Deterministic Operations Research
Errata

Updated: October 17, 2013

Chapter 1

1. (pg. 7) In line 2 (from the top of the page), the word "flower" should read "flour".

Chapter 2

1. (pg. 22) Line -7 (from the bottom of the page), the number 60 in the "profit" equation should be 65.

2. (pg. 22) Line -3 (from the bottom of the page), the number "150" should read "120, so that the phrase is "Since there are only 120 hours per week..."

3. (pg. 23) In Linear Program 2.1, the number 60 in the "max" line should be 65.

4. (pg. 23) Line -4, the two numbers 9.02336 should each be 9.03226.

5. (pg. 23) On the last line the term "integer variables" should be "integer values".

6. (pg. 34) The solution provided at the top of the page is incorrect. The correct solution is to purchase 10,000 barrels of crude oil 1, 15,000 barrels of crude oil 2, and 7,625 barrels of crude oil 3. These barrels are blended as

	Crude Oil 1	Crude Oil 2	Crude Oil 3	Total
Regular	3750	6750	4500	15000
Premium	6250	8250	3125	17625

   where the optimal profit would be \$1,169,375.

7. (pg. 34) In the second paragraph, the word "regular" should be "premium" (in lines 2 and 4 of this paragraph). In addition, the optimal profit should be \$970,625 instead of \$1,042,190.

8. (pg. 53) In the linear program at the top of the page, the second constraint should be

$$2x + 4y - \ z \qquad - s_2 = \ 2$$

   where the "+" in front of both z and s_2 should be "-".

9. (pg. 74) In Exercise 2.15, the word "regular" should be "premium".

10. (pg. 75) In Exercise 2.19, line 6: the word "five" should be "four", in that "The logs can be purchased in any of four diameters,...". Also, the first table should have an additional column for board feet per log, as given below.

Log Diameter	Cost/Log	Blanks/Log	Max Logs	Board feet/Log
8	100	70	100	400
10	120	90	75	600
14	150	120	60	1000
18	175	150	40	1400

Finally, the mill can handle only 50 logs (not 1000) and its kiln can dry at most 7500 board feet of lumber (not 30,000).

11. (pg. 77) In Exercise 2.24, the amount of hours available should be 250, 600, and 700, respectively. Also, the amount of wood planks should be 1000 instead of 5000.

Chapter 3

1. (pg. 115) In Exercise 3.8, there is a comma missing in the table, Zone 8, between F and 8.
2. (pg. 123) In Figure 3.8, the edge $(2, 4)$ does not have a weight assigned to it. It should have $c_{24} = 1$.
3. (pg. 123) In Exercise 3.27, the next-to-last line of the exercise should be "edge (i, j)." instead of "edge $c_{i,j}$."
4. (pg. 124) In Exercise 3.29, line 3. There are three beverages produced, not four.

Chapter 4

1. (pg. 127) In Example 4.1, the (E/W, 6) entry of the table should be 40 and not 50.
2. (pg. 127) In the 7^{th} line from the bottom of the page, the distance c_{26} calculated is actually for c_{15}, so that
$$c_{15} = |20 - 160| + |90 - 10| = 220.$$
3. (pg. 128) In Example 4.2 there are multiple errata:
   (a) In line -9 (9^{th} line from the bottom), the value is 1080 instead of 1100
   (b) In line -4, the routes should be the "6" and "7" should be interchanged, and the value is 1100 instead of 1120.
4. (pg. 152) In Exercise 4.1, the table elements (2,5) and (5,2) should be 35 and not 40.

Chapter 5

1. (pg. 191) In Exercise 5.4, the problem should be formatted as

$$
\begin{aligned}
\min \quad & x_1 + x_2 + ... + x_{12} \\
\text{s.t.} \quad & \\
& x_1 + x_3 + x_5 + x_7 + x_8 + x_9 \geq 1 \\
& x_2 + x_8 + x_9 \geq 1 \\
& x_1 + x_4 + x_7 + x_8 + x_9 \geq 1 \\
& x_4 + x_{10} \geq 1 \\
& x_1 + x_4 + x_6 \geq 1 \\
& x_6 + x_{10} + x_{11} \geq 1 \\
& x_1 + x_3 + x_5 + x_7 + x_{12} \geq 1 \\
& x_1 + x_2 + x_3 + x_8 + x_9 \geq 1 \\
& x_4 + x_6 + x_{10} + x_{11} + x_{12} \geq 1 \\
& x_i \in \{0,1\} \qquad i \in \{1,2,\ldots,12\}
\end{aligned}
$$

2. (pg. 191) In Exercise 5.6, the constraint should be

$$\sum_{i \in S_k} x_i \geq 1$$

   (In the book the x_i is missing.)

3. (pg. 192) In Exercise 5.7, the problem should be formatted as

$$
\begin{aligned}
\max \quad & x_1 + x_2 + ... + x_{12} \\
\text{s.t.} \quad & \\
& x_1 + x_3 + x_5 + x_7 + x_8 + x_9 \leq 1 \\
& x_2 + x_8 + x_9 \leq 1 \\
& x_1 + x_4 + x_7 + x_8 + x_9 \leq 1 \\
& x_4 + x_{10} \leq 1 \\
& x_1 + x_4 + x_6 \leq 1 \\
& x_6 + x_{10} + x_{11} \leq 1 \\
& x_1 + x_3 + x_5 + x_7 + x_{12} \leq 1 \\
& x_1 + x_2 + x_3 + x_8 + x_9 \leq 1 \\
& x_4 + x_6 + x_{10} + x_{11} + x_{12} \leq 1 \\
& x_i \in \{0,1\} \qquad i \in \{1,2,\ldots,12\}
\end{aligned}
$$

Chapter 6

1. (pg. 206) In the discussion between Examples 6.5 and 6.6, the inequality

$$\lambda \leq \frac{15}{36}$$

should be

$$\lambda \leq \frac{15}{49}.$$

Also, two lines down the formula for $\widehat{\lambda}$ should be

$$\widehat{\lambda} = \min\left\{\frac{15}{57}, \frac{19}{28}, \frac{15}{49}\right\}.$$

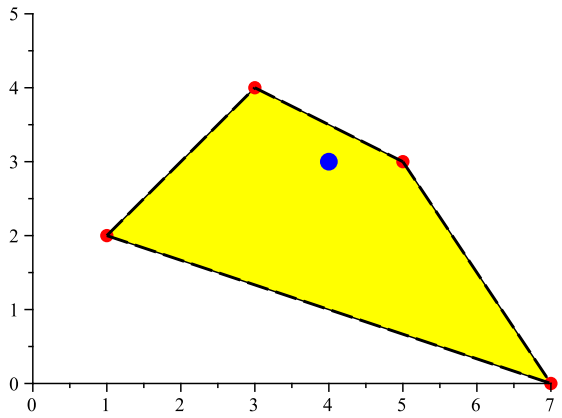
2. (pg. 216) In Example 6.14, the inequality in the last two lines includes the term

$$(x_1, y_1) \cdot (x_2, y_2) \leq \|(x_1, x_2)\| \, \|(y_1, y_2)\| .$$

This should be

$$(x_1, y_1) \cdot (x_2, y_2) \leq \|(x_1, y_1)\| \, \|(x_2, y_2)\| .$$

3. (pg. 219) Figure 6.11 is incorrect - point $(3, 3)$ is marked instead of $(4, 3)$. The correct figure is below.



4. (pg. 223) The proof of Example 6.21 is incorrect. Here is the entire correct version of Example 6.21:

Let $f(x,y) = x^2 + y^2$. If $\mathbf{w} = (w_x, w_y)$ and $\mathbf{z} = (z_x, z_y)$, then

$$\begin{aligned} f(\lambda\mathbf{w} + (1-\lambda)\mathbf{z}) &= f(\lambda w_x + (1-\lambda)z_x, \lambda w_y + (1-\lambda)z_y) \\ &= (\lambda w_x + (1-\lambda)z_x)^2 + (\lambda w_y + (1-\lambda)z_y)^2 \\ &= \lambda^2 w_x^2 + 2\lambda(1-\lambda)w_x z_x + (1-\lambda)^2 z_x^2 \\ &\quad + \lambda^2 w_y^2 + 2\lambda(1-\lambda)w_y z_y + (1-\lambda)^2 z_y^2. \end{aligned}$$

We know that $(w_x - z_x)^2 \geq 0$ (since w_x and z_x are real numbers). Expanding $(w_x - z_x)^2$ gives

$$(w_x - z_x)^2 = w_x^2 - 2w_x z_x + z_x^2,$$

which shows that

$$w_x^2 + z_x^2 \geq 2w_x z_x.$$

A similar argument shows that $w_y^2 + z_y^2 \geq 2w_y z_y$.

Thus, we get that

$$\begin{aligned} f(\lambda\mathbf{w} + (1-\lambda)\mathbf{z}) &= f(\lambda w_x + (1-\lambda)z_x, \lambda w_y + (1-\lambda)z_y) \\ &= \lambda^2 w_x^2 + 2\lambda(1-\lambda)w_x z_x + (1-\lambda)^2 z_x^2 \\ &\quad + \lambda^2 w_y^2 + 2\lambda(1-\lambda)w_y z_y + (1-\lambda)^2 z_y^2 \\ &\leq \lambda^2 w_x^2 + \lambda(1-\lambda)(w_x^2 + z_x^2) + (1-\lambda)^2 z_x^2 \\ &\quad + \lambda^2 w_y^2 + \lambda(1-\lambda)(w_y^2 + z_y^2) + (1-\lambda)^2 z_y^2 \\ &= \lambda w_x^2 + (1-\lambda)z_x^2 + \lambda w_y^2 + (1-\lambda)z_y^2 \\ &= \lambda(w_x^2 + w_y^2) + (1-\lambda)(z_x^2 + z_y^2) \\ &= \lambda f(\mathbf{w}) + (1-\lambda)f(\mathbf{z}), \end{aligned}$$

and so $f(x,y)$ is convex.

Chapter 7

1. (pg. 240) The definition of **Basic Solution** is poorly worded. The correct definition is "Solution $\mathbf{x}$ is a *basic solution* if (a) $\mathbf{x}$ satisfies all equality constraints of S and (b) at least n of the constraints of S are active at $\mathbf{x}$, of which there are n such constraints that are linearly independent."

Chapter 8

1. (pg. 315) In exercise 8.26, the **d** before the "(Hint)" on the second-to-last line should be $\mathbf{d}^{N(j)}$. (bold "d")

Chapter 10

1. (pg. 382) The first sentence Exercise 10.3 (c), "QE is willing to increase the number of hours for Production?" should end in a period ".".

2. (pg. 382) In Exercise 10.4, lines 7 and 8 in the problem, the words "rubber" and "leather" should be reversed, so that there are 160,000 square inches of leather and 150,000 square inches of rubber.

Chapter 11

1. (pg. 396), in the second-to-last line of the page the problem at the bottom of the page should have an "=" instead of "≥", so that it reads

$$\begin{bmatrix} B^T & -I & 0 \\ N^T & 0 & -I \end{bmatrix} \begin{bmatrix} \mathbf{y} \\ \mathbf{w}_B \\ \mathbf{w}_N \end{bmatrix} = \begin{bmatrix} \mathbf{c}_B \\ \mathbf{c}_N \end{bmatrix}$$

2. (pg. 398) In Algorithm 11.1, Step 1, the quotation marks around variables x_j should be removed.

3. (pg. 398) The line in Algorithm 11.1, "Step 2" should end with a right parenthesis ")" between N and "."

4. (pg. 412-413) In Example 11.9, the number in the first row, last column should be changed from "25" to "35" (the last column of numbers should be 25, 50, 40 for each of the three tables).

5. (pg. 444) The first constraint in Exercise 11.14 should have its right-hand side value be 18, not 15, i.e.

$$2x_1 + x_2 + 3x_3 + 2x_4 = 18$$

6. (pg. 445) In Exercise 11.16, Add the following last line: Let $\beta = 0.9995$.

7. (pg. 446) In Exercise 11.17, Add the following last line: Let $\beta = 0.9995$.

8. (pg. 447) In Exercise 11.20, the symbol $\overline{a}_{kj}$ should be d_j. Also, the word "nonpositive" should be "nonnegative".

Chapter 12

1. (pg 488) In Exercise 12.15, swap $x_{Det,Den}$ with $x_{Det,Cin}$ in lines 3 and 4, so that we have $x_{Det,Cin} = x_{Atl,Den} = x_{Atl,Cin} = 50$, $x_{Det,Den} = 60$, $x_{Den,LA} = x_{Den,Chi} = x_{Cin,LA} = 40$, and $x_{Den,Phi} = x_{Cin,Chi} = x_{Cin,Phi} = 30$.

Chapter 13

1. (pg. 512) In Exercise 13.3, the sense "≤" in inequality $3x + 2y \leq 3$ should be "≥", so that the inequality is $3x + 2y \geq 3$.

2. (pg. 513) In Exercise 13.11, all elements "−1" in matrix A should be "1", so that the matrix is

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

3. (pg. 513) In Exercise 13.12, the elements of row 2 in matrix A should be negated, so that the matrix is

$$A = \begin{bmatrix} 1 & 0 & 1 & -1 & -1 \\ 1 & -1 & 0 & 0 & 0 \\ 0 & -1 & -1 & 0 & 1 \end{bmatrix}$$

Chapter 14

1. (pg. 523) In Figure 14.3, the branches from subproblem $P7$ should be labeled $y \leq 4$ and $y \geq 5$, not $x \leq 4$ and $y \geq 5$ and the branches from subproblem $P11$ should be labeled $y \leq 3$ and $y \geq 4$ and not $x \leq 3$ and $y \geq 4$.

2. (pg. 551) In Exercise 14.1, the right-hand side of the second constraint should be 48 instead of 45.

3. (pg. 552) In Exercise 14.5, the constraints should all be "$\geq$" instead of "$\leq$", else the origin is the optimal solution by default.

Chapter 15

1. (pg. 561) In line 4 from the top, the number 0.0.755436 should be 0.755436.

2. (pg. 576) In Exercise 15.10, last line: parent P_2 should read $(1, 5, 2, 3, 6, 4)$ and not $(3, 5, 2, 1, 6, 4)$.

3. (pg. 576) In Exercise 15.11, the text beginning with "This generates the offspring" through the rest of the exercise should be removed.

Appendix A

1. (pg. 588) In the formula for calculating the determinant of a matrix A, the exponent of (-1) should be $i + j$ and not $i + 1$. The correct formula is

$$det(A) = \sum_{j=1}^{m} (-1)^{i+j} a_{ij}\, det(A_{ij}).$$