -0.925$°C/mb
c. $z = -6.33$
d. 0.690
e. 0.876
f. 0.925
7.2. a. 3
b. 117.9
c. 0.974
d. 0.715
7.3. ln $[\bar{y}/(1-\bar{y})]$
7.4. a. 1.74 mm
b. [0 mm, 13.1 mm]
7.5. Range of slopes, –0.850 to -1.095; MSE = 0.369
7.6. a. –59 n.m.
b. –66 n.m.
7.7. a. 65.8°F
b. 52.5°F
c. 21.7°F
d. 44.5°F

7.8. a. 0.65
b. 0.49
c. 0.72
d. 0.56
7.9. $f_{MOS} = 30.8°F + (\ 0\ )\ (Th)$
7.10. 0.20
7.11. a. 12 mm
b. [5 mm, 32 mm], [1 mm, 55 mm]
c. 0.625

CHAPTER 8

8.1. a. .0025 .0013 .0108 .0148 .0171 .0138 .0155 .0161 .0177 .0176 .0159 .0189
.4087 .0658 .1725 .0838 .0445 .0228 .0148 .0114 .0068 .0044 .0011 .0014
b. 0.162
8.2. 1644 1330
364 9064
8.3. a. 0.863
b. 0.493
c. 0.578
d. 0.691
e. 0.407
8.4. a. 0.074
b. 0.097
c. 0.761
d. 0.406
8.5. a. 0.9597 .0127 .0021 .0007
.0075 .0043 .0014 .0005
.0013 .0013 .0009 .0003
.0007 .0006 .0049 .0009
b. 0.966
c. 0.369
d. 0.334
8.6. a. 5.37°F
b. 7.54°F
c. –0.03°F
d. 1.95%
8.7. a. 0.1215
b. 0.1699
c. 28.5%

8.8. a. .0415 .0968 .1567 .1428 .1152 .0829 .1060 .0829 .0783 .0553 .0415
.3627 .2759 .1635 .0856 .0498 .0230 .0204 .0102 .0051 .0026 .0013

c. $H = .958, .862, .705, .562, .447, .364, .258, .175, .097, .042$
$F = .637, .361, .198, .112, .062, .039, .019, .009, .004, .001$

d. $A = 0.831$, $z = -14.9$

8.9. a. 0.298
b. 16.4%
c. 0.755

8.10. a. 30.3
b. 5.31 dam^2
c. 46.9%
d. 0.726
e. 0.714

8.11. a. 5 rank 1, 2 rank 2, 3 rank 3, 2 rank 4, 2 rank 5, 6 rank 6
b. underdispersed

8.12. .352, .509, .673, .598, .504, .426, .343, .275, .195, .128, –.048

CHAPTER 9

9.1. a. $p_{01} = 0.45$, $p_{11} = 0.79$
b. $\chi^2 = 3.51$, $p \approx 0.064$
c. $\pi_1 = 0.682$, $n_{\bullet 1}/n = 0.667$
d. $r_0 = 1.00$, $r_1 = 0.34$, $r_2 = 0.12$, $r_3 = 0.04$
e. 0.624

9.2 a. $r_0 = 1.00$, $r_1 = 0.40$, $r_2 = 0.16$, $r_3 = 0.06$, $r_4 = 0.03$, $r_5 = 0.01$
a. $r_0 = 1.00$, $r_1 = 0.41$, $r_2 = -0.41$, $r_3 = -0.58$, $r_4 = -0.12$, $r_5 = 0.32$

9.3 a. AR(1): $\phi = 0.80$; $s^2_\varepsilon = 36.0$
AR(2): $\phi_1 = 0.89$, $\phi_2 = -0.11$; $s^2_\varepsilon = 35.5$
AR(3): $\phi_1 = 0.91$, $\phi_2 = -0.25$, $\phi_3 = 0.16$; $s^2_\varepsilon = 34.7$
b. AR(1): BIC = 369.6
c. AR(1): AIC = 364.4

9.4 $x_1 = 71.5$, $x_2 = 66.3$, $x_3 = 62.1$

9.5 a. 28.6
b. 19.8
c. 4.5

9.6 a. $C_1 = 16.92°F$, $\phi_1 = 199°$; $C_2 = 4.16°F$, $\phi_2 = 256°$

9.7 a. 82.0°F
b. 74.8°F

9.8 b. 0.990

9.9 56

9.10 a. e.g., $f_A = 1 - .0508\ mo^{-1} = .9492\ mo^{-1}$
b. ≈ twice monthly

9.12 a. [0.11, 16.3]
b. $C_{11}^2 < 0.921$, do not reject

CHAPTER 10

10.1. $\begin{bmatrix} 216.0 & -4.32 \\ 135.1 & 7.04 \end{bmatrix}$

10.2. $([X]^{\mathrm{T}}\,\boldsymbol{y})^{\mathrm{T}} = [627,\ 11475]$, $[X^{\mathrm{T}}\,X]^{-1} = \begin{bmatrix} .06263 & -.002336 \\ -.002336 & .0001797 \end{bmatrix}$, $\boldsymbol{b}^{\mathrm{T}} = [12.46,\ 0.60]$

10.3. 90°

10.6. a. $\begin{bmatrix} 59.5 & 58.1 \\ 58.1 & 61.8 \end{bmatrix}$

b. $\begin{bmatrix} .205 & -.193 \\ -.193 & .197 \end{bmatrix}$

c. $\begin{bmatrix} .205 & -.193 \\ -.193 & .197 \end{bmatrix}$

d. $\begin{bmatrix} 6.16 & 4.64 \\ 4.64 & 6.35 \end{bmatrix}$

e. 1.765

10.7. a. $\begin{bmatrix} 59.52 & 75.43 & 58.07 & 51.70 \\ 75.43 & 185.47 & 81.63 & 110.80 \\ 58.07 & 81.63 & 61.85 & 56.12 \\ 51.70 & 110.80 & 56.12 & 77.58 \end{bmatrix}$

b. $\boldsymbol{\mu}_{\mathrm{y}}{}^{\mathrm{T}} = [21.4,\ 26.0]$

$[S_{\mathrm{y}}] = \begin{bmatrix} 98.96 & 75.55 \\ 75.55 & 62.92 \end{bmatrix}$

CHAPTER 11

11.2. a. $\boldsymbol{\mu} = [29.87,\ 13.00]^{\mathrm{T}}$, $[S] = \begin{bmatrix} 4.96 & 0.15 \\ 0.15 & 27.12 \end{bmatrix}$

b. $N_2(\boldsymbol{\mu}, [\Sigma])$; $\boldsymbol{\mu} = [-1.90,\ 5.33]^{\mathrm{T}}$ $[\Sigma] = \begin{bmatrix} 5.23 & 7.01 \\ 7.01 & 50.24 \end{bmatrix}$

11.3. $r = 0.974 > r_{\mathrm{crit}}\ (10\%) = 0.970$; do not reject

11.4. a. $T^2 = 68.5 >> 18.421 = \chi^2{}_2(.9999)$; reject

b. $\boldsymbol{a} \propto [-.6217,\ .1929]^{\mathrm{T}}$

11.5. a. $T^2 = 7.80$, reject @ 5%

b. $\boldsymbol{a} \propto [-.0120,\ .0429]^{\mathrm{T}}$

CHAPTER 12

12.1. a. 3.78, 4.51
b. 118.8
c. 0.979

12.2. a. Correlation matrix: $\Sigma\ \lambda_k = 3$
b. 1, 1, 1
c. $\boldsymbol{x}_1^T \approx [\ 26.2, 42.6, 1009.6]$

12.3. a. [1.51, 6.80], [0.22, 0.98], [0.10, 0.46]
b. λ_2 and λ_3 may be entangled

12.4. a. $\begin{bmatrix} .593 & .332 & .734 \\ .552 & -.831 & -.069 \\ -.587 & -.446 & .676 \end{bmatrix}$

b. $\begin{bmatrix} .377 & .556 & 1.785 \\ .351 & -1.39 & -.168 \\ -.373 & -.747 & 1.644 \end{bmatrix}$

12.5. 9.18, 14.34, 10.67

CHAPTER 13

13.1. Jan 6: $v_1 = .038$, $w_1 = .433$; Jan 7: $v_1 = .868$, $w_1 = 1.35$

13.2. 39.0°F, 23.6°F

13.3. a. $\begin{bmatrix} 1.883 & 0 & 1.838 & -.212 \\ 0 & .927 & .197 & .791 \\ 1.838 & .197 & 1.904 & 0 \\ -.212 & .791 & 0 & .925 \end{bmatrix}$

b. $\boldsymbol{a}_1 = [.728, .032]^T$, $\boldsymbol{b}_1 = [.718, -.142]^T$, $r_{C1} = 0.984$
$\boldsymbol{a}_2 = [-.023, 1.038]^T$, $\boldsymbol{b}_2 = [.099, 1.030]^T$, $r_{C2} = 0.867$

CHAPTER 14

14.1 b. R_1: $-1 \le x \le 0.25$
R_2: $0.25 < x \le 1.5$
c. R_1: $-1 \le x \le -0.33$
R_2: $-0.33 < x \le 1.5$

14.2 a. $\boldsymbol{a}_1^T = [0.83, -0.56]$
b. 1953
c. 1953

14.3. a. $\delta_1 = 38.65$, $\delta_2 = -14.99$; Group 3
b. 5.2 x 10^{-12}, 2.8 x 10^{-9}, 0.99999997
14.4. a. 0.006
b. 0.059
c. 0.934

CHAPTER 15

15.1.
$$\begin{bmatrix} 0 & & & & & \\ 3.63 & 0 & & & & \\ 2.30 & 1.61 & 0 & & & \\ 3.14 & 0.82 & 0.90 & 0 & & \\ 0.73 & 4.33 & 2.93 & 3.80 & 0 & \\ 1.64 & 2.28 & 0.72 & 1.62 & 2.22 & 0 \end{bmatrix}$$

15.2. a. 1967+1970, $d = 0.72$; 1965+1969, $d = 0.73$; 1966+1968, $d = 0.82$; (1967+1970) + (1966+1968), $d = 1.61$; all, $d = 1.64$.
b. 1967+1970, $d = 0.72$; 1965+1969, $d = 0.73$; 1966+1968, $d = 0.82$; (1967+1970) + (1966+1968), $d = 2.28$; all, $d = 4.33$.
c. 1967+1970, $d = 0.72$; 1965+1969, $d = 0.73$; 1966+1968, $d = 0.82$; (1967+1970) + (1966+1968), $d = 1.60$; all, $d = 3.00$.
15.3. a. 1967+1970, $d = 0.50$; 1965+1969, $d = 0.60$; 1966+1968, $d = 0.70$; (1967+1970) + (1965+1969), $d = 1.25$; all, $d = 1.925$.
b. 1967+1970, $d = 0.125$; 1965+1969, $d = 0.180$; 1966+1968, $d = .245$; (1967+1970) + (1965+1969), $d = 1.868$; all, $d = 7.053$.
15.4. {1966, 1967}, {1965, 1968, 1969, 1970}; {1966, 1967, 1968}, {1965, 1969, 1970}; {1966, 1967, 1968, 1970}, {1965, 1969}.