CHAPTER 28: EXAMPLES OF PERFORMING SIMULATIONS ON SPREADSHEETS WITH ANALYTIC SOLVER PLATFORM

28-1.

(a)   Answers will vary. A typical set of 5 runs: 45.83, 46.26, 45.94, 45.98, and 46.89.

(b)   Answers will vary. A typical set of 5 runs: 46.49, 46.12, 46.38, 46.23, and 46.37.

(c)   The mean completion times in part *b* should be more consistent.

28-2.

(a)   Error function (Scale = 0.0109, Shift = 460.94)

(b)   Normal Distribution (Mean = 460.94, Standard Deviation = 64.78).

28-3.

(a)   Uniform Distribution (Min = 302, Max = 496).

(b)   Max Extreme Distribution (Mode = 62.01, Scale = 46.41, Shift = 301.99).

28-4.

	A	B	C	D	E	F	G	H	I
1								(all times in months)	
2							Start	Activity	Finish
3	Activity	Predecessor	Distribution	Parameters			Time	Time	Time
4	A Secure funding	—	Normal (mean, st. dev.)	6	1		0.0	6.257	6.3
5	B Design Building	A	Uniform (min, max)	6	10		6.3	9.188	15.4
6	C Site Preparation	A	Triangular (min, most likely, max)	1.5	2	2.5	6.3	1.661	7.9
7	D Foundation	B, C	Triangular (min, most likely, max)	1.5	2	3	15.4	2.219	17.7
8	E Framing	D	Triangular (min, most likely, max)	3	4	6	17.7	4.100	21.8
9	F Electrical	E	Triangular (min, most likely, max)	2	3	5	21.8	2.322	24.1
10	G Plumbing	E	Triangular (min, most likely, max)	3	4	5	21.8	3.514	25.3
11	H Walls and Roof	F, G	Triangular (min, most likely, max)	4	5	7	25.3	4.862	30.1
12	I Finish Work	H	Triangular (min, most likely, max)	5	6	7	30.1	6.000	36.1
13	J Landscaping	H	Fixed (5)				30.1	5	35.1
14									
15								Project Completion Time	35.140
16								Mean Project Completion Time	34.917

(a)   The mean project completion time is approximately 35 months.

(b) The probability that the project completion time will be less than 36 months is approximately 72%.


Simulation Results - I15
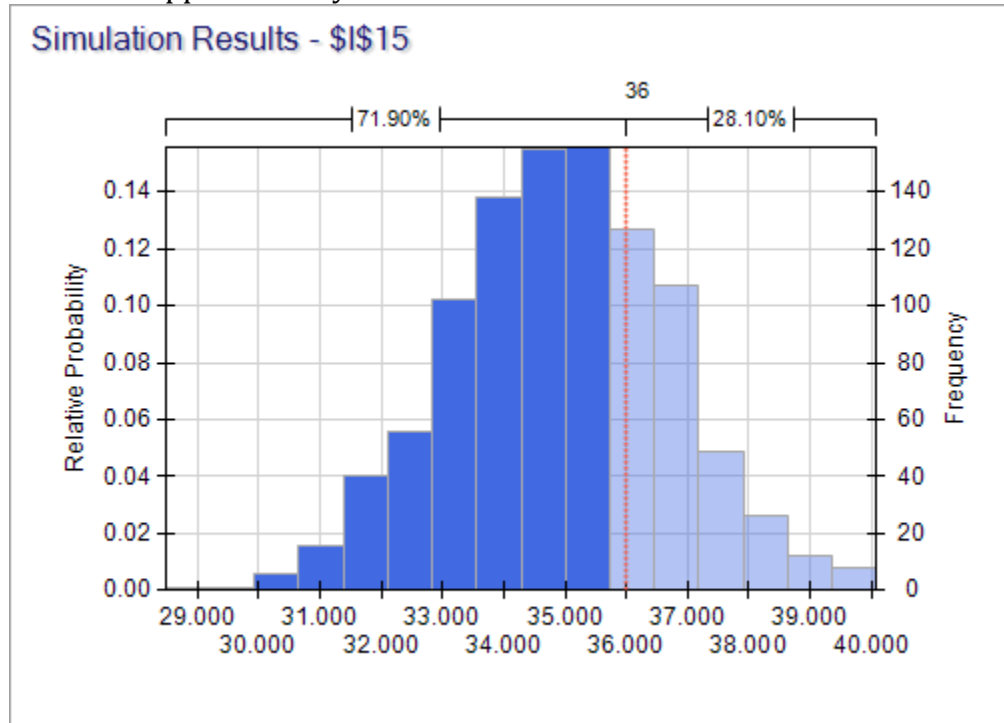
(c) Activity B and then Activity A have the largest impact on the project completion time.
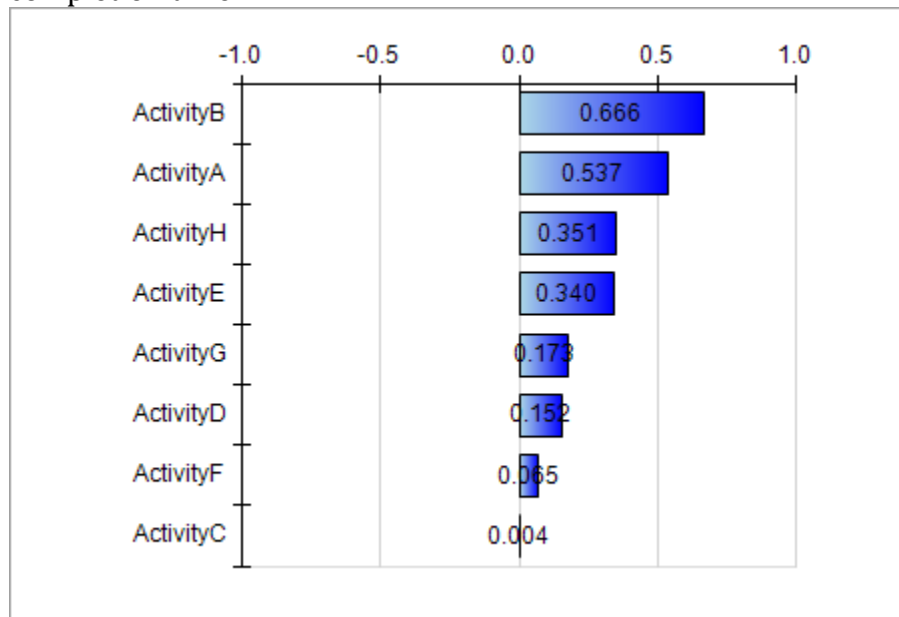
28-5.

	A	B	C	D	E	F
1	Size of Claim	Prob.	Distribution	Parameters		Claim (If Claim is This Size)
2	None	40%	Fixed	$0		$0
3	Small	40%	Uniform(Min,Max)	$0	$2,000	$54
4	Large	20%	Uniform(Min,Max)	$2,000	$20,000	$4,554
5						
6	Size of Claim	2				
7	(0=None,1=Small,2=Large)				Simulated Claim	$4,554
8					Mean Claim	$2,567

The mean claim is approximately $2,567.

Simulation Results - F7

28-3
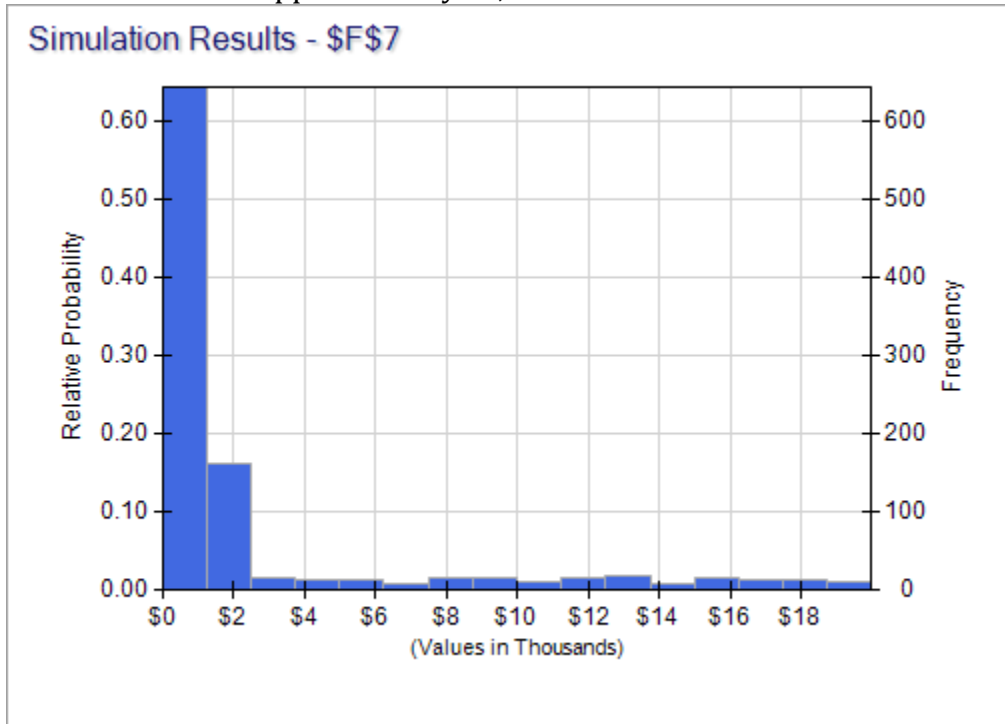
28-6.

(a) Option 2 (Hotel Project only). The mean NPV is approximately $11.5 million, with an approximately 70% chance of being nonnegative.

	A	B	C	D	E	F	G	H
3				**Project Simulated**				
4				**Cash Flow**				
5		**Hotel Project:**		**($millions)**				
6		Construction Costs:	Year 0	-80				
7			Year 1	-76.763	Normal	-80	5	(mean, st. dev.)
8			Year 2	-74.188	Normal	-80	10	(mean, st. dev.)
9			Year 3	-98.612	Normal	-70	15	(mean, st. dev.)
10		Revenue per Share	Year 4	38.767	Normal	30	20	(mean, st. dev.)
11			Year 5	69.990	Normal	40	20	(mean, st. dev.)
12			Year 6	65.203	Normal	50	20	(mean, st. dev.)
13		Selling Price per Share	Year 7	793.807	Uniform	200	844	(lower, upper)
14								
15		**Shopping Center Project**						
16		Construction Costs:	Year 0	-90				
17			Year 1	-49.723	Normal	-50	5	(mean, st. dev.)
18			Year 2	-26.847	Normal	-20	5	(mean, st. dev.)
19			Year 3	-57.320	Normal	-60	10	(mean, st. dev.)
20		Revenue per Share	Year 4	15.628	Normal	15	15	(mean, st. dev.)
21			Year 5	9.743	Normal	25	15	(mean, st. dev.)
22			Year 6	14.163	Normal	40	15	(mean, st. dev.)
23		Selling Price per Share	Year 7	612.961	Uniform	160	615	(lower, upper)
24								
25				**Think Big's**				
26				**Simulated Cash Flow**				
27				**($millions)**				**Share**
28			Year 0	-13.200			Hotel	16.50%
29			Year 1	-12.666			Shopping Center	0.00%
30			Year 2	-12.241				
31			Year 3	-16.271			Cost of Capital	10%
32			Year 4	6.397				
33			Year 5	11.548				
34			Year 6	10.759				
35			Year 7	130.978				
36								
37		Net Present Value ($millions)		37.769				
38								
39		MeanNPV ($millions)		11.546				
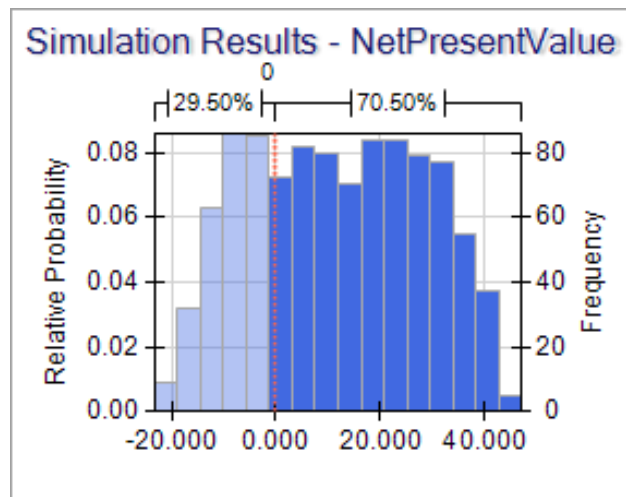
(b) Option 3 (Shopping Center Project only). The mean NPV is approximately $6.6 million, with an approximately 71% chance of being nonnegative.

|	A	B	C	D	E	F	G	H
3				**Project Simulated**				
4				**Cash Flow**				
5		**Hotel Project:**		**($millions)**				
6		Construction Costs:	Year 0	-80				
7			Year 1	-79.864	*Normal*	-80	5	(mean, st. dev.)
8			Year 2	-56.819	*Normal*	-80	10	(mean, st. dev.)
9			Year 3	-69.994	*Normal*	-70	15	(mean, st. dev.)
10		Revenue per Share	Year 4	70.702	*Normal*	30	20	(mean, st. dev.)
11			Year 5	57.821	*Normal*	40	20	(mean, st. dev.)
12			Year 6	16.736	*Normal*	50	20	(mean, st. dev.)
13		Selling Price per Share	Year 7	549.769	*Uniform*	200	844	(lower, upper)
14								
15		**Shopping Center Project**						
16		Construction Costs:	Year 0	-90				
17			Year 1	-56.321	*Normal*	-50	5	(mean, st. dev.)
18			Year 2	-26.445	*Normal*	-20	5	(mean, st. dev.)
19			Year 3	-87.406	*Normal*	-60	10	(mean, st. dev.)
20		Revenue per Share	Year 4	0.980	*Normal*	15	15	(mean, st. dev.)
21			Year 5	38.831	*Normal*	25	15	(mean, st. dev.)
22			Year 6	25.538	*Normal*	40	15	(mean, st. dev.)
23		Selling Price per Share	Year 7	407.887	*Uniform*	160	615	(lower, upper)
24								
25				**Think Big's**				
26				**Simulated Cash Flow**				
27				**($millions)**				**Share**
28			Year 0	-11.799			Hotel	0.00%
29			Year 1	-7.384			Shopping Center	13.11%
30			Year 2	-3.467				
31			Year 3	-11.459			Cost of Capital	10%
32			Year 4	0.128				
33			Year 5	5.091				
34			Year 6	3.348				
35			Year 7	53.474				
36								
37		Net Present Value ($millions)		2.593				
38								
39		MeanNPV ($millions)		6.571				

28-5
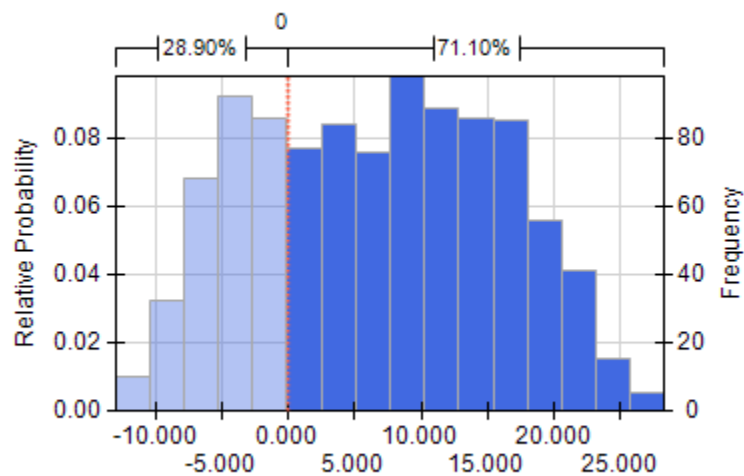
(c) Option 1 appears to be the best. It has the highest expected NPV ($18 million vs. less than $12 million vs. less than $7 million) *and* there is less chance of losing money (less than 20% vs. nearly 30% for options 2 and 3).

28-7.

(a) The mean profit is approximately $572. There is a 100% chance of making at least $0 profit.
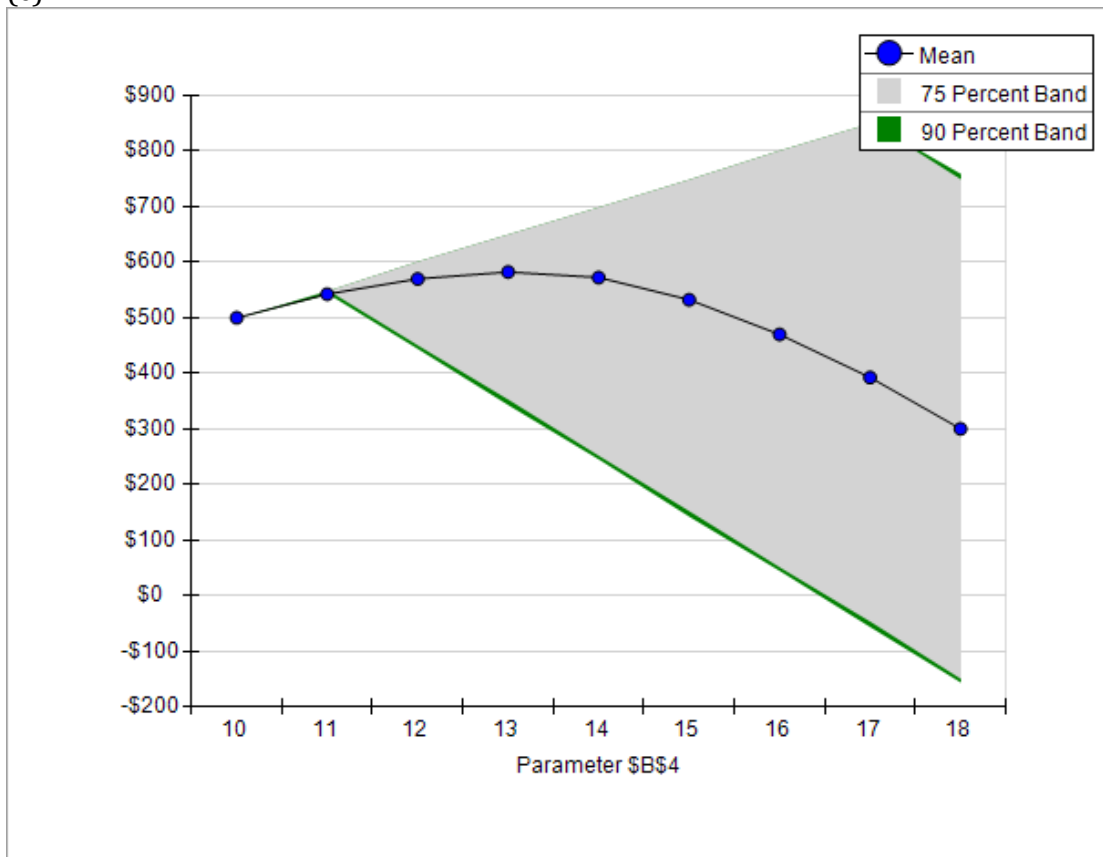
	A	B	C	D	E
1	Purchase Price	$100			
2	Selling Price	$150			
3					
4	Order Quantity	14			
5				Value	Probability
6	Demand	14	Custom Discrete	10	0.05
7				11	0.1
8	Revenue	$2,100		12	0.1
9	Purchase Cost	$1,400		13	0.15
10	Total Profit	$700		14	0.2
11	Mean Total Profit	$572.50		15	0.15
12				16	0.1
13				17	0.1
14				18	0.05

Simulation Results - B10
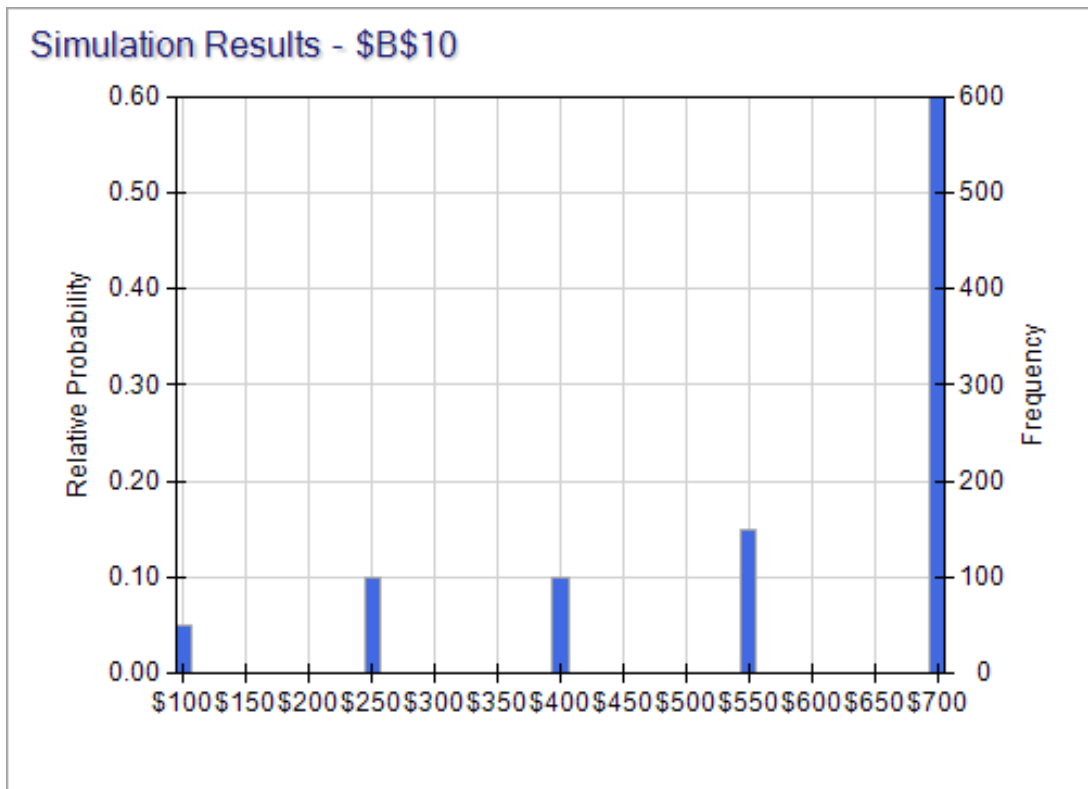
(b) Thirteen tickets maximizes Susan's mean profit.

Order Quantity	Mean Total Profit
10	$500.00
11	$542.50
12	$570.00
13	$582.50
14	$572.50
15	$532.50
16	$470.00
17	$392.50
18	$300.00

(c)

(d) Thirteen tickets is the optimal order quantity found by Solver.

	A	B	C	D	E
1	Purchase Price	$100			
2	Selling Price	$150			
3					
4	Order Quantity	13			
5				Value	Probability
6	Demand	13	Custom Discrete	10	0.05
7				11	0.1
8	Revenue	$1,950		12	0.1
9	Purchase Cost	$1,300		13	0.15
10	Total Profit	$650		14	0.2
11	Mean Total Profit	$582.50		15	0.15
12				16	0.1
13				17	0.1
14				18	0.05

28-8.

(a) A bid of approximately $5.3 million maximmizes the mean profit.

OurBid	Mean Profit ($million)
5.20	0.469
5.25	0.481
5.30	0.485
5.35	0.482
5.40	0.476
5.45	0.467
5.50	0.405
5.55	0.315
5.60	0.253

(b) The optimal bid is approximately $5.302 million, as found by Solver.

	A	B	C	D	E
1		**Reliable Construction Co. Contract Bidding**			
2					
3		**Data**			
4		Our Project Cost ($million)	4.550		
5		Our Bid Cost ($million)	0.050		
6					
7		**Competitor Bids**	Competitor 1	Competitor 2	Competitor 3
8		Bid ($million)	4.753	5.832	5.648
9					
10		Distribution	*Triangular*	*Triangular*	*Uniform*
11					
12		Competitor Distribution Parameters (Proportion of Our Project Cost)			
13		Minimum	95%	110%	120%
14		Most Likely	130%	125%	
15		Maximum	160%	140%	130%
16					
17		Competitor Distribution Parameters ($millions)			
18		Minimum	4.323	5.005	5.460
19		Most Likely	5.915	5.688	
20		Maximum	7.280	6.370	5.915
21					
22		**Minimum Competitor**			
23		**Bid ($million)**	4.753		
24					
25		**Our Bid ($million)**	5.302		
26					
27		**Win Bid?**	0	(1=yes, 0=no)	
28					
29		**Profit ($million)**	-0.050		
30					
31		**Mean Profit ($million)**	0.496140938		

28-9.

(a) A long-term loan of approximately $5 million maximizes Everglades's mean ending balance.

LT Loan	Mean 2021 Ending Balance
0	8.95
5	9.17
10	8.21
15	6.13
20	3.67

(b)
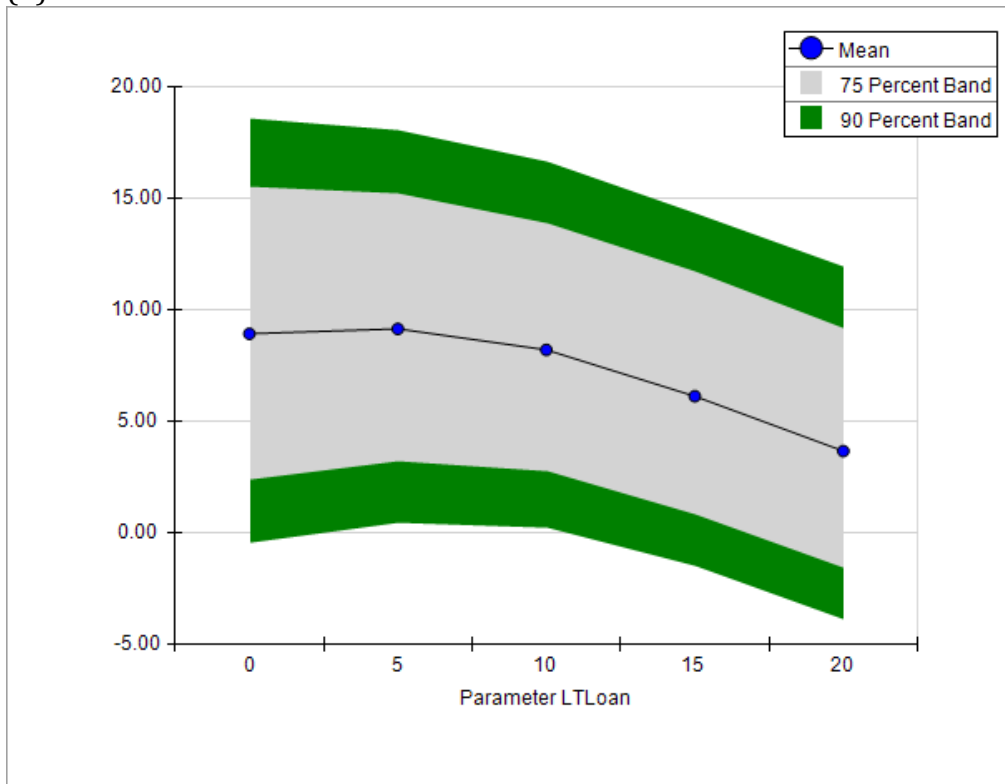
(c) The optimal long-term loan is approximately $3.82 million, as found by Solver.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1		**Everglade Cash Flow Management Problem When Applying Simulation**														
2																
3		LT Rate	5%													
4		ST Rate	7%													
5																
6		Start Balance	1				(all cash figures in millions of dollars)									
7		Minimum Cash	0.5													
8																
9			Cash Flow (Triangular Distribution)			Simulated						Balance				
10						Cash	LT	LT	ST	LT	ST	Before	ST	Ending		Minimum
11		Year	Min	Likely	Max	Flow	Loan	Interest	Interest	Payback	Payback	ST Loan	Loan	Balance		Balance
12		2011	-9	-8	-7	-8.73	3.82					-3.91	4.41	0.50	>=	0.50
13		2012	-4	-2	1	-2.55		-0.19	-0.31		-4.41	-6.96	7.46	0.50	>=	0.50
14		2013	-7	-4	0	-3.62		-0.19	-0.52		-7.46	-11.29	11.79	0.50	>=	0.50
15		2014	0	3	7	0.99		-0.19	-0.83		-11.79	-11.31	11.81	0.50	>=	0.50
16		2015	3	6	9	6.16		-0.19	-0.83		-11.81	-6.17	6.67	0.50	>=	0.50
17		2016	1	3	5	3.03		-0.19	-0.47		-6.67	-3.80	4.30	0.50	>=	0.50
18		2017	-6	-4	-2	-4.34		-0.19	-0.3008		-4.2972	-8.62	9.12	0.50	>=	0.50
19		2018	4	7	12	8.96		-0.19	-0.64		-9.12	-0.49	0.99	0.50	>=	0.50
20		2019	-5	-2	4	1.54		-0.19	-0.0696		-0.9938	0.78	0.00	0.78	>=	0.50
21		2020	5	10	18	7.98		-0.19	0		0	8.57	0.00	8.57	>=	0.50
22		2021						-0.19	0	-3.82	0	4.56		4.56	>=	0.50
23																
24												Mean 2021 Ending Balance		9.20		

28-10.

(a) Accepting approximately 185 reservations maximizes the mean profit.

Reservations to Accept	Mean Profit
180	$11,612
181	$11,719
182	$11,806
183	$11,875
184	$11,918
185	$11,940
186	$11,936
187	$11,917
188	$11,875
189	$11,812
190	$11,732

(b)
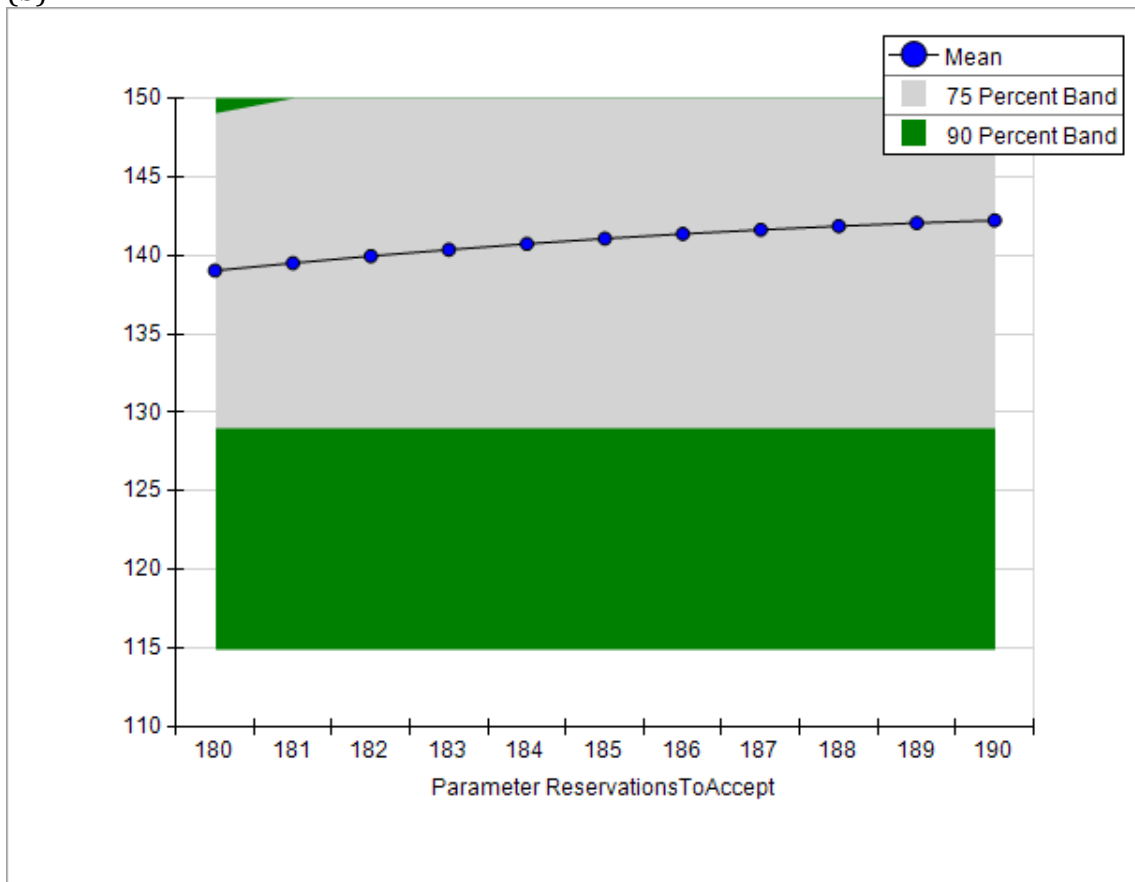
(c) The optimal number of reservations to accept is approximately 185, as found by Solver.

	B	C	D	E	F
3		Data			
4	Available Seats	150			
5	Fixed Cost	$30,000			
6	Avg. Fare / Seat	$300			
7	Cost of Bumping	$450			
8					
9				Mean	Standard Dev.
10	Ticket Demand	161.58	Normal	195	30
11	Demand (rounded)	162			
12					
13	Reservations to Accept	185			
14					
15				Tickets	Probability
16				Purchased	to Show up
17	Number that Show	129	Binomial	162	80%
18					
19					
20	Number of Filled Seats	129		Ticket Revenue	$38,700
21	Number Denied Boarding	0		Bumping Cost	$0
22				Fixed Cost	$30,000
23	Mean Filled Seats	141.04		Profit	$8,700
24	Mean Denied Boarding	0.86			
25	Mean Profit	$11,925			