Rules of thumb for endowment management

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Very preliminary!
Please do not quote.

Comments welcome.

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ABSTRACT

Suppose that an endowment is meant to provide long-term funding for a particular activity. How should the endowment be managed? I use Monte Carlo simulation to cast light on the combined effects of the investment and payout policy. I simulate three policies:

- Constant real payout policy: In this policy the amount paid out in real terms to the endowment beneficiary is constant. This creates the risk that the endowment will run out at some point, though as long as the endowment exists the beneficiary will get a constant (in real terms) amount. The simulations allow conclusions about the anticipated lifetime of the endowment and the average and standard deviation of the terminal endowment. Our simulations allow us to examine the effects of varying the investment policies and percentage payouts.
- A rolling percentage payout: In this policy the amount paid out is a percentage of the average endowment over the past three years. The real amount paid out varies tremendously, but payouts are guaranteed forever. The beneficiary bears the risk of the investment policy. The simulations generate dramatic examples of this risk and also allow us to examine the effects of varying the investment and percentage payout policies.
- A policy in which the preservation of the principal is paramount: In this policy a payout is allowed only if the principal is preserved in nominal terms. This *seems* (I can't find any references) to be the legal standard for endowments in some jurisdictions.

The modeling techniques are used in this note are flexible and can be used for a variety of situations. They add clarity to the usually murky discussions between donors and institutions about the management of large, donor-directed gifts.

AT THIS POINT, THIS IS NOT A PAPER, JUST A COLLECTION OF THOUGHTS AND SIMULATIONS

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Rules of thumb for endowment management

Introduction

Your institution has just received $1 million from a donor. The donor wishes the funds to be held in perpetuity, with a "reasonable percentage" to be transferred each year to fund a chair of ornithology. You are managing the funds, and you have the following questions:

- What is a "reasonable percentage?" You have heard 5% batted around, but you cannot find any empirical support for this number.
- What is the influence of inflation? Presumably any payouts from the endowment should be adjusted for future inflation.
- What should be the investment policy? Your investment committee has a finance professor as a member who believes that all investments should be broken down into a riskless (bond) component and a risky (market stock) component. But he cannot offer you reasonable advice about how to plan this breakdown between the two components.[1]

This topic has been the subject of considerable discussion in the NGO community. Although the issues have been identified, recommendations about the effects of various investment and payout policies are sparse.[2]

In this paper we offer a simple solution to this problem by using a Monte Carlo simulation. We will illustrate this solution and show that it offers some practical rules of thumb for investment.

Payout policy: Maintaining the real value of the payout

Below we give a simulation for 100 years of investment performance. We assume that the endowment is invested 50% in the risky asset and 50% in the risk-free asset. The simulation parameters are:

- The risky asset has a lognormal distribution with annual μ = 11% and σ = 25%, and the risk-free rate is r_f = 2% annually.
- At the end of each year, 5% of the initial $1 million is withdrawn from the account, and the remainder is invested according to the proportions.
- The Monte Carlo simulation proceeds by simulating the annual return on the risky asset as $1+\tilde{r} = Exp\left[\mu + \sigma Z\right]$, where Z is a draw from the standard normal distribution. Our examples use Excel, where Z is drawn using the Excel function **NormSInv(Rand())**.
- If at any point the draw is bigger than the endowment, the remaining funds are zero. In this case the endowment does not survive and the ornithology chair is out of cash.

[1] He's heard, says the professor, that 60/40 risky/non-risky is a common practice, but he cannot offer you any advice on why this should be so.

[2] See, for example, the excellent position paper by the CommonFund.

In the example below, the endowment does not run out over the period of 100 years:

	A	B	C
1	**ENDOWMENT MANAGEMENT: ONE PATH EXAMPLE** **Payout policy: Constant % ("draw") * Initial Endowment, Adjusted for Inflation**		
2	Initial endowment	1,000,000	
3	Annual draw	5%	
4	Inflation	3.50%	
5	Risky investment		
6	Mean	11%	
7	Sigma	25%	
8	Risk free	2%	
9	Proportion of risky	50%	
10			
11	Ending endowment	954,666,078	<-- =B116
12	Minimum	1,000,000	<-- =MIN(B16:B116)
13	Year endowment runs out	100	<-- =IF(ISERROR(MATCH(0,B16:B116,0)-1)=TRUE,100,MATCH(0,B16:B116,0)-1)
14			
15	**Year**	**Endow. at beg. year**	
16	0	1,000,000	
17	1	1,168,579	<-- =IF(B16-draw*B2*(1+Inflation)^A16>0,(B16-draw*B2*(1+Inflation)^A16)*(B9*EXP(mu+si
18	2	1,340,215	<-- =IF(B17-draw*B2*(1+Inflation)^A17>0,(B17-draw*B2*(1+Inflation)^A17)*(B9*EXP(mu+si
19	3	1,119,530	
20	4	1,339,719	
21	5	1,417,937	
22	6	1,932,919	
23	7	2,032,922	
24	8	2,219,378	
25	9	2,389,133	
26	10	2,143,089	
111	95	396,901,271	
112	96	473,931,971	
113	97	531,588,649	
114	98	680,629,174	
115	99	759,217,571	
116	100	954,666,078	

Although this particular simulation ends well, not all simulations turn out so auspiciously. In the simulation below, the endowment runs out after 27 years:

	A	B	C
1	**ENDOWMENT MANAGEMENT: ONE PATH EXAMPLE Payout policy: Constant % ("draw") * Initial Endowment, Adjusted for Inflation**		
2	Initial endowment	1,000,000	
3	Annual draw	5%	
4	Inflation	3.50%	
5	Risky investment		
6	Mean	11%	
7	Sigma	25%	
8	Risk free	2%	
9	Proportion of risky	50%	
10			
11	Ending endowment	0	<-- =B116
12	Minimum	0	<-- =MIN(B16:B116)
13	Year endowment runs out	27	<-- =IF(ISERROR(MATCH(0,B16:B116,0)-1)=TRUE,100,MATCH(0,B16:B116,0)-1)
14			
15	**Year**	**Endow. at beg. year**	
16	0	1,000,000	
17	1	1,252,941	<-- =IF(B16-draw*B2*(1+Inflation)^A16>0,(B16-draw*B2*(1+Inflation)^A16)*(B9*EXP(mu+si
18	2	1,480,905	<-- =IF(B17-draw*B2*(1+Inflation)^A17>0,(B17-draw*B2*(1+Inflation)^A17)*(B9*EXP(mu+si
19	3	1,433,036	
20	4	1,407,043	
21	5	1,187,742	
22	6	1,040,485	
23	7	1,065,410	
24	8	1,251,402	
25	9	1,168,141	
26	10	1,118,575	
111	95	0	
112	96	0	
113	97	0	
114	98	0	
115	99	0	
116	100	0	

Computing some statistics

The Excel spreadsheet above can adapted to give some statistics that are helpful for managerial decisions. In the spreadsheet below we run 100 simulations given the following data:

	A	B	C	D
1	**ENDOWMENT MANAGEMENT EXAMPLE**			
2	Initial endowment	1,000,000		
3	Inflation	2%		
4	Annual draw	5%		
5	Risky investment			
6	Mean	8%		
7	Sigma	22%		
8	Risk free rate	3%		
9	Proportion of risky	60%		

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We assume that the annual draw is 5%*1,000,000 adjusted for the 2% annual inflation, and let the endowment run until the money runs out. Here are some of the endowment paths:

	A	B	C	D	E	F	G	H	I
31		**Endowment at beginning of year**							
32	**Year ↓ Simulation →**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
33	0	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
34	1	1,140,881	1,251,770	934,513	1,346,945	1,047,489	903,478	991,869	1,297,494
35	2	1,208,479	1,251,861	996,175	1,172,098	1,054,024	1,049,096	1,133,359	1,202,398
36	3	1,252,156	1,714,586	912,778	1,407,691	905,808	1,351,141	1,235,820	1,200,582
37	4	1,206,455	1,436,189	1,075,593	1,404,267	932,226	1,628,452	1,292,943	1,207,348
38	5	1,269,729	1,624,151	1,083,769	1,363,674	834,609	2,017,620	1,360,406	1,078,105
39	6	1,380,611	1,511,036	1,141,922	1,295,088	1,074,907	2,130,747	1,412,810	954,663
123	90	0	53,381,028	0	0	630,828,779	41,469,524	0	0
124	91	0	62,604,203	0	0	614,040,527	41,840,833	0	0
125	92	0	66,573,780	0	0	671,721,305	47,722,056	0	0
126	93	0	56,248,118	0	0	732,203,645	56,359,143	0	0
127	94	0	61,552,735	0	0	820,074,129	64,499,213	0	0
128	95	0	49,767,908	0	0	768,011,216	54,506,694	0	0
129	96	0	59,043,290	0	0	743,815,723	60,102,132	0	0
130	97	0	62,496,061	0	0	803,267,124	64,315,813	0	0
131	98	0	66,026,251	0	0	823,617,345	68,686,888	0	0
132	99	0	72,637,933	0	0	822,803,162	65,134,396	0	0
133	100	0	75,237,632	0	0	932,399,191	64,606,986	0	0

By using Excel's **Data Table** , we can compute many statistics for this problem. Below, for example, we show the percentage of paths that last as long as 100 years:

	G	H	I	J	K	L	M	N	O
1			**Survival Percentage: Maintain Real Value of Initial after 100 Years**						
2				Draw from initial as % ↓					
3				**3%**	**4%**	**5%**	**6%**	**7%**	**8%**
4			**0%**	0%	0%	0%	0%	0%	0%
5	Percentage in risky asset →		**20%**	2%	0%	0%	0%	0%	0%
6			**40%**	50%	11%	1%	0%	0%	0%
7			**60%**	60%	37%	13%	7%	1%	0%
8			**80%**	74%	49%	29%	20%	3%	5%
9			**100%**	76%	62%	40%	28%	8%	10%

Not surprisingly, maintaining the real value of the endowment after 100 years requires a large investment in the risky asset. Also not surprisingly, increasing the annual draw has a negative survival influence. A typical set of parameters is 60% in the risky asset, 40% in the riskless, and a 5% annual draw adjusted for inflation. In this case the probability of surviving 100 years is only 13%.

The next table shows that the average life of this investment/drawdown policy is 42.74 years:

	Q	R	S	T	U	V	W	X	Y
1				**Average Year the Endowment Runs Out**					
2				Draw from initial as % ↓					
3				**3%**	**4%**	**5%**	**6%**	**7%**	**8%**
4			**0%**	41.00	29.00	23.00	19.00	16.00	14.00
5	Percentage in risky asset →		**20%**	57.20	35.40	25.83	21.22	17.17	14.96
6			**40%**	84.43	49.75	33.35	24.68	19.88	16.23
7			**60%**	86.13	70.29	42.74	31.10	25.19	18.10
8			**80%**	89.14	71.63	53.96	41.49	31.65	22.57
9			**100%**	90.53	76.95	62.14	45.78	30.22	27.53

How much is left?

Another interesting statistic is the remainder of the endowment after 100 years. The following two tables show the average remaining endowment at the end of 100 years and the standard deviation of the endowment. For the 60%/40%/5% policy discussed earlier, the average amount left is $41 million with a standard deviation of $224 million. For a donor who is interested in a perpetual endowment, these are not encouraging statistics.

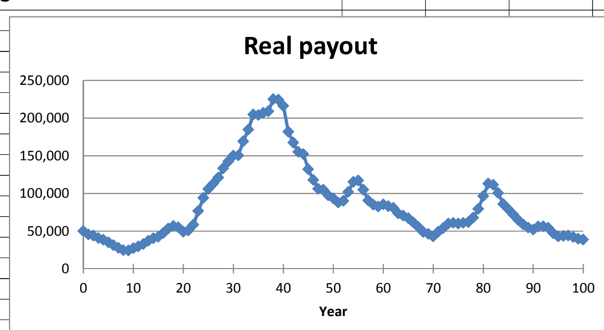
	G	H	I	J	K	L	M	N	O
11				Average Remaining Endowment After 100 Years ($ millions)					
12				Draw from initial as % ↓					
13				3%	4%	5%	6%	7%	8%
14			0%	0	0	0	0	0	0
15	Percentage in risky asset →		20%	0	0	0	0	0	0
16			40%	61	7	3	0	0	0
17			60%	443	288	41	13	3	0
18			80%	1,296	954	579	102	49	96
19			100%	2,531	7,123	1,568	1,325	606	633

	G	H	I	J	K	L	M	N	O
22				Standard deviation After 100 Years ($ millions)					
23				Draw from initial as % ↓					
24				3%	4%	5%	6%	7%	8%
25			0%	0	0	0	0	0	0
26	Percentage in risky asset →		20%	4	0	0	0	0	0
27			40%	84	35	4	0	0	0
28			60%	657	296	224	144	0	0
29			80%	6,654	1,448	8,041	1,199	863	506
30			100%	12,627	6,328	8,930	1,956	3,949	3,170

Another Payout Policy: Drawdowns based on average endowment

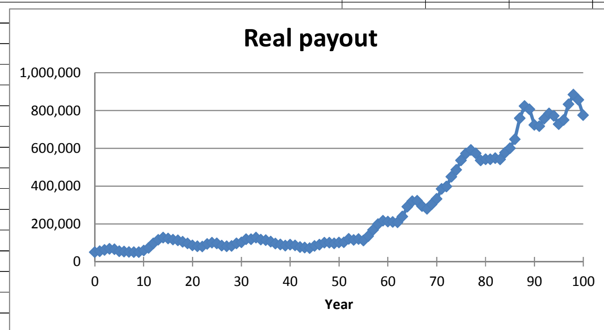
The policy in the previous section is not, of course, the only endowment management policy that can be followed. In this section we examine a common payout policy in which the payout is based on the average endowment in a number of previous years. Suppose, for example, that the endowment manager chooses a 60%/40%/5% policy in which the 5% payout is based on the average endowment principal in the three previous years. We refer to this policy as 60%/40%/5%/3. Below we show the real payout over 100 years for a two simulations:

	A	B	C	D
1	ENDOWMENT MANAGEMENT: ONE PATH EXAMPLE Payout policy: x% of 3-year average endowment			
2	Initial endowment	1,000,000		
3	Annual draw	5%		
4	Inflation	3.0%		
5	Risky investment			
6	Mean	11%		
7	Sigma	25%		
8	Risk free	5%		
9	Proportion of risky	60%		
10				
11	Ending real endowment	879,468	<-- =B119/(1+Inflation)^100	
12	Real payout			
13	Minimum	24,375	<-- =MIN(C19:C119)	
14	Maximum	225,065	<-- =MAX(C19:C119)	
15	Average	51,076	<-- =STDEV(C19:C119)	
16	Standard deviation	51,076	<-- =STDEV(C19:C119)	
17				
18	Year	Endow. at beg. year	Real payout	
19	0	1,000,000	50,000	<-- =draw*B19/(1+Inflation)^A19
20	1	871,778	45,432	<-- =draw*AVERAGE(B19:B20)/(1+Inflation)^A20
21	2	923,756	43,918	<-- =draw*AVERAGE(B19:B21)/(1+Inflation)^A21
22	3	860,959	40,518	<-- =draw*AVERAGE(B20:B22)/(1+Inflation)^A22
23	4	820,944	38,585	<-- =draw*AVERAGE(B21:B23)/(1+Inflation)^A23
24	5	760,879	35,119	<-- =draw*AVERAGE(B22:B24)/(1+Inflation)^A24
25	6	664,898	31,360	
26	7	615,909	27,668	



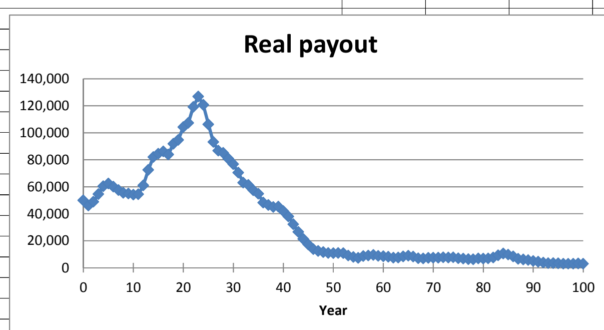
In the path simulated below, the payouts increase over time, presumably because of the (random) success of the investment policy. As can be seen in the summary tables below, these scenarios are not uncommon:

	A	B	C	D	E	F	G	H
1	**ENDOWMENT MANAGEMENT: ONE PATH EXAMPLE** **Payout policy: x% of 3-year average endowment**							
2	Initial endowment	1,000,000						
3	Annual draw	5%						
4	Inflation	3.0%						
5	Risky investment							
6	Mean	11%						
7	Sigma	25%						
8	Risk free	5%						
9	Proportion of risky	60%						
10								
11	Ending real endowment	15,170,711	<-- =B119/(1+Inflation)^100					
12	Real payout							
13	Minimum	49,698	<-- =MIN(C19:C119)					
14	Maximum	883,564	<-- =MAX(C19:C119)					
15	Average	260,385	<-- =STDEV(C19:C119)					
16	Standard deviation	260,385	<-- =STDEV(C19:C119)					
17								
18	**Year**	Endow. at beg. year	Real payout					
19	0	1,000,000	50,000	<-- =draw*B19/(1+Inflation)^A19				
20	1	1,245,147	54,494	<-- =draw*AVERAGE(B19:B20)/(1+Inflation)^A20				
21	2	1,691,878	61,850	<-- =draw*AVERAGE(B19:B21)/(1+Inflation)^A21				
22	3	1,500,089	67,676	<-- =draw*AVERAGE(B20:B22)/(1+Inflation)^A22				
23	4	1,232,475	65,518	<-- =draw*AVERAGE(B21:B23)/(1+Inflation)^A23				
24	5	1,102,219	55,132	<-- =draw*AVERAGE(B22:B24)/(1+Inflation)^A24				
25	6	1,428,301	52,524					
26	7	1,218,505	50,805					



The following graph shows a simulated investment path that ultimately leads to very low payouts:

	A	B	C	D	E	F	G	H
1	**ENDOWMENT MANAGEMENT: ONE PATH EXAMPLE** **Payout policy: x% of 3-year average endowment**							
2	Initial endowment	1,000,000						
3	Annual draw	5%						
4	Inflation	3.0%						
5	Risky investment							
6	Mean	11%						
7	Sigma	25%						
8	Risk free	5%						
9	Proportion of risky	60%						
10								
11	Ending real endowment	60,936	<-- =B119/(1+Inflation)^100					
12	Real payout							
13	Minimum	2,969	<-- =MIN(C19:C119)					
14	Maximum	126,862	<-- =MAX(C19:C119)					
15	Average	34,780	<-- =STDEV(C19:C119)					
16	Standard deviation	34,780	<-- =STDEV(C19:C119)					
17								
18	**Year**	Endow. at beg. year	Real payout					
19	0	1,000,000	50,000	<-- =draw*B19/(1+Inflation)^A19				
20	1	896,027	46,020	<-- =draw*AVERAGE(B19:B20)/(1+Inflation)^A20				
21	2	1,217,207	48,909	<-- =draw*AVERAGE(B19:B21)/(1+Inflation)^A21				
22	3	1,463,035	54,547	<-- =draw*AVERAGE(B20:B22)/(1+Inflation)^A22				
23	4	1,390,722	60,283	<-- =draw*AVERAGE(B21:B23)/(1+Inflation)^A23				
24	5	1,485,561	62,386	<-- =draw*AVERAGE(B22:B24)/(1+Inflation)^A24				
25	6	1,430,640	60,116					
26	7	1,326,360	57,493					



The endowment-based average drawdown policy transfers much of the risk of the investment policy to the beneficiary of the endowment, though it does guarantee that the endowment payouts will continue forever.[3]

[3] There is no free lunch.

Many simulations and some statistics

We run 100 simulated paths and compute statistics for the real payouts. As can be seen from one such simulated pattern below, on average the real payout for this policy is higher than in the previous policy.

	A	B	C	D	E	F	G	H	I	J	K
1	**ENDOWMENT MANAGEMENT: ONE PATH EXAMPLE** **Payout policy: x% of 3-year average endowment**										
2	Initial endowment	1,000,000									
3	Annual draw	5%									
4	Inflation	4.0%									
5	Risky investment										
6	Mean	8%									
7	Sigma	25%									
8	Risk free	5%									
9	Proportion of risky	60%									
10											
11	Ending real endowment	5,036,146	<-- =B229/(1+Inflation)^100								
12	**Real payout**					**Ending endowment in real terms**					
13	Average	426,847	<-- =AVERAGE(B22:CW122)			Average	38,038,252	<-- =AVERAGE(B229:CW229)/(1+Inflation)^100			
14	Standard deviation	1,340,097	<-- =STDEV(B22:CW122)			Standard deviation	81,559,874	<-- =STDEV(B229:CW229)/(1+Inflation)^100			
15	Minimum	3,591	<-- =MIN(B22:CW122)			Minimum	161,520	<-- =MIN(B229:CW229)/(1+Inflation)^100			
16	Maximum	25,094,764	<-- =MAX(B22:CW122)			Maximum	538,959,981	<-- =MAX(B229:CW229)/(1+Inflation)^100			
17											
18											
19											
20	**Annual payouts Simulation→**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
21	**Year**										
22	0	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
23	1	49,292	58,145	45,000	47,058	47,234	51,890	50,302	44,175	46,752	57,263
24	2	45,930	62,609	43,209	50,774	44,617	48,429	45,925	43,953	52,143	56,259
25	3	42,585	70,917	40,338	54,771	39,919	47,638	41,152	40,603	55,752	61,480
26	4	37,987	74,379	41,853	54,863	34,682	44,543	34,827	40,832	60,100	57,539
27	5	36,363	75,309	41,849	47,764	29,036	43,160	31,872	42,207	55,202	55,319
28	6	35,326	70,033	43,257	42,183	27,619	41,641	29,768	51,321	54,657	48,729
29	7	35,568	67,888	50,624	43,862	25,915	39,566	29,171	62,908	53,485	42,446
30	8	36,960	62,538	58,844	43,333	26,601	40,430	31,535	72,455	58,200	35,674

In this particular simulation, the average annual real (i.e., inflation-adjusted) payout is $426,847. There is, however, enormous uncertainty about this payout, as can be seen from the standard deviation ($1,340,097) and the range of the minimum/maximum. The ending endowment in real terms is also highly variable. In our simulation it ranges from $161,520 to $538 million!

Using the **Data Tables** feature of Excel, here are some further data.

Statistics for real annual payout

We first examine the average and standard deviation of the real annual payout over 100 years of simulated data. The parameters are as given above (r_f = 5%, μ = 8%, σ = 25%, inflation = 4%). Not surprisingly, the average real annual payout increases with the percentage in the risky asset:

	L	M	N	O	P	Q	R	S	T	U
3				**Average real annual payout**						
4				Drawdown in % ↓						
5				**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**
6	Percentage in risky		**0%**	28,247	30,912	31,777	31,440	30,340	28,795	27,029
7	asset -->		**10%**	40,703	43,309	44,725	44,469	41,421	38,048	36,608
8			**20%**	59,892	63,630	61,116	64,129	57,358	50,862	47,488
9			**30%**	80,186	102,447	99,838	96,366	84,158	75,719	67,137
10			**40%**	144,363	146,497	137,620	140,039	114,090	119,538	112,753
11			**50%**	204,772	265,395	242,550	256,065	252,777	187,449	165,226
12			**60%**	333,245	347,888	388,517	451,733	299,306	234,200	182,771
13			**70%**	720,182	334,102	530,028	769,406	725,702	525,464	410,751
14			**80%**	583,990	723,285	1,356,355	551,281	884,888	496,823	371,540
15			**90%**	629,066	1,169,090	2,735,611	1,297,536	1,067,324	950,717	1,582,764

However, the standard deviation of the real annual payout also increases dramatically with the percentage in the risky asset:

	W	X	Y	Z	AA	AB	AC	AD	AE	AF
3				**Standard deviation of real annual payout**						
4				Drawdown in % ↓						
5				**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**
6	Percentage in risky		**0%**	4,741	4,476	5,242	7,163	9,655	12,315	14,947
7	asset -->		**10%**	17,232	17,394	15,480	14,815	12,505	13,395	14,509
8			**20%**	44,964	43,005	43,907	41,537	35,849	31,123	28,109
9			**30%**	106,907	102,637	132,243	99,904	64,715	73,677	58,341
10			**40%**	315,153	368,023	219,600	311,878	172,185	229,297	158,165
11			**50%**	512,647	487,812	541,266	667,476	2,103,656	254,036	219,397
12			**60%**	675,678	765,279	1,152,456	1,279,434	1,161,998	1,092,462	356,991
13			**70%**	1,934,411	1,493,908	1,748,070	2,335,983	1,048,525	981,756	1,042,100
14			**80%**	3,124,730	2,966,868	6,594,534	3,818,868	2,027,318	2,931,379	3,115,443
15			**90%**	25,607,473	6,005,910	22,615,006	10,093,675	4,237,049	7,800,217	7,111,056

Another way of looking at the payouts is to examine the ratio between the minimum and the maximum payout over 100 years. In the table below we see the minimum real payout over 100 years. Not surprisingly, this is roughly monotonic in the percentage invested in the risky asset:

	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC
3				**Minimum Real Payout**						
4				Drawdown in % ↓						
5				**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**
6	Percentage in risky		**0%**	23,387	25,991	26,495	25,529	23,621	21,186	18,530
7	asset -->		**10%**	17,179	22,478	22,678	22,542	19,498	17,584	12,742
8			**20%**	17,373	18,204	18,809	16,739	12,311	15,090	10,457
9			**30%**	10,338	10,478	11,909	16,361	18,136	11,087	6,973
10			**40%**	11,620	6,686	5,043	8,572	9,841	10,628	5,062
11			**50%**	6,923	4,473	4,984	4,084	4,876	3,954	4,782
12			**60%**	2,626	4,574	4,884	5,253	1,886	2,763	3,253
13			**70%**	4,488	762	719	1,495	3,755	1,504	471
14			**80%**	881	3,983	3,555	1,699	2,420	974	684
15			**90%**	56	2,318	1,731	1,112	227	483	616

The maximum real payout shows a reverse pattern—the higher the percentage invested in the risky asset, the higher the maximum real payout. All of this is, of course consistent with the higher standard deviation of the payout as the percentage invested in the risky asset grows:

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
3				**Maximum Real Payout**						
4				Drawdown in % ↓						
5				**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**
6	Percentage in risky		**0%**	39,826	41,105	50,000	60,000	70,000	80,000	90,000
7	asset -->		**10%**	206,805	139,201	142,990	135,549	102,206	103,309	90,000
8			**20%**	471,141	313,011	432,576	522,640	369,885	377,304	339,474
9			**30%**	1,548,094	1,438,031	1,015,804	1,122,546	1,517,941	748,052	1,099,503
10			**40%**	3,719,491	4,226,560	2,582,730	2,666,798	2,921,417	3,459,658	6,675,283
11			**50%**	12,061,611	11,632,974	11,331,030	25,717,703	10,007,200	3,518,229	5,039,327
12			**60%**	40,647,161	44,374,592	135,444,873	9,820,210	17,415,918	19,080,980	7,473,414
13			**70%**	58,831,268	36,583,429	26,737,747	110,648,578	59,776,444	15,872,416	21,294,789
14			**80%**	128,339,380	30,170,709	308,548,812	163,709,470	41,818,132	118,330,703	49,453,154
15			**90%**	519,441,650	114,472,570	751,995,978	167,687,888	159,246,067	70,516,889	119,366,023

Preserving the endowment principal: legal limitations

Some jurisdictions require preservation of principal for perpetual endowments.[4] This seems to mean that a payment to the endowment beneficiary is possible to the extent that the endowment principal is preserved.[5] One would suspect that this transfers more of the uncertainty of the endowment to the beneficiary.

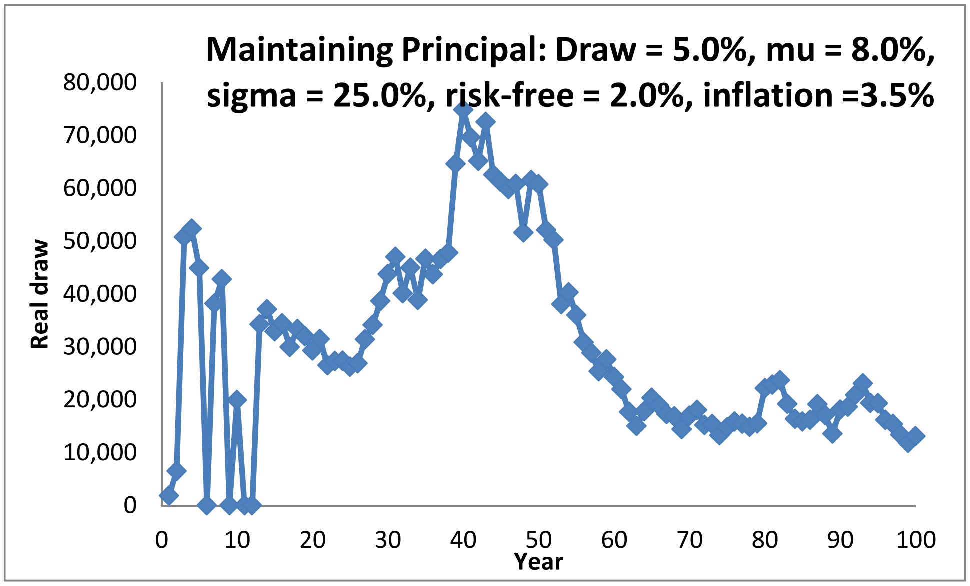
To model this restriction we denote by *draw* the desired percentage payout to the beneficiary. Then the actual payout at time *t* can be written:

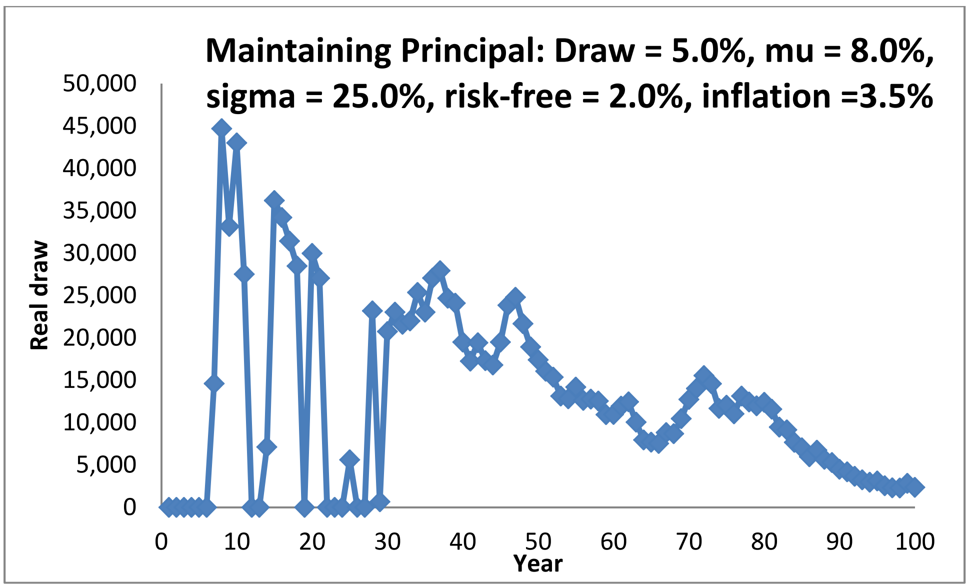
$$payout_t = \begin{cases} draw*(1+r_{t-1})*Endowment_{t-1} & If\ (1\text{-}draw)*(1+r_{t-1})*Endowment_{t-1} > Endowment_0 \\ Max\left[(1+r_{t-1})*Endowment_{t-1} - Endowment_0, 0\right] & Otherwise \end{cases}$$

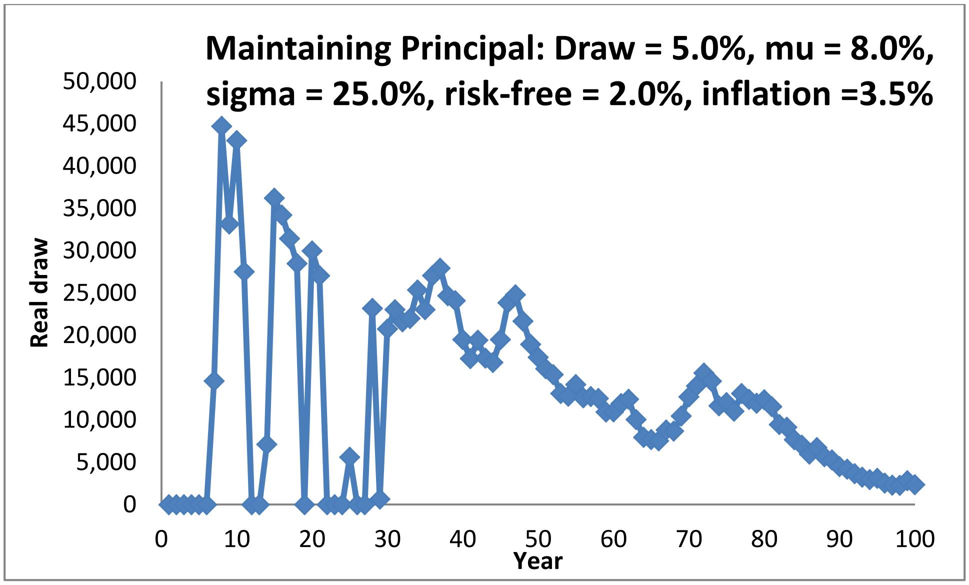
The charts below show some typical paths for the inflation-adjusted drawdown:

[4] This point needs to be checked! I think Israel is one such jurisdiction, and I recall reading that Illinois is another. However, I suspect that this may not be a point of law, but rather an interpretation by lawyers of the meaning of "perpetual." Points of comparison: Corporate law requirements to pay dividends only without impairment of stock capital, Japanese insurance requirements to pay dividends only out of dividends earned … . All of these are special cases. (??)

[5] In real terms? In nominal terms? I'm assuming nominal …


Maintaining Principal: Draw = 5.0%, mu = 8.0%, sigma = 25.0%, risk-free = 2.0%, inflation =3.5%
Real draw
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0
10
20
30
40
50
60
70
80
90
100
Year


Maintaining Principal: Draw = 5.0%, mu = 8.0%, sigma = 25.0%, risk-free = 2.0%, inflation =3.5%
Real draw
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
0
10
20
30
40
50
60
70
80
90
100
Year



Sensitivity analysis

We simulate 100 years of annual drawdowns and endowments. The table below shows the average annual real (i.e. inflation-adjusted) draw. Going down the columns shows that for a given draw percentage the average annual payout is an increasing function of the percentage invested in the risky asset. Surprisingly, perhaps, larger draw percentages lead to smaller annual average payouts. This is apparently due to the larger number of zero payouts when the draw percentage increases (see third table below).

	E	F	G	H	I	J	K	L	M
2				Average annual real draw ($thousand)					
3				Annual draw %					
4				3%	4%	5%	6%	7%	8%
5	Percentage in risky asset -->		0%	20.20	20.20	20.20	20.20	20.20	20.20
6			20%	52.07	44.86	41.80	40.29	40.06	39.38
7			40%	194.64	131.83	106.46	79.93	64.29	67.04
8			60%	571.47	381.87	295.29	206.79	203.59	109.67
9			80%	1,980.15	1,267.76	1,560.25	528.58	244.92	187.00
10			100%	12,495.75	8,890.83	3,247.98	1,501.07	589.90	934.02

As might be expected, the standard deviation of the real payout is an increasing function of the percentage invested in the risky asset.

	O	P	Q	R	S	T	U	V	W
2				Standard deviation annual real draw ($thousand)					
3				Annual draw %					
4				3%	4%	5%	6%	7%	8%
5	Percentage in risky asset -->		0%	0.00	0.00	0.00	0.00	0.00	0.00
6			20%	33.49	20.55	25.07	29.56	33.43	36.98
7			40%	304.46	171.87	117.07	52.61	49.72	50.19
8			60%	2,897.34	2,087.76	302.99	533.42	167.09	129.52
9			80%	9,846.78	5,752.62	10,451.44	2,105.79	483.02	561.03
10			100%	77,514.58	25,473.20	62,561.71	3,651.23	3,469.11	4,932.24

	Z	AA	AB	AC	AD	AE	AF	AG	AH
2				**Percentage of zeros**					
3				Annual draw %					
4				3%	4%	5%	6%	7%	8%
5	Percentage in risky asset -->		0%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6			20%	2.56%	9.62%	16.69%	24.01%	26.65%	29.00%
7			40%	2.97%	6.09%	11.52%	18.81%	23.09%	28.50%
8			60%	6.00%	6.13%	9.02%	14.78%	18.05%	20.92%
9			80%	5.27%	7.90%	10.09%	11.78%	19.10%	20.31%
10			100%	6.47%	6.09%	10.72%	16.00%	11.69%	20.39%

This last table shows that the percentage of zero payouts is a non-linear function of the percentage in the risky asset. For a higher draw percentage it is, on average, preferable to invest more in the risky asset if the purpose is to minimize the percentage of zero payouts.

Increasing the clarity of discussions with donors

The simulations above can help clarify discussions with donors. The main conclusions are that drawdowns above the risk free rate are possible in the long term only if very large amounts are invested in the risky asset. This, of course, leads to increased variability of the endowment and to an average shorter life of the endowment.

Endowments can, of course, be made to last forever by investing wholly in the risk free asset and drawing down only the real annual returns. But for many donors and activities, this is too restrictive and all concerned may prefer shorter life spans and more productive payouts.

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Recommendation

I have been on both sides of the discussion of investment and payout policy. As a chaired professor, I benefit from the payouts of a defined endowment. In my volunteer life I have often led discussions of endowment investment policy. I wrote this note partially to clarify the issues for myself.

My recommendations:

- To the extent that the beneficiary of the activity is

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Summary

Investment committees are often at a loss to determine the correct combination of drawdown and investment policies for endowments. In this note we have attempted to quantify the issues in a way that can be managerially useful. Our major conclusion is that a very large investment in the risky asset is the only way to ???

References

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Commonfund's study also noted that the average higher ed institution spent 4.4 percent of its endowment assets in the 2007 fiscal year. Legally, endowment management teams don't have to spend anything. By contrast, the IRS requires charitable foundations to spend 5 percent of assets each year.

http://www.universitybusiness.com/viewarticle.aspx?articleid=1024