Appendix D

Answers to Exercises

CHAPTER 2

2.1. b. Pr $\{A \cup B\} = 0.7$
c. Pr $\{A \cap B^C\} = 0.1$
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. a. 0.82
b. Smaller: since Pr$\{B|A\}>$Pr$\{B\}$, Pr$\{A \cap B\}=$Pr$\{B|A\}$Pr$\{A\} >$ Pr$\{B\}$Pr$\{A\}$

2.6. 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. $\gamma_{YK} = 0.158$, $\gamma = 0.877$

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. 0.163

4.2. a. 0.0364
b. 0.344

4.3. a. $\mu_{drought} = 0.056$, $\mu_{wet} = 0.565$
b. 0.054
c. 0.432

4.4. \$280 million, \$2.825 billion

4.5. $Np(1-p) + (Np)^2$
4.6. a. 1/2
b. 0.00694
4.7. a. $\mu = 24.8°C$, $\sigma = 0.98°C$
b. $\mu = 76.6°F$, $\sigma = 1.76°F$
4.8. a. 0.278
b. 22.9°C
4.9. 0.043
4.10. a. $\alpha = 3.785$, $\beta = 0.934''$
b. $\alpha = 3.785$, $\beta = 23.7$ mm
4.11. a. $q_{30} = 2.41'' = 61.2$ mm; $q_{70} = 4.22'' = 107.2$ mm
b. 0.30″, or 7.7 mm
c. $\cong 0.05$
4.12. a. $q_{30} = 2.30'' = 58.3$ mm; $q_{70} = 4.13'' = 104.9$ mm
b. 0.46″, or 11.6 mm
c. $\cong 0.07$
4.13. 4.32″
4.14. a. $\beta = 35.1$ cm, $\zeta = 59.7$ cm
b. $x = \zeta - \beta \ln [-\ln(F)]$; $\Pr\{X \leq 221 \text{ cm}\} = 0.99$
4.15. a. 5.33″
b. 0.264
4.16. a. $\mu_{max} = 31.8°F$, $\sigma_{max} = 7.86°F$, $\mu_{min} = 20.2°F$, $\sigma_{min} = 8.81°F$, $\rho = 0.810$
b. 0.728
4.18. a. $\beta = \Sigma x/n$
b. $-\mathbf{I}^{-1}(\hat{\beta}) = \hat{\beta}^2/n$
4.19. 0.201
4.20. $x(u) = \beta [-\ln(1-u)]^{1/\alpha}$

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. $p = 0.40$
5.4. $z = -4.00$
$p = 0.000063$
$p = 0.000032$
5.5. $n \geq 86$
5.6. a. 0.5
b. 10.95°F
5.7. $|r| \geq 0.377$
5.8. a. $D_n = 0.152$ (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)
$r = 0.971$ (do not reject)
5.9. $\Lambda = 21.86$, reject ($p < .001$)

5.10. a. $U_1 = 1$, reject ($p < .005$)
b. $z = -3.18$, reject ($p = .0007$)
5.11. $\approx$ [1.02, 3.59]
5.12. 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 (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 p = 0.003
5.13. a. Counting method, no (need $\geq$3 locally significant); FDR, yes
b. $p = .007$ and $p = .009$ significant according to FDR
5.14.

a	df	SS	MS	F
Total	43	6777.73		
Treatment	3	2302.82	767.61	6.86
Error	40	4447.91	111.87	

b.	df	SS	MS	F
Total	43	6777.73		
Blocks	10	3721.73	372.17	15.9
Treatment	3	2302.82	767.61	32.8
Error	30	701.18	23.37	

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. $\mu'_{\text{h}} = 455.6$, $\sigma'_{\text{h}} = 33.3$
b. $\mu_+ = 455.6$, $\sigma_+ = 60.1$
6.5. a. $\mu'_{\text{h}} = 427.4$, $\sigma'_{\text{h}} = 28.6$
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.

Total	26	318.2874	
Regression	1	316.6065	316.6065
Residual	25	1.6809	0.06724

b. 1
c. 12.73
d. 0.9947
e. 0.56
f. $t = 68.6$

7.3. $\ln [\bar{y}/(1-\bar{y})]$
7.4. a. 1.74 mm
b. [0 mm, 13.1 mm]
7.5. MSE = 0.369
slopes: -.926,-.926,-.928,-.924,-.940,-.921,-.909,-.928,-.917,-.897,-.928,-.919,-.921, -.921,-.854,-1.095,-.927,-.952,.850,-.922
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. [4.9°C, 8.8°C]
b. [5.1°C, 8.5°C]
8.2. 0.873
8.3. a. 0.059
b. 0.345
c. 0.143
8.4. (25.5°C, 1.3 m/s), (27.5°C, 1.8 m/s), (27.0°C, 3.1 m/s), (26.4°C, 0.7 m/s), (28.4°C, 2.4 m/s)

CHAPTER 9

9.1. 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

9.2. 1644 1330
364 9064

9.3. a. 0.863
b. 0.493
c. 0.578
d. 0.691
e. 0.407

9.4. a. 0.074
b. 0.097
c. 0.761
d. 0.406

9.5. a. .9597 .0127 .0021 .0007
.0075 .0043 .0014 .0005
.0013 .0013 .0009 .0003
.0007 .0006 .0049 .0009
b. 0.966
c. 0.371
d. 0.336

9.6. a. 5.37°F
b. 7.54°F
c. –0.03°F
d. 1.95%

9.7. a. –118%
b. 60.0%

9.8. a. 0.1215
b. 0.1699
c. 28.5%
e. 0.392

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

9.10. 0.16

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

9.12. a. $\pi_{MRH}(\boldsymbol{y}_0)=3$, $\pi_{MRH}(\boldsymbol{y}_1)=1$, $\pi_{MRH}(\boldsymbol{y}_2)=2$, $\pi_{MRH}(\boldsymbol{y}_3)2$, $\pi_{MRH}(\boldsymbol{y}_4)=5$, $\pi_{MRH}(\boldsymbol{y}_5)=1$
b. $b = 5$

9.13. a. 22
b. 0.0192

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

9.15. a. 0.140
b. 0.224

9.16. a. 30.3
b. 5.31 dam^2
c. 46.9%
d. 0.726
e. 0.714
9.17. .352, .509, .673, .598, .504, .426, .343, .275, .195, .128, –.048

CHAPTER 10

10.1. 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
10.2. 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. $r_0 = 1.00$, $r_1 = 0.41$, $r_2 = –0.41$, $r_3 = –0.58$, $r_4 = –0.12$, $r_5 = 0.32$
10.3. a. AR(1): $\phi = 0.80$; $s_\varepsilon^2 = 36.0$
AR(2): $\phi_1 = 0.89$, $\phi_2 = –0.11$; $s_\varepsilon^2 = 35.5$
AR(3): $\phi_1 = 0.91$, $\phi_2 = –0.25$, $\phi_3 = 0.16$; $s_\varepsilon^2 = 34.7$
b. AR(1): BIC = 369.6
c. AR(1): AIC = 364.4
10.4. $x_1 = 71.5$, $x_2 = 66.3$, $x_3 = 62.1$
10.5. a. 28.6
b. 19.8
c. 4.5
10.6. a. 0.67 m/s
b. [12.9 m/s, 16.5 m/s]
10.7. a. $C_1 = 16.92$°F, $\phi_1 = 199$°; $C_2 = 4.16$°F, $\phi_2 = 256$°
10.8. a. 82.0°F
b. 74.8°F
10.9. b. 0.990
c. C_1^2, $p = .00593$
d. C_1^2, $p = .00593 < 0.05/6$
e. C_1^2
10.10. 56
10.11. a. e.g., $f_A = 1 - .0508\ \text{mo}^{-1} = .9492\ \text{mo}^{-1}$
b. ≈ twice monthly
10.13. [0.11, 16.3]

CHAPTER 11

11.1. $\begin{bmatrix} 216.0 & -4.32 \\ 135.1 & 7.04 \end{bmatrix}$
11.2. $([X]^T \boldsymbol{y})^T = [627, 11475]$, $[X^T X]^{-1} = \begin{bmatrix} .06263 & -.002336 \\ -.00236 & .0001797 \end{bmatrix}$, $\boldsymbol{b}^T = [12.46, 0.60]$
11.3. 90°

11.6. $\frac{1}{n}(\overline{\boldsymbol{x}}-\mu)^T[S]^{-1}(\overline{\boldsymbol{x}}-\mu)$

11.7. $[E]\boldsymbol{u}$

11.8. 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

11.9. 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. $\boldsymbol{\mu}_y^T = [21.4, 26.0]$

$[S_y] = \begin{bmatrix} 98.96 & 75.77 \\ 75.55 & 62.92 \end{bmatrix}$

CHAPTER 12

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

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

12.3. 0.334

12.4. a. $N_1(31.4, 21.4)$

b. 0.306

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

12.6. a. $T^2 = 68.5 >> 18.421 = \chi_2^2(.9999)$; reject

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

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

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

CHAPTER 13

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

13.2. a. 0.430, –0.738
b. –.439, .354, .183, –.433, .371, .231

13.3. a. Correlation matrix: $\Sigma\ \lambda_k = 3$
b. 1, 1, 1
c. 2.3 mm

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

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

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

13.6. 9.18, 14.34, 10.67

13.7. 37.5 + .838 IPpt + 1.831 IMax + 5.017 IMin + .341 CPpt + 2.42 CMax + 4.876 CMin

CHAPTER 14

14.1. 6 Jan: $v_1 = .038$, $w_1 = .433$; 7 Jan: $v_1 = .868$, $w_1 = 1.35$

14.2. 39.0°F, 23.6°F

14.3. 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. $\boldsymbol{a}_1 = [.728, .032]^T$, $\boldsymbol{b}_1 = [.718, -.142]^T$, $r_{C_1} = 0.984$
$\boldsymbol{a}_2 = [-.023, 1.038]^T$, $\boldsymbol{b}_2 = [.099, 1.030]^T$, $r_{C_2} = 0.867$

CHAPTER 15

15.1. 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: $-0.33 < x \le 1.5$

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

15.3. a. $[.734\ .367]^T$
b. w = 0.66 > 0 => ″yes″ group
c. 0.66

15.4. a. $\delta_1 = 38.65$, $\delta_2 = -14.99$; Group 3
b. 5.2 x 10^{-12}, 2.8 x 10^{-9}, 0.99999997

15.5. a. 0.006
b. 0.059
c. 0.934

CHAPTER 16

16.1.
$$\begin{bmatrix} 0 & & & & & \\ 3.59 & 0 & & & & \\ 2.29 & 1.59 & 0 & & & \\ 3.12 & 0.82 & 0.89 & 0 & & \\ 0.71 & 4.27 & 2.89 & 3.75 & 0 & \\ 1.64 & 2.24 & 0.71 & 1.59 & 2.20 & 0 \end{bmatrix}$$

16.2. a. 1967+1970, $d = 0.71$; 1965+1969, $d = 0.71$; 1966+1968, $d = 0.82$; (1967+1970) + (1966+1968), $d = 1.59$; all, $d = 1.64$.
b. 1967+1970, $d = 0.71$; 1965+1969, $d = 0.71$; 1966+1968, $d = 0.82$; (1967+1970) + (1966+1968), $d = 2.24$; all, $d = 4.27$.
c. 1967+1970, $d = 0.71$; 1965+1969, $d = 0.71$; 1966+1968, $d = 0.82$; (1967+1970) + (1966+1968), $d = 1.58$; all, $d = 2.97$.

16.3. 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, $d = 7.053$.

16.4. {1966, 1967}, {1965, 1968, 1969, 1970}; {1966, 1967, 1968}, {1965, 1969, 1970}; {1966, 1967, 1968, 1970}, {1965, 1969}.

16.5. a. f_1
b. $\Pr\{f_1\}=0.71$, $\Pr\{f_2\}=0.29$