

Example: Investing for retirement

Amanda has 30 years to save for her retirement. Initially, she invests \$8,000 in her retirement account. Each subsequent year she invests 3% more. Estimate the balance of Amanda's retirement account at the end of 30 years.

Model 1: Suppose the *mean* annual return on stocks is 8% (a representative return for her investment style).

	A	B	C	D	E
1	Investing for retirement				
2					
3	Initial yearly investment	\$8,000			
4	Annual increase in investment	3.00%			
5					
6	Annual return on investment	8.00%			
7					
8		Amount	Beginning		Ending
9	Year	invested	balance	Return	balance
10	1				
11	2				
12	3				
13	4				
14	5				
15	6				
16	7				
17	8				
18	9				
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36	27				
37	28				
38	29				
39	30				

Model 1 Results:

	A	B	C	D	E
1	Investing for retirement				
2					
3	Initial yearly investment	\$8,000			
4	Annual increase in investment	3.00%			
5					
6	Annual return on investment	8.00%			
7					
8		Amount	Beginning		Ending
9	Year	invested	balance	Return	balance
10	1	\$8,000.00	\$8,000	8.00%	\$8,640
11	2	\$8,240.00	\$16,880	8.00%	\$18,230
12	3	\$8,487.20	\$26,718	8.00%	\$28,855
13	4	\$8,741.82	\$37,597	8.00%	\$40,605
14	5	\$9,004.07	\$49,609	8.00%	\$53,577
15	6	\$9,274.19	\$62,852	8.00%	\$67,880
16	7	\$9,552.42	\$77,432	8.00%	\$83,627
17	8	\$9,838.99	\$93,466	8.00%	\$100,943
18	9	\$10,134.16	\$111,077	8.00%	\$119,963
19	10	\$10,438.19	\$130,401	8.00%	\$140,833
20	11	\$10,751.33	\$151,585	8.00%	\$163,712
21	12	\$11,073.87	\$174,785	8.00%	\$188,768
22	13	\$11,406.09	\$200,174	8.00%	\$216,188
23	14	\$11,748.27	\$227,937	8.00%	\$246,172
24	15	\$12,100.72	\$258,272	8.00%	\$278,934
25	16	\$12,463.74	\$291,398	8.00%	\$314,710
26	17	\$12,837.65	\$327,547	8.00%	\$353,751
27	18	\$13,222.78	\$366,974	8.00%	\$396,332
28	19	\$13,619.46	\$409,951	8.00%	\$442,747
29	20	\$14,028.05	\$456,775	8.00%	\$493,317
30	21	\$14,448.89	\$507,766	8.00%	\$548,388
31	22	\$14,882.36	\$563,270	8.00%	\$608,332
32	23	\$15,328.83	\$623,660	8.00%	\$673,553
33	24	\$15,788.69	\$689,342	8.00%	\$744,489
34	25	\$16,262.35	\$760,752	8.00%	\$821,612
35	26	\$16,750.22	\$838,362	8.00%	\$905,431
36	27	\$17,252.73	\$922,684	8.00%	\$996,498
37	28	\$17,770.31	\$1,014,269	8.00%	\$1,095,410
38	29	\$18,303.42	\$1,113,714	8.00%	\$1,202,811
39	30	\$18,852.52	\$1,221,663	8.00%	\$1,319,396

Problem?

Model 2: Suppose the annual return on stocks follows a *normal distribution* with a mean of 8% and a standard deviation of 25%.

	A	B	C	D	E
1	Investing for retirement				
2					
3	Initial yearly investment	\$8,000			
4	Annual increase in investment	3.00%			
5					
6	Annual return on investment (normal dist.)				
7	Mean	8.00%			
8	St. dev.	25.00%			
9					
10		Amount	Beginning		Ending
11	Year	invested	balance	Return	balance
12	1				
13	2				
14	3				
15	4				
16	5				
17	6				
18	7				
19	8				
...					
39	28				
40	29				
41	30				

Step 1: Loading @Risk.

Step 2: Revise Excel worksheet.

Step 3: Specify *output cells*.

Step 4: Choose simulation settings.

Iterations = _____
 Simulations = _____

Step 5: Run simulation.

Step 6: Examine the results.

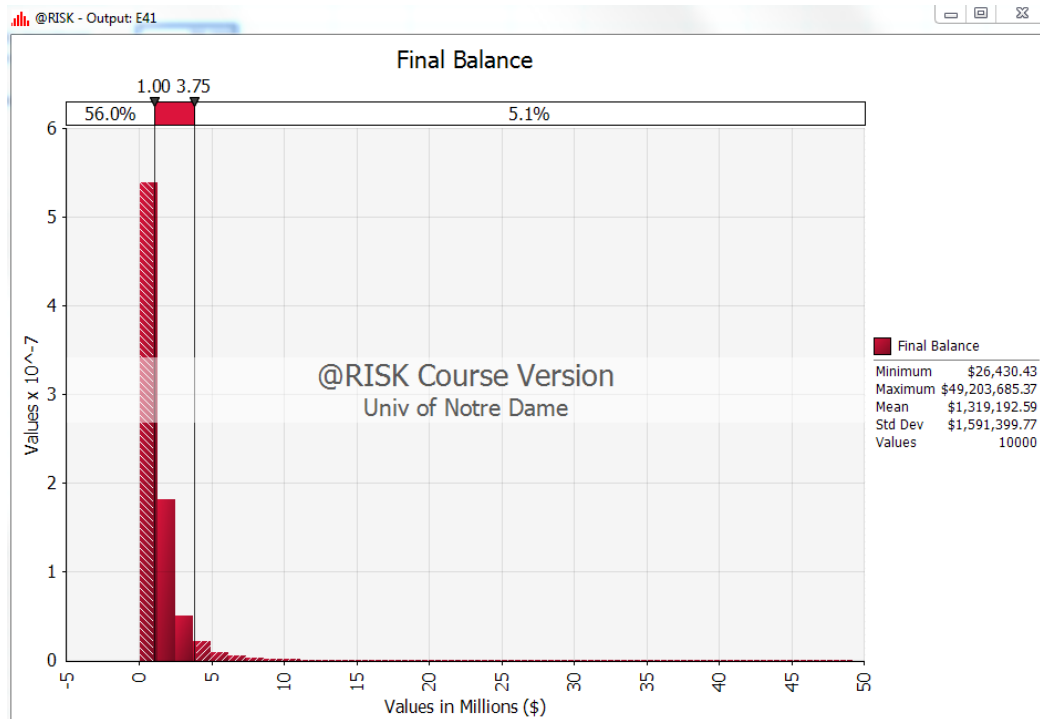
Model 2 Results:

One particular simulation result for Model 2:

	A	B	C	D	E
1	Investing for retirement				
2					
3	Initial yearly investment	\$8,000			
4	Annual increase in investment	3.00%			
5					
6	Annual return on investment (normal dist.)				
7	Mean	8.00%			
8	St. dev.	25.00%			
9					
10		Amount	Beginning		Ending
11	Year	invested	balance	Return	balance
12	1	\$8,000.00	\$8,000	16.93%	\$9,354
13	2	\$8,240.00	\$17,594	45.27%	\$25,558
14	3	\$8,487.20	\$34,045	17.07%	\$39,856
15	4	\$8,741.82	\$48,597	16.28%	\$56,508
16	5	\$9,004.07	\$65,512	9.55%	\$71,766
17	6	\$9,274.19	\$81,041	-46.97%	\$42,979
18	7	\$9,552.42	\$52,531	1.02%	\$53,066
19	8	\$9,838.99	\$62,905	-12.15%	\$55,265
20	9	\$10,134.16	\$65,399	43.95%	\$94,145
21	10	\$10,438.19	\$104,583	-10.11%	\$94,005
22	11	\$10,751.33	\$104,757	7.12%	\$112,217
23	12	\$11,073.87	\$123,291	25.08%	\$154,212
24	13	\$11,406.09	\$165,619	-7.83%	\$152,650
25	14	\$11,748.27	\$164,398	15.43%	\$189,758
26	15	\$12,100.72	\$201,859	14.61%	\$231,356
27	16	\$12,463.74	\$243,820	-29.55%	\$171,766
28	17	\$12,837.65	\$184,603	-29.66%	\$129,842
29	18	\$13,222.78	\$143,065	48.88%	\$213,002
30	19	\$13,619.46	\$226,621	11.11%	\$251,806
31	20	\$14,028.05	\$265,834	-8.06%	\$244,409
32	21	\$14,448.89	\$258,858	23.71%	\$320,221
33	22	\$14,882.36	\$335,103	49.16%	\$499,854
34	23	\$15,328.83	\$515,183	44.20%	\$742,884
35	24	\$15,788.69	\$758,673	29.47%	\$982,240
36	25	\$16,262.35	\$998,503	26.65%	\$1,264,613
37	26	\$16,750.22	\$1,281,364	11.56%	\$1,429,518
38	27	\$17,252.73	\$1,446,771	42.92%	\$2,067,653
39	28	\$17,770.31	\$2,085,423	-13.63%	\$1,801,123
40	29	\$18,303.42	\$1,819,426	41.19%	\$2,568,768
41	30	\$18,852.52	\$2,587,621	42.40%	\$3,684,843

@Risk output for Model 2:

Browse results:



Simulation Detailed Statistics:

@RISK - Detailed Statistics

Name	Final Balance
Description	Output
Cell	Model 2 Results!E..
Minimum	26430.43
Maximum	4.920368E+07
Mean	1319193
Std Deviation	1591400
Variance	2.532553E+12
Skewness	8.066064
Kurtosis	159.3809
Errors	0
Mode	473230.4
5% Perc	240736.9
10% Perc	313589.4
15% Perc	377160.6

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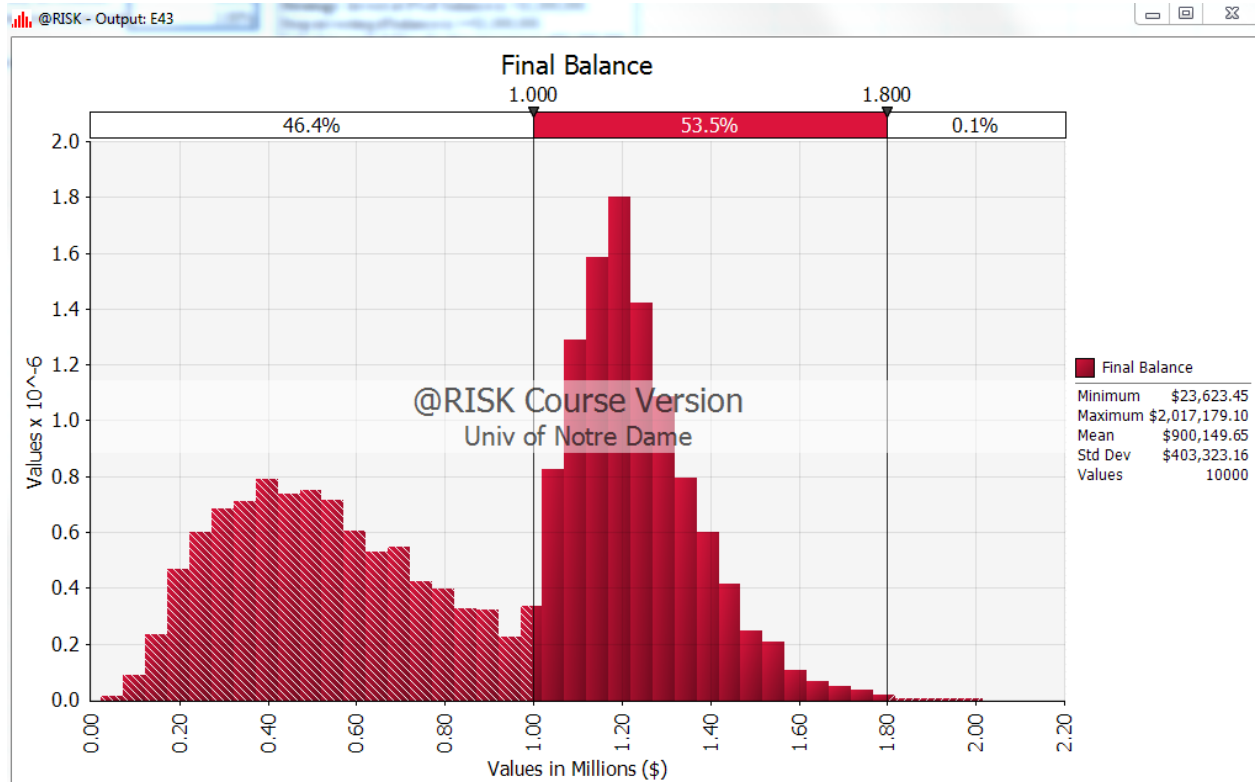
Target #1 (Value)	
Target #1 (Perc%)	

Question: What's the probability of getting a final balance of more than \$1,000,000?

Model 3: Examine a strategy to invest at 8% if balance is <\$1,000,000. Stop investing if balance is >=\$1,000,000. Calculate the probability of achieving target of \$1,000,000.

	A	B	C	D	E
1	Investing for retirement				
2					
3	Initial yearly investment	\$8,000	<div>Strategy: Invest at 8% if balance is <\$1,000,000. Stop investing if balance is >=\$1,000,000. Calculate probability of achieving target of \$1,000,000.</div>		
4	Annual increase in invest	3.00%			
5					
6	Annual return on investment (normal dist.)				
7	Mean	8.00%			
8	St. dev.	25.00%			
9					
10	Target	\$1,000,000			
11					
12		Amount	Beginning		Ending
13	Year	invested	balance	Return	balance
14	1				
15	2				
16	3				
17	4				
18	5				
19	6				
20	7				
21	8				
22	9				
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32	19				
33	20				
34	21				
35	22				
36	23				
37	24				
38	25				
39	26				
40	27				
41	28				
42	29				
43	30				

@Risk output for Model 3:



Question: What is the probability of achieving target of \$1,000,000?