Retirement Planning (A)

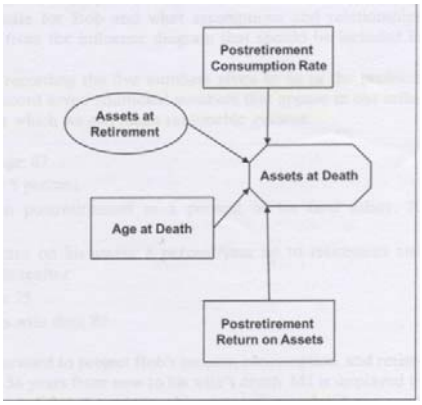
Bob Davidson is a 46-year-old, married, tenured professor at a small New England college. His current salary is $116,000. His employer contributes an amount equal to 10 percent of his salary to a retirement fund, and Bob himself has been contributing $9,500 a year. The current value of his retirement fund is $167,000. Bob would like to know whether his current level of retirement savings is adequate. [p. 80]

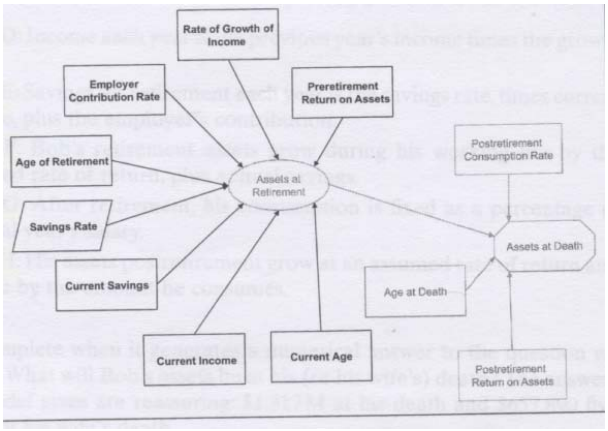
<u>We will assume:</u>

- Bob will retire at 67
- He will save 5% of his gross income each year until retirement
- He will consume 70% of his final gross salary each year in retirement
- His assets will earn 8%/year up to retirement and 5%/year after.
- He will die at 75
- His wife will die when he would have been 80

<u>We will choose Assets at Death as the outcome measure:</u>

Influence Diagram





Version 1 (M1)

	A	B	C	D	E	F	G	H
5		**Parameters**						
6			Current income	$116,000				
7			Current savings	$167,000				
8			Employer savings rate	10%				
9			Current savings	$9,500				
10			Age	46				
11			Return on assets					
12			pre-retirement	8%				
13			post-retirement	5%				
14			Percent of final income spent	70%				
15			Income growth rate	4%				
16								
17		**Decision**						
18			Savings rate	5.00%				
19								
20					**Savings out of**	**Retirement assets**	**Consumption**	**Retirement assets**
21		**Mode**	**Age**	**Income**	**income**	**pre retirement**	**post retirement**	**post returement**
22			46					
23			47					
24			48					
25			49					
39			63					
40			64					
41			65					
42			66					
43			67					
44			68					
45			69					
46			70					
47			71					
55			79					
56			80					

[note: hidden rows]

Income = Prior year * (1 + growth rate)
Saving out of income = (personal savings rate + employer savings rate) * income
Retirement assets pre retirement = prior year * (1 + pre-retirement return on assets) + savings
Consumption post retirement = percent * ending income
Retirement assets post retirement = assets * (1 + post-retirement return on assets) - consumption

Implementation Details:

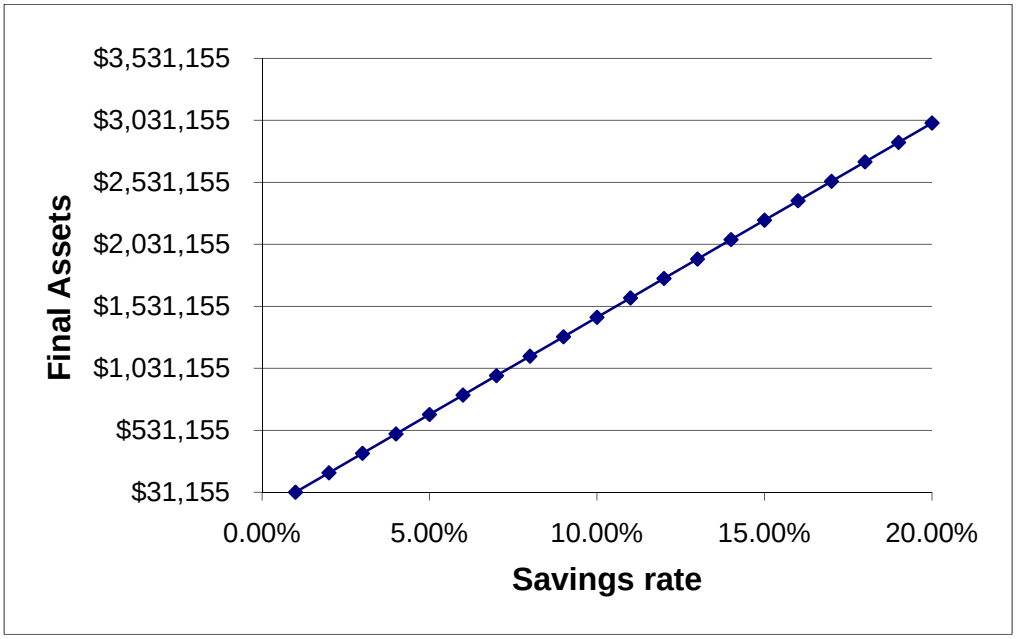
D22	=D6
D23	=D22*(1+$D$15)
E22	=($D$8+$D$18)*D22
F22	=D7
F23	=F22*(1+$D$12)+E23
G44	=D14*D43
G45	=G45
H44	=F43*(1+$D$13)-G44
H45	=H44*(1+$D$13)-G45

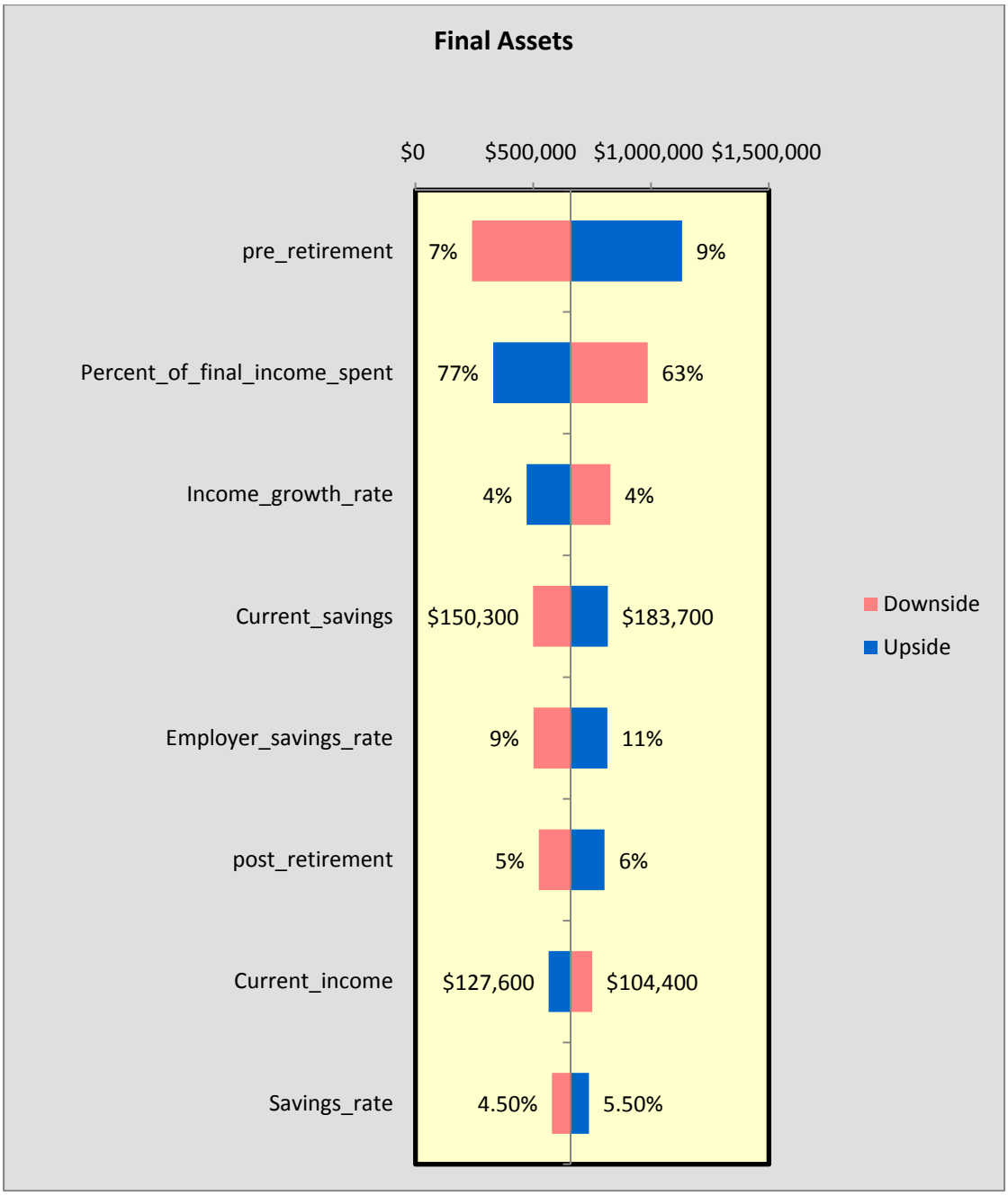
	A	B	C	D
1	**Retirement Planning**			
2				
3				
4				
5		**Parameters**		
6			Current income	$116,000
7			Current savings	$167,000
8			Employer savings rate	10%
9			Current savings	$9,500
10			Age	46
11			Return on assets	
12			pre-retirement	8%
13			post-retirement	5%
14			Percent of final income spent	70%
15			Income growth rate	4%
16				
17		**Decision**		
18			Savings rate	5.00%

	B	C	D	E	F	G	H
16							
17	**Decision**						
18		Savings rate	5.00%				
19							
20				**Savings out of**	**Retirement assets**	**Consumption**	**Retirement assets**
21	**Mode**	**Age**	**Income**	**income**	**pre retirement**	**post retirement**	**post retirement**
22		46	116,000	$17,400	$167,000		
23		47	120,640	$18,096	$198,456		
41		65	244,395	$36,659	$1,720,007		
42		66	254,170	$38,126	$1,895,733		
43		67	264,337	$39,651	$2,087,042		
44		68				185,036	$2,006,358
45		69				185,036	$1,921,640
46		70				185,036	$1,832,686
54		78				185,036	$940,783
55		79				185,036	$802,787
56		80				185,036	$657,890

Insights from initial model:

- Model predicts Bob's assets at age 80 will be $657,890
- Savings rate (1 way data table) and chart → savings rate is adequate
- Goal seek (shows 0.8% savings needed to "break even" on final assets)
- Tornado → Bob's assets at death are highly sensitive to savings rate

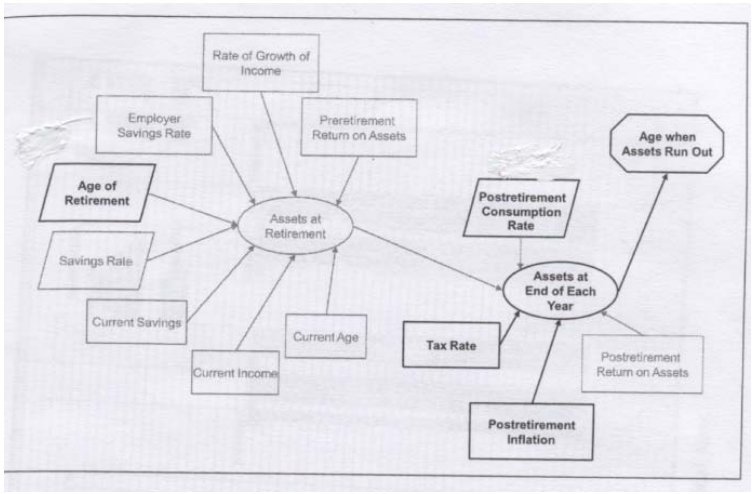



Final Assets
$0
$500,000
$1,000,000
$1,500,000
pre_retirement
7%
9%
Percent_of_final_income_spent
77%
63%
Income_growth_rate
4%
4%
Current_savings
$150,300
$183,700
Employer_savings_rate
9%
11%
post_retirement
5%
6%
Current_income
$127,600
$104,400
Savings_rate
4.50%
5.50%
Downside
Upside

Version 2 (M2)

In addition to wanting to know what his assets might be at death, Bob probably would like to know:

- The number of years he could live comfortably in retirement
- The probability of running out of savings before he dies
- The maximum amount he can spend each year in retirement and not run out before a certain age
- The amount he will have saved when he retires
- Combination of savings rates and postretirement consumption rates that guarantee sufficient assets to a certain age



	A	B	C	D
1	**Retirement Planning**			
2				
3				
4				
5		**Parameters**		
6		**Current**	Current income	$116,000
7			Current savings	$200,000
8			Age	46
9		**Assumed**	Employer savings rate	10%
10			ROA pre-retirement	9%
11			ROA post-retirement	5%
12			Income growth rate (includes inflation)	4%
13			Inflation post-retirement	2%
14			Tax rate post-retirement	25%
15		**Decision**	Savings rate	10.00%
16			Percent of final income spent	70%
17			Retirement age	66.0

	B	C	D	E	F	G	H
23	**Model**						
24		**PRE-RETIREMENT**		**Employer**	**Personal**	**Beginning of**	**End of**
25		**Age**	**Salary**	**contribution**	**Contribution**	**Year Assets**	**Year Assets**
26		46					
27		47					
28		48					
29		49					
30		50					
31		51					
32		52					
33		53					
34		54					
35		55					
36		56					
37		57					
38		58					
54		74					
55		75					
56		76					
57		77					
58		78					
59		79					
60		80					
61		81					
62		82					
63		83					
64		84					
65		85					
66		86					
67		87					
68		88					
69		89					
70		90					

Pre-Retirement (Logic)

D: Salary = previous year's salary times the growth rate.

E: Employer contribution = salary times the employer contribution rate.

F: Personal contribution = salary times the personal contribution rate.

G: Beginning of year assets = assets from the end of the previous year.

H: End of year assets = assets at the end of year are assets from the beginning of the year, times the quantity one plus the rate of return, plus employer contributions and personal contributions.

Hint: Age 46 -> =G26*(1+$D$10)+E26+F26

	I	J	K	L	M	N	O
23							
24		POST-RETIREMENT			Beginning of	End of	Funds depleted?
25		Age	Spending	Withdrawal	Year Assets	Year Assets	1=Yes
26		65					
27		66					
28		67					
29		68					
30		69					
31		70					
32		71					
33		72					
34		73					
35		74					
36		75					
37		76					
38		77					
54		93					
55		94					
56		95					
57		96					
58		97					
59		98					
60		99					
61		100					

Post-Retirement

K: Spending = the first year of retirement is the final working year's salary times the percent of final income spent; thereafter, spending grows at the rate of inflation.

Hint: Age 46 -> =D16*VLOOKUP(J26,C26:D70,2,1)

L: Withdrawal = spending divided by the quantity one minus the tax rate.

M: Beginning of year assets = assets at the end of the previous year.

N: End of year assets = assets from the beginning of the year, times the quantity one plus the rate of return, minus the withdrawal.

O: Funds depleted? = retirement funds are depleted when end-of-year assets are negative.

Implementation Hints:

You might use a VLOOKUP in K26 and M26 to pick out the appropriate date to start the postretirement calculations depending on the year of retirement.

K26 logic: Percent of final income spent * VLOOKUP(J26(the post retirement age), beginning age->end of salary range, column number for salary)

M26 logic: VLOOKUP(J26(the post retirement age), beginning age->end of year assets range, column number for end of year assets)

You can use a combination of INDEX and MATCH in cell I6 to identify the year funds run out:

INDEX(J26:J61, MATCH(1,O26:O61,0))

To find the age in the range J26:J61, based on the location calculated by the MATCH function.

You might use an IF function in column O to identify when the end of year assets turn negative by using a 1 if they are negative and a 0 otherwise.

Requirements:

1. Develop insights from creating a data table and tornado chart (use the "assumed" parameters as inputs) – use age 80 for final assets.
2. Use scenario manager to create a report based on the following with outcomes of final assets at age 80 and Year funds out:
    a. Base case – use the current parameters
    b. Worst case – savings rate = 5%, percent final income spent = 80%, retirement age = 64
    c. Best case – savings rate = 12%, percent final income spent = 60%, retirement age = 68
3. Use @Risk to examine the problem stochastically assuming the pre-retirement returns are normally distributed with mean of 8% and standard deviation of 2%, and the post-retirement returns are triangularly distributed with a minimum of 2%, most likely of 5% and a maximum of 7%. Create a forecast chart. Comment on the probability of final assets being positive.