**Errata for Book *Operations Research Models and Methods***
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Corrections marked with a (1) superscript were added to the text after the first printing. Other corrections have not been made. Please send corrections or suggestions to one of the authors with addresses at www.ormm.net. Updated versions of the errata are maintained on the web site.

## Chapter 2

Car rental problem (page 42 – 43), the solution is not correct. The correct answer is:: M=1; W = 7, F = 4, MTuW = 2, Weekday = 2, Week = 5. The cost is 2210.

Ex. 15. The solution to the LP is not integer. There is no guarantee of integrality when the series of 1's in each column of the LP is broken by 0's. An integer solution is obtained by requiring the Solver to give integer answers. This makes the model into an integer program.

On page 36 in 3rd paragraph change "hours" to "minutes".

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## Chapter 3

Page 77 in the last of tables 3.6 (at the bottom of the page). Both "-0.5"s in the $x_4$ column should be positive.
Page 79, Table 3.7. The last basic variable should be $x_5$ not $x_1$.
Page 81, Table 3.11. The entry for $x_3$ in row 2 should be 0 rather than 1.
Page 81, Table 3.11. The entry for $x_3$ in row 2 should be 0 rather than 1.
Page 83, Table 3.12. The first two entries of row x5 should be "0 1" rather than "1 0"
Page 82, In the middle of the page the reference to Definition 4 should be to Definition 5.
Page 83, Table 3.14. The circle should be around the 0.25 in the $x_3$ column and the arrow should be pointing at the $x_3$ column not the $x_4$ column.
Page 83, Table 3.15. $x_1$ should be $x_3$.

On page 87 in the equation near the bottom use: Minimize $\hat{w}$
On page 87 in the equation near the bottom use: Minimize $\hat{w}$
On page 88 in Phase 1 of the Example use: Maximize $w = -\hat{w}$
On page 89, Table 3.22, the 0' row is not correct. The coefficients should be 7 and -3 rather than the other way.
Page 92, Table 3.25. In the Basic column, it should be $x_4$ and $x_5$, not $x_1$ and $x_2$.

On page 100 (last line) and 102, the table reference should be to Table 3.35 not Table 3.24.
Page 125, Table 4.6. Bases 2, 3, 4, and 5 have typos:
#2 should be $x_1$, $x_{s2}$, $x_{s3}$ not $x_{s1}$, $x_{s2}$, $x_{s3}$;

#3 should be $x_2$, $x_{s2}$, $x_{s3}$ not $x_{s2}$, $x_{s2}$, $x_{s3}$;
#4 should be $x_1$, $x_{s1}$, $x_{s3}$ not $x_{s1}$, $x_{s1}$, $x_{s3}$;
#5 should be $x_{s1}$, $x_2$, $x_{s3}$not $x_{s1}$, $x_{s2}$, $x_{s3}$.

Exercise 20, page 106, should be $x_j \geq 0$, not $0 \leq x_j \leq 1$. [1]

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**Chapter 4**
Ex. 11. The column in the tableau for $x_4$ should be 0,0,1, rather than 0,1,0.[1]

Ex. 13g. Change 4th to 3rd

Ex. 13k. Say that $x_3$ has an upper bound of 1.5 and $x_3$= 1.5. The problem is …[1]

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**Chapter 6**
Page 210, top of the page $\pi_4$ should equal 28 not 27.

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**Chapter 8**
page 299. In Step 3 of the algorithm, Equation 14 should be Equation 13.

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**Chapter 9**
Page322. Change any to every in Definition 5

**Definition 5**: A set $S \subseteq \Re^n$ is convex if <u>every</u> point…

Page 348: In the table in the array describing geometric programming, the word polynomial should posynomial both with respect to $f(\mathbf{x})$ and $g_i(\mathbf{x})$

Page 349: posinomial should be spelled posynomial

Exercise 11, page 353; rephrase: "Use the definition of convexity and induction to prove Lemma 1." [1]

Exercise 14, page 353; should read

"Following the suggestions in Section 9.3, prove that $f(\mathbf{x})$ is convex if and only if

$$f(\mathbf{x}_1) \geq f(\mathbf{x}_2) + \nabla^T f(\mathbf{x}_2)(\mathbf{x}_1 - \mathbf{x}_2) \text{ for all } \mathbf{x}_1, \mathbf{x}_2 \in S$$

where S is a convex set." [1]

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**Chapter 10**

Page 403; missing parenthesis in equation. Should be

$$f(\mathbf{x}) \cong q(\mathbf{x}) = \ldots$$ [1]

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**Chapter 12**

p433, line 8 change from
"One failure leads to (1,0) and two failures lead to (2,0)..."
to
"One failure leads to (1,0) and two failures lead to (1,1)..."

Ex. 26 is meaningless as written. It should be replaced with the following. [1]

26. Heart patients at a local hospital can be found in one of two places: the coronary care unit or in a regular room.

    a. If we assume that the number of heart patients remains constant and that the 1-day transition probabilities are as shown, what are the steady-state probabilities for an individual patient?

One-day transition probabilities — heart patients

| | CCU | Hospital rehabilitation | Not hospitalized |
|---|---|---|---|
| Coronary care unit (CCU) | 0.700 | 0.200 | 0.100 |
| Hospital rehabilitation | 0.050 | 0.800 | 0.150 |
| Not hospitalized | 0.015 | 0.005 | 0.980 |

    b. Assume persons leaving the hospital from the CCU actually die. For each fatality, a new heart patient enters a competing hospital. There is a 1-day probability of 0.05 that a patient leaves the competing hospital and enters the CCU. How would you change the 1-day transition matrix? Compute steady-state probabilities.

Exercise 29. In table, letter "*n*" should be italic only, not bold. [1]

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**Chapter 13**

Ex. 10.e. The expected cost vector should be: $\mathbf{C} = (1250, 1400, 900, 0)^T$. [1]

Ex. 12.a. Add to the problem statement of part a:
"The stock price is currently \$39." [1]

Ex. 13. Labels on parts d and c are switched. [1]

## Chapter 14

1. Table 14.9, in summation term, index "*K*" on $\pi$ should be lower case. [1]

2. Exercise 14, parts c, d, e: The data in the tables for "Mean Time" should be shifted to the left to line up with the column headers. [1]

3. Exercise 15, parts a and b: The data in the tables for "Mean Time" should be shifted to the left to line up with the column headers. [1]

## Chapter 16

Page 562, in table at bottom, change $\rho = \lambda/s\mu$ to $\rho = \lambda/2\mu$. Also, give second formula for $L$:

$$L = L_q + L_s = L_q + \lambda/\mu = 0.8727$$ [1]

The corrections for pages 563, 572 and 573 were suggested by R.G. Vickson, University of Waterloo.

Page 563. In the expression for $\Pr\{T_{sys} > t\}$ the term in the inner parentheses becomes indeterminate when $s - 1 - s\rho = 0$. Taking the limit of the expression in the inner parentheses we find:

$$\Pr\{T_{sys} > t\} = e^{-\mu t}\left[1 + \frac{(s\rho)^s \pi_0}{s!(1-\rho)}(\mu t)\right],\ t \geq 0 \text{ for } \rho = \frac{s-1}{s}$$

Page 572-573. The section of Finite Input Source Systems has several errors. The last sentence of the first paragraph of the section should read.

We assume arrivals balk when $n = K$ and $K \leq N$. The results of the section also hold when the maximum number in the system is equal to the population.

The expression for $q_n$ should be:

$$q_n = \frac{(N-n)\pi_n}{N - L - (N-K)\pi_K} \quad \text{for } n = 0, \ldots, K-1,$$

In Figure 16.10, the expression for $P_B$ should be:

$$P_B = \sum_{n=s}^{K} \pi_n$$

The expression for the average arrival rate should be

$$\bar{\lambda} = \lambda\left[N - L - \pi_K(N-K)\right] \text{ for } K \leq N$$

Exercise 15. Remove second occurrence of sentence “The company has two technicians who can … to effect a repair.” Also, change “affect” to “effect” in first occurrence. [1]

Exercise 17. Change the service rate to 8 customers per hour for a better problem. [1]

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**Chapter 18**
Ex. 4d use $t = 1$. [1]

Ex. 10b and c should ask for 12 replications rather than 10. [1]

Ex. 15. Add the sentence: Simulate the process of passing from system 1 to system 2 with a Bernoulli random variable. [1]

Ex. 21 should refer to Table 18.19 rather than 18.20. Note that Table 18.19 in Chapter 18 is in error as well as Appendix A1 of the simulation chapter. [1]

Table 18.19 is in error. The correct table should be: [1]

Table 18.19 Error as Function of Sample Size for Inventory Simulation

| Measures | Demand ($D$) | Lead time ($T_L$) |
|---|---|---|
| Estimated mean | 11.65 | 2.8 |
| Estimated standard deviation | 2.594 | 0.980 |
| Estimated size ($n$) for 1% error | 3290 | 8127 |
| Sample size ($n$) for 5% error | 77 | 188 |
| Sample size ($n$) for 10% error | 14 | 33 |

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**Supplement**

The discussion concerning confidence limits in the Simulation supplement distributed on the original edition student disk is in error. It is corrected on the Teach ORMM CD and on the web. The correct confidence limit discussion is below.

**Confidence Intervals**

Once $\bar{x}$ and the *standard error of the mean*, $\sigma_{\bar{x}}$, are determined, the confidence interval and maximum error for $\mu_x$ are given by

$$\mu_x = \bar{x} + z_{\alpha/2}\sigma_{\bar{x}} \qquad \text{(A.6)}$$

or

$$\mu_x = \bar{x} + t_{\alpha/2}\hat{\sigma}_{\bar{x}} \qquad \text{(A.7)}$$

as the case may be, where $\hat{\sigma}_{\overline{X}}$ is the estimated standard error when (A.5) is used in place of $\sigma_X^2$ in (A.3) or (A.4). For A.7, the value of $t_{\alpha/2}$ depends on the number of degrees of freedom, *df*, where *df* $= n - 1$. If $\sigma_X$ is known, then the maximum error $\varepsilon$ for a given level of confidence can be found from

$$\varepsilon = z_{\alpha/2}\sigma_{\bar{x}} \text{ or } z_{\alpha/2}\sigma_x / \sqrt{n}$$

when (A.3) applies. It follows that

$$n = \left(\frac{z_{\alpha/2}\sigma_X}{\varepsilon}\right)^2 \tag{A.8}$$

provides the required sample size which satisfies a given maximum error and confidence level.

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**Error in Probability Supplement**

Page 24

*The c.d.f. of the Triangular Distribution*

$$F(x) = \begin{cases} 0 \text{ for } x \le 0 \\ \dfrac{x^2}{c} \text{ for } 0 < x \le c \\ \dfrac{x(2-x)-c}{(1-c)} \text{ for } c \le x < 1 \\ 1 \text{ for } x > 1 \end{cases}.$$

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