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Decision Models and Analytics
Assignment 5 Report

Problem: Retirement Planning

Assume an investment advisor, Roy Dodson, is assisting a widowed client in determining a sustainable retirement withdrawal. The client is a 59 year-old woman who turns 60 in two months. She has $1,000,000 in a tax-deferred retirement account that will be the primary source of her retirement income. Roy has designed a portfolio for his client with returns he expects to be normally distributed with a mean of 8% and standard deviation of 2%. Withdrawals will be made at the beginning of each year on the client's birthday.

Roy assumes that the inflation rate will be 3%, based on long-term historical data. So if her withdrawal at the beginning of the first year is $40,000, her inflation-adjusted withdrawal at the beginning of the second year will be $41,200, and third year's withdrawal will be $42,436, and so on.

To account for this uncertainty in the client's age at death, Roy would like to model the client's remaining life expectancy as a random variable between 0 and 50 years that follows a lognormal distribution with a mean of 20 and standard deviation of 10 (rounded to the nearest integer). In consultation with his client, he also wants to limit the chance that she will run out of money before her death to a maximum of 5%.

Questions:

1. If Roy advise his client to withdraw $ 60,000 on her 60th birthday, what is the probability that she will run out of money before her death?
2. What is the maximum amount she should withdraw on her 60th birthday?

Solution:

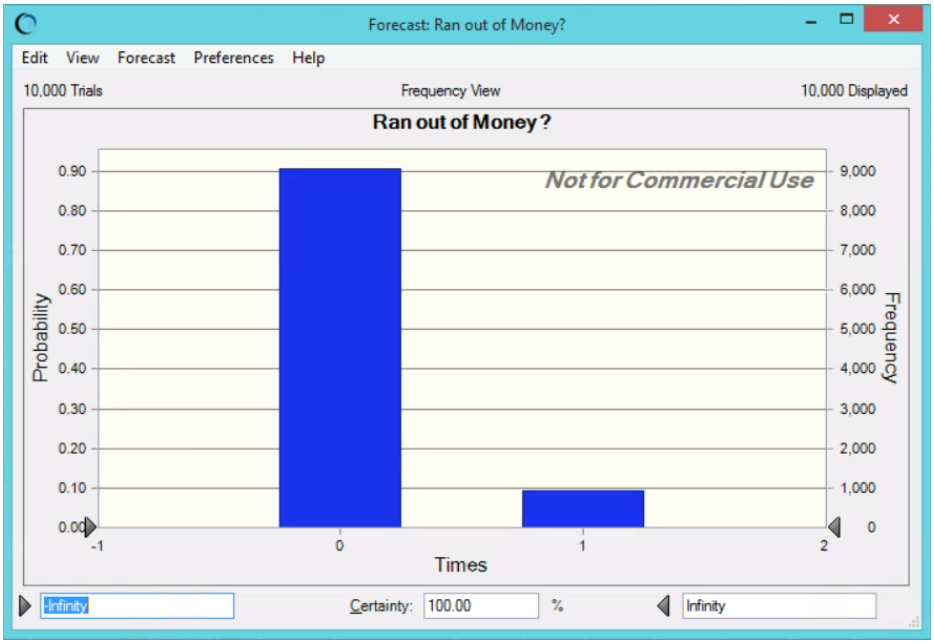
Excel File: Assignment 5.xlsx

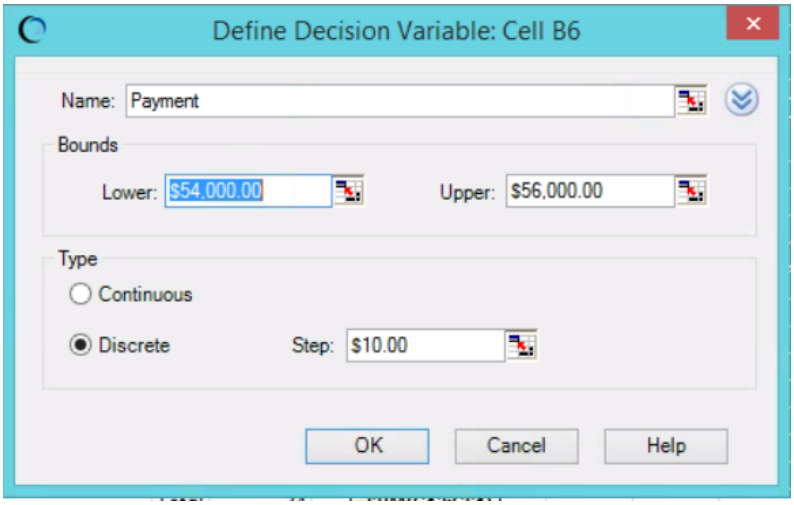
If Roy advises his client to withdraw $60,000 on her 60th birthday, the probability that she will run out of money before her death is approximately 9%. The maximum amount she should withdraw on her 60th birthday is $55,790.

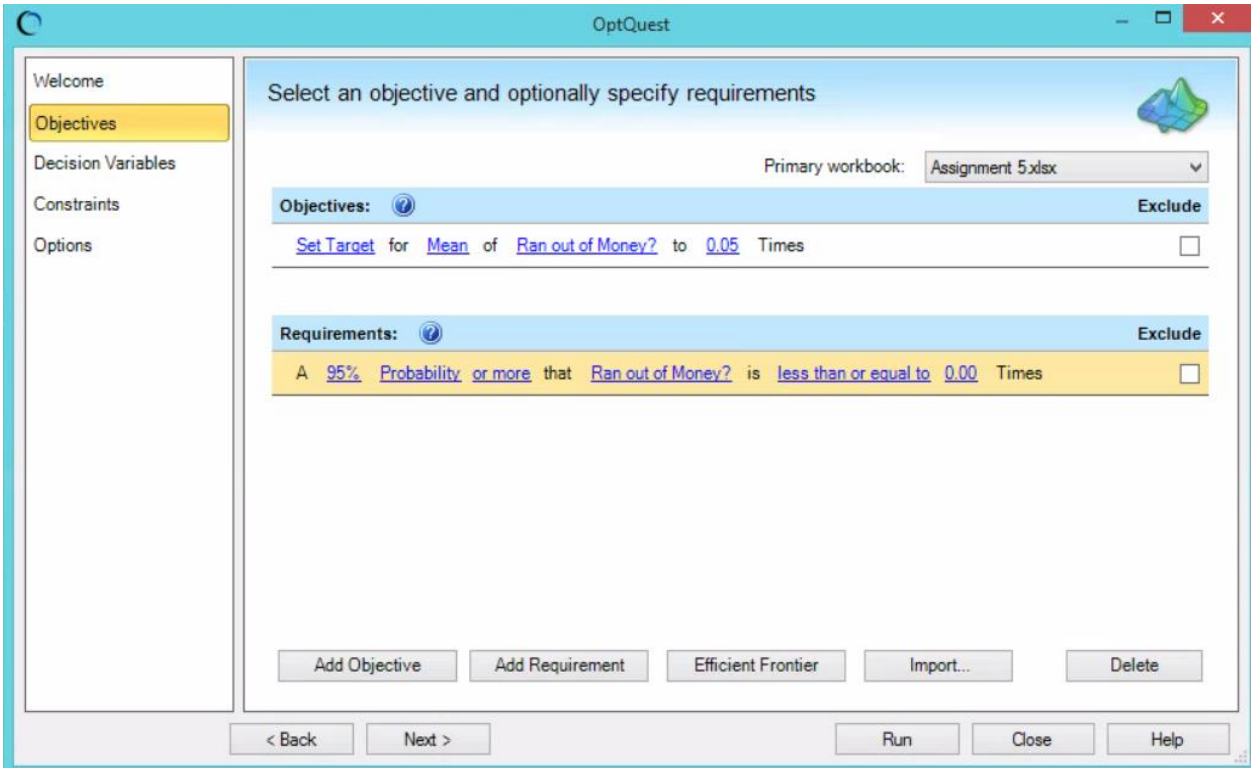
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1														
2														
3	401 K Savings	$ 1,000,000.00												
4	Portfolio Standard Dev.	2%												
5	Portfolio Expected Retur	8.00%						Years till Death						
6	First Withdraw Amount	$55,790.00		=IF(B12>=C12,(B12-C12)*(1+D12),0)				0						
7	Inflation	3%												
8			=CB.Normal(B5,B4)						=ROUND(CB.Lognormal2(20,10,0,50),0)					
9														
10			=C12*(1+B7)											
11	Year	Year Start	Draw Down	Return	Year End		Positive?		Ran out of Money?			1 = Running out		0 = Fine
12	1	$ 1,000,000.00	$55,790.00	11.04%	$ 1,048,427.26		1		0					
13	2	$ 1,048,427.26	$57,463.70	7.25%	$ 1,062,774.60		=IF(E12>0,1,0)		=IF(G62<H6,1,0)					
14	3	$ 1,062,774.60	$59,187.61	6.35%	$ 1,067,350.79		1							
15	4	$ 1,067,350.79	$60,963.24	6.96%	$ 1,076,431.72		1							
16	5	$ 1,076,431.72	$62,792.14	7.91%	$ 1,093,770.79		1							
59	48	$ -	$223,823.62	9.32%	$ -		0							
60	49	$ -	$230,538.33	7.21%	$ -		0							
61	50	$ -	$237,454.48	6.20%	$ -		0							
62						Total	=SUM(G12:G61)							
63														

1 = Running out of money before she dies 0 = Not running out of money before she dies

If she withdraws $60,000 on her 60th birthday the probability she runs out before she dies is 9%.







Problem: Airline Reservations with Overbooking

Transcontinental Airlines has a daily flight from San Francisco to Chicago. There are 140 coach seats and 10 business seats available. The profit per seat sold is $300 and $1000 for coach and business seats respectively.

Demand is uniformly distributed between 2 and 18 for business seats and between 100 and 220 seats for coach seats. This is a nonrefundable fare, so no-shows forfeit the entire fare. Each customer has an 80% probability to show up for his or her flight.

If we overbook this flight and have to deny boarding to a passenger, the total cost to Transcontinental will be $500 per coach passenger and $2000 per business passenger. However, in case a coach passenger needs to be bumped, if there are available seats in business class, we can upgrade customers from coach at no cost. Note that business customers cannot be downgraded to coach.

Questions:

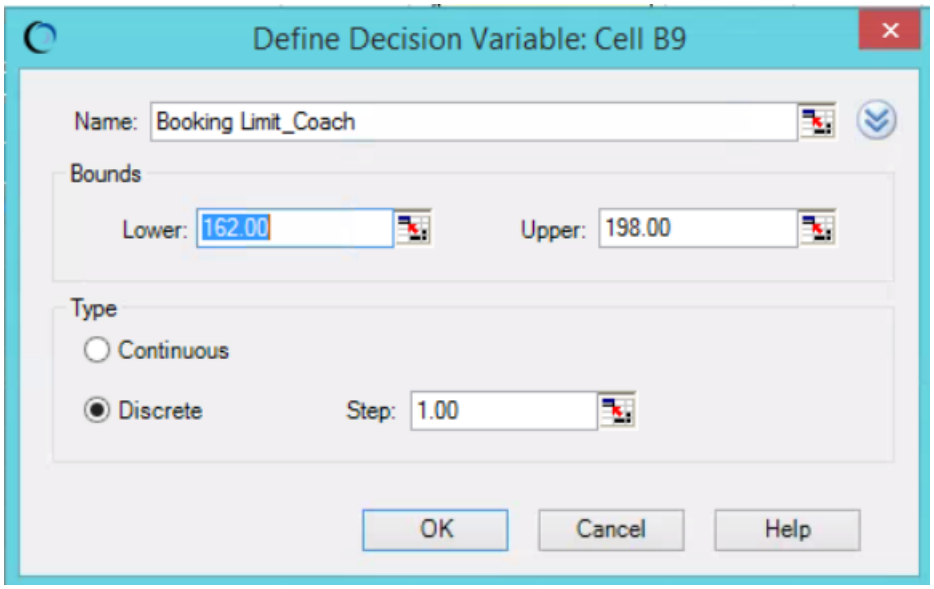
Determine the overbooking limit for each customer class.

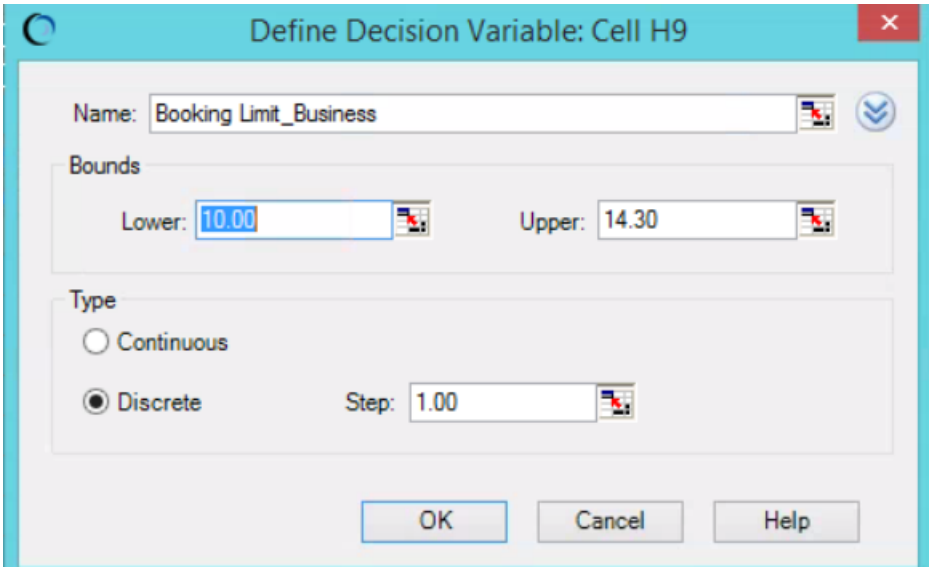
Solution:

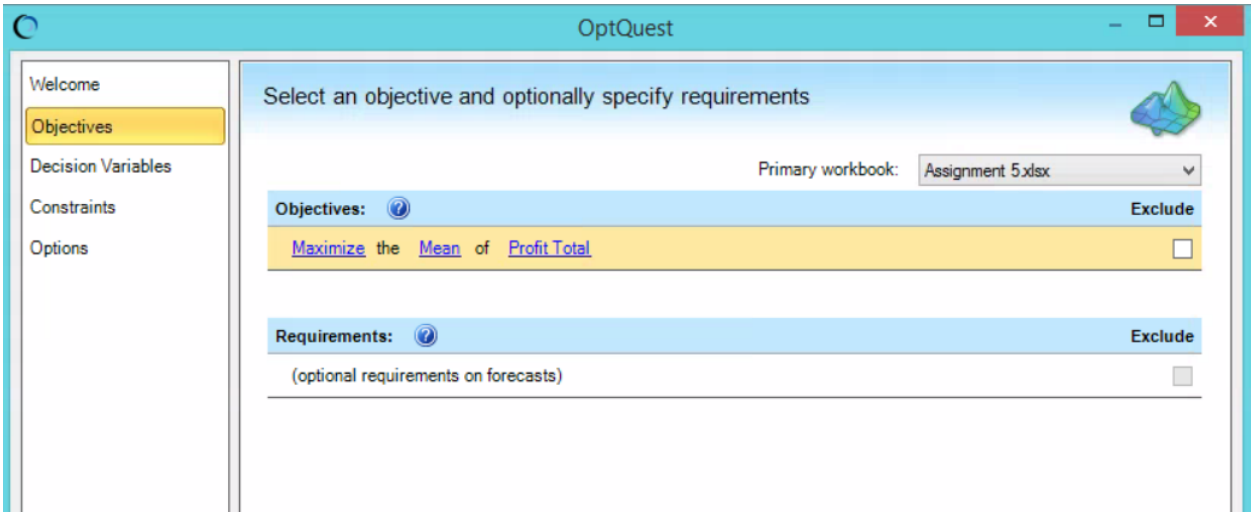
Excel File: Assignment 5.xlsx

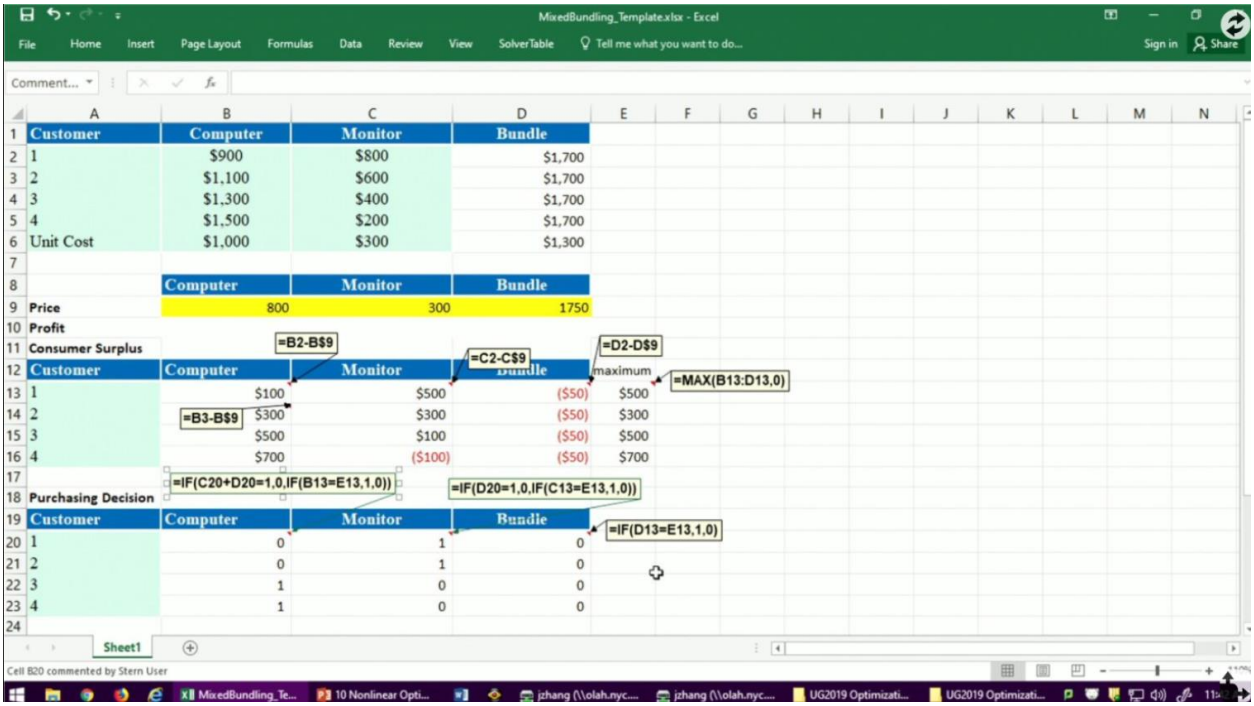
The optimal overbooking limit for coach class should be 180 seats and for business class it should be 13.

	A	B	C	D	E	F	G	H	I	J	K	L
1	**Data**	Coach					**Data**	Business				
2	Avilable Seats	140					Avilable Seats	10				
3	Averg Profit/Seat	$300					Averg Profit/Seat	$1,000				
4	Cost of Bumping	$500	=CB.Uniform(D6,E6)				Cost of Bumping	$2,000	=CB.Uniform(J6,K6)			
5				Mean	Stdev					Mean	Stdev	
6	Ticket Demand	186	Uniform	100	220		Ticket Demand	16	Uniform	2	18	
7	Demand (rounded)	186					Demand (rounded)	16				
8												
9	Booking Limit	184					Booking Limit	13				
10		=CB.Binomial(E12,D12)		# of Tickets	Prob			=CB.Binomial(K12,J12)		# of Tickets	Prob	
11				Sold	Show Up					Sold	Show Up	
12	Number of Passengers Show up	142	Distributi	184	=MIN(B7,B9)		Number of Passengers Show up	10	Distributi	13	=MIN(H7,H9)	
13												
14	Number of Filled Seats	=MAX(MAX(0,B12-B2)-H14,0)					Number of Empty Seats	0	=MAX(H2-H12,0)			
15	Number of Denied Boa	2					Number of Denied Boarding	0	=MAX(0,H12-H2)			
16												
17	Ticket Revenue	$55,200	=B3*D12				Ticket Revenue	$13,000	=H3*J12			
18	Bumping Cost	$1,000	=B4*B15				Bumping Cost	$0	=H4*H15			
19	Profit	$54,200	=B17-B18				Profit	$13,000	=H17-H18			
20												
21	Profit Total	$67,200	=SUM(B19,H19)									




Define Decision Variable: Cell H9
Name: Booking Limit_Business
Bounds
Lower: 10.00
Upper: 14.30
Type
Continuous
Discrete
Step: 1.00
OK
Cancel
Help


OptQuest
Welcome
Objectives
Decision Variables
Constraints
Options
Select an objective and optionally specify requirements
Primary workbook: Assignment 5.xlsx
Objectives:
Exclude
Maximize the Mean of Profit Total
Requirements:
Exclude
(optional requirements on forecasts)



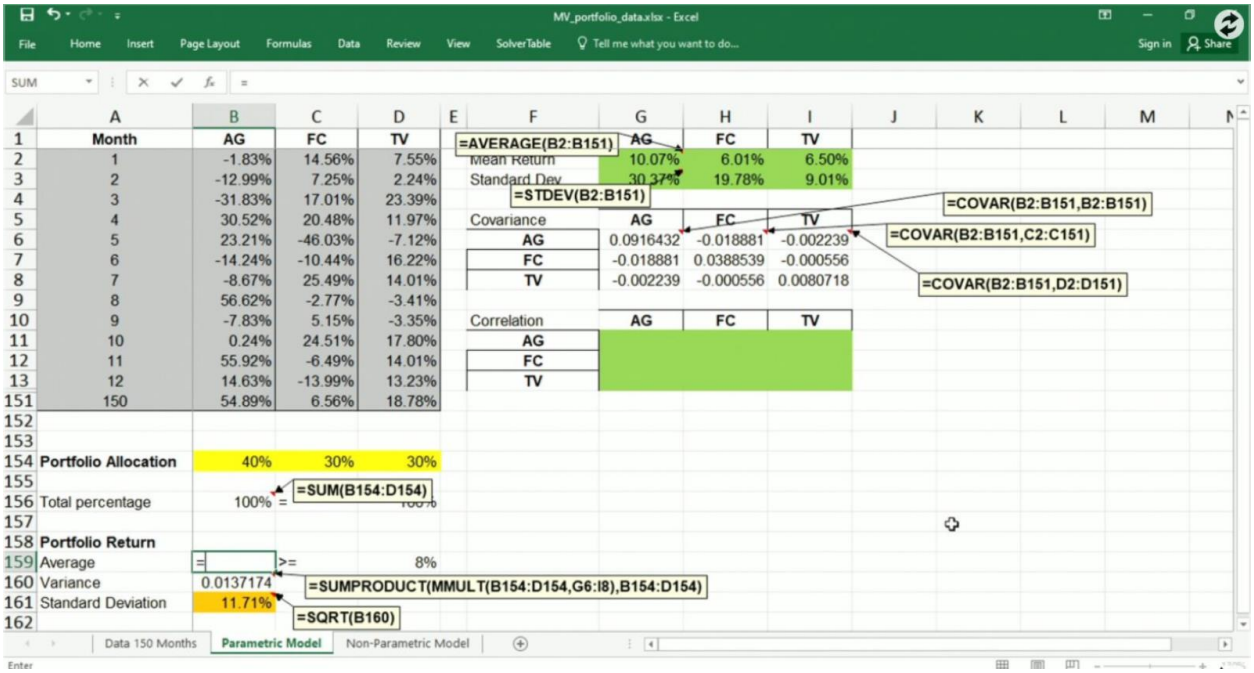
Customer	Computer	Monitor	Bundle
1	$900	$800	$1,700
2	$1,100	$600	$1,700
3	$1,300	$400	$1,700
4	$1,500	$200	$1,700
Unit Cost	$1,000	$300	$1,300

	Computer	Monitor	Bundle
Price	800	300	1750
Profit			
Consumer Surplus			

Customer	Computer	Monitor	Bundle	maximum
1	$100	$500	($50)	$500
2	$300	$300	($50)	$300
3	$500	$100	($50)	$500
4	$700	($100)	($50)	$700

Purchasing Decision

Customer	Computer	Monitor	Bundle
1	0	1	0
2	0	1	0
3	1	0	0
4	1	0	0



Month	AG	FC	TV
1	-1.83%	14.56%	7.55%
2	-12.99%	7.25%	2.24%
3	-31.83%	17.01%	23.39%
4	30.52%	20.48%	11.97%
5	23.21%	-46.03%	-7.12%
6	-14.24%	-10.44%	16.22%
7	-8.67%	25.49%	14.01%
8	56.62%	-2.77%	-3.41%
9	-7.83%	5.15%	-3.35%
10	0.24%	24.51%	17.80%
11	55.92%	-6.49%	14.01%
12	14.63%	-13.99%	13.23%
150	54.89%	6.56%	18.78%

	AG	FC	TV
Mean Return	10.07%	6.01%	6.50%
Standard Dev	30.37%	19.78%	9.01%

Covariance	AG	FC	TV
AG	0.0916432	-0.018881	-0.002239
FC	-0.018881	0.0388539	-0.000556
TV	-0.002239	-0.000556	0.0080718

Correlation	AG	FC	TV
AG			
FC			
TV			

Portfolio Allocation	40%	30%	30%
Total percentage	100%		

Portfolio Return

Average	=	>=	8%
Variance	0.0137174		
Standard Deviation	11.71%		