ELEC 481 Homework 7

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14/06/22

Question 1a. There are six possible combinations of the variables. They can be seen in figure 1. The joint probability distribution can be seen in the third column, and as expected they sum to 1.

Shifts/Day	Useful Life (years)	Probability	Revenue/year	Net Present Worth
1	4	13.00%	22000	-25481.35236
2	4	39.00%	30000	1616.337694
3	4	13.00%	37000	25326.81649
1	6	7.00%	22000	4863.872515
2	6	21.00%	30000	42996.18979
3	6	7.00%	37000	76361.96741

Figure 1: Net present worth by possibilities for question 1

Question 1b. The net present worth can be calculated as

$$NPW = P + A(P/A, 7\%, n)$$

for each option. Doing so results in the last column of figure 1.

Question 1c. The optimistic scenario is that the useful life and revenue is maximized, which gives a present worth of \$76361.97 with probability 7% (for 3 shifts/day and 6 years useful life). The pessimistic approach is that they are both minimized giving a net present worth of \$-25481.35 with probability 13% (for 1 shift/day and 4 useful years). The most likely is the possibility with the highest probability, which from figure 1 we can see is 2 shifts a day with a useful life of 4 years which gives a present net worth of \$1616.34 with probability 39% (for 2 shifts/day and 4 years useful life).

Question 2. There are 6 different ways to role a 7 and 4 other ways to role an 8, for a total of 10. Since there are 36 possible outcomes this means that there's a $\frac{10}{36}$ chance of losing the bet and a $\frac{1}{36}$ chance of winning. The extra roles in between don't change the probabilities since they are independent and just trigger a restart. Thus the expected value is

$$EV = 10 \cdot \frac{1}{10+1} - 1 = \$ - 0.09.$$

Question 3. First we consider D2. The expected value of A2 is clearly \$10000, whereas the expected value of A1 is $0.4 \cdot 12000 + 0.6 \cdot 8100 = \$9660$. The expected value of option B is simply $0.4 \cdot 9000 + 0.6 \cdot 5000 = \$6600$. The expected value of A is $0.6 \cdot 4000 + 0.4 \cdot 10000 = \$6400$. Thus option B should be chosen because it has a higher expected value.

Question 4. Using excel 30 random samples were drawn from the distribution and plotted as seen in figure 2. The resulting net present worth was calculated using:

$$NPW = -P + 45000 \cdot (P/A, 4\%, n).$$

Here P is the capital cost and n is the number of years. Note that the expected value and standard deviation shown in figure 2 change every time the numbers are regenerated because the sample size isn't very big.

Capital Cost ($)	Life (years)	Net Present Worth ($)
2923160.246	9	422738.9791
2615572.564	7	85352.03745
2575118.222	9	770781.0032
2912367.373	7	-211442.7716
3224400.134	6	-865438.5489
2945285.037	7	-244360.4358
2937209.252	6	-578247.6661
3006359.041	10	643544.0601
2867104.598	8	162630.5958
2883550.6	10	766352.5003
2551583.94	9	794315.2849
2692429.93	8	337305.2636
3205706.996	10	444196.1043
3236845.886	9	109053.3383
3433271.738	9	-87372.51335
3110288.267	10	539614.8341
3423228.996	10	226674.1048
2344360.013	8	685375.181
2550218.401	7	150706.2009
3008247.251	9	337651.9737
2632652.372	7	68272.22945
2749279.074	8	280456.1198
2998690.125	6	-639728.5396
3684189.63	7	-983265.0282
2787861.116	7	-86936.5147
3361850.748	10	288052.3525
2779581.945	9	566317.2797
2495227.702	9	850671.5231
2668554.5	10	981348.6012
2729147.471	9	616751.7541
2830792.22	9	515107.0052
	Total	224079.8809
	Standard Deviation	501757.0817

Figure 2: Random combinations of parameters for question 4.