Q1. In each year, there is 50% chance of reaching a good economy, and 50% chance of reaching a bad economy. Project X and Project Y have the following cashflows in dollars, respectively, depending on how good the economy is. Discount rate is 10% per year.

<Project X>

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  | Good Economy |
|  |  |  |  | 2000 |
|  | |  | | --- | |  | | Good Economy |  |
|  |  | 1000 |  | Bad Economy |
|  |  |  | 500 |
| -500 |  |  |  |  |
|  |  |  |  | Good Economy |
|  | Bad Economy | 500 |
|  | -500 |  |  |
|  |  |  |  | Bad Economy |
|  |  |  | -1000 |
|  |  |  |  |  |
| Year 0 |  | Year 1 |  | Year 2 |

<Project Y>

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  | Good Economy |
|  |  |  |  | 4000 |
|  |  | Good Economy |  |
|  | 1500 |  | Bad Economy |
|  |  | 500 |
| -500 |  |  |  |  |
|  |  |  |  | Good Economy |
|  | Bad Economy | -500 |
|  | -1000 |  |  |
|  |  |  |  | Bad Economy |
|  |  |  | -2000 |
|  |  |  |  |  |
| Year 0 |  | Year 1 |  | Year 2 |

(A) Compute the expected NPV and the standard deviation of NPV for Project X and Project Y.

Please refer to the Excel spread sheet.

For Project X

|  |  |
| --- | --- |
| Expected NPV | 140.4958678 |
| Std of NPV | 1441.698762 |

For Project Y

|  |  |
| --- | --- |
| Expected NPV | 140.4958678 |
| Std of NPV | 2812.119337 |

(B) Suppose that you can abandon the projects in Year 1 at no cost, in which case you will get no cashflow in Year 2. Compute how much each of Project X and Project Y is worth in terms of expected NPV, including this real option value.

Because the expected cashflow in Year 2 is negative when the economy is bad in Year 1, it is better to exercise the real option to abandon for both Project X and Project Y.

For Project X

|  |  |
| --- | --- |
| Expected NPV | 243.8016529 |
| Real option value | 103.3057851 |

For Project Y

|  |  |
| --- | --- |
| Expected NPV | 657.0247934 |
| Real option value | 516.5289256 |

(C) Which project has higher real option value? Project Y

Project Y has higher real option value.

Note that when there is no real option, the expected NPV for both Project X and Project Y are the same, and Project Y has higher standard deviation of NPV. This suggests that Project Y has more volatile CF, and because we can protect the downside by abandoning the project, the real option value is worth more for Project Y.

Q2. In each year, there is 40% chance of reaching a good economy, and 60% chance of reaching a bad economy. Project Z has the following cashflows in dollars, depending on how good the economy is. Discount rate is 10% per year.

<Project Z>

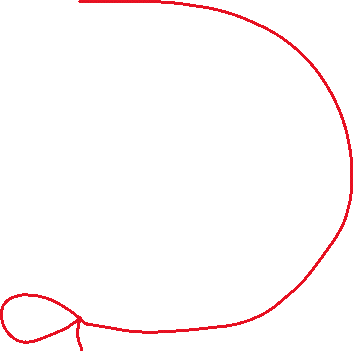
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  | Good Economy |
|  |  |  |  | 5000 |
|  | |  | | --- | |  | | Good Economy |  |
|  |  | 1200 |  | Bad Economy |
|  |  |  | 500 |
| -500 |  |  |  |  |
|  |  |  |  | Good Economy |
|  | Bad Economy | 500 |
|  | -500 |  |  |
|  |  |  |  | Bad Economy |
|  |  |  | -2000 |
|  |  |  |  |  |
| Year 0 |  | Year 1 |  | Year 2 |

(A) Compute the expected NPV of the project -$71.9008



Please refer to the Excel spread sheet.

Since this is a negative NPV project, you should reject it



(B) You have the real option to expand in Year 1. If you choose to expand the project, you need to make an additional investment of $500, and your cashflow in Year 2 will double compared to the original plan. (For instance, if you decide to expand in Year 1 under a bad Economy in Year 1, Project Z will produce $1000 under a good economy in Year 2 and -$4000 under a bad economy in Year 2.) Compute the value of this real option to expand.



The expected NPV including the real option is 506.6116.

Thus, the value of the real option to expand is $576.5124

You determine to expand under a good economy in Year 1 because exercising the option will increase the NPV. However, you should not expand under a bad economy in Year 1; otherwise, the NPV will be smaller.

Q3. The CEO of Company SZ wants to invest in a portfolio of two real investment projects, Project A and Project B. Below are information about these projects.

<Project A>

The NPV has an expected value of $4000 and standard deviation of $4000.

<Project B>:

The NPV has an expected value of $5000 and standard deviation of $5000.

The correlation between NPV of Project A and NPV of Project B is 0.4.

What is the coefficient of variation of the NPV of this portfolio that consists of Project A and Project B? 0.8389

Expected NPV of the portfolio = 4000 + 5000 = 9000

Std of NPV of the portfolio = sqrt(4000^2 + 5000^2 + 2\*4000\*5000\*0.4) = 7550

CV = 7550/9000 = 0.8389

Note that CV of the portfolio is lower than CV of Project A, which is equal to 1.

Note that CV of the portfolio is lower than CV of Project B, which is equal to 1.

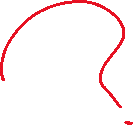
Q4. Suppose that you are a movie producer. You have two different movies to produce in mind: <CUHKSZ 1: Wonderful Longgang> and <CUHKSZ 2: Boring Longgang>. The production of each movie costs $4000, and some revenues from ticket sales will be generated in the following year of the movie production (Suppose there is neither additional cost nor tax associated with ticket sales; in other words, revenues themselves will represent incremental after-tax cashflows from the movie.) Because there is uncertainty about the popularity of the movies, the amount of revenues depends on the demand: with 30% chance, you will face high demand, in which case each movie will generate $9000 in the following year of the production and with 70% chance, you will face low demand, in which case each movie will generate $2000 in the following year of the production. The appropriate discount rate associated with the project is 10% per year.

(A) Determine the expected NPV of the project of producing both <CUHKSZ 1: Wonderful Longgang> and <CUHKSZ 2: Boring Longgang> today. -$545

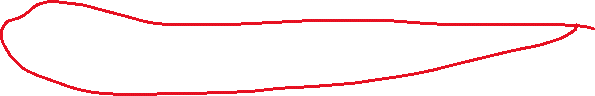


Expected NPV = (-4000 + 9000/1.1\*0.3 + 2000/1.1\*0.7)\*2 = -545

(B) Instead of simultaneously producing both movies today, you will make a slight change in the production plan. Today, you produce <CUHKSZ 1: Wonderful Longgang> and will wait for another year to see if the demand for this movie is high or low. If you encounter a high demand for <CUHKSZ 1: Wonderful Longgang> in Year 1, you are sure that <CUHKSZ 2: Boring Longgang> will have a high demand. Conversely, if you encounter a low demand for <CUHKSZ 1: Wonderful Longgang> in Year 1, you are sure that <CUHKSZ 2: Boring Longgang> will also have a low demand. In this case, compute the expected NPV of this project of producing <CUHKSZ 1: Wonderful Longgang> and <CUHKSZ 2: Boring Longgang> sequentially by taking into consideration the real option to delay. Just as in Part (A), the movie production costs $4000 each and it takes one year to obtain demand-dependent cashflows in the following year. $868



If the demand is high for <CUHKSZ 1: Wonderful Longgang>, it makes sense to produce <CUHKSZ 2: Boring Longgang> because NPV of producing <CUHKSZ 2: Boring Longgang> in Year 1 = -4000 + 9000/1.1 = 4182 > 0



If the demand is low for <CUHKSZ 1: Wonderful Longgang>, it makes sense to NOT produce <CUHKSZ 2: Boring Longgang> because NPV of producing <CUHKSZ 2: Boring Longgang> in Year 1 = -4000 + 2000/1.1 =-2182 < 0

To summarize, a) you produce <CUHKSZ 1: Wonderful Longgang> today, b) you decide to produce <CUHKSZ 2: Boring Longgang> in Year 1 if you experience high demand for <CUHKSZ 1: Wonderful Longgang> in Year 1, c) you decide to NOT produce <CUHKSZ 2: Boring Longgang> in Year 1 if you experience low demand for <CUHKSZ 1: Wonderful Longgang> in Year 1



Expected NPV = - 4000 + 0.3 \*(9000 - 4000 + 9000/1.1)/1.1 + 0.7\*(2000)/1.1 = 868 > 0



Including the real option to delay, this is a positive NPV project. Hence, you should take it.