Lecture XXIV: Stochastic Net Present Value

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1 Why Stochastic Net Present Value?

Why Stochastic Net Present Value?

- Market approaches to valuing investments under risk are feasible if the asset or a similar asset are traded in a market.
- Many investments made by individual firms are not traded on the open market – consider the investment in an environmental sensitive investment such as a better dairy barn (Purvis et al. 1995).
- One alternative is to develop the components of risk for the potential investment.

Modeling Randomness

- As a starting point, consider the randomness of the revenues for a potential investment.
    - The price could be random – in the dairy example the price of milk is random.
    - We can estimate the population characteristics of that randomness – mean and variance.

Historical Data

Year	Price	Yield
2007	19.13	16,832
2008	18.32	17,175
2009	12.81	18,087
2010	16.29	18,711
2011	20.15	19,067
2012	18.57	19,024
2013	20.04	19,374
2014	23.98	20,390
2015	17.10	20,656
2016	16.24	20,350
Average	18.26	1,967
Std. Dev.	2.97	1,316

Generating Random Prices

- There are many different assumptions we can make about the variability – inherent riskiness of revenue.

- For our purposes here, assume that both prices and yields are normally distributed.

- Mathematically, we are interested in generating a price "draw"

$$\tilde{p}_t = \bar{p}_t + \text{Std.Dev.} \times \epsilon_t \tag{1}$$

where ϵ_t is a standard normal draw.

- A simple way to generate a normal variation is to draw a random number between 0 and 1 (i.e., using the **RAND()** function is Excel).
- Then we ask – what is the standard normal draw that would have produced that probability – to simplify we are going to use the **NORM.S.INV()** command.

RAND()	NORM.S.INV()	$\bar{p}_t+$ Std.Dev. $\times \epsilon$
0.71726	0.57473	19.96996
0.94571	1.60461	23.02869
0.39428	-0.26818	17.46650
0.45505	-0.11291	17.92767
0.91992	1.40452	22.43443
0.70828	0.54836	19.89164
0.31116	-0.49256	16.80010
0.40001	-0.25331	17.51066
0.22687	-0.74920	16.03789
0.18467	-0.89772	15.59676

Possible Prices for the Life of the Investment

Year	Random Price Draw						
	1	2	3	4	5	6	7
1	19.970	13.584	16.708	19.667	11.829	17.817	18.683
2	23.029	22.403	21.061	16.493	15.837	20.218	19.216
3	17.466	21.633	14.841	19.923	22.763	20.742	20.331
4	17.928	18.195	19.500	20.752	13.663	13.372	15.442
5	22.434	15.239	23.299	20.803	12.952	16.389	17.108
6	19.892	16.334	20.821	15.799	16.154	15.675	17.838
7	16.800	13.135	13.311	14.932	16.231	15.690	16.600
8	17.511	17.916	22.124	14.598	18.753	22.386	16.200
9	16.038	11.220	14.632	21.206	19.684	16.214	19.212
10	15.597	22.620	17.086	17.677	15.915	22.787	17.727

Random Cash Flows

- Assuming an annual yield of 18,966.60 pounds per cow and an annual operating cost of $ 275,000 we can compute the cash flows for 7 random draws.

Year	Random Price Draw						
	1	2	3	4	5	6	7
1	103,763	–17,358	41,894	98,016	–50,644	62,928	79,353
2	161,782	149,909	124,456	37,816	25,374	108,467	89,462
3	56,271	135,304	6,483	102,872	156,737	118,405	110,610
4	65,033	70,097	94,849	118,595	–15,859	–21,379	17,882
5	150,497	14,032	166,903	119,562	–29,345	35,844	49,481
6	102,284	34,800	119,904	24,653	31,386	22,301	63,326
7	43,639	–25,874	–22,536	8,209	32,847	22,586	39,846
8	57,124	64,806	144,617	1,874	80,681	149,586	32,259
9	29,186	–62,195	2,519	127,206	98,339	32,524	89,386
10	20,822	154,024	49,063	60,273	26,853	157,192	61,221

- Assuming a discount rate of 5 % and that the investment cost
  $ 475,000 – these cash flows yield a sample of 7 net present
  values

Draw	NPV
1	168193
2	-64106
3	95275
4	77261
5	-219614
6	47499
7	23359
Average	18,267
Std. Dev	126,584