THE INVESTOR'S DILEMMA DECISION ANALYSIS

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Problem Statement:

Carlos Morales, a home-style inventor, has a new product idea but faces technical and market uncertainties. He estimates a 50% chance of technical feasibility and an 80% chance of market success. He's offered a €10,000 market analysis claiming 80% accuracy for identifying successful products and 90% for failures. An angel investor offers a €50,000 risk-mitigating loan with 400% interest on success or no repayment on failure. Carlos must decide whether to start with the angel investor, conduct a market analysis, or proceed independently.

Decision Tree method:

We generated a Decision Tree for Carlos' dilemma, which organizes and represents the various decisions, uncertainties, and possible outcomes that Carlos will face.

Carlos must take 3 decisions, to determine the technical feasibility, to conduct or not conduct market analysis, and whether he wants to go ahead with Angel Investor. Furthermore, Expected Monetary Value (EMV) is used to evaluate each approach by weighing each possible outcome by its possibility. Optimal decision strategy will be provided based on the highest EMV.

We consider 2 decisions initially, if we're going ahead with Angel Investor or not, and each node is split into market analysis and not doing market analysis. We further made the decision about when we should conduct the market analysis, before, during or after, if at all we are conducting.

Our assumptions:

Firstly, we assume that angel investment is considered at the beginning. This assumption is made because involving an angel investor is likely to alter the terms of the deal, and it's crucial to factor in the possibility of external assistance from the beginning.

Secondly, conducting a market analysis is positioned as a preliminary step before introducing the products to the market. It represents a logical and sensible approach to assessing how the product might impact the market.

Subsequently, the progression involves moving on to stage 1(feasibility study) and budgeting for the completion of research and development (R&D). This sequential order is chosen because these expenses have an enduring impact on the entire process, regardless of whether the product succeeds or fails.

Our recommendation:

Our recommendation for Carlos is to advance with the product development and market launch, declining Angel Investor's €50,000 offer and opting out of the market analysis. This course of action is advised as it yields a higher profit, concluding that the best EMV would be €270,000.

Expenditure		Angel Investment		Revenue
Stage 1 (Technical Feasibility)	€ 50,000	Risk Mediating Loan	€ 50,000	€1,500,000
R&D	€ 500,000	Loan repayment with 400% Interest	€ 250,000	
Market analysis	€ 10,000			
Failure loss	€ 300,000			
Total Expenditure:	€ 860,000			

Calculations:

P (Market Success/MS) = 0.8 **P (+ | Market Success) = 0.8** **P (+ | Market Failure) = 0.1**

P (Market Failure/MF) = 0.2 **P (- | Market Success) = 0.8** **P (- | Market Failure) = 0.9**

P (MS ∩ +) = P (+ |MS) * P (MS)
= 0.8 * 0.8 = 0.64

P (MS ∩ -) = P (- |MS) * P (MS)
= 0.2 * 0.8 = 0.16

P (MF ∩ +) = P (+ |MF) * P (MF)
= 0.1 * 0.2 = 0.02

P (MF ∩ -) = P (- |MF) * P (MF)
= 0.9 * 0.2 = 0.18

P (Market Success | +) = 0.64 / 0.66
= 0.97

P (Market Success | -) = 0.16 / 0.34
= 0.47

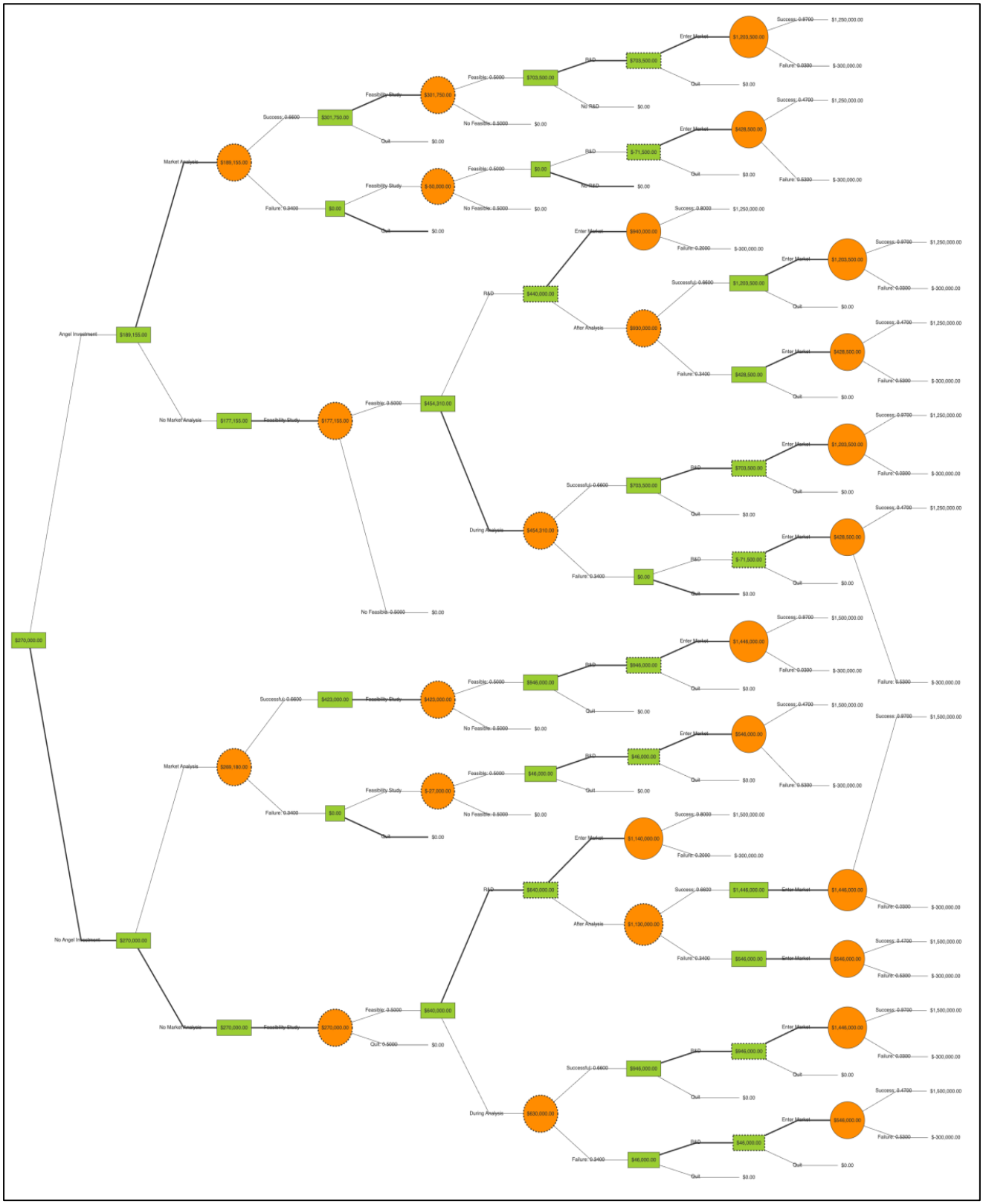
P (Market Failure | +) = 0.02 / 0.66
= 0.03

P (Market Failure | -) = 0.18 / 0.34
= 0.53

Probability Table:

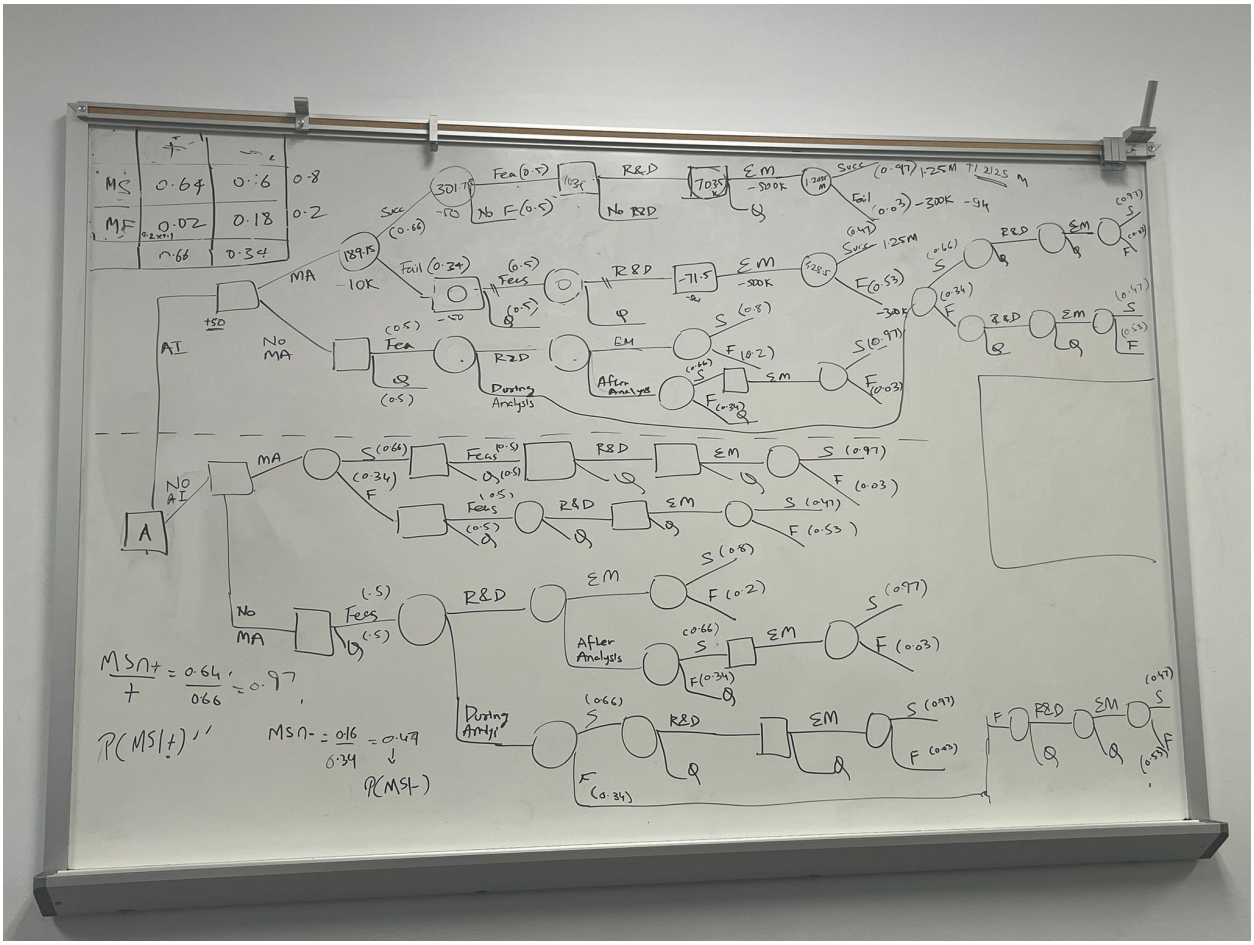
	Market Success (MS)	Market Failure (MF)	Total
Market Feasibility Success (+)	P (MS ∩ +) = 0.8 * 0.8 = 0.64	P (MF ∩ +) = 0.1 * 0.2 = 0.02	0.66
Market Feasibility Failure (-)	P (MS ∩ -) = 0.8 * 0.2 = 0.16	P (MF ∩ -) = 0.9 * 0.2 = 0.18	0.34
Total	0.8	0.2	1

Decision Tree:



APPENDIX

1.1: Group work



Note: The above image is a work in progress and NOT the final decision tree used for this project.

1.2: RMD FILE

Code Hide

```
## get the active dataset and show the first few observations
.get_data() %>%
  head()
```

price <int>	carat <dbl>	clarity <fct>	cut <fct>	color <fct>	depth <dbl>	table <dbl>	x <dbl>	y <dbl>	z <dbl>
580	0.32	VS1	Ideal	H	61.0	56.0	4.43	4.45	2.71
650	0.34	SI1	Very Good	G	63.4	57.0	4.45	4.42	2.81
630	0.30	VS2	Very Good	G	63.1	58.0	4.27	4.23	2.68
706	0.35	VVS2	Ideal	H	59.2	56.0	4.60	4.65	2.74
1080	0.40	VS2	Premium	F	62.6	58.0	4.72	4.68	2.94
3082	0.60	VVS1	Ideal	E	62.5	53.7	5.35	5.43	3.38

6 rows | 1-10 of 12 columns

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```
## access a dataset
diamonds %>%
  select(price, clarity) %>%
  head()
```

price <int>	clarity <fct>
580	VS1
650	SI1
630	VS2
706	VVS2
1080	VS2
3082	VVS1

6 rows

Hide

```
## add a variable to the diamonds data
diamonds <- mutate(diamonds, log_price = log(price))

## show the first observations in the price and log_price columns
diamonds %>%
  select(price, log_price) %>%
  head()
```

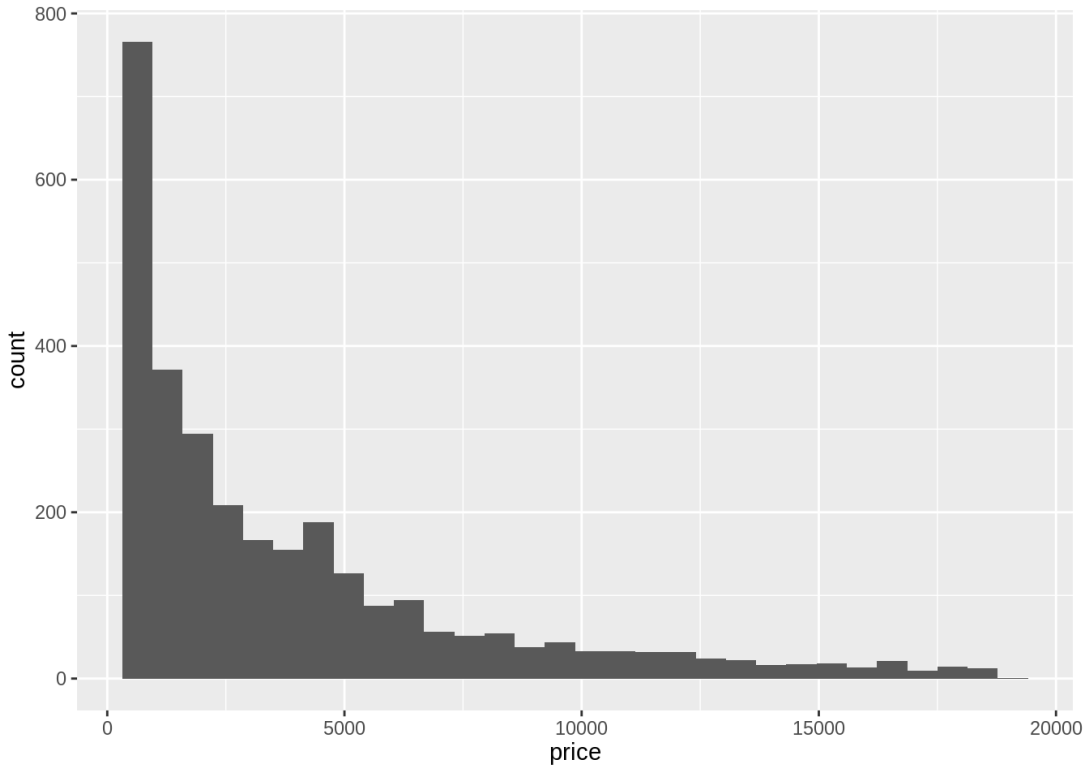
price <int>	log_price <dbl>
580	6.363028
650	6.476972

price <int>	log_price <dbl>
630	6.445720
706	6.559615
1080	6.984716
3082	8.033334

6 rows

Hide

```
## create a histogram of prices
diamonds %>%
  ggplot(aes(x = price)) +
    geom_histogram()
```



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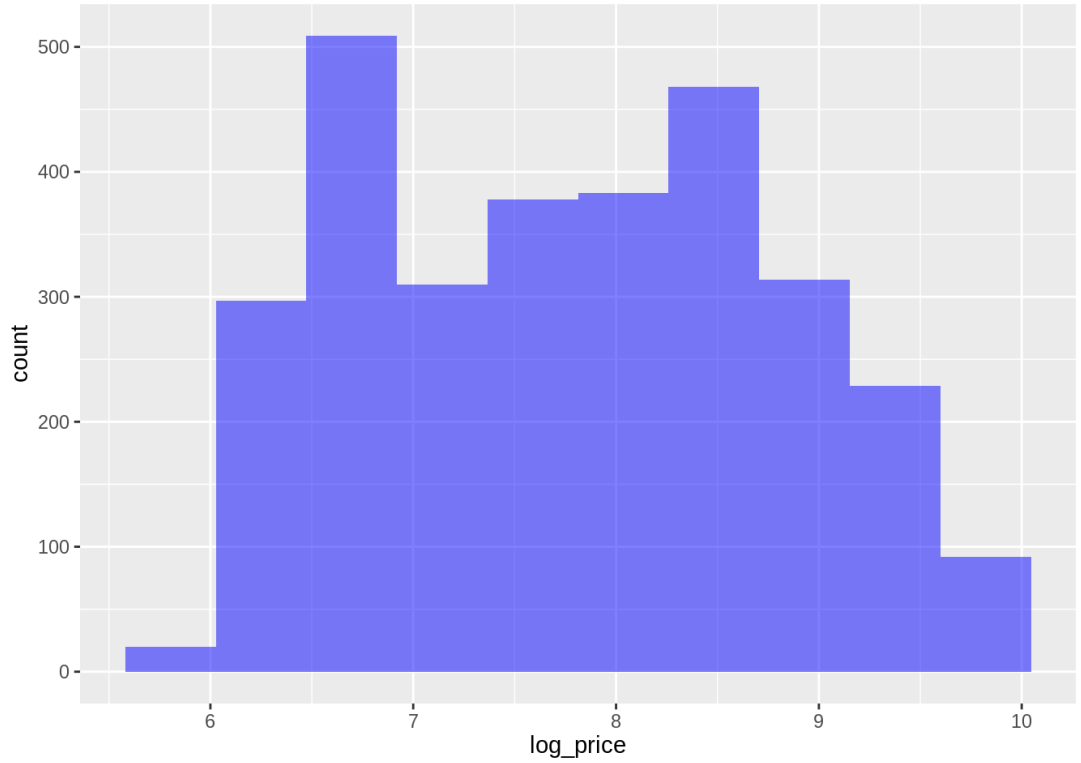
```
## and a histogram of log-prices using radiant.data::visualize
visualize(diamonds, xvar = "log_price", custom = TRUE)
```



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```
## open help in the R-studio viewer from Radiant
# help(package = "radiant.data")

## If you are familiar with Shiny you can call reactives when the code
## is evaluated inside a Shiny app. For example, if you transformed
## some variables in Data > Transform you can call the transform_main
## reacive to see the latest result. Very useful for debugging
# transform_main() %>% head()
result <- dtree(yl = "Sign_contract")
summary(result, input = TRUE, output = FALSE)
```

```
Decision tree input:
name: The Investor's Dilemmar
variables:
    P(S1): 0.97
    P(F1): 0.03
    P(S2): 0.47
    P(F2): 0.53
    P(S3): 0.8
    P(F3): 0.2
    Successful: 1250000
    Failure: -300000
type: decision
Angel Investment:
    payoff: 50000
    type: decision
    Market Analysis:
        cost: 10000
        type: chance
        Success:
            p: 0.66
            type: decision
            Feasibility Study:
                cost: 50000
                type: chance
                Feasible:
                    p: 0.5
                    type: decision
                    R&D:
                        cost: 500000
                        type: decision
                        Enter Market:
                            type: chance
                            Success:
                                p: 0.97
                                payoff: 1250000
                            Failure:
                                p: 0.03
                                payoff: -300000
                        Quit:
                            payoff: 0
                    No R&D:
                        payoff: 0
                No Feasible:
                    p: 0.5
                    payoff: 0
            Quit:
                payoff: 0
        Failure:
            p: 0.34
            type: decision
            Feasibility Study:
                cost: 50000
                type: chance
                Feasible:
                    p: 0.5
                    type: decision
                    R&D:
                        cost: 500000
                        type: decision
                        Enter Market:
```

```
                        type: chance
                        Success:
                            p: 0.47
                            payoff: 1250000
                        Failure:
                            p: 0.53
                            payoff: -300000
                    Quit:
                        payoff: 0
                No R&D:
                    payoff: 0
            No Feasible:
                p: 0.5
                payoff: 0
        Quit:
            payoff: 0
No Market Analysis:
    type: decision
    Feasibility Study:
        cost: 50000
        type: chance
        Feasible:
            p: 0.5
            type: decision
            R&D:
                cost: 500000
                type: decision
                Enter Market:
                    type: chance
                    Success:
                        p: 0.8
                        payoff: 1250000
                    Failure:
                        p: 0.2
                        payoff: -300000
                After Analysis:
                    cost: 10000
                    type: chance
                    Successful:
                        p: 0.66
                        type: decision
                        Enter Market:
                            type: chance
                            Success:
                                p: 0.97
                                payoff: 1250000
                            Failure:
                                p: 0.03
                                payoff: -300000
                        Quit:
                            payoff: 0
                    Failure:
                        p: 0.34
                        type: decision
                        Enter Market:
                            type: chance
                            Success:
                                p: 0.47
                                payoff: 1250000
                            Failure:
```

```
                                    p: 0.53
                                    payoff: -300000
                            Quit:
                                payoff: 0
                During Analysis:
                    cost: 10000
                    type: chance
                    Successful:
                        p: 0.66
                        type: decision
                        R&D:
                            cost: 500000
                            type: decision
                            Enter Market:
                                type: chance
                                Success:
                                    p: 0.97
                                    payoff: 1250000
                                Failure:
                                    p: 0.03
                                    payoff: -300000
                            Quit:
                                payoff: 0
                        Quit:
                            payoff: 0
                    Failure:
                        p: 0.34
                        type: decision
                        R&D:
                            cost: 500000
                            type: decision
                            Enter Market:
                                type: chance
                                Success:
                                    p: 0.47
                                    payoff: 1250000
                                Failure:
                                    p: 0.53
                                    payoff: -300000
                            Quit:
                                payoff: 0
                        Quit:
                            payoff: 0
            No Feasible:
                p: 0.5
                payoff: 0
No Angel Investment:
    type: decision
    Market Analysis:
        cost: 10000
        type: chance
        Successful:
            p: 0.66
            type: decision
            Feasibility Study:
                cost: 50000
                type: chance
                Feasible:
                    p: 0.5
                    type: decision
```

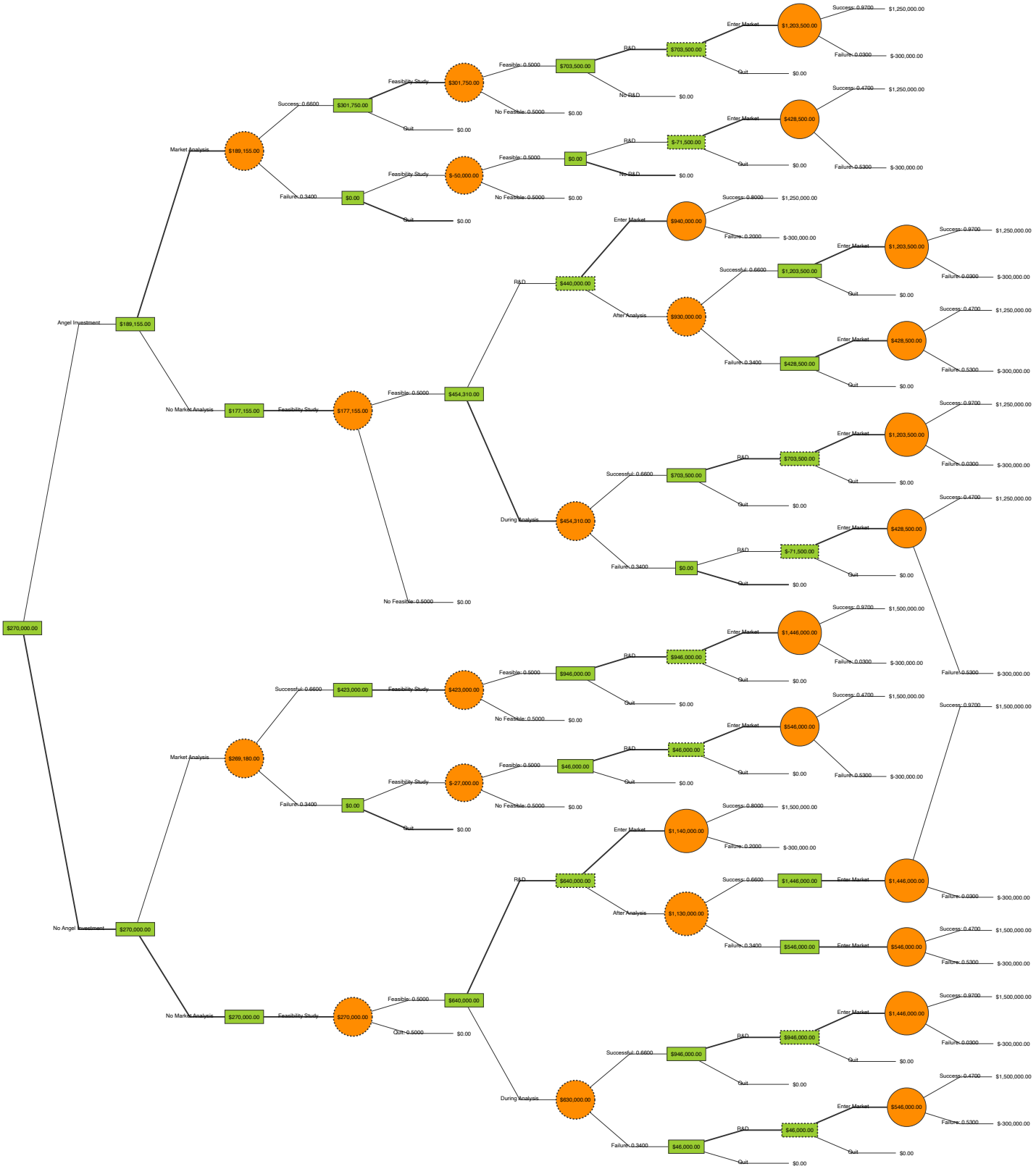
```
                R&D:
                    cost: 500000
                    type: decision
                    Enter Market:
                        type: chance
                        Success:
                            p: 0.97
                            payoff: 1500000
                        Failure:
                            p: 0.03
                            payoff: -300000
                    Quit:
                        payoff: 0
                Quit:
                    payoff: 0
            No Feasible:
                p: 0.5
                payoff: 0
    Failure:
        p: 0.34
        type: decision
        Feasibility Study:
            cost: 50000
            type: chance
            Feasible:
                p: 0.5
                type: decision
                R&D:
                    cost: 500000
                    type: decision
                    Enter Market:
                        type: chance
                        Success:
                            p: 0.47
                            payoff: 1500000
                        Failure:
                            p: 0.53
                            payoff: -300000
                    Quit:
                        payoff: 0
                Quit:
                    payoff: 0
            No Feasible:
                p: 0.5
                payoff: 0
        Quit:
            payoff: 0
No Market Analysis:
    type: decision
    Feasibility Study:
        cost: 50000
        type: chance
        Feasible:
            p: 0.5
            type: decision
            R&D:
                cost: 500000
                type: decision
                Enter Market:
                    type: chance
```

```
                    Success:
                        p: 0.8
                        payoff: 1500000
                    Failure:
                        p: 0.2
                        payoff: -300000
                After Analysis:
                    cost: 10000
                    type: chance
                    Success:
                        p: 0.66
                        type: decision
                        Enter Market:
                            type: chance
                            Success:
                                p: 0.97
                                payoff: 1500000
                            Failure:
                                p: 0.03
                                payoff: -300000
                    Failure:
                        p: 0.34
                        type: decision
                        Enter Market:
                            type: chance
                            Success:
                                p: 0.47
                                payoff: 1500000
                            Failure:
                                p: 0.53
                                payoff: -300000
            During Analysis:
                cost: 10000
                type: chance
                Successful:
                    p: 0.66
                    type: decision
                    R&D:
                        cost: 500000
                        type: decision
                        Enter Market:
                            type: chance
                            Success:
                                p: 0.97
                                payoff: 1500000
                            Failure:
                                p: 0.03
                                payoff: -300000
                        Quit:
                            payoff: 0
                    Quit:
                        payoff: 0
                Failure:
                    p: 0.34
                    type: decision
                    R&D:
                        cost: 500000
                        type: decision
                        Enter Market:
                            type: chance
```

```
                            Success:
                                p: 0.47
                                payoff: 1500000
                            Failure:
                                p: 0.53
                                payoff: -300000
                        Quit:
                            payoff: 0
                Quit:
                    payoff: 0
        Quit:
            p: 0.5
            payoff: 0
```

Hide

```
plot(result, final = TRUE) %>% render()
```


$270,000.00
Angel Investment
$189,155.00
Market Analysis
$189,155.00
Success: 0.6600
$301,750.00
Feasibility Study
$301,750.00
Feasible: 0.5000
$703,500.00
R&D
$703,500.00
Enter Market
$1,203,500.00
Success: 0.9700
$1,250,000.00
Failure: 0.0300
$-300,000.00
Quit
$0.00
No R&D
$0.00
No Feasible: 0.5000
$0.00
Quit
$0.00
Failure: 0.3400
$0.00
Feasibility Study
$-50,000.00
Feasible: 0.5000
$0.00
R&D
$-71,500.00
Enter Market
$428,500.00
Success: 0.4700
$1,250,000.00
Failure: 0.5300
$-300,000.00
Quit
$0.00
No R&D
$0.00
No Feasible: 0.5000
$0.00
Quit
$0.00
No Market Analysis
$177,155.00
Feasibility Study
$177,155.00
Feasible: 0.5000
$454,310.00
R&D
$440,000.00
Enter Market
$940,000.00
Success: 0.8000
$1,250,000.00
Failure: 0.2000
$-300,000.00
After Analysis
$930,000.00
Successful: 0.6600
$1,203,500.00
Enter Market
$1,203,500.00
Success: 0.9700
$1,250,000.00
Failure: 0.0300
$-300,000.00
Quit
$0.00
Failure: 0.3400
$428,500.00
Enter Market
$428,500.00
Success: 0.4700
$1,250,000.00
Failure: 0.5300
$-300,000.00
Quit
$0.00
No Feasible: 0.5000
$0.00
During Analysis
$454,310.00
Successful: 0.6600
$703,500.00
R&D
$703,500.00
Enter Market
$1,203,500.00
Success: 0.9700
$1,250,000.00
Failure: 0.0300
$-300,000.00
Quit
$0.00
Quit
$0.00
Failure: 0.3400
$0.00
R&D
$-71,500.00
Enter Market
$428,500.00
Success: 0.4700
$1,250,000.00
Failure: 0.5300
$-300,000.00
Quit
$0.00
Quit
$0.00
No Angel Investment
$270,000.00
Market Analysis
$269,180.00
Successful: 0.6600
$423,000.00
Feasibility Study
$423,000.00
Feasible: 0.5000
$946,000.00
R&D
$946,000.00
Enter Market
$1,446,000.00
Success: 0.9700
$1,500,000.00
Failure: 0.0300
$-300,000.00
Quit
$0.00
Quit
$0.00
No Feasible: 0.5000
$0.00
Failure: 0.3400
$0.00
Feasibility Study
$-27,000.00
Feasible: 0.5000
$46,000.00
R&D
$46,000.00
Enter Market
$546,000.00
Success: 0.4700
$1,500,000.00
Failure: 0.5300
$-300,000.00
Quit
$0.00
Quit
$0.00
No Feasible: 0.5000
$0.00
No Market Analysis
$270,000.00
Feasibility Study
$270,000.00
Feasible: 0.5000
$640,000.00
R&D
$640,000.00
Enter Market
$1,140,000.00
Success: 0.8000
$1,500,000.00
Failure: 0.2000
$-300,000.00
After Analysis
$1,130,000.00
Success: 0.6600
$1,446,000.00
Enter Market
$1,446,000.00
Success: 0.9700
$1,500,000.00
Failure: 0.0300
$-300,000.00
Failure: 0.3400
$546,000.00
Enter Market
$546,000.00
Success: 0.4700
$1,500,000.00
Failure: 0.5300
$-300,000.00
Quit: 0.5000
$0.00
During Analysis
$630,000.00
Successful: 0.6600
$946,000.00
R&D
$946,000.00
Enter Market
$1,446,000.00
Success: 0.9700
$1,500,000.00
Failure: 0.0300
$-300,000.00
Quit
$0.00
Quit
$0.00
Failure: 0.3400
$46,000.00
R&D
$46,000.00
Enter Market
$546,000.00
Success: 0.4700
$1,500,000.00
Failure: 0.5300
$-300,000.00
Quit
$0.00
Quit
$0.00