University of Texas at Austin

Quiz #5

Real options.

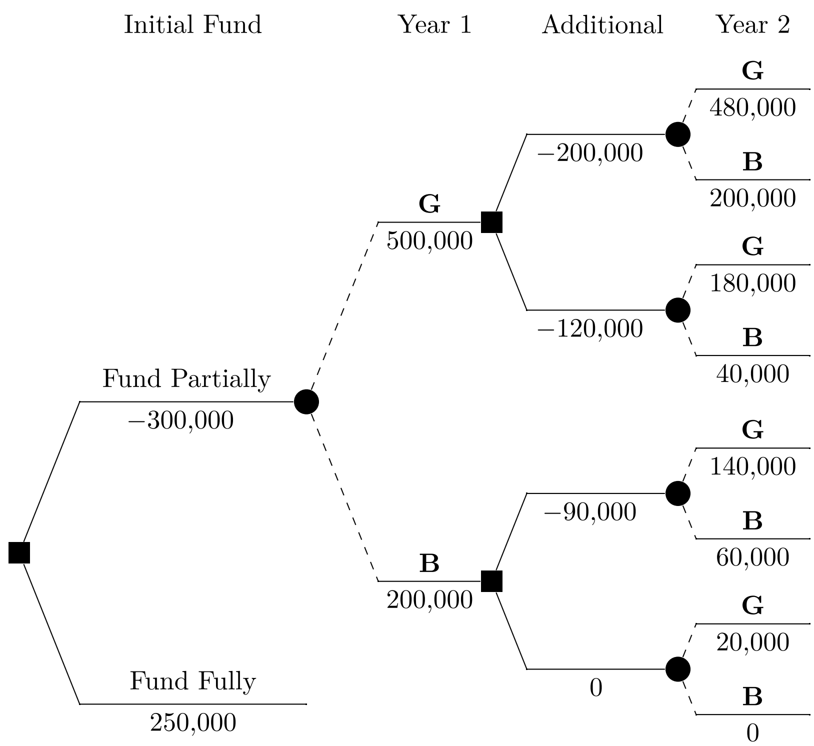
Problem 5.1. (15 points) A video game production company is considering a pair of games: Shmoopie and Pinkipoo. When the production of two games is fully funded at time-0 the project has a net present value of 250,000.

The decision tree below shows the cash flows when the launch at the beginning of the Year 1 (i.e., at $t = 0$) is only partial with an option to provide different amounts of funding at the beginning of Year 2 (i.e., at $t = 1$) depending on how well the first game did.

This tree reflects two possible receptions of the two games at each information node (**G** = good, **B** = bad). The probability of the game being a success is given to be 3/4 and the probability of it being merely playable is 1/4.

Assume the interest rate is 0%.

Find the **initial** (i.e., at $t = 0$) value of the option to fund partially.



Solution: As usual, when pricing options, we are moving backwards through the tree.

- In the *uppermost final* information node, the possible cashflows are 480,000 with probability 3/4 and 200,000 with probability 1/4. So, the value of the project at that node equals

$$480000\left(\frac{3}{4}\right) + 200000\left(\frac{1}{4}\right) = 410000.$$

- In the *second-by-height final* information node, the possible cashflows are 180,000 with probability 3/4 and 40,000 with probability 1/4. So, the value of the project at that node equals

$$180000\left(\frac{3}{4}\right) + 40000\left(\frac{1}{4}\right) = 145000.$$

- In the *third-by-height final* information node, the possible cashflows are 140,000 with probability 3/4 and 60,000 with probability 1/4. So, the value of the project at that node equals
$$140000\left(\frac{3}{4}\right)+60000\left(\frac{1}{4}\right)=120000.$$
- In the *lowest final* information node, the possible cashflows are 20,000 with probability 3/4 and 0 with probability 1/4. So, the value of the project at that node equals
$$20000\left(\frac{3}{4}\right)=15000.$$

We continue working backwards, at the **upper decision** node at the end of Year 1, we can go "up" or "down" in the tree.

- We go "up" by investing 200,000; combining this cashflow with the average revenue at the *uppermost final* node, we get the total effect of going "up" to be
$$410000-200000=210000.$$
- We go "down" by investing 120,000; combining this cashflow with the average revenue at the *second-by-height final* node, we get the total effect of going "down" to be
$$145000-120000=25000.$$

Comparing the two values we obtained, we conclude that the **optimal** decision at this node is to go "up" and we keep the value of this project at this node to be
$$210000+500000=710000.$$
Here, we took into account that the first game was a success resulting in 500,000 in revenue in Year 1.

Similarly, at the **lower decision** node at the end of Year 1, we can go "up" or "down" in the tree.

- We go "up" by investing 90,000; combining this cashflow with the average revenue at the *third-by-height final* node, we get the total effect of going "up" to be
$$120000-90000=30000.$$
- We go "down" by investing nothing; so, the total effect of going "down" is 15000.

Comparing the two values we obtained, we conclude that the **optimal** decision at this node is to go "up" and we keep the value of this project at this node to be
$$30000+200000=230000.$$
Here, we took into account that the first game was "so-so" resulting in 200,000 in revenue in Year 1.

Altogether, at the information node corresponding to Year 1, we have that the expected value of the project is
$$710000\left(\frac{3}{4}\right)+230000\left(\frac{1}{4}\right)=590000.$$

Now, we take into account that we funded the series partially with 300,000. So, the total expected present value of the cashflows we get should we decide to fund partially is
$$590000-300000=290000$$
The total value of the option is
$$290000-250000=40000.$$