Appendix C
Answers
Introduction to Scientific Computing and Data Analysis, 2nd Ed, by M. H. Holmes

Chapter 1
Introduction to Scientific Computing

1.16
a) 1000.03583648424; b) 1000.38056571994; c) 1.92929676762289; d) 0.00100058231560099; e) 500501.210707288; f)1000.45867514539; g) 4.70173884586451

1.17
(a) 2.5e-09, (b) 0.25

1.18
(b) 7.07106781186547e+209, (c) 17.07106781186547e-201

Chapter 2
Solving A Nonlinear Equation

2.11 (e)
A = -0.808730600479392; B = 2.02097993808977; C =0.569840290998053; D = 0.77288295914921; E =1.31409680433497; F =1.19912073071795

2.12
partial solution: 0.463647609000806, 3.6052402625906

2.13
c) 1.16556118520721

2.14
c) $\theta = \pi/6$, $\varphi = 5.874070380211116$

2.15
e) $w = 19.096120582363440$

2.17
f) t=10 min, $S = 93.518993960281492\,\text{mM}$

2.18
e) $f = 0.063569292626255$

2.19
e) $v = 35.3425966571947\,\text{m/s}$

2.20
e) $v = 24.4408608474134\,m^3$

Chapter 3
Matrix Equations

Note: The computed value for some of the answers involving very ill-conditioned matrices can depend on which version of MATLAB you are using. The reason is that MATLAB uses the LAPACK library (what is considered to be the best algorithms currently available) and they are often upgraded. So, for example, R2015a uses Intel MKL 11.1.1, R2016a uses Intel MKL 11.2.3, and R2016b uses Intel MKL 11.3.1. Those interested in MKL (also known as the Intel Math Kernel Library) should consult Intel's web-site for this.

3.43
$n = 3$, $||\mathbf{x} - \mathbf{x}_M||/||\mathbf{x}|| = 2.22e-16$, $\kappa(\mathbf{A}) = 5.33$
$n = 9$, $||\mathbf{x} - \mathbf{x}_I||/||\mathbf{x}|| = 7.77e-16$, $||\mathbf{r}|| = 5.68e-14$

3.44
$n = 8$, $||\mathbf{x} - \mathbf{x}_M||/||\mathbf{x}|| = 2.1647e-10$, $\kappa(\mathbf{A}) = 3.96e+07$

Chapter 4
Eigenvalue Problems

4.24
(c) $-5.000049348445e-01$

4.27
(d) 3141592.65

4.33
(a) $\mathbf{q}_3 = (0, -1, 0)^T$, (c) $\mathbf{q}_3 = (0, -1/\sqrt{2}, -1/\sqrt{2})^T$

4.41
(d) 109, 145, 109, 145, 182, 145, 109, 145, 109

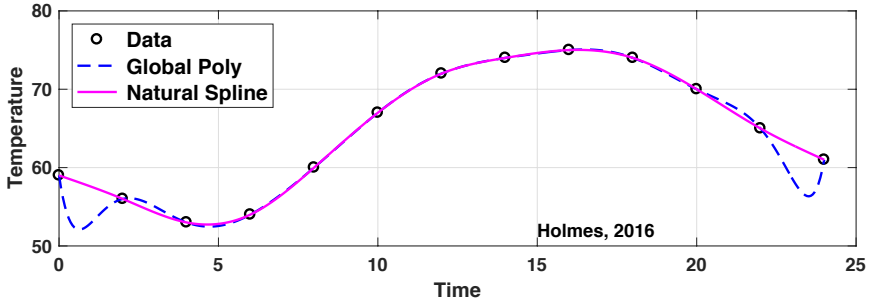
(e) 25
(f) 133, 133, 133, 133, 89, 178, 133, 133, 133

4.43
(d) $9.565146919506e-09$

Chapter 5
Interpolation

5.27
(b) $n > 122$

5.23
(a)



5.33
(c) $\delta = 1.6 \times 10^{-11}$

Chapter 6
Numerical Integration

6.17
(b) $hc * 4.058674557357435e+03$

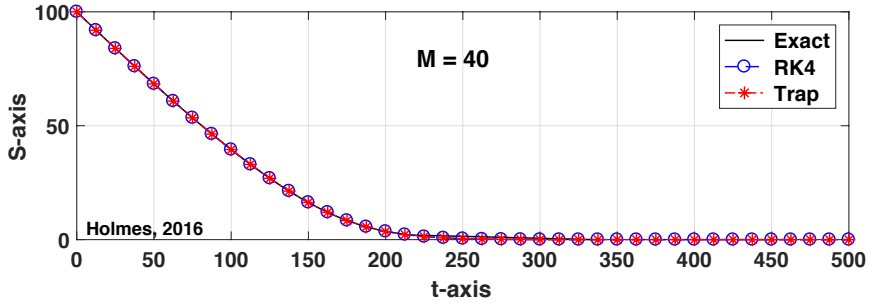
6.21
3.118169429070039

6.19
(c) $nt = 40$; $y(3) - y_{21} = -0.2242$

6.20
(c) $nt = 40$; $y(3) - y_{21} = -0.2505$

Chapter 7
Initial Value Problems

7.32
(d)



e) $e_\infty \approx 0.1458$ when $M = 20$ for the trapezoidal method, and $e_\infty \approx 0.0014$ when $M = 40$ for RK4.

7.35
(c) Taking R to be the volumetric mean radius, $v(0) = 8.89619614e+03\,\mathrm{m/s}$

7.36
(c) $r(1) = 1.26775487\,\mathrm{au}$

Chapter 8
Optimization: Regression

8.4
(a) 3/5, 4/5

8.32
(c) $(p, \varepsilon) = (1.2319, 0.9660)$, (d) $(p, \varepsilon) = (1.2429, 0.9232)$

8.33
(a) $v_1 = 22.64$, $v_2 = -0.25$ (b) $v_1 = 24.91$, $v_2 = -0.33$

8.34
(a) $(\alpha, \beta) = (3.8079\text{e-}09,\ 2.0790)$, (b) $(\alpha, \beta) = (1.3890\text{e-}09,\ 2.2263)$

Chapter 9
Optimization: Descent Methods

9.25
(a) The surface plot is shown in the figure.

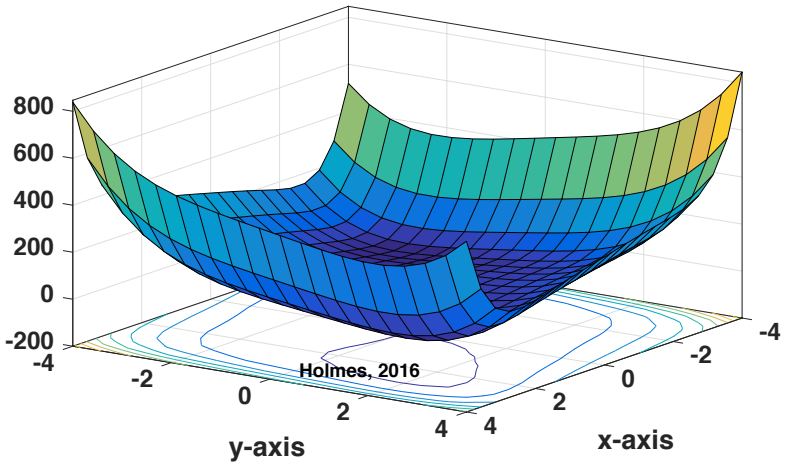


Figure C.1 Surface for Exercise 9.25(a).

Chapter 10
Data Analysis

10.3
(b) 62/51, 160/51

10.2
(c) $z = 2.5$

10.13
(b) $\mathbf{x}_1^* = (-1/2, 1/2)^T$
(d) $\mathbf{y}_i^* = \frac{1}{\sqrt{2}} \begin{pmatrix} 2 & \\ 4/\sqrt{5} & -4/\sqrt{5} \end{pmatrix} \mathbf{x}_i^*$