

APPENDIX A Answers to Selected Problems

Chapter 2: Competitiveness, Strategy, and Productivity

- Last week: Labor productivity = 37.5 bookcases per worker.
Week before: Labor productivity = 40 bookcases per worker.
- A crew size of two had the highest productivity (250 yards installed).
- Week 1: 5.62.
Week 2: 5.45.
Week 3: 5.20.
Week 4: 5.01.
- a. Before: Labor productivity = 16 carts per worker per hour.
After: Labor productivity = 21 carts per worker per hour.
b. Before: Multifactor productivity = .89 cart per dollar.
After: Multifactor productivity = .93 cart per dollar.
- 11.1%.
- 4.3%.

Chapter 3: Forecasting

- a. blueberry = 33, cinnamon = 35, cupcakes = 47.
b. Demand did not exceed supply.
- b. (1) 20.86, (2) 19, (3) 19.26, (4) 20, (5) 20.4.
- a. 88.16 percent.
b. 88.54 percent.
- a. 22. b. 20.75. c. 20.72.
- a. Increasing by 15,000 bottles per year.
b. 320 (i.e., 320,000 bottles).
- 500 - 20t.
- a. $F_t = 208.48 + 19.06t$. b. 588.40 c. Week 32.
- a. $F_t = 195.47 + 7.00t$. b. 307.22.
 $F_{16} = 307.47$ $F_{18} = 321.47$
 $F_{17} = 314.14$ $F_{19} = 328.47$
- $Q_1: 157.85; Q_2: 175; Q_3: 126.3; Q_4: 325; Q_5 = 322.85$.
- Fri. = 0.79, Sat. = 1.34, Sun. = 0.87.

15. Day Relative

1	.902
2	.836
3	.919
4	1.034
5	1.416
6	1.487
7	.427

- b. Jan. 800
Feb. 810
Mar. 900
Apr. 810
- b. \$147,000.
- b. \$17.90.

- b. -0.985.
- b. $Y = 66.33 + .584x$. c. 90.27.
- a. $r = +.96$. b. $Y = -0.672 + 6.158x$.
c. About 12 mowers.
- a. $MAD_5 = 5$ b. $\bar{TS}_5 = 1.40$
 $MAD_6 = 5.9$ $TS_6 = -0.17$
 $MAD_7 = 4.73$ $TS_7 = -0.63$
 $MAD_8 = 3.911$ $TS_8 = -0.26$
 $MAD_9 = 4.238$ $TS_9 = -1.42$
etc. etc.

28. a.	MSE	MAD	b. MAPE ₁ = .36%
Forecast 1	10.44	2.8	MAPE ₂ = .46%
Forecast 2	42.44	3.6	
Naive	156	10.7	

- a. Initial MAD = 4.727. The tracking signal for month 15 is 4.087, so at that point, the forecast would be suspect.
b. $\Sigma \text{ errors} = -1$, $\Sigma \text{ errors}^2 = 345$. Control limits: 0 ± 12.38 (in limits). Plot reveals cycles in errors.

Chapter 4 Supplement: Reliability

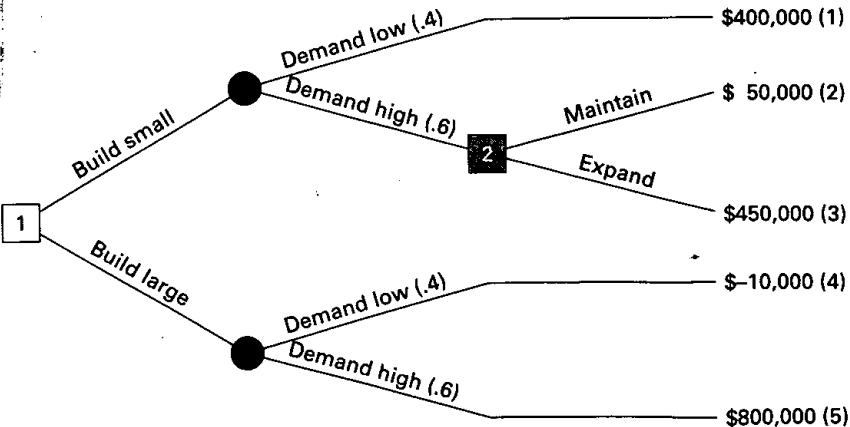
- a. .81. b. .9801. c. .9783.
- .9033.
- .9726.
- .93.
- a. .9315. b. .9953. c. .994.
- a. .7876. b. .90 component.
- a. Plan 2 (.9934).
- a. .984. b. .991.
- a. .996.
- .995
- .006.
- a. (1) .2725. b. (1) .6671.
(2) .2019. (2) .3935.
(3) .1353. (3) .1813.
c. (1) 21 months. (3) 90 months.
(2) 57 months. (4) 138 months.
- a. .6321. b. Three months or 90 days.
- a. .3012. b. .1813. c. .5175.
- a. .2231. b. .8647.
c. .0878. d. .0302.
- a. .2266. b. .4400. c. .3830.
- a. (1) .9772. b. Approximately zero.
(2) .5000.
(3) .0013.
- a. .93. b. .98.
- .96.

Chapter 5: Strategic Capacity Planning for Products and Services

1. a. Utilization = 70%.
Efficiency = 87.5%.
b. Utilization = 67%.
Efficiency = 80%.
2. 20 jobs per week.
3. a. 46,000 units. b. (1) \$3,000.
(2) \$8,200.
c. 126,000 units. d. 25,556 units.
4. a. A: 8,000 units. b. 10,000 units.
B: 7,500 units.
c. A: \$20,000.
B: \$18,000.
5. a. 39,683 units. b. \$1.71 (rounded up).
6. a. A: \$82.
B: \$92.
C: \$100.
c. A: 0 to less than 178.
B: Never.
C: 178+.
d. 1/3 day, 2/3 evening.
7. Vendor best for $Q < 63,333$. For larger quantities, produce in-house at \$4 per unit.
8. a. Vendor B best for 10,000 and 20,000.
9. 3 cells.
10. a. Buy 2 Bs. b. Buy 2 Bs.
11. a. one: $Q = 80$. two: $Q = 152$.
12. One line.

Chapter 5 Supplement: Decision Theory

1. a. Expand (80).
b. Do nothing (50).
c. Indifferent between do nothing and subcontract (55).
d. Subcontract (10).
2. a. Expand (62).
c. \$9 (000).
3. Do nothing: $P(\text{high}) < .50$.
Subcontract: $.50 < P(\text{high}) < .67$.
Expand: $P(\text{high}) > .67$.
4. a.



- b. \$164,000.
- c. Large 0 to .46.
Small .46 to 1.00.
5. Subcontract: \$1.23.
Expand: \$1.57.
Build: \$1.35.
6. a. Relocate.
b. Renew.
c. Relocate.
d. Relocate.
7. a. Renew.
b. EVPI = \$1,575,000.
c. Yes.
9. b. Build large: \$53.6 million.
Build small: \$42 million.
c. \$12.4.
d. Build small for $P(\text{high}) < .721$.
Build large for $P(\text{high}) > .721$.
10. Buy two (\$113.5).
11. A: 49.
B: 46.
13. a. New staff.
b. Redesign.
c. New staff.
d. New staff or redesign.
16. b. Alternative C.
c. $P(2) > .625$.
d. $P(1) < .375$.
17. b. Alternative B.
c. $P(2) < .444$.
d. $P(1) > .556$.

Chapter 6: Process Selection and Facility Layout

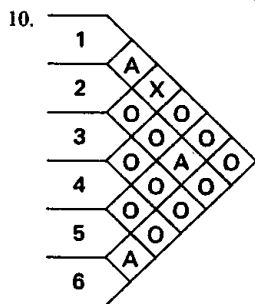
1. a. Minimum is 2.4 minutes, maximum is 18 minutes.
b. 25 units to 187.5 units. c. Eight.
d. 3.6 minutes. e. (1) 50 units.
(2) 30 units.

2. a. Station	Tasks	Time
1	a	1.4
2	b, e	1.3
3	d, c, f	1.8
4	g, h	1.5

3. a. Station	Tasks	Time
1	f, a, g	14
2	d, b, c	13
3	e, h	13
4	i	5

4. a. (3) 11.54%. (4) 323 units per day.
b. (1) 12.3 minutes. (3) 182.6 units per day.
(4) 91.3 units per day.
5. b. 2 minutes. c. Three stations.
6. c. (1) 11.1%. (2) 11.1%. (3) 11.1%.
7. b. CT = .84 min. or 50.4 sec.

c. $n = 3.83$ (round to 4) stations.



11.

1	5	4
3	8	7
6	2	

13.

3	1	8
9	7	4
5	2	6

14.

A	B	C
#1	#4	#2
	D	
	#3	

TC = \$14,150.

16. A: 3; B: 5; C: 1; D: 4; E: 6; F: 2.

17. A: 1; B: 2; C: 5; D: 4; E: 9; F: 8; G: 6; H: 10; I: 7; J: 3.

Chapter 6 Supplement: Linear Programming

1. a. (1) $x_1 = 2, x_2 = 9, Z = 35$.
 (2) No.
 (3) No.
 (4) No.
- b. (1) $x_1 = 1.5, x_2 = 6.25, Z = 65.6$.
 (2) No.
 (3) Yes, S has surplus of 15.
 (4) No.
- c. (1) $A = 24, B = 20, Z = \$204$.
 (2) Yes. Labor, 420 hr.
 (3) No.
 (4) No.
2. a. $S = 8, T = 20, Z = \$58.40$.
 b. (1) $x_1 = 4.2, x_2 = 1.6, Z = 13.2$.
 (2) Yes. $E = 4.6$.
 (3) No.
 (4) No.

3. $H = 132$ units, $W = 36$ units, Profit = \$6,360.
4. Deluxe = 90 bags, Standard = 60 bags, Profit = \$243.
5. 500 apple, 200 grape, Revenue = \$990. Fifty cups of sugar will be unused.
7. a. $x_1 = 4, x_2 = 0, x_3 = 18$.
 $S_1 = 3, S_2 = 0, S_3 = 0$.
 $Z = 106$.
 b. $x_1 = 15, x_2 = 10, x_3 = 0$.
 $s_1 = 0, s_2 = 0, s_3 = 5$.
 $Z = 210$.
9. $A = 0, B = 80, C = 50$.
 $Z = 350$.
 C_A (insignificance): \$0 to \$3.04.
 C_B (optimality): \$1.95 to \$3.75.
 C_C (optimality): \$2.00 to \$5.00.
11. a. board = 0, holder = 50.
 b. Cutting = 16 minutes, gluing = 0 minutes, finishing = 210 minutes.
12. a. Ham = 37.14, deli = 18, cost = \$165.42.
 b. Ham = 20, deli = 84, profit = \$376.
14. $Z = \$433$.
15. a. Machine and materials are binding.
 b. No change.
 c. No change.
 d. Only s_2 would change. It would be 46.
 e. None.
 f. Yes; \$844.
16. a. \$1.50; range is 510 to 750.
 b. \$1.50/pound.
 c. \$0; range 375 to infinity.
 d. None.
 e. 150 pounds of pine bark.
 f. Optimal quantities would not change; Z would increase by \$75.
 g. Yes, \$1,155.
 h. Yes, \$1,110.

Chapter 7: Design of Work Systems

1. 15.08 minutes.
2. a. 1.2 minutes.
 b. 1.14 minutes.
 c. 1.27 minutes.
3.

Element	OT	NT	ST
1	0.46	0.414	0.476
2	1.505	1.280	1.472
3	0.83	0.913	1.050
4	1.16	1.160	1.334
4.

Element	Average
1	4.1
2	1.5
3	3.3
4	2.8
7. 5.85 minutes.
8. 7.125 minutes.

10. 57 observations.
11. 37 cycles.
12. a. 12%. b. 163 observations.
13. 377 observations.

Chapter 7 Supplement: Learning Curves

1. a. 178.8 hours.
b. 1,121.4 hours.
c. 2,914.8 hours.
2. a. 41.47 hours.
b. 60.55 hours.
c. 72.20 hours.
3. a. 56.928 days.
b. 42.288 days.
c. 37.512 days.
5. a. $P = 85$ percent.
b. 26.21 minutes.
6. 87.9 minutes.
7. 201.26 hours.
8. a. 11.35 hours.
b. 13.05 hours.
c. 13.12 hours.
9. a. \$80.31.
b. 10 units.
10. B and C.
12. 30.82 hours.
13. No.
14. 18.76 hours.
15. Art: 20; Sherry: 4; Dave: 10.
16. 7 repetitions.
17. Beverly: 6; Max: 22; Antonio: 4.

Chapter 8: Location Planning and Analysis

1. Kansas City: \$256,000.
2. a. A: 16,854; B: 17,416; C: 17,753.
b. C: \$14,670.
3. a. 120 units. b. A: 0 to 119; B: 121+.
4. a. B: 0 to 33; C: 34 to 400; A: 400+.
5. C (\$270,000).
6. Biloxi (\$160,000).
7. a. (1) outside; (2) city. b. 230 cars.
9. A.
10. a. $B = C > A$.
b. $B > C > A$.
11. (5,4) is optimal.
12. (6,7).
13. (6,6).
14. (3,2,21).

Chapter 8 Supplement: The Transportation Model

1. $X_{12} = 15$ $X_{13} = 75$
 $X_{21} = 105$
 $X_{31} = 45$ $X_{32} = 60$
TC = \$1,050

2.

	A	B	C	Dummy
1		500		
2	400			
N1		100	350	50

	A	B	C	Dummy
1		500		
2	400			
N2		100	350	50

3.

	A	B	C
1			210
2	140		
3	80	60	10
Tol.		160	

	A	B	C
1			210
2	60	80	
3		140	10
Cin.	160		

Chapter 9: Management of Quality

2.

	Res.	Com.
Noisy	10	3
Failed	7	2
Odor	5	7
Warm	3	4

Chapter 10: Quality Control

1. a. .0124. b. 24.40 ounces and 24.60 ounces.
2. a. LCL: 0.996 liter. b. Not in control.
UCL: 1.004 liters.
3. a. Mean: LCL is 3.019, UCL is 3.181.
Range: LCL is 0.1845, UCL is 0.7155.
b. Yes.
4. Mean: LCL is 78.88 cm.
UCL is 81.04 cm.
Range: LCL is 0 cm.
UCL is 3.95 cm.
Process in control.

5. a.

1	2	3	4
.020	.010	.025	.045
- b. 2.5 percent.
- c. Mean = .025, standard deviation = .011.
- d. LCL = .0011, UCL = .0489.
- e. .0456.
- f. Yes.
- g. Mean = .02, standard deviation = .01.
- h. LCL = 0, UCL = .04.

6. LCL: 0.

UCL: .0234.

Revised limits based on 12 samples:

LCL: 0.

UCL: .0197.

7. Yes, UCL = 16.266, LCL = 0.

8. Yes, UCL = 5.17, LCL = 0.

9. No; UCL = .079, LCL = .001. No.

10. 35 pieces.

11. One in 30 is "out." Tolerances seem to be met. Approximately 97% will be acceptable.

12. a. LCL: 3.73.

UCL: 3.97.

Out of control.

b. Random variations.

13. **NUMBER OF RUNS**

Test	Observed	Expected	Standard Deviation	z	Conclude
a. Med	18	14	2.50	1.6	Okay
U/D	17	17	2.07	0	Okay
b. Med	8	14	2.50	-2.40	Nonrandom
U/D	22	17	2.07	2.41	Nonrandom

14. a. Med: $z = 1.11$.

U/D: $z = 0.68$.

b. Med: $z = -1.11$.

U/D: $z = -1.36$.

15. Med: $z = -2.34$.

U/D: $z = -1.45$.

16. 440 pieces.

18. a. 566 units.

b. 62 units.

c. \$1,160.

19. Med: $z = +0.9177$.

U/D: $z = +0.5561$.

20. b. 4.5, .192.

c. 4.5, .086.

d. 4.242 to 4.758.

f. None.

21. a. 1.11. b. Yes.

22. Machine 005 is capable.

24. $C_{pk}: H = .94, k = 1.00, T = 1.33$.

26. Melissa.

3. c. .0024.

5. a. 0.16.

b. 2.

c. (1) Accept.

(2) .0362.

(3) .9638.

(4) $p(\text{Type I}) = .0362$.

$p(\text{Type II}) = 0$.

Chapter 11: Inventory Management

1. Item Category

4021	A
9402	C
4066	B
6500	C
9280	C
4050	C
6850	B
3010	C
4400	B

2. a. Item Category

K34	C
K35	A
K36	B
M10	C
M20	C
Z45	A
F14	B
F95	A
F99	C
D45	B
D48	C
D52	C
D57	B
N08	C
P05	B
P09	C

3. a. 36 bags.

b. 18 bags.

c. 135.

d. \$2,700.

e. Increase by \$131.84.

4. a. 204 packages.

b. \$6,118.82.

c. Yes.

d. No; TC = \$6,120; only save \$1.18.

5. a. \$105.

6. \$364.

7. a. 1-6: 75 units; 7-12: 91 units.

b. EOQ requirement.

c. 1-6: 50 units; 7-12: 100 units.

8. a. \$1.32.

b. \$24.30.

Chapter 10 Supplement: Acceptance Sampling

1. a. (1) Yes. (2) Yes. b. .0067.

2. b. .0390.

9. a. 4,812.
b. 15.59 (approx. 16).
c. .96.
10. a. 10,328 bags.
b. 3,098 bags.
c. 10.33 days.
d. 7.75 (approx. 8).
e. \$774.50.
11. a. 1,414 units.
b. 7.07 days.
c. 120 units.
d. No.
12. a. 37.5 batches.
b. 1,000 units.
c. 625 units.
d. No.
13. a. 5,000 boxes.
b. 3.6 orders.
14. a. 600 stones.
b. 600 stones.
c. 150 stones on hand.
15. Indifferent between 495 and 1,000 pulleys.
16. A, 500 units.
18. 6,600 feet.
19. a. 370 units.
b. 70 units.
c. Both smaller.
20. a. 91 pounds.
b. ROP = 691 pounds.
21. a. 8.39 gallons.
b. 34 gallons, .1423.
c. risk = .4168.
22. 70.14 gallons.
23. .1093.
24. ROP = 70.14.
25. a. 400 gallons.
b. 45.02 gallons.
26. a. 72 boxes.
b. .0023.
c. .0228.
27. a. 749 pounds. b. 4.073 pounds.
28. a. 134 rolls.
b. 36 rolls.
c. .055 per cycle [$\sigma_{dLT} = \sqrt{LT} \sigma_d$].
d. .9996.
29. 0.40 cases.
30. a. -0.40 gal.
b. * -1.98 gal.
31. KO33: 581.
K144: 458.
L700: 0.
32. a. P34: ROP = 131.1 units.
P 35: Every 4 weeks.
b. 306 units.
c. 334 units.
34. 25 dozen.
35. a. Nine spares. b. $C_s \leq \$10.47$.
36. 78.9 pounds.
37. \$4.89 per quart.
38. Five cakes.
39. 421.5 pounds.
40. a. \$0.53 to \$1.76.
c. \$56.67 to \$190.00.
41. 3 spares.
42. 2 cakes.

Chapter 12: Aggregate Planning

1. b. \$6,350
2. a. \$4,670.
b. \$4,800.
3. b. \$4,640.
4. \$4,970.
7. a. \$31,250.
b. \$31,520.
8. a. 500 cases.
b. 500 cases.
c. 750 cases.
10. B: \$14,340.
C: \$14,370.
11. \$13,475.
12. \$13,885.
13. \$12,930.
15. \$124,960.
16. \$126,650; additional cost: \$230.

Chapter 13: MRP and ERP

1. F = 2, G = 1, H = 1, J = 6, D = 10, L = 2, A = 4.
2. a. E = 138.
b. Week 5.
3. a. 360.
b. Day 1 (now).

Appendix A Answers to Selected Problems

4. a. Master
Schedule

Week	Beg. Inv.	1	2	3	4	5	6
Quantity							80

E	LT = 2	Beg. Inv.	1	2	3	4	5	6
Gross requirements								80
Scheduled receipts								
Projected on hand								
Net requirements								80
Planned-order receipts								80
Planned-order releases						80		

B(2)	LT = 2	Beg. Inv.	1	2	3	4	5	6
Gross requirements						160		
Scheduled receipts								
Projected on hand		60	60	60	60	60	20	20
Net requirements						100		
Planned-order receipts						120		
Planned-order releases				120				

J(4) and J(3)	LT = 1	Beg. Inv.	1	2	3	4	5	6
Gross requirements				480		240		
Scheduled receipts					30	30	30	
Projected on hand		20	20	20	50	80	50	50
Net requirements				460		160		
Planned-order receipts				480		180		
Planned-order releases			480		180			

b. Master Schedule

Week	Beg. Inv.	1	2	3	4	5	6
Quantity							70

E	LT = 2	Beg. Inv.	1	2	3	4	5	6
Gross requirements								70
Scheduled receipts								
Projected on hand								
Net requirements								70
Planned-order receipts								70
Planned-order releases						70		

B(2)	LT = 1	Beg. Inv.	1	2	3	4	5	6
Gross requirements						140		
Scheduled receipts								
Projected on hand		60	60	60	60	60	40	40
Net requirements						80		
Planned-order receipts						120		
Planned-order releases				120				

J(4) and J(3)	LT = 1	Beg. Inv.	1	2	3	4	5	6
Gross requirements				480		210		
Scheduled receipts					30	30	30	
Projected on hand		20	20	20	50	80	80	80
Net requirements				460		130		
Planned-order receipts				480		180		
Planned-order releases			480		180			

There will be an additional 20 units of B and 30 units of J.

Appendix A Answers to Selected Problems

5. c. Master
Schedule

Weeks	Beg. Inv.	1	2	3	4	5	6	7
Quantity							100	100

d. P LT = 1 wk.

	Beg. Inv.	1	2	3	4	5	6	7
Gross requirements							100	100
Scheduled receipts								
Projected on hand								
Net requirements							100	100
Planned-order receipts							100	100
Planned-order releases						100	100	

K LT = 2 wk.

	Beg. Inv.	1	2	3	4	5	6	7
Gross requirements						100	100	
Scheduled receipts				10			30	
Projected on hand				10	10	10		
Net requirements						90	70	
Planned-order receipts						90	70	
Planned-order releases				90	70			

G (3) LT = 1 wk.

	Beg. Inv.	1	2	3	4	5	6	7
Gross requirements				270	210			
Scheduled receipts								
Projected on hand	40	40	40	40				
Net requirements				230	210			
Planned-order receipts				253	231			
Planned-order releases			253	231				

H (4) LT = 1 wk.

	Beg. Inv.	1	2	3	4	5	6	7
Gross requirements				360	280			
Scheduled receipts								
Projected on hand	200	200	200	200	40			
Net requirements				160	240			
Planned-order receipts				200	240			
Planned-order releases			200	240				

6. Master Schedule	Day	Beg. Inv.	1	2	3	4	5	6	7
	Quantity					100	150		200

Table	Beg. Inv.	1	2	3	4	5	6	7
Gross requirements					100	150		200
Scheduled receipts								
Projected on hand								
Net requirements					100	150		200
Planned-order receipts					100	150		200
Planned-order releases				100	150		200	

Wood Sections (2)	Beg. Inv.	1	2	3	4	5	6	7
Gross requirements				200	300		400	
Scheduled receipts			100					
Projected on hand			100	100				
Net requirements				100	300		400	
Planned-order receipts				100	300		400	
Planned-order releases			400		400			

Braces (3)	Beg. Inv.	1	2	3	4	5	6	7
Gross requirements				300	450		600	
Scheduled receipts								
Projected on hand	60	60	60	60				
Net requirements				240	450		600	
Planned-order receipts				240	450			
Planned-order releases		240	450	600				

Legs (4)	Beg. Inv.	1	2	3	4	5	6	7
Gross requirements				400	600		800	
Scheduled receipts								
Projected on hand	120	120	120	120				
Net requirements				280	600		800	
Planned-order receipts				308	660		880	
Planned-order releases		968		880				

Appendix A Answers to Selected Problems

10. Order 160 units in week 2.

11. a. Master Schedule for E.

Week number	1	2	3	4	5	6	7	8
Quantity					120			

Item: E LT = 1 week								
Gross requirements					120			
Scheduled receipts								
Projected on hand								
Net requirements					120			
Planned-order receipts					120			
Planned-order releases				120				

Item: I (2) LT = 1 week								
Gross requirements				240				
Scheduled receipts			40					
Projected on hand			40	40				
Net requirements				200				
Planned-order receipts				200				
Planned-order releases			200					

Item: N (4) LT = 2 weeks								
Gross requirements			800					
Scheduled receipts								
Projected on hand	100	100	100					
Net requirements			700					
Planned-order receipts			700					
Planned-order releases	700							

Item: V LT = 2 weeks								
Gross requirements			200					
Scheduled receipts			10					
Projected on hand								
Net requirements			190					
Planned-order receipts			190					
Planned-order releases	190							

13. c. Master Schedule for golf carts.

Week number	1	2	3	4	5	6	7	8	9
Quantity						100		100	100

Item: Golf cart LT = 1 week									
Gross requirements						100		100	100
Scheduled receipts									
Projected on hand									
Net requirements						100		100	100
Planned-order receipts						100		100	100
Planned-order releases					100		100	100	

Item: Bases LT = 1 week									
Gross requirements						100		100	100
Scheduled receipts									
Projected on hand	20	20	20	20	50	100	50	100	50
Net requirements						0		0	50
Planned-order receipts				30	50	50	50	50	50
Planned-order releases		30	50	50	50	50	50		

15. Labor: 53.3% 106.7% 80% 93.3%
 Machine: 60% 120% 90% 105%

Chapter 14: JIT and Lean Operations

- 3.
- 3.
- 3.
- 3 cycles.
- 4 cycles.

Chapter 14 Supplement: Maintenance

- Expected recalibration cost = \$925 a month.
Use the service contract.
- Expected repair cost = \$456 a month.
Option #1: \$500.
Option #2: \$422.

Equipment	Ratio	Interval (days)
A201	.115	17.60
B400	.054	25.17
C850	.099	34.88

Chapter 15: Scheduling

- 1-A, 2-B, 3-C, TC = 15.
- 1-B, 2-C, 3-A, TC = 21.

3. 1-A, 2-E, 3-D, 4-B, 5-C; or 1-A, 2-D, 3-E, 4-B, 5-C.

4. 1-B, 2-C, 4-A, TC = 26.

5. a. 1-A, 2-B, 3-C, 4-D, 5-E.

b. 1-E, 2-B, 3-C, 4-D, 5-A.

	FCFS	SPT	EDD	CR
Av. flow time	26.5	19.75	21	24.75
Av. job tardiness	11	6	6	9.25
Av. no. of jobs	2.86	2.14	2.27	2.68

7. FCFS: a-b-c-d-e.

SPT: c-b-a-e-d.

EDD: a-b-c-e-d.

CR: a-b-c-e-d.

	FCFS	SPT	EDD	CR
Av. flow time	17.40	14.80	16.80	20.60
Av. job tardiness	5.20	5.40	4.60	8.80
Av. no. of jobs	2.72	2.31	2.63	3.23

9. B-A-G-E-F-D-C.

10. a. e-b-g-h-d-c-a-f.

c. 2 hours.

11. a. B-A-C-E-F-D.

12. a. b-a-c-d-e.

b. 37 minutes.

c. 15 minutes.

13. G-A-E-D-B-C-F.
 14. a., b. Grinding flow time is 93 hours. Total time is 37 hours.
 c. Grinding flow time is 107 hours. Total time is 35 hours.

15. a.

	FCFS	SPT	EDD	CR
Av. flow time	15.25	11.12	15.60	15.60
Av. job tardiness	1.7	2.33	0.55	0.55
Av. no. of jobs	3.91	2.85	4.00	4.00

- c. a-c-b-e-d-f
 16. b-c-e-a-d.
 19. A-B-C.
 20. C-B-A.
 21. B-C-D-A.

Chapter 16: Supply Chain Management

1. Use 2-day freight.
 2. Use 6-day.
 3. Ship 2-day using A.

Chapter 17: Project Management

1. a. 1-3-6-9-11-12: 31.
 b. 1-2-4-6-8-9: 32.
 c. 1-2-5-12-16: 44.
 3. Concerned about critical path activities F, H, and J, but also about A, B, C and E.
 5. a. Summary:

Activity	ES	EF	LF	LS	Slack
1- 2	0	4	11	7	7
2- 4	4	13	21	12	8
4- 7	13	18	26	21	8
7-10	18	20	28	26	8
10-12	21	24	31	28	7
2- 5	4	12	19	11	7
5- 8	12	19	26	19	7
8-10	19	21	28	26	7
1- 3	0	10	10	0	0
3- 6	10	16	16	10	0
6- 9	16	20	20	16	0
9-11	20	25	25	20	0
11-12	25	31	31	25	0

- b. Summary:

Activity	ES	EF	LF	LS	Slack
1	0	5	5	0	0
2	5	23	23	5	0
3	5	15	33	20	15
4	23	26	40	37	14
5	23	33	33	23	0
6	33	37	44	40	7
7	33	44	44	33	0
8	44	53	53	44	0
9	53	55	55	53	0

6. 30 weeks.
 7. b. 24 days: .9686; 21 days: .2350.
 8. a. .6881.
 b. .030.
 c. .0204.
 9. .3479.
 10. b. .52.
 11. b. .030.
 c. .2085.

12.

Path	Mean	Standard Deviation
a-d-e-h	24.34	1.354
a-f-g	15.50	1.258
b-i-j-k	14.83	1.014
c-m-n-o	26.17	1.658

- 27 weeks: .6742; 26 weeks: .4099.
 14. Crash schedule (1 week each): C, C, F, F, E, P.
 15. a. Crash four weeks:
 (1) 7-11, (2) 1-2, (3) 7-11 and 6-10, (4) 11-13 and 4-6.

Chapter 18: Waiting Lines

1. a. 2.25 customers.
 b. 75 percent.
 c. Two hours.
 d. .5625.
 2. a. 0.67 customer.
 b. One minute.
 c. 1.33 customers.
 3. a. 6 minutes.
 b. 0.25.
 c. 2.25 customers.
 4. a. 40 percent.
 b. 0.1523.
 c. 0.19 hour.
 d. .2286.
 5. a. Morning: 0.375 minute; .45.
 Afternoon: 0.678 minute; .54.
 Evening: 0.635 minute; .44.
 b. M: 4; A: 8; E: 5.
 6. a. 4.444 trucks.
 b. 6.67 minutes.
 c. .711.
 d. 6 minutes.
 e. The system would be overloaded.
 f. 13.186.
 7. a. One dock.
 b. One dock.
 8. a. 0.952 mechanic.
 b. 0.229.
 c. 0.056 hr.
 d. 0.60.
 e. Two.

- 9. a. 0.995 customer.
b. 2.24 days.
c. 31.1 percent.
d. 0.875 customer.
- 10. a. .437
b. 0.53 machine.
c. 1.33 machines.
d. 40.72 pieces.
e. Three.
- 11. a. 28.56 pieces.
b. Two.
- 12. a. 15.9 pieces.
b. Three.
- 13. Three.
- 14. a. .90.
b. $W_1 = .12$ hour.
 $W_2 = .3045$ hour.
 $W_3 = 2.13$ hours.
c. $L_1 = .365$.
 $L_2 = .914$.
 $L_3 = 6.395$.
- 15. a. .75.
b. $L_1 = .643$.
 $L_2 = 1.286$.
- 18. a. approx. 0.0116.
b. approx. 0.433.

Chapter 18 Supplement: Simulation

- 1. 5.25 jobs.
- 2. 1: 80 percent, 2: 40 percent, 3: 40 percent.

5. Patient	Time
1	19.44
2	20.24
3	17.92
4	19.38
5	18.96
6	16.48
7	20.66

7. Day	Usage
1	43.932
2	48.036
3	34.908
4	32.758
5	42.186
6	30.438
7	33.298
8	41.678
9	33.526
10	30.904

8. Period	Usage
1	2
2	1
3	3
4	1
5	1
6	4
7	5
8	3
9	1
10	2

10. b. Day	Order Size
1	—
2	—
3	—
4	—
5	3
6	—
7	—
8	1
9	—
10	—
11	3
12	—

- 13. Ball 1: 1,520 points; ball 2: 1,120 points; ball 3: 1,170 points.
- 14. Ball 1: 2,120 points; ball 2: 720 points; ball 3: 770 points.

APPENDIX B

Tables

- A. Areas under the normal curve, 0 to z, 848
- B. Areas under the standardized normal curve
 1. From $-\infty$ to $-z$, 849
 2. From $-\infty$ to $+z$, 850
- C. Cumulative Poisson probabilities, 851
- D. Cumulative binomial probabilities, 853

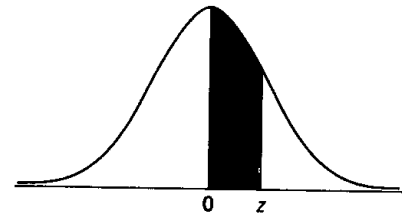


Table A Areas under the normal curve, 0 to z

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2703	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

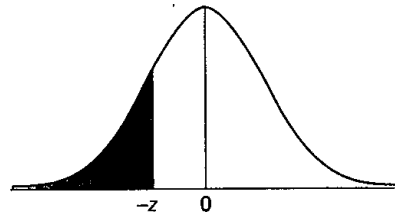


Table B
1. Areas under the standardized normal curve, from $-\infty$ to $-z$

.09	.08	.07	.06	.05	.04	.03	.02	.01	.00	z
.0002	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	-3.4
.0003	.0004	.0004	.0004	.0004	.0004	.0004	.0005	.0005	.0005	-3.3
.0005	.0005	.0005	.0006	.0006	.0006	.0006	.0006	.0007	.0007	-3.2
.0007	.0007	.0008	.0008	.0008	.0008	.0009	.0009	.0009	.0010	-3.1
.0010	.0010	.0011	.0011	.0011	.0012	.0012	.0013	.0013	.0013	-3.0
.0014	.0014	.0015	.0015	.0016	.0016	.0017	.0018	.0018	.0019	-2.9
.0019	.0020	.0021	.0021	.0022	.0023	.0023	.0024	.0025	.0026	-2.8
.0026	.0027	.0028	.0029	.0030	.0031	.0032	.0033	.0034	.0035	-2.7
.0036	.0037	.0038	.0039	.0040	.0041	.0043	.0044	.0045	.0047	-2.6
.0048	.0049	.0051	.0052	.0054	.0055	.0057	.0059	.0060	.0062	-2.5
.0064	.0066	.0068	.0069	.0071	.0073	.0075	.0078	.0080	.0082	-2.4
.0084	.0087	.0089	.0091	.0094	.0096	.0099	.0102	.0104	.0107	-2.3
.0110	.0113	.0116	.0119	.0122	.0125	.0129	.0132	.0136	.0139	-2.2
.0143	.0146	.0150	.0154	.0158	.0162	.0166	.0170	.0174	.0179	-2.1
.0183	.0188	.0192	.0197	.0202	.0207	.0212	.0217	.0222	.0228	-2.0
.0233	.0239	.0244	.0250	.0256	.0262	.0268	.0274	.0281	.0287	-1.9
.0294	.0301	.0307	.0314	.0322	.0329	.0336	.0344	.0351	.0359	-1.8
.0367	.0375	.0384	.0392	.0401	.0409	.0418	.0427	.0436	.0446	-1.7
.0455	.0465	.0475	.0485	.0495	.0505	.0516	.0526	.0537	.0548	-1.6
.0559	.0571	.0582	.0594	.0606	.0618	.0630	.0643	.0655	.0668	-1.5
.0681	.0694	.0708	.0721	.0735	.0749	.0764	.0778	.0793	.0808	-1.4
.0823	.0838	.0853	.0869	.0885	.0901	.0918	.0934	.0951	.0968	-1.3
.0985	.1003	.1020	.1038	.1056	.1075	.1093	.1112	.1131	.1151	-1.2
.1170	.1190	.1210	.1230	.1251	.1271	.1292	.1314	.1335	.1357	-1.1
.1379	.1401	.1423	.1446	.1469	.1492	.1515	.1539	.1562	.1587	-1.0
.1611	.1635	.1660	.1685	.1711	.1736	.1762	.1788	.1814	.1841	-0.9
.1867	.1894	.1922	.1949	.1977	.2005	.2033	.2061	.2090	.2119	-0.8
.2148	.2177	.2206	.2236	.2266	.2296	.2327	.2358	.2389	.2420	-0.7
.2451	.2483	.2514	.2546	.2578	.2611	.2643	.2676	.2709	.2743	-0.6
.2776	.2810	.2843	.2877	.2912	.2946	.2981	.3015	.3050	.3085	-0.5
.3121	.3156	.3192	.3228	.3264	.3300	.3336	.3372	.3409	.3446	-0.4
.3483	.3520	.3557	.3594	.3632	.3669	.3707	.3745	.3783	.3821	-0.3
.3859	.3897	.3936	.3974	.4013	.4052	.4090	.4129	.4168	.4207	-0.2
.4247	.4286	.4325	.4364	.4404	.4443	.4483	.4522	.4562	.4602	-0.1
.4641	.4681	.4721	.4761	.4801	.4840	.4880	.4920	.4960	.5000	-0.0

$$P(x \leq c) = \sum_{x=0}^{x=c} \frac{\mu^x \cdot e^{-\mu}}{x!}$$

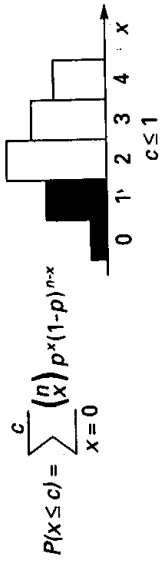


Table C
Cumulative Poisson probabilities

$\mu \backslash x$	0	1	2	3	4	5	6	7	8	9
0.05	.951	.999	1.000							
0.10	.905	.995	1.000							
0.15	.861	.990	.999	1.000						
0.20	.819	.982	.999	1.000						
0.25	.779	.974	.998	1.000						
0.30	.741	.963	.996	1.000						
0.35	.705	.951	.994	1.000						
0.40	.670	.938	.992	.999	1.000					
0.45	.638	.925	.989	.999	1.000					
0.50	.607	.910	.986	.998	1.000					
0.55	.577	.894	.982	.998	1.000					
0.60	.549	.878	.977	.997	1.000					
0.65	.522	.861	.972	.996	.999	1.000				
0.70	.497	.844	.966	.994	.999	1.000				
0.75	.472	.827	.960	.993	.999	1.000				
0.80	.449	.809	.953	.991	.999	1.000				
0.85	.427	.791	.945	.989	.998	1.000				
0.90	.407	.772	.937	.987	.998	1.000				
0.95	.387	.754	.929	.984	.997	1.000				
1.0	.368	.736	.920	.981	.996	.999	1.000			
1.1	.333	.699	.900	.974	.995	.999	1.000			
1.2	.301	.663	.880	.966	.992	.998	1.000			
1.3	.273	.627	.857	.957	.989	.998	1.000			
1.4	.247	.592	.833	.946	.986	.997	.999	1.000		
1.5	.223	.558	.809	.934	.981	.996	.999	1.000		
1.6	.202	.525	.783	.921	.976	.994	.999	1.000		
1.7	.183	.493	.757	.907	.970	.992	.998	1.000		
1.8	.165	.463	.731	.891	.964	.990	.997	.999	1.000	
1.9	.150	.434	.704	.875	.956	.987	.997	.999	1.000	
2.0	.135	.406	.677	.857	.947	.983	.995	.999	1.000	
2.2	.111	.355	.623	.819	.928	.975	.993	.998	1.000	
2.4	.091	.308	.570	.779	.904	.964	.988	.997	.999	1.000
2.6	.074	.267	.518	.736	.877	.951	.983	.995	.999	1.000
2.8	.061	.231	.470	.692	.848	.935	.976	.992	.998	.999

Table C (concluded)

$\mu \backslash x$	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
3.0	.050	.199	.423	.647	.815	.916	.966	.988	.996	.999	1.000											
3.2	.041	.171	.380	.603	.781	.895	.955	.983	.994	.998	1.000											
3.4	.033	.147	.340	.558	.744	.871	.942	.977	.992	.997	.999	1.000										
3.6	.027	.126	.303	.515	.706	.844	.927	.969	.988	.996	.999	1.000										
3.8	.022	.107	.269	.474	.668	.816	.909	.960	.984	.994	.998	.999	1.000									
4.0	.018	.092	.238	.433	.629	.785	.889	.949	.979	.992	.997	.999	1.000									
4.2	.015	.078	.210	.395	.590	.753	.868	.936	.972	.989	.996	.999	1.000									
4.4	.012	.066	.185	.359	.551	.720	.844	.921	.964	.985	.994	.998	.999	1.000								
4.6	.010	.056	.163	.326	.513	.686	.818	.905	.955	.980	.992	.997	.999	1.000								
4.8	.008	.048	.143	.294	.476	.651	.791	.887	.944	.975	.990	.996	.999	1.000								
5.0	.007	.040	.125	.265	.441	.616	.762	.867	.932	.968	.986	.995	.998	.999	1.000							
5.2	.006	.034	.109	.238	.406	.581	.732	.845	.918	.960	.982	.993	.997	.999	1.000							
5.4	.005	.029	.095	.213	.373	.546	.702	.822	.903	.951	.978	.990	.996	.999	1.000							
5.6	.004	.024	.082	.191	.342	.512	.670	.797	.886	.941	.972	.988	.995	.998	.999	1.000						
5.8	.003	.021	.072	.170	.313	.478	.638	.771	.867	.929	.965	.984	.993	.997	.999	1.000						
6.0	.003	.017	.062	.151	.285	.446	.606	.744	.847	.916	.957	.980	.991	.996	.999	.999	1.000					
6.2	.002	.015	.054	.134	.259	.414	.574	.716	.826	.902	.949	.975	.989	.995	.998	.999	1.000					
6.4	.002	.012	.046	.119	.235	.384	.542	.687	.803	.886	.939	.969	.986	.994	.997	.999	1.000					
6.6	.001	.010	.040	.105	.213	.355	.511	.658	.780	.869	.927	.963	.982	.992	.997	.999	.999	1.000				
6.8	.001	.009	.034	.093	.192	.327	.480	.628	.755	.850	.915	.955	.978	.990	.996	.999	.999	1.000				
7.0	.001	.007	.030	.082	.173	.301	.450	.599	.729	.830	.901	.947	.973	.987	.994	.998	.999	1.000				
7.2	.001	.006	.025	.072	.156	.276	.420	.569	.703	.810	.887	.937	.967	.984	.993	.997	.999	.999	1.000			
7.4	.001	.005	.022	.063	.140	.253	.392	.539	.676	.788	.871	.926	.961	.980	.991	.996	.998	.999	1.000			
7.6	.001	.004	.019	.055	.125	.231	.365	.510	.648	.765	.854	.915	.954	.976	.989	.995	.998	.999	1.000			
7.8	.000	.004	.016	.048	.112	.210	.338	.481	.620	.741	.835	.902	.945	.971	.986	.993	.997	.999	1.000			
8.0	.000	.003	.014	.042	.100	.191	.313	.453	.593	.717	.816	.888	.936	.966	.983	.992	.996	.998	.999	1.000		
8.2	.000	.003	.012	.037	.089	.174	.290	.425	.566	.692	.796	.873	.926	.960	.979	.990	.995	.998	.999	1.000		
8.4	.000	.002	.010	.032	.079	.157	.267	.400	.537	.666	.774	.857	.915	.952	.975	.987	.994	.997	.999	1.000		
8.6	.000	.002	.009	.030	.070	.142	.246	.323	.509	.640	.752	.849	.909	.949	.973	.986	.993	.997	.999	1.000		
8.8	.000	.002	.007	.024	.062	.128	.226	.348	.482	.614	.729	.822	.889	.935	.964	.981	.990	.995	.998	.999	1.000	
9.0	.000	.001	.006	.021	.055	.116	.207	.324	.456	.587	.706	.803	.876	.926	.959	.978	.989	.995	.998	.999	1.000	
9.5	.000	.001	.004	.015	.040	.089	.165	.269	.392	.522	.645	.752	.836	.898	.940	.967	.982	.991	.996	.998	.999	



$$P(X \leq c) = \sum_{x=0}^c \binom{n}{x} p^x (1-p)^{n-x}$$

Table D Cumulative binomial probabilities

n	x	P																	
		.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90
1	0	.9500	.9000	.8500	.8000	.7500	.7000	.6500	.6000	.5500	.5000	.4500	.4000	.3500	.3000	.2500	.2000	.1500	.1000
	1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0	.9025	.8100	.7225	.6400	.5625	.4900	.4225	.3600	.3025	.2500	.2025	.1600	.1225	.0900	.0625	.0400	.0225	.0100
	1	.9975	.9900	.9775	.9600	.9375	.9100	.8775	.8400	.7975	.7500	.6975	.6400	.5775	.5100	.4375	.3600	.2775	.1900
3	2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	0	.8574	.7290	.6141	.5120	.4219	.3430	.2746	.2160	.1664	.1250	.0911	.0640	.0429	.0270	.0156	.0080	.0034	.0010
4	1	.9928	.9720	.9393	.8960	.8438	.7840	.7183	.6480	.5748	.5000	.4253	.3520	.2818	.2160	.1563	.1040	.0608	.0280
	2	.9999	.9990	.9966	.9920	.9844	.9730	.9571	.9360	.9089	.8760	.8336	.7840	.7254	.6570	.5781	.4880	.3859	.2710
5	3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	0	.8145	.6561	.5220	.4096	.3164	.2401	.1785	.1296	.0915	.0625	.0410	.0256	.0150	.0081	.0039	.0016	.0005	.0001
6	1	.9860	.9477	.8905	.8192	.7383	.6517	.5630	.4752	.3910	.3125	.2415	.1792	.1265	.0837	.0508	.0272	.0120	.0037
	2	.9995	.9963	.9880	.9728	.9492	.9163	.8735	.8208	.7585	.6875	.6090	.5248	.4370	.3483	.2617	.1808	.1095	.0523
7	3	1.0000	.9999	.9995	.9984	.9961	.9919	.9850	.9744	.9590	.9375	.9085	.8704	.8215	.7599	.6836	.5904	.4780	.3439
	0	.7738	.5905	.4437	.3277	.2373	.1681	.1160	.0778	.0503	.0313	.0185	.0102	.0053	.0024	.0010	.0003	.0001	.0000
8	1	.9774	.9185	.8352	.7373	.6328	.5282	.4284	.3370	.2562	.1875	.1312	.0870	.0540	.0308	.0156	.0067	.0022	.0005
	2	.9988	.9914	.9734	.9421	.8965	.8369	.7648	.6826	.5931	.5000	.4069	.3174	.2352	.1631	.1035	.0579	.0266	.0086
9	3	1.0000	.9995	.9978	.9933	.9844	.9692	.9460	.9130	.8688	.8125	.7438	.6630	.5716	.4718	.3672	.2627	.1648	.0815
	0	.8000	.6500	.5100	.3800	.2600	.1500	.0500	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
10	4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	0	.7351	.5314	.3771	.2621	.1780	.1176	.0754	.0467	.0277	.0156	.0083	.0041	.0018	.0007	.0002	.0001	.0000	.0000
11	1	.9672	.8857	.7765	.6554	.5339	.4202	.3191	.2333	.1636	.1094	.0692	.0410	.0223	.0109	.0046	.0016	.0004	.0001
	2	.9978	.9842	.9527	.9011	.8306	.7443	.6471	.5443	.4415	.3438	.2553	.1792	.1174	.0705	.0376	.0170	.0059	.0013
12	3	.9999	.9987	.9941	.9830	.9624	.9295	.8826	.8208	.7447	.6563	.5585	.4557	.3529	.2557	.1694	.0989	.0473	.0159
	0	.8000	.6500	.5100	.3800	.2600	.1500	.0500	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
13	4	1.0000	.9999	.9996	.9984	.9954	.9891	.9777	.9590	.9308	.8906	.8364	.7667	.6809	.5798	.4661	.3446	.2235	.1143
	0	.8000	.6500	.5100	.3800	.2600	.1500	.0500	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
14	5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	0	.8000	.6500	.5100	.3800	.2600	.1500	.0500	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
15	6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	0	.8000	.6500	.5100	.3800	.2600	.1500	.0500	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

Table D (continued)

P

<i>n</i>	<i>x</i>	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90
7	0	.6983	.4783	.3206	.2097	.1335	.0824	.0490	.0280	.0152	.0078	.0037	.0016	.0006	.0002	.0001	.0000	.0000	.0000
	1	.9556	.8503	.7166	.5767	.4449	.3294	.2338	.1586	.1024	.0625	.0357	.0188	.0090	.0038	.0013	.0004	.0001	.0000
	2	.9962	.9743	.9262	.8520	.7564	.6471	.5323	.4199	.3164	.2266	.1529	.0963	.0556	.0288	.0129	.0047	.0012	.0002
	3	.9998	.9973	.9879	.9667	.9294	.8740	.8002	.7102	.6083	.5000	.3917	.2898	.1998	.1260	.0706	.0333	.0121	.0027
	4	1.0000	.9998	.9988	.9953	.9871	.9712	.9444	.9037	.8471	.7734	.6836	.5801	.4677	.3529	.2436	.1480	.0738	.0257
	5	1.0000	1.0000	.9999	.9996	.9987	.9962	.9910	.9812	.9643	.9375	.8976	.8414	.7662	.6706	.5551	.4233	.2834	.1497
	6	1.0000	1.0000	1.0000	1.0000	.9999	.9998	.9994	.9984	.9963	.9922	.9848	.9720	.9510	.9176	.8665	.7903	.6794	.5217
	7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	0	.6634	.4305	.2725	.1678	.1001	.0576	.0319	.0168	.0084	.0039	.0017	.0007	.0002	.0001	.0000	.0000	.0000	.0000
	1	.9428	.8131	.6572	.5033	.3671	.2553	.1691	.1064	.0632	.0352	.0181	.0085	.0036	.0013	.0004	.0001	.0000	.0000
	2	.9942	.9619	.8948	.7969	.6785	.5518	.4278	.3154	.2201	.1445	.0885	.0498	.0253	.0113	.0042	.0012	.0002	.0000
	3	.9996	.9950	.9786	.9437	.8862	.8059	.7064	.5941	.4470	.3633	.2604	.1737	.1061	.0580	.0273	.0104	.0029	.0004
	4	1.0000	.9996	.9971	.9896	.9727	.9420	.8939	.8263	.7396	.6367	.5230	.4059	.2936	.1941	.1138	.0563	.0214	.0050
	5	1.0000	1.0000	.9998	.9988	.9958	.9887	.9747	.9502	.9115	.8555	.7799	.6848	.5722	.4482	.3215	.2031	.1052	.0381
	6	1.0000	1.0000	1.0000	.9999	.9996	.9987	.9964	.9915	.9819	.9648	.9368	.8936	.8309	.7447	.6329	.4967	.3428	.1869
	7	1.0000	1.0000	1.0000	1.0000	1.0000	.9999	.9998	.9993	.9983	.9961	.9916	.9832	.9681	.9424	.8999	.8322	.7275	.5695
	8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	0	.6302	.3874	.2316	.1342	.0751	.0404	.0207	.0101	.0046	.0020	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000
	1	.9288	.7748	.5995	.4362	.3003	.1960	.1211	.0705	.0385	.0195	.0091	.0038	.0014	.0004	.0001	.0000	.0000	.0000
	2	.9916	.9470	.8591	.7382	.6007	.4628	.3373	.2318	.1495	.0898	.0498	.0250	.0112	.0043	.0013	.0003	.0000	.0000
	3	.9994	.9917	.9661	.9144	.8343	.7297	.6089	.4826	.3614	.2539	.1658	.0994	.0536	.0253	.0100	.0031	.0006	.0001
	4	1.0000	.9991	.9944	.9804	.9511	.9012	.8283	.7334	.6214	.5000	.3786	.2666	.1717	.0988	.0489	.0196	.0056	.0009
	5	1.0000	.9999	.9994	.9969	.9900	.9747	.9464	.9006	.8342	.7461	.6386	.5174	.3911	.2703	.1657	.0856	.0339	.0083
	6	1.0000	1.0000	1.0000	.9997	.9987	.9957	.9888	.9750	.9502	.9102	.8505	.7682	.6627	.5372	.3993	.2618	.1409	.0530
	7	1.0000	1.0000	1.0000	1.0000	.9999	.9996	.9986	.9962	.9909	.9805	.9615	.9295	.8789	.8040	.6997	.5638	.4005	.2252
	8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9999	.9997	.9992	.9980	.9954	.9899	.9793	.9596	.9249	.8658	.7684	.6126
	9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	0	.5987	.3487	.1969	.1074	.0563	.0282	.0135	.0060	.0025	.0010	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000
	1	.9139	.7361	.5443	.3758	.2440	.1493	.0860	.0464	.0233	.0107	.0045	.0017	.0005	.0001	.0000	.0000	.0000	.0000
	2	.9885	.9298	.8202	.6778	.5256	.3828	.2616	.1673	.0996	.0547	.0274	.0123	.0048	.0016	.0004	.0001	.0000	.0000
	3	.9980	.9872	.9500	.8791	.7759	.6496	.5138	.3823	.2660	.1719	.1020	.0548	.0260	.0106	.0035	.0009	.0001	.0000
	4	.9999	.9984	.9901	.9672	.9219	.8497	.7515	.6331	.5044	.3770	.2616	.1662	.0949	.0473	.0197	.0064	.0014	.0001
	5	1.0000	.9999	.9986	.9936	.9803	.9527	.9051	.8338	.7384	.6230	.4956	.3669	.2485	.1503	.0781	.0328	.0099	.0016
	6	1.0000	1.0000	.9999	.9991	.9965	.9894	.9740	.9452	.8980	.8281	.7340	.6177	.4862	.3504	.2241	.1209	.0500	.0128
	7	1.0000	1.0000	1.0000	.9999	.9996	.9984	.9952	.9877	.9726	.9453	.9004	.8327	.7384	.6172	.4744	.3222	.1798	.0702
	8	1.0000	1.0000	1.0000	1.0000	1.0000	.9999	.9995	.9983	.9955	.9893	.9767	.9536	.9140	.8507	.7660	.6242	.4557	.2639
	9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9999	.9997	.9990	.9975	.9940	.9865	.9718	.9437	.8926	.8031	.6513
	10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table D (concluded)

n	P																			
	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90		
15	.4633	.2059	.0874	.0352	.0134	.0047	.0016	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
1	.8290	.5490	.3186	.1871	.0802	.0353	.0142	.0052	.0017	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
2	.9638	.8159	.6042	.3980	.2361	.1268	.0617	.0271	.0107	.0037	.0011	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	
3	.9945	.9444	.8227	.6482	.4613	.2969	.1727	.0905	.0424	.0176	.0063	.0019	.0005	.0001	.0000	.0000	.0000	.0000	.0000	
4	.9994	.9873	.9383	.8358	.6865	.5155	.3519	.2173	.1204	.0592	.0255	.0093	.0028	.0007	.0001	.0000	.0000	.0000	.0000	
5	.9999	.9978	.9832	.9389	.8516	.7216	.5643	.4032	.2608	.1509	.0769	.0338	.0124	.0037	.0008	.0001	.0000	.0000	.0000	
6	1.0000	.9997	.9964	.9819	.9434	.8689	.7548	.6098	.4522	.3036	.1818	.0950	.0422	.0152	.0042	.0008	.0001	.0000	.0000	
7	1.0000	1.0000	.9994	.9958	.9827	.9500	.8868	.7869	.6535	.5000	.3465	.2131	.1132	.0500	.0173	.0042	.0006	.0000	.0000	
8	1.0000	1.0000	.9999	.9992	.9958	.9848	.9578	.9050	.8182	.6964	.5478	.3902	.2452	.1311	.0566	.0181	.0036	.0003	.0000	
9	1.0000	1.0000	1.0000	.9999	.9992	.9963	.9876	.9662	.9231	.8491	.7392	.5968	.4357	.2784	.1484	.0611	.0168	.0022	.0000	
10	1.0000	1.0000	1.0000	1.0000	.9999	.9993	.9972	.9907	.9745	.9408	.8796	.7827	.6481	.4845	.3135	.1642	.0617	.0127	.0000	
11	1.0000	1.0000	1.0000	1.0000	1.0000	.9999	.9995	.9981	.9937	.9824	.9576	.9095	.8273	.7031	.5387	.3518	.1773	.0556	.0000	
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9999	.9997	.9989	.9963	.9893	.9729	.9383	.8732	.7639	.6020	.3958	.1841	.0000	
13	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9999	.9995	.9983	.9948	.9858	.9647	.9198	.8329	.6814	.4510	.0000	
14	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9999	.9995	.9984	.9953	.9866	.9648	.9126	.7941	.0000	
15	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	
20	.3585	.1216	.0388	.0115	.0032	.0008	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
1	.7358	.3917	.1756	.0692	.0243	.0076	.0021	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
2	.9245	.6769	.4049	.2061	.0913	.0355	.0121	.0036	.0009	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
3	.9841	.8670	.6477	.4114	.2252	.1071	.0444	.0180	.0049	.0013	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
4	.9974	.9568	.8298	.6296	.4148	.2375	.1182	.0510	.0189	.0059	.0015	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
5	.9997	.9887	.9327	.8042	.6172	.4164	.2454	.1256	.0553	.0207	.0064	.0016	.0003	.0000	.0000	.0000	.0000	.0000	.0000	
6	1.0000	.9976	.9781	.9133	.7858	.6080	.4166	.2500	.1299	.0577	.0214	.0065	.0015	.0003	.0000	.0000	.0000	.0000	.0000	
7	1.0000	.9996	.9941	.9679	.8982	.7723	.6010	.4159	.2520	.1316	.0580	.0210	.0060	.0013	.0002	.0000	.0000	.0000	.0000	
8	1.0000	.9999	.9987	.9900	.9591	.8667	.7624	.5956	.4143	.2517	.1308	.0565	.0196	.0051	.0009	.0001	.0000	.0000	.0000	
9	1.0000	1.0000	.9998	.9974	.9861	.9520	.8782	.7553	.5914	.4119	.2493	.1275	.0532	.0171	.0039	.0006	.0000	.0000	.0000	
10	1.0000	1.0000	1.0000	.9994	.9961	.9829	.9468	.8725	.7507	.5881	.4086	.2447	.1218	.0480	.0139	.0026	.0002	.0000	.0000	
11	1.0000	1.0000	1.0000	.9999	.9991	.9949	.9804	.9435	.8692	.7483	.5857	.4044	.2376	.1133	.0409	.0100	.0013	.0001	.0000	
12	1.0000	1.0000	1.0000	1.0000	.9998	.9987	.9940	.9790	.9420	.8684	.7480	.5841	.3990	.2277	.1018	.0321	.0059	.0004	.0000	
13	1.0000	1.0000	1.0000	1.0000	1.0000	.9997	.9985	.9935	.9786	.9423	.8701	.7500	.5834	.3920	.2142	.0867	.0219	.0024	.0000	
14	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9997	.9984	.9936	.9793	.9447	.8744	.7546	.5836	.3828	.1958	.0673	.0113	.0000	
15	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9997	.9985	.9941	.9811	.9490	.8818	.7625	.5852	.3704	.1702	.0432	.0000	
16	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9997	.9987	.9951	.9840	.9556	.8929	.7748	.5886	.3523	.1330	.0000	
17	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9998	.9991	.9964	.9879	.9645	.9087	.7939	.5951	.3231	.0000	
18	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9999	.9995	.9979	.9924	.9757	.9308	.8244	.6063	.0000	
19	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9999	.9998	.9992	.9968	.9885	.9612	.8784	.0000	
20	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	

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