Spreadsheet Modeling & Decision Analysis, 8ed
Cliff T. Ragsdale

Check figures for selected problems.

Chapter 2

6. Optimal objective value = 52
7. Optimal objective value = 40
8. Optimal objective value = 125
9. Optimal objective value = 260
10. Optimal objective value = 10.55
11. Optimal objective value = does not exist
12. Optimal objective value = 154
13. Optimal objective value = 6900
14. Optimal objective value = 2014
15. Optimal objective value = 132000
16. Optimal objective value = 32500
17. Optimal objective value = 28000
18. Optimal objective value = 0.75
19. Optimal objective value = 3.5 million
20. Optimal objective value = 775
21. Optimal objective value = 3480
22. Optimal objective value = 33600
23. Optimal objective value = 59300
24. Optimal objective value = 26740
25. Optimal objective value = 26000
26. Optimal objective value = 90000

Chapter 3

3. Maximum profit = $28,000
4. Maximum profit = $32,500
5. Maximum profit = $132,000
6. Maximum profit = $28,000
7. Minimal cost = $3.5 million
8. Maximum profit = $33,600
9. Maximum profit = $59,300
10. Maximum profit = $26,740
11. Maximum profit = $26,000
12. Maximum profit = $90,000 (alternate optimal solutions exist)
13. c. Minimum cost = $2,975,000
14. c. Maximum revenue = $220,290
15. c. Maximum profit = $60,400
16. c. Minimum cost = $79.25
17. c. Maximum profit = $6,925
18. c. Minimum cost = $5.85
19. b. Maximum return = 10.25%
20. c. Maximum revenue = $444,000
21. c. Total Profit = $215,000
22. c. Maximum return = $8,898 (or 8.898%)
23. c. Minimum transportation cost = $730
24. c. Maximum profit = $2,913.2
25. c. Maximum new customers = 113,500

26. c. Total leasing cost = $7 million
27. c. Minimum cost = $1,049 (in $1,000s)
28. c. Profit = $1,526,500
29. c. Maximum Profit = $5,012.5 (in $1,000s)
30. c. Minimum number of employees = 640
31. c. Minimum processing time = 1258.33 minutes.
32. c. Maximum steam production = 32,174 pounds per ton
33. c. Maximum profit = $1,007,750
34. c. Total cost = $16,625
35. b. Minimum cost = $3,011,360
36. c. Minimum cost = $44,067.67
37. c. Maximum profit = $241,750
38. c. Profit = $669,000
39. c. Minimum cost = $83,617
40. c. Maximum profit = $29,100
41. b. Total investment = $246,769
42. c. Maximum amount of money at the beginning of year 1 = $1,449,606
43. c. Minimum investment = $38,149
44. c. Minimum investment = $38,647
45. b. Total Profit = $1,309,900
46. c. Minimum cost = $92,800
47. Among other things, defer $3,010 in payments in March
48. b. Total Finance Charge = $22,878.
49. b. Branches 1, 2, 6 & 8 are efficient
50. b. Sheritown Inn, Merrylot, FairPrice Inn, Johnson Loward's, Sleep Well Inns, and Western Hotels are efficient.

Chapter 4

3. c. 4.67
   d. 15.33.
4. a. Constraint 2 is binding.
   d. It can decrease by any amount without changing the solution.

5. a. 0
   b. The new objective would be unbounded.
   6. d. No.
   h. Every additional ton of concentrate unit shipped from Eustis to Miami would increase costs by $50.

7. c. $225
8. a. No.
9. b. The profit per acre of cantaloupes would have to increase by $99.50.
10. d. $350*20=$7000.
11. a. No.
    e. Yes.
12 b. The solution would not change.
   f. Every 100 unit increase in production capacity results in 250 more gas trimmer being made instead of bought.
13. a. No.
    b. Yes.
14. d. Yes, the allowable increase on the profit coefficient for pallets of Aspen panels is $7.14, so the solution would change.
15. b. Yes.
16. a. No.
17. a. No.
18 c. Yes. Profits would increase by $7×1,000=$7,000.

19. b. Location 6.
20. c. $31.
21. a. $1,526.5
22. c. Regular octane rating = 90.0, supreme octane rating = 102.11.
23. c. $424
24. b. Macon. Each additional unit of capacity there increases costs by $36.45 (which is the cheapest way to increase capacity).
    e. $1 extra.
25. b. Yes.
    f. $1.87.
26. c. $0.
27. b. $0.
28. f. $X_1 = 5,\ X_2 = 0$
29. f. There are alternate optimal solutions. One is given by $X_1 = 2,\ X_2 = 5,\ S_3 = 5$.
30. b. $\{X_1, X_2\}, \{X_1, X_3\}, \{X_1, S_1\}, \{X_1, S_2\}, \{X_2, X_3\},$ $\{X_2, S_1\}, \{X_2, S_2\}, \{X_3, S_1\}, \{X_3, S_2\}, \{S_1, S_2\}$
31. b. i. S=4
32. b. i. S=3

Chapter 5

3. a. Total cost = $3,398
6. This is a transportation problem.
7. The cost on each arc increases by $2,000.
8. b. 310 feet.
9. c. Total Cost = $83,565.
10. Optimal sum of assigned rankings = 23
11. c. Total Cost = $1,006,675
12. c. Total Cost = $220,050
13. b. Minimum total cost of $67,825.
14. c. Minimum total cost of $62.
15. c. Total Profit = $12,750
16. c. Total Cost = $21,000
17. b. Minimum total cost of $2,700.
18. Maximal flow = 24 tons of sewage per hour.
19. c. Minimum total cost = $285
20. Minimum total cost = $455
21. c. Total cost = $1,875
22. c. Total Cost = $25.43 million
23. c. Total layover hours = 15, longest layover time = 7 hours.
24. b. Total distance = 1863
25. c. Total cash required = $273,658
26. c. The system can handle 1,625,000 calls
27. c. The maximum flow is 55 tons.
28. Minimum cost = $125 million
29. b. 7,000,000 packets per minute
30. c. Total cost: $20,150.
31. Maximum flow = 500 bags per minute.
32. Minimum cost = $8 million
33. Total cost = $270
34. b. Total cost = $2,350

Chapter 6

5. b. Total NPV = $573,000.
8. c. Profit = $869
9. c. Minimum Cost = $3,150
10. d. 3
11. a. $332,129
12. c. Total cost = $2,512
13. c. Total cost = $1,475,000
14. c. Total Cost = $3,115,000
15. c. Minimum total cost = $1,475,000
16. b. Expected NPV: $24,322,000
17. c. Total cost = $42,300
18. c. Total Cash Received $275,000
19. c. Total NPV = $1,925,000
20. c Minimum trucking cost = $1,016.
21. c. Maximum monthly rental income = $23,200
22. c. Total boards cut = 2167 (other solutions exist)
23. c. Minimum cost = $242,000
24. c Total cost = $7,425,000.
25. c. Total cost = $7,800,000.
26. b. Total cost = $7,376,000.
27. c. Total cost = $421
28. c. Total cost = $31,671.
29. c. Minimum shortage = 300 gallons
30. c. Maximum amount of money at the beginning of year 1 = $197,925
31. c. Total cost = $82,290
32. c. Minimum total cost = $1,565.
33. c. Minimum total cost = $715,000.
34. b. Build Red Snappers at sites 4, 8 & 9. Build Olive Groves at sites 1, 6 & 10. NPV=$105.8.
35. c. Profit = $545,444.
36. b. Profit = $377 thousand.
37. c. A total of 153,000 people can be reached within 4 minutes.
38. b. Maximum pieces processed in any week: 353,856
39. b. Total cost = $855,000
40. b. Total cost = $22,200
41. b. Total cost = $119 million.
42. a. Total hubs = 8, Total coverage = 55.

Chapter 7

5. d. None.
6. b. $d_1^- = 2$, $d_1^+ = 0$
7. c. $X_1 = 8.57$ and $X_2 = 0.857$
9. c. Wythe = 3.33, Giles = 3.67, Maximum excess = 6.667
10. b. Obj =0.96
11. b. Minimum objective value = 2
12. c. Aqua-Spas = 61, Hydro-Luxes = 134
13. b. Min cost = $0.865 per pound, Min Fat Content = 5%
14. c. The solution is: $X_1=37$, $X_2=5$, Q = 11.67%.
15. b. Maximum Deviation = 13.53%
16. d. Primetime=1, Soaps=8, News=1
17. b. Sulfur 1100, Coal dust 1.7, Steam 32,174

18. c. Robo-I = 2, Robo-II = 5, Robo-III = 8
19. b. Total Cost = $3470
20. a. Environmental impact score = 407
21. c. The solution is: X_1= 3, X_2= 4, X_3= 1, Minimax percentage deviation = 7.8%.
22. b. Best possible value for objective 1 = 1965, Best possible value for objective 2 = 67.4%
23. b. E=10, N=5
24. c. Max Deviation = 1.97%
25. c. Maximum deviation = 0.8571
26. b. Optimal solution: S = 6 , A= 6
27. b. Build towers in areas 8, 11, 19 & 22; Profit = $377 thousand.
28. b. A = 18,055.70, B = -0.1266
29. A = 13,368.36, B = -0.1429
30. The optimal solution is: X_{2A}= X_{2B} = X_{1C} = X_{2D} = X_{1E} = 1, d=14

Chapter 8

7. c. Profit = $2,648.78
8. Profit $129,096.
9. c. Maximum profit = $1,668.8 (in $000s)
10. c. X=8.0372, Y=6.0545
11. a. Minimize r . This is a linear objective.
12. b. This model is linear.
13. Yield = 12.51%
14. b. $7,693
15. b. Minimal team handicap variance = 0.2778
16. a. Distance = 1862 miles.
17. c. Portfolio variance = 3.965
18. c. Model 1 = 34, Model 2 = 14, Model 3 = 32
19. a. Q=1000, Cost = $48,855
20. a. Maximum rating = 115.5.
21. c. Aqua-Spas = $1,282, Hydro-Luxes = $1,433
22. c. Maximum profit = $84.52
23. a. Minimum return ≈ 16.6%
24. a. Minimum rate of return ≈ 16.6%
25. a. 399.22 miles of pipe would be needed.
26. c. X = 11.97, Y = 35.36, Total shipping miles = 8079.27
27. b. The solution is: X=35, Y=57
28. c. Total cost = $887,123
29. b. Prob. of receiving all donations = 0.15396
30. c. Probability of no failure = 0.96
31. b. Distance = 25.486
32. a. Variance = 0.00947
33. a. Variance=0.00088, Return=10.68%.
34. Windsor = 20.7%, Flagship = 33.6%, Templeman = 10.6%, T-Bills = 35.1%
35. b. Expected earnings = $952
36. b. This generates $952 in expected earnings.
37. b. 3 mortgage packages of at least $1 million can be created.
38. a. Max lateness = 30.
39. c. Tour length = 122.8.
40. b. Tour length = 7,289.6
41. a. Total distance = 250.60 (better solutions may exist).
42. b. 97 out of 127 or 76%

Chapter 9

6. c. R^2=0.849.
7. c. R^2=0.922.
8. d. A t-top adds approximately $2886 to the re-sale value of the car.
9. a. The relation between mileage and price seems to be fairly linear while the relationship between model year and price appears to be quadratic.
10. d. Adjusted R^2 =0.997.
11. c. X_3 & X_2
12. c. The R^2 statistic indicates that approximately 96.6% of the total variation in the % of O-ring expansion is accounted for by temperature.
13. b. R^2 = 0.817.
14. d. R^2 = 0.9837.
15. b. R^2 = 0.778.
    d. R^2 = 0.972.
16. d. 90.961
17. b. $R_a^2 = 0.895$; but not a good fit
18. c. R^2 = 0.0502.
    f. R^2 = 0.774.
19. b. R^2 = 0.769
20. c. Adjusted R^2 =0.672.
21. d. About 7346 pounds of EO.
22. b. Adjusted R^2 =0.8299.
23. b. Years of service. R^2 = 0.737.
24. c. Attic insulation and square footage.
25. a. b_0 = 6.030, b_1 = 0.170
26. a. b_0 = 4.591, b_1 = 0.191

Chapter 10

7. a.

	Centroids	
Group	**GPA**	**GMAT**
1	3.19	598.23
2	2.68	527.06

8. a.

	Centroids		
Group	**Calavarite**	**Sylvanite**	**Petzite**
1	0.0548	0.0634	0.0373
2	0.0385	0.0466	0.0312

9. a.

	Centroid		
Group	**Liquidity**	**Profitability**	**Activity**
1	0.848	0.249	1.505
2	0.707	0.200	1.376

10. b. Among the rules with a minimum lift ratio of 2, a paint product appears as an antecedent in all (4) rules leading to a tools product consequent. The same is true of the (2) rules leading to a plumbing product consequent.

11. e. Results will very depending on the distance metric used; but using Ward's method, the number of observations in groups 1, 2, 3, and 4 are 68, 137, 78, and 24, respectively.

Chapter 11

3. b. Forecast for September = 38.5 + 0.25(32 - 38.5) =36.875
4. Non-stationary.
5. c.

Forecasts	2-Period	4-Period
21	542.0	533.8
22	547.0	536.4

6. c. Forecast for year 21 = 1×552 + 0×532 + 0×528 = 552
   Forecast for year 22 = 1×552 + 0×552 + 0×532 = 552
7. b. Forecast for year 21 = 553.56 + 1×13.21 = 566.77
   Forecast for year 22 = 553.56 + 2×13.21 = 579.98
8. c. Forecast for year 21 = 532 + 1 (552-532) = 552
   Forecast for year 22 = 552 + 1 (552-552) = 552
9. c. Forecast for year 21 = 552 + 1×11.42 = 563.42
   Forecast for year 22 = 552 + 2×11.42 = 574.84
10. d. Forecast for year 21 = 312.1 + 12.228×21 = 568.90
    Forecast for year 22 = 312.1 + 12.228×22 = 581.13
11. Nonstationary.
12. b. Forecast for year 14 = 172250 + 1×8500 = 180750
    Forecast for year 15 = 172250 + 2×8500 = 189250
13. b. Forecast for year 14 = 185266 + 1×8699 = 193965
    Forecast for year 15 = 185266 + 2×8699 = 202665
14. b. Approximately 95.6% of the total variation in price is accounted for by the model.
15. b. $R^2 = .8406$
16. d.

Mo	Forecast
35	48618.7

17. d.

Mo	Forecast
36	40845.4

18. d.

Mo	Forecast
37	43029.9

19. d.

Mo	Forecast
38	55797.6

20. d.

Mo	Forecast
39	54666.8

21. d.

Mo	Forecast
40	53118.6

22. b. Approximately 54.8% of the total variation in the number of units sold is being accounted for by this
e.

Seasonal Index	
1	84.2%
2	92.3%
3	126.8%
4	96.8%

23. a. $\hat{Y} = 23.45 + 1.498t + 0.0364t^2$
b. The adjusted-R^2 statistic is 0.450.
e.

Seasonal Index	
1	83.8%
2	92.3%
3	127.1%
4	96.9%

24. c. Forecast for quarter 1 = 41.9-4.37 = 37.5
Forecast for quarter 2 = 41.9+0.56 = 42.5
Forecast for quarter 3 = 41.9+11.23 = 53.1
Forecast for quarter 4 = 41.9+1.10 = 43.0
25. a. α=0.5885, β=0.2904
26. a. α = 0.114, β = 1.0
27. a. α = 0.222, β = 1.0, γ=0.675
28. a. α = 0.330, β = 0.280, γ = 0.533
29. a. $\hat{Y} = 23.17 + 1.68t - 4.94X_2 - 1.63X_3 + 10.68X_4$
where: X_2 = 1 in Qtr 1, and 0 otherwise
X_3 = 1 in Qtr 2, and 0 otherwise
X_4 = 1 in Qtr 3, and 0 otherwise
b. Approximately 94.2% of the total variation in the number of units sold is accounted for by this model.
30. The data appear to be non-stationary.
31. b.

	2-Period	4-Period
MSE:	5.73	6.38

32. a. w_1 = 0.789, w_2 = 0.015, w_3 = 0.091, w_4 = 0.105
33. c. Forecast for week 23 = 174.7 + 0.678×(175-174.7) = 174.9
Forecast for week 24 = 174.9 + 0.678×(174.9-174.9) = 174.9
34. a. α = 0.678, β = 0.
35. b. Approximately 50.6% of the total variation in sales is accounted for by the model.
36. b. The adjusted-R^2 for this model is 45.9%. This is lower than the adjusted-R^2 for the linear trend model, suggesting that the quadratic term is unnecessary.
37. a. α = 1.00, β =0.0058
387.a. α = 0.179, β =0.3569, γ=0.5
39. a. α = 0.13, β =0.3099, γ = 0.5
40. Nonstationary.
41. b.

Month	Period	Forecast
Nov	95	143164.31
Dec	96	143289.44
Jan	97	143414.56
Feb	98	143539.69

42. a. α = 0.6517, β =0.091
43. b. The R^2 for this model is 97.5%.
f. The adjusted-R^2 for this model is 99.1%.

44. Nonstationary.
45. b. 2-Period MSE = 0.0458, 4-Period MSE = 0.0843
46. a. MSE = 0.0315
47. a. $\alpha = 1$, MSE = 0.03472
48. a. MSE = 0.06758
49. a. MSE = 0.03515
50. b.

Period	Month	Forecast
83	11	6.36
84	12	6.36

51. The data appear to be fairly stationary
52. a. MSE = 21757.5
53. a. MSE = 16201.1
54. a. MSE = 21757.5
55. a. MSE = 15733.9
56. The data appear to be fairly stationary.
57. a. MSE = 0.05432
58. a. MSE = 0.05434
59. a. MSE = 0.5432
60. a. MSE = 0.5434
61. There is slight upward trend in the data over time.
62. a. MSE = 997.967
63. a. MSE = 832.519
64. a. MSE = 912.868
65. a. MSE = 723.177

Chapter 12

3. b. Approximately $3,200,000
4. A reorder point of around 40 and an order quantity of 33 seems to provide the maximum monthly net profit for this item.
5. b. About 67% of the time
6. b. About $26,500 may be withdrawn.
7. b. Reorder point should be about 45,000.
8. a. About 0.0335
9. a. Mean = 900, Std Dev = 11.19, P(<920) = 0.9641
10. b. About 0.125
11. b. About $12,535
12. b. 7, Expected revenue ≈ $128,500
13. b. min $4,390, max $8,190
14. c. About 13.4%
15. b. Expected profit ≈ $3,267
16. a. Approximately $8,374,000
17. a. Average $20,819,912
18. a Approximately 107 reservations should be accepted.
19. c. Probability of investment being worth more than $1,000,000 ≈ 0.11
20. a. Greg should deposit about $1,500 per year in his flexible spending account.
21. b. Expected NPV ≈ $2.0 million
22. b. Average donation per answered door ≈ $11.87
23. a. Average total cost ≈ $399,827
24. c. Probability of making at least $12,000 net profit in each of the next 5 years ≈ 0.612

25. a. About $9.15.
26. a. About $2,407,000
27. d. ≈ -$144,540
28. a. The optimal expected profit is approximately $9.31.
29. d. Probability of total weekly claims exceeding $20,000 ≈ 0.15
30. b. ≈ $991,000
31. b. Probability of selling at least 10 cars ≈ 0.29
32. a. Average weekly revenue ≈ $2,466
33. b. 8 employees should be scheduled.
34. b. About $9.90
35. c. About $7.12
36 b. Expected return = 14.52%, St dev = 4.96%

Windsor	45%
Columbus	29%
Vanguard	26%
Integrity	0%
Nottingham	0%

37. a. Approximately $291,000
38. b. Approximately 0.845
39. The company should accrue about $39.5 million.

Chapter 13

5. c. 30 minutes
6. d. P(x>3)=1-P(x≤3) = 1-0.00674-0.03369-0.08422-0.14037 = 0.73497
7. a. Expected service time = 1/40 = 0.025 hours (or 1.5 minutes)
8. c. 2.25
   d. 0.1 hours or 6 minutes
9. a. Average wait time is 49.02 minutes, Average number waiting is 7.3535

10. With 3 servers the average waiting time is 0.3057 hours or 18.34 minutes.
11. c. A crew size of 2 results in the lowest hourly cost for this operation.
12. b. Arrival rate = 1/2 per minute
13. a. 40 minutes
14. b. $w-w_q$ = 0.1002-0.0585=0.0417 hours or 2.502 minutes
15. b. 0.2667 hours or 16 minutes
16. a. 50/4=12.5 arrivals per minute per chute
17. b. 0.059 hours or 3.54 minutes
18. c. 0.0408 hours or approximately 2.45 minutes
19. a. 56 minutes
20. a. 14 (arrival rate) × 0.1393 (prob of balk) × $55 (profit margin) = $107.26 per hour
21. d. 6.625 days
22. a. 0.0486
23. b. 2.5 minutes
24. a. 45.3%
25. c. 0.394 hours or approximately 23.6 minutes
27. a. 16.099

Chapter 14

4. g. .005*30,000 = $150
5. a. Large order
   b. Medium order
6. e. Order 15

g. $2.59
7. b. Plan III
8. b. Self-Insure
f. Self-Insure..
9. a Large development
c. Medium development
10. b. $434,750
11. b. Building a small development provides the greatest expected utility.
12. a. 0.983181
13. b. This decision rule results in a tie.
f. Buy now.
14. P(HD | Pos EKG)=0.667.
15. P(OM|~A) = 0.5024
17. c. $5.355.
18. c. $5.3603.
19. b. Bid $7 million, EMV = $9.48 million
20. b. Bid $1.45 million
21. b. Option 2 should be selected
22. b. Option 2 should be selected. Estimated NPV of interest payments = $127,871.
23. P(Credit Denied | Bad Credit Risk) = 0.165/0.2 = 0.825.
24. b. 0.70
25. b. 0.600
26. b. 0.70
27. EMV of during renovation = -122.1
28. Answers will vary.
29. c. Location 1 has the highest weighted score
30. c. Sedan 2 has the highest weighted score
31. b. Yes
32. c. Select model Y

Chapter 15

5. d. 18 time periods
6. d. 15 time periods
7. c. Critical Path: A→B→D→G→H
8. 28 days
9. Total Crash Cost $246
10. c. 53 days
11. c. 26 weeks
12. c. 23 weeks
13. c. 27 days
14. Finish time: 21, Total Crash Cost: $1,900
15. c. Expected Time = 10.17
Expected Variance = 0.50
16. c. Approximately 70.33% of the customers would receive the coupon.
17. c. 39 days.
18. b. Expected length= 40.5 days, Variance = 5.75 days.
19. b. ~ 43 days
20. c. 59 days
21. a. 49 days, $34,500
22. d. 0.00124
23. b. 61.9 days
24. b. 22 days.
25. d. Average finish time: 352.54 days
26. e. 252 days, Cost = $3,166.20