Unofficial Errata for *Differential Equations and Boundary Value Problems, Computing and Modeling, 3rd Edition* (Edwards and Penney)

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Note. This is an unofficial list of mistakes, goofs, bloopers, and glitches I've run across in using this book in my differential equations class. I'm disappointed to find so many errors in the third edition of a book, particularly considering how expensive it is. That being said, I have no illusions of perfection. I appreciate the difficulty of technical writing, and offer this errata list as constructive criticism to the authors. I am making it available on the web to students and teachers as a service that I hope will improve your experience with differential equations classes.

Also, if you find errors in this errata list, please let me know! I fully expect to find a few...

And thanks to everyone who contributed, particularly my Math 131 students!

1 First-Order Differential Equations

1.1 Differential Equation and Mathematical Models

1.2 Integrals as General and Particular Solutions

#2. The answer in the back of the book is wrong. It should be

$$y(x) = \frac{1}{3}(x-2)^3 + 1$$

It's also wrong in the instructor's manual. They solved for C but forgot to write it down.

#14. The answer in the back of the book is wrong. It should be

$$y(x) = \frac{1}{3}t^3 + \frac{1}{2}t^2 - 7t + 4$$

It's also wrong in the instructor's manual. They forgot the exponent on the t^2.

1.3 Slope Fields and Solution Curves

#11-20, directions. The theorem is stated as "If these things are true, then there exists a unique solution." Thus, the directions here are technically nonsense: If the theorem applies, it guarantees both existence and uniqueness. Hence, many of the solutions in the manual are also nonsense. (Every existence theorem I've ever seen needs either all the hypotheses given here or some Lipschitz condition, so there's no way to prove existence without assuming enough to guarantee uniqueness as well.) What you should do with these problems is to just check whether the theorem applies.

#30. The definition of y should be

$$y(x) = \begin{cases} +1 & \text{if } x \leq c \\ \cos(x-c) & \text{if } c < x < c+\pi \\ -1 & \text{if } x \geq c+\pi \end{cases}$$

It's also helpful to realize that the ODE $y' = -\sqrt{1-y^2}$ guarantees that y is a decreasing function.

Application: The Mathematica command is slightly wrong. It's better to use

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<<Graphics‘PlotField‘
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1.4 Separable Equations and Applications

#10. The answer in the back of the book is wrong. It should be

$$\frac{1+x}{1+(1+x)C} - 1$$

It's right in the instructor's manual.

#30. The answer in the back of the book is wrong. The instructor's manual has it right: For an initial condition $y(a) = b$, there is no solution if $b < 0$. For $b = 0$, there are an infinite number of solutions formed by joining parabolas to segments of the x axis. For $b > 0$, there are two solutions locally, because the existence and uniqueness theorem applies to the two branches of the original equation:

$$(y')^2 = 4y \implies y' = 2\sqrt{y} \text{ or } y' = -2\sqrt{y}$$

However, the theorem only guarantees local existence and uniqueness. Once the solution passes outside the rectangle required by the hypotheses of the theorem, anything could happen. In this case, there are an infinite number of solutions through every initial condition with $b \geq 0$, formed by joining parabolas to segments of the x axis, and if $b > 0$, then all of them will share one of two parabolic segments.

#32. The integral formula

$$\int \frac{1}{u\sqrt{u^2-1}} du = \sec^{-1} u + C$$

is the simplest way to find the general solution, but that formula is not in the integral table in the endpapers.

#39. The problem assumes that the dog is given only an injection. He's not on an IV or anything.

1.5 Linear First Order Equations

#20. The answer in the back of the book is wrong. It should be

$$y(x) = -1 + e^{x+x^2/2}$$

The answer is also wrong in the instructor's manual. The error first appears where they multiply by $1/\rho$.

#22. The answer in the back of the book is wrong. It should be

$$y(x) = e^{x^2}(x^3 + 5)$$

The answer is also wrong in the instructor's manual. The error first appears where they multiply by $1/\rho$.

1.6 Substitution Methods and Exact Equations

p71 ex 11. The first equation should be

$$yp\frac{dp}{dy} = p^2$$

The dx is a typo.

#32. The answer in the back of the book is wrong. It should be

$$2x^2 - xy + 3y^2 = C$$

It's also wrong in the instructor's manual. They lost the 2 somewhere along the way.

#56. The last line in the instructor's manual is wrong. It should be $(1-n)Q$ as stated in the problem, not $(1-n)Qv$.

2 Mathematical and Numerical Models

2.1 Population Models

#28. The differential equation should be

$$\frac{dx}{dt} = 0.0001x^2 - 0.01x$$

The P is a typo.

3 Linear Equations of Higher Order

3.1 Introduction

3.2 General Solutions

#36 and 37. These problems refer to equation (21) when it should refer to (23).

3.3 Homogeneous Equations with Constant Coefficients

3.4 Mechanical Vibrations

#6. The answer in the back is almost right, but the explanation in the solution manual is wrong. Here's the right way to think about it: Suppose we have two clocks, one correct and one slow. Suppose the slow clock (the pendulum at the equator) loses ε ticks per day. This means that after 24 hours, the correct clock shows a time of say n ticks, and the slow clock shows a time $n - \varepsilon$ ticks. The frequency of the correct clock is $f_1 = n/24$, and the frequency of the slow clock is $f_2 = (n - \varepsilon)/24$. Thus, the ratio of their periods is

$$\frac{p_1}{p_2} = \frac{24/n}{24/(n-\varepsilon)} = \frac{n-\varepsilon}{n}$$

Using $n = 86400$ (one tick per second, that many seconds in a day) and $\varepsilon = 160$ (number of seconds in 2 min 4 sec), the resulting bulge is $7.339\ldots$ miles. The solution manual incorrectly uses the formula $n/(n+\varepsilon)$ for the ratio of their periods. To see why their approach is wrong, consider a slow clock that's half the speed of the correct clock, so $p_2 = 2p_1$. So after a day, the slow clock loses 12 hours worth of ticks, and $\varepsilon = 43200$. With the formula here, the ratio of the periods comes out to be $1/2$. The approach in the book gives the incorrect value of $2/3$.

#22. The answers in the back aren't quite right with the problem and the text of the chapter. The time-varying amplitude ought to have a t in it to be in harmony with the definition on p. 189:

$$\frac{2}{\sqrt{3}}e^{-4t}$$

The problem asks for a frequency, but the functions in question are not actually periodic, so it should ask for a pseudo-frequency. Plus the answer in the back gives the circular pseudo-frequency (in radians/sec) rather than the pseudo-frequency (in Hz). The circular pseudo-frequency is

$$\omega = 4\sqrt{3} \quad \text{in radians per second}$$

the pseudo-period is

$$T = \frac{2\pi}{\omega} \quad \text{in seconds}$$

and the pseudo-frequency is

$$\nu = \frac{1}{T} = \frac{2\sqrt{3}}{\pi} \quad \text{in Hz.}$$

The same inconsistencies are present in the instructor's manual.

3.5 Nonhomogeneous Equations and Undetermined Coefficients

#44. The answer in the back has a sign mistake. The particular solution is

$$y_p(x) = \frac{15}{482}\cos 4x - \frac{4}{482}\sin 4x - \frac{3}{26}\cos 2x + \frac{2}{26}\sin 2x.$$

The solution manual has the same mistake, plus an addition typo (C should be 15/482, not −14/482). As the manual contains no details about how the solution was obtained, I can't guess where they made the mistake.

3.6 Forced Oscillations and Resonance

#20. Just a tiny thing: The answer in the back is given in radians/second and Hz, but not rpm as the problem requests.

4 Introduction to Systems

5 Linear Systems

5.1 Matrices and Linear Systems

#22. There's a typo in the answer in the back: The Wronskian should be $-5e^t$. The same mistake appears in the solution manual.

#24. There's a typo in the answer in the back: The Wronskian should be $-e^{5t}$. The sign mistake probably comes from switching the columns when taking the determinant, which is really harmless.

5.2 The Eigenvalue Method

5.3 Second-Order Systems

#10. The answers in the instructor's manual and in the back of the book have some of the coefficients backward. It should be $a_1 = -15$ and $b_1 = 1$ giving the solution

$$\begin{aligned} x_1(t) &= -15\cos 2t + \cos 4t + 14\cos t \\ x_2(t) &= -15\cos 2t - \cos 4t + 16\cos t \end{aligned}$$

The printed solution clearly does not satisfy $x_2(0) = 0$.

5.4 Multiple Eigenvalue Solutions

The algorithm on p. 337 is a little messy. You have to keep trying different $\mathbf{u}_1$ until you get one that creates full chains of generalized eigenvectors. I find it easier to solve for an eigenvector $(A - \lambda I)\mathbf{v}_1 = 0$, then solve for $(A - \lambda I)\mathbf{v}_2 = \mathbf{v}_1$ etc. This involves more solving, but there's less guesswork and it's easier to explain this direct method to students. The book's method is slick but it comes with so many places to get stuck. Example 6 is helpful, but I'd still rather do generalized eigenvector chains the direct way.

#33 The 9 in $\mathbf{v}_2$ is wrong. It should be

$$\mathbf{v}_2 = \begin{bmatrix} 0 & 0 & 1 & i \end{bmatrix}^T$$

6 Nonlinear systems and phenomena

6.1 Stability and the phase plane

6.2 Linear and almost linear systems

p. 386, Theorem 2: This is stated incorrectly. If λ_1 and λ_2 are real, there is no way the fixed point can be a spiral.

p. 387, Figure 6.2.12: This table is incorrect. If the eigenvalues are real and equal, the fixed point can't be a spiral.

6.3 Ecological models

p. 396–397: Not exactly an error, but a point of clarification is in order: If the fourth fixed point lies in the first quadrant, then condition 1 (that $c_1c_2 < b_1b_2 \implies$ coexistence) holds. If the fourth fixed point doesn't lie in the first quadrant, then condition 1 does not work. Here's an example:

$$\begin{aligned} x' &= x(1 - x - y/3) \\ y' &= y(1/2 - y/2 - x) \end{aligned}$$

In this example, $c_1c_2 < b_1b_2$ but the fourth fixed point doesn't lie in the first quadrant, and most solutions in the first quadrant converge to the stable fixed point on the x axis.

7 Laplace transform

8 Power series

9 Fourier series

9.1 Periodic functions and trigonometric series

9.2 General Fourier series and convergence

p. 581, eq 6: The second term in the summation should be

$$b_n \sin \frac{n\pi t}{L}$$

9.3 Fourier sine and cosine series

6. There's a typo in the answer in the back. The second sum in the sine series should have denominators $1/n^3$, so the $1/3^2$ should be $1/3^3$.