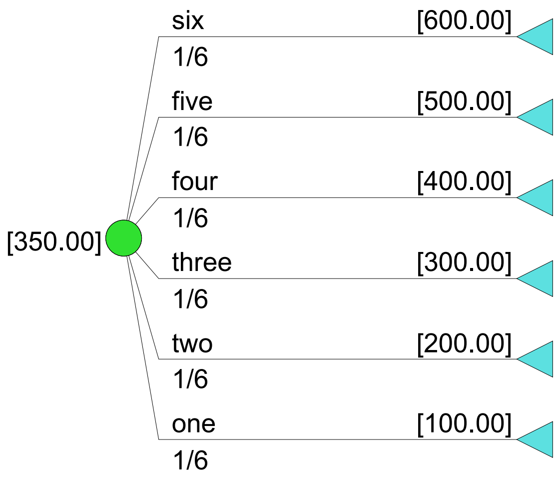
TIE4203 Decision Analysis in Industrial Operations and Management
Solutions to Tutorial #10

Question 1 (P11.1)

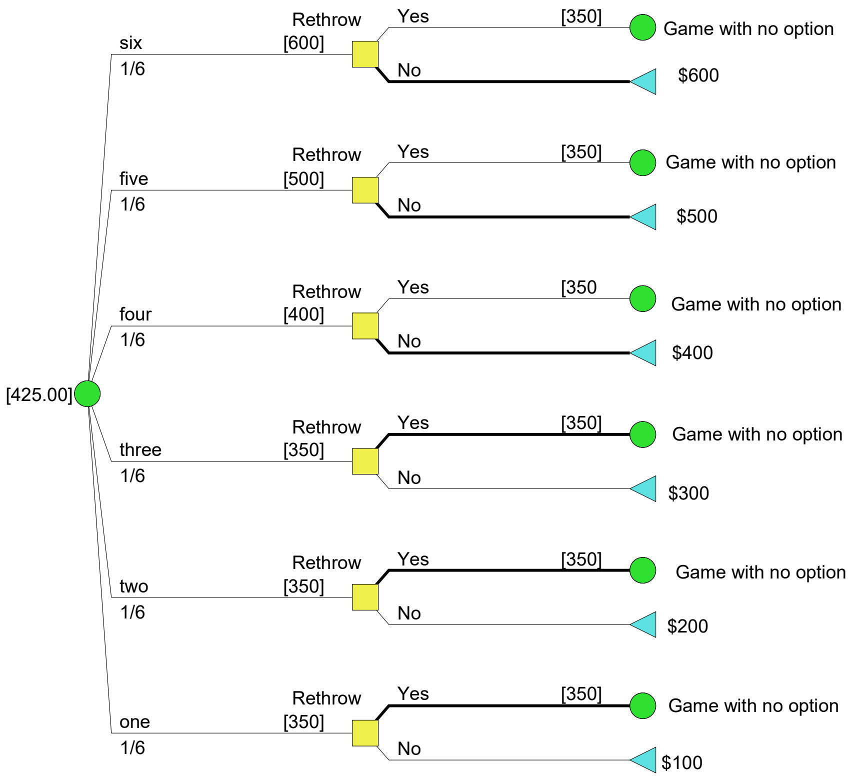
(*a*) Ella is risk neutral.

- The probability tree for the basic game:



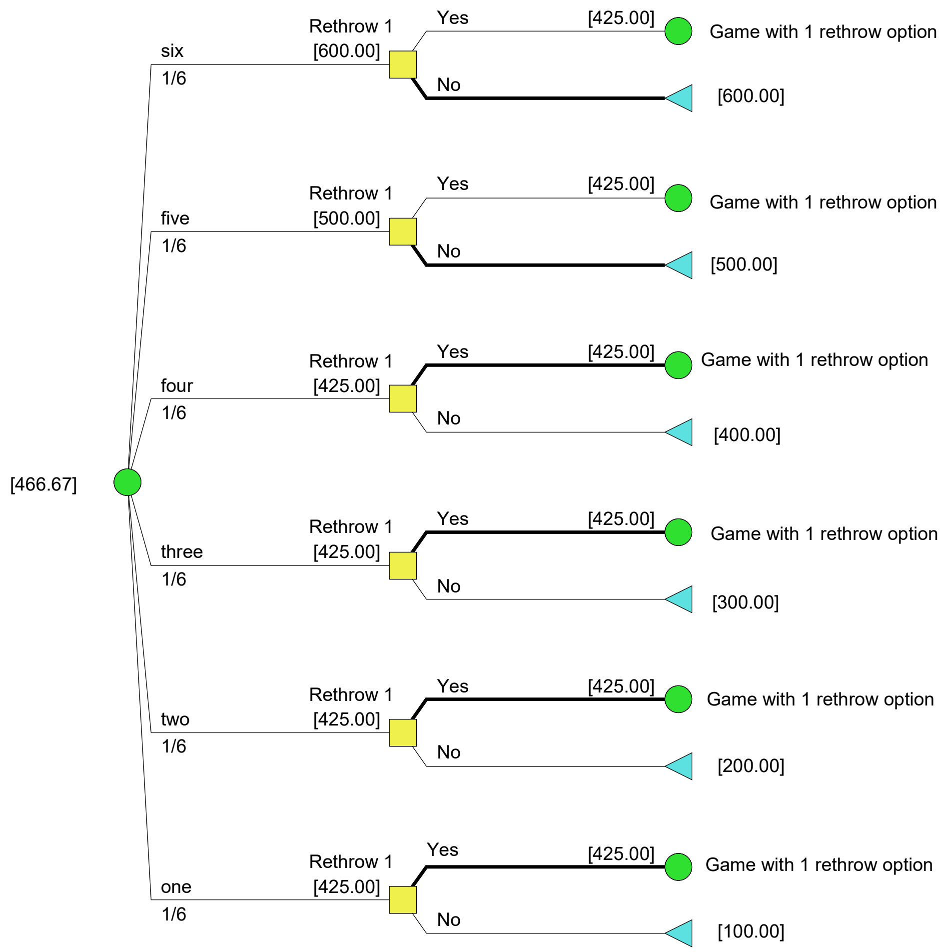
- Ella's personal indifferent buying price for the game = **$ <u>350.00</u>**

(***b***) Decision Tree with one-rethrow option:



- If the option is exercised, the problem reduces to the basic (one-throw) game with an expected value of $350.
- The option is exercised the outcome is 3 or below.
- Expected value with one-rethrow option = $ **<u>425.00</u>**
- Ella's personal indifferent buying price for this game = $ **<u>425.00</u>**
- Value of Option for one-rethrow = 425.00 – 350.00 = **$ <u>75.00</u>**

(*c*) Decision tree with two-rethrow option:



- If first rethrow option is exercised, the problem reduces the basic game with no option with an expected value of \$ 425.
- The first rethrow option is exercised when the first outcome is 4 or below.
- The second rethrow option is exercised the second outcome is 3 or below (see decision tree in part (*b*).
- Expected value with two-rethrow options
  = personal indifferent buying price for this game
  = **\$ <u>466.67</u>**
- Value of Option for two-rethrow = 466.67 – 350.00 = **\$ <u>117.67</u>**

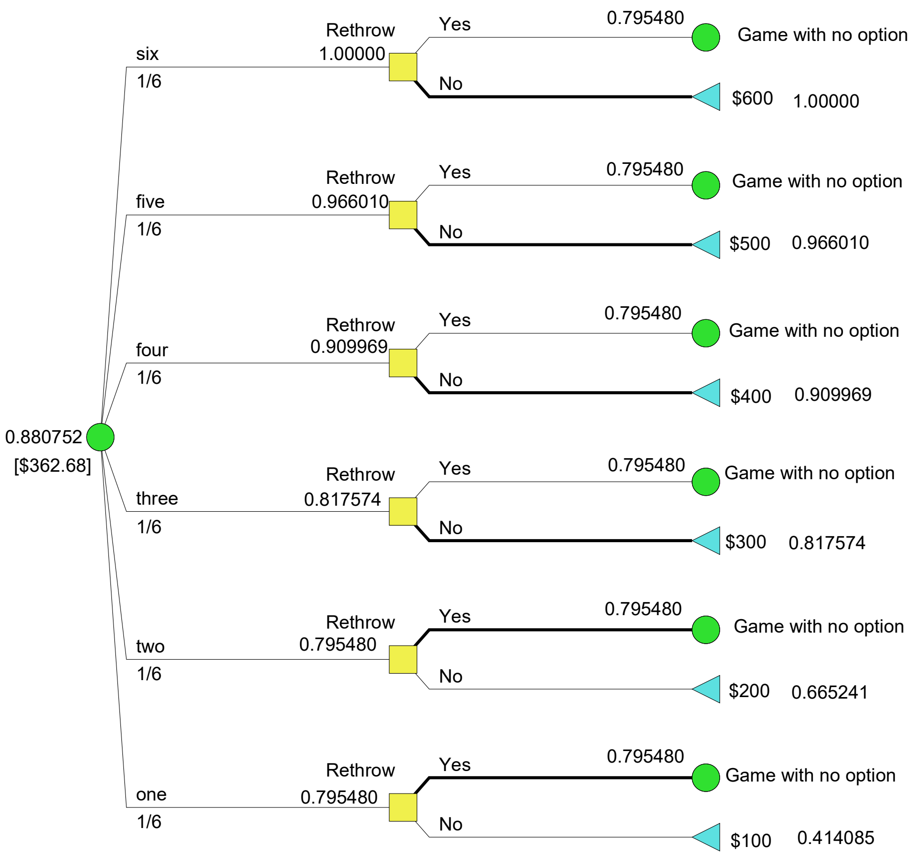
Question 2 (P11.2)

(*a*)

- Ella has delta property with Risk Tolerance =\$200.
- Let $u(\$600) = 1$ and $u(\$0) = 0$, then Ella's utility function is $u(x) = 1.0523957(1 - e^{-x/200})$
- The probability tree for the game:

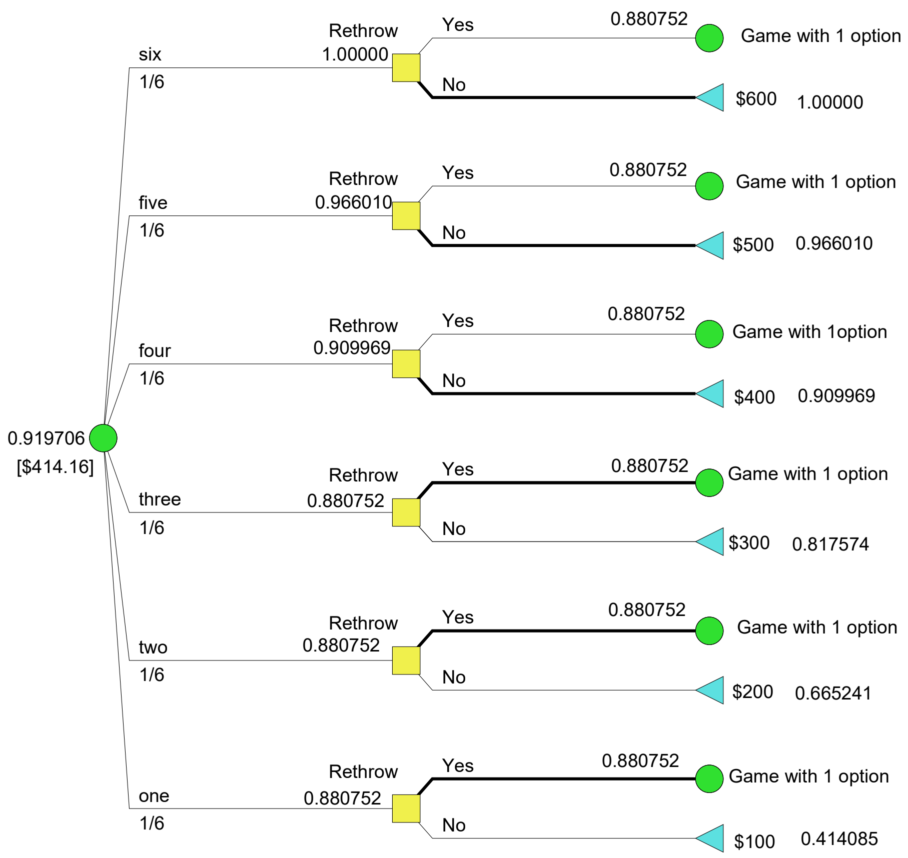
- Expected utility of game = 0.795480
- CE of game = \$ 282.02
- Ella's personal indifferent buying price for the game = **\$ <u>282.02</u>**

(*b*) Decision Tree with one-rethrow option:



- If the rethrow option is exercised, the problem reduces to the basic game with Expected utility = 0.795480 and CE = $282.02.
- The option is exercised when the first outcome is 2 or below.
- Expected utility with one rethrow option = 0.880752
- CE with one-rethrow option = $362.86
- Ella's personal indifferent buying price for this game = **$ <u>362.86</u>**
- Value of Option for one-rethrow = 362.86 – 282.02 = **$ <u>80.84</u>**

(c) Decision tree with two-rethrow options:



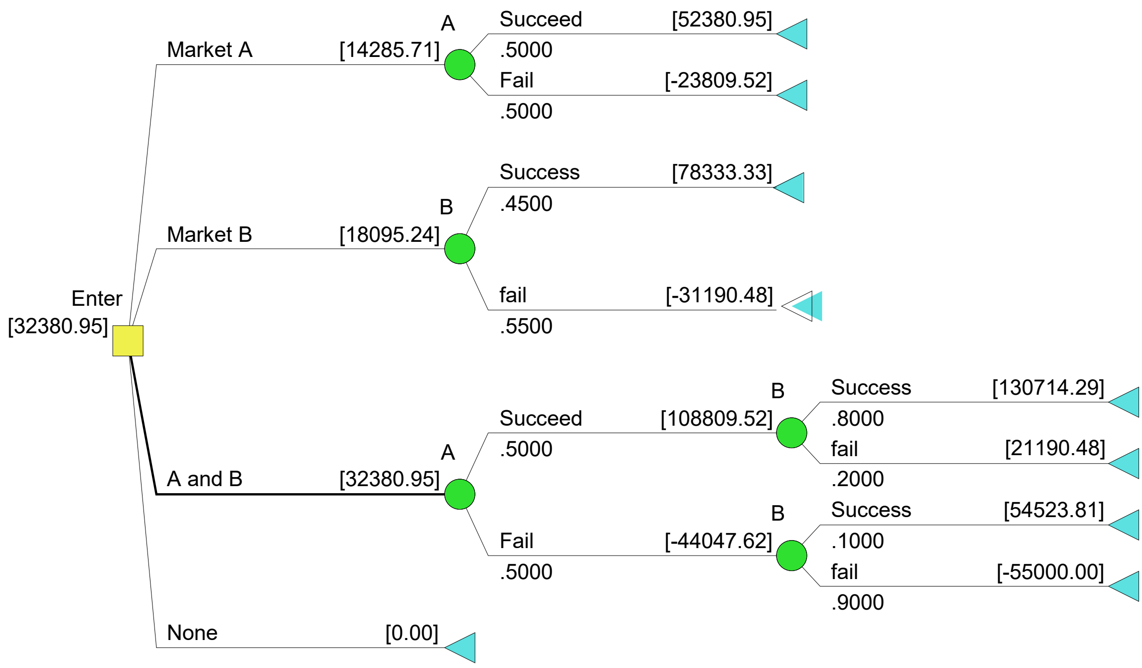
- If throw option after the first throw is exercised, the problem reduces to a game with one re-throw option with expected utility = 0.880752 and CE = $362.68.
- The first rethrow option is exercised when the outcome is 3 or below.
- Expected utility with two rethrow options = 0.919706
- CE with two-rethrow options = personal indifferent buying price for game = **$ 414.16**
- Value of Option for two-rethrow optons = 414.16 – 282.02 = **$ 132.14**

Comparison of results

	Risk Neutral	Risk averse RT=$200
CE of Base game	$ 350.00	$ 282.02
CE of with option for one re-throw	$ 425.00	$ 362.86
Value of Option for one re-throw	$ 75.00	$ 80.84
CE of with option for two re-throws	$ 467.67	$ 414.16
Value of Option for two re-throws	$ 117.67	$ 132.14

Question 3 (P11.3)

(*a*) Decision for base model:



Computation of end-point NPVs

Enter Market A only now

If product succeeds: $NPV = -100{,}000 + \dfrac{160{,}000}{(1+0.05)} = \$\,52{,}380.95$

If product fails: $NPV = -100{,}000 + \dfrac{80{,}000}{(1+0.05)} = \text{-}\,\$23{,}809.52$

Enter Market B only now

If product succeeds: $NPV = -55{,}000 + \dfrac{140{,}000}{(1+0.05)} = \$78{,}333.33$

If product fails: $NPV = -55{,}000 + \dfrac{25{,}000}{(1+0.05)} = \text{-}\,\$31{,}190.48$

Enter Market A and B now:

If A succeeds, B succeeds: $52,380.95 + $78,333.33 = $130,714.29

If A succeeds, B fails: $52,380.95 – $31,190.48 = $21,190.48

If A fails, B succeeds: -$23,809.52 + $78,333.33 = $54,523.81

If A fails, B fails: -$23,809.52 - $31,190.48 = -$55,000.00

Enter None:

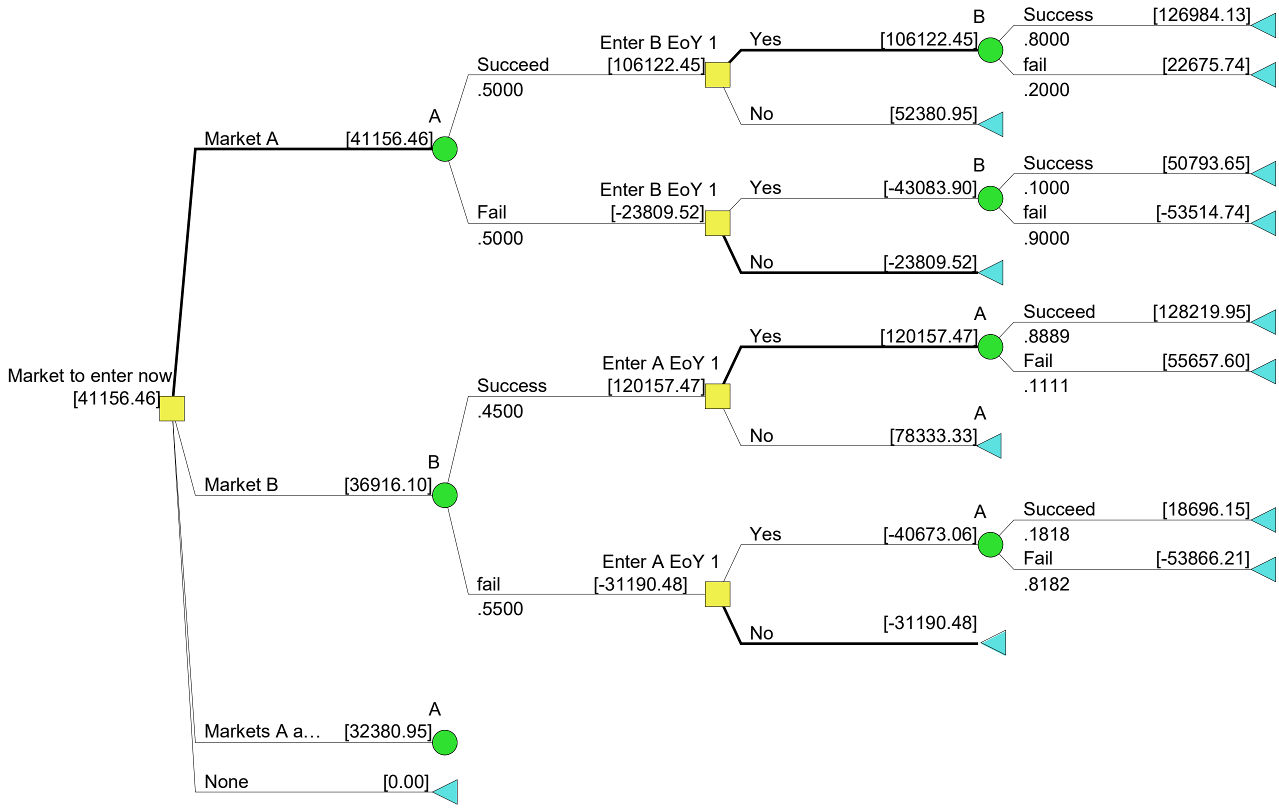
NPV = 0

The best decision is to enter both markets now.

Expected NPV = **$32,380.95**

(*b*)

Decision tree with option to delay one market by a year.



Computation of additional end-point NPVs

Enter Market A and Market B one year later:

If A succeeds, B succeeds: $NPV = 52{,}380.95 + \dfrac{78{,}333.33}{(1+0.05)} = \$126{,}984.13$

If A succeeds, B fails: $NPV = 52{,}380.95 + \dfrac{-31{,}190.48}{(1+0.05)} = \$\,22{,}675.74$

If A fails, B succeeds: $NPV = -23.809.52 + \dfrac{78{,}333.33}{(1+0.05)} = \$\,50{,}793.65$

If A fails, B fails: $NPV = -23{,}809.52 + \dfrac{-31{,}190.48}{(1+0.05)} = -\$\,53{,}514.74$

Enter Market B now and Market A one year later

If B succeed, A succeeds: $NPV = 78{,}333.33 + \dfrac{52{,}380.95}{(1+0.05)} = \$128{,}219.95$

If B succeed, A fails: $NPV = 78{,}333.33 + \dfrac{-2{,}3809.52}{(1+0.05)} = \$\,55{,}657.60$

If B fails, A succeeds: $NPV = -31{,}190.48 + \dfrac{52{,}380.95}{(1+0.05)} = \$\,18{,}696.15$

If B fails, A fails: $NPV = -31{,}190.48 + \dfrac{-2{,}3809.52}{(1+0.05)} = -\$\,53{,}866.21$

Optimal Decision Policy:

Enter Market A now.
If successful after one year, Enter Market B.
Else do not enter Market B.

Expected NPV = **$ <u>41,156.46</u>**

(*c*)

Present Equivalent Value of Option to Delay entering market

= $41,156.46 - $32,380.95

= **$ <u>8,775.51</u>**