Risk and Managerial Options in Capital Budgeting

An Illustration of Total Risk (Discrete Distribution)

ANNUAL CASH FLOWS: YEAR 1
PROPOSAL A

State	Probability	Cash Flow
Deep Recession	.05	$ -3,000
Mild Recession	.25	1,000
Normal	.40	5,000
Minor Boom	.25	9,000
Major Boom	.05	13,000

Summary of Proposal A

The standard deviation = SQRT (14,400,000) = $3,795

The expected cash flow = $5,000

An Illustration of Total Risk (Discrete Distribution)

ANNUAL CASH FLOWS: YEAR 1

PROPOSAL B

State	Probability	Cash Flow
Deep Recession	.05	$ -1,000
Mild Recession	.25	2,000
Normal	.40	5,000
Minor Boom	.25	8,000
Major Boom	.05	11,000

Summary of Proposal B

The **standard deviation** =

SQRT (8,100,000) = **$2,846**

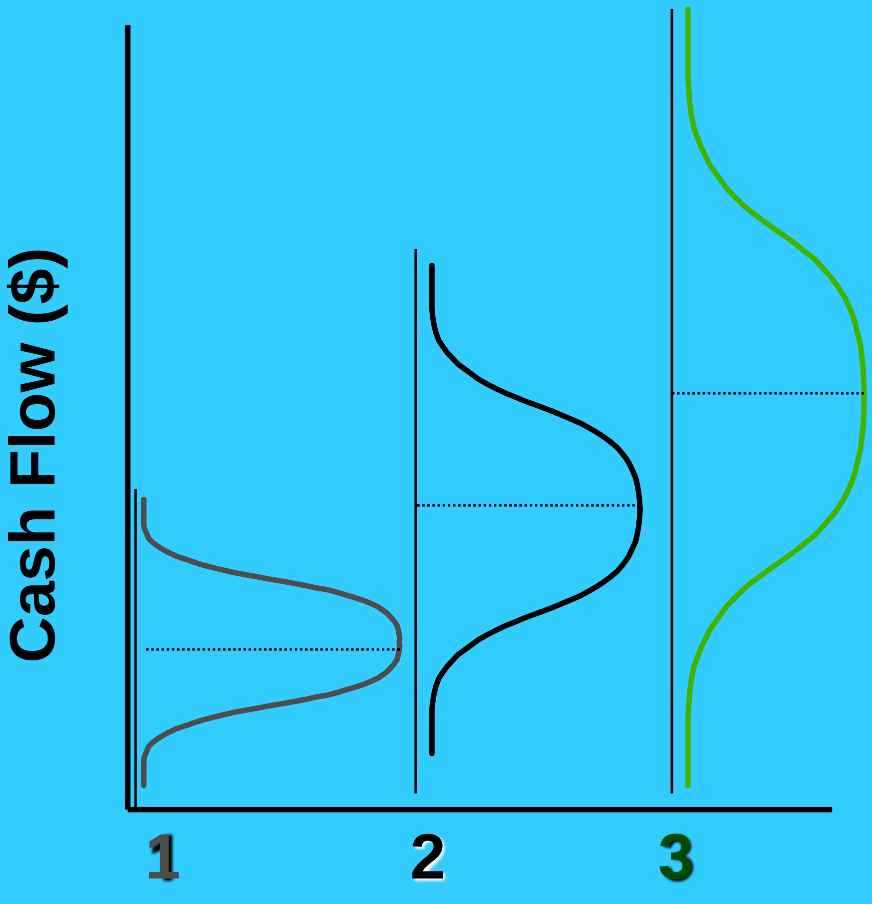
The **expected cash flow** = **$5,000**

The standard deviation of Proposal B < Proposal A.
($2,846 < $3,795)

Total Project Risk

Projects have risk that may *change* from period to period.

Projects are more likely to have *continuous*, rather than discrete distributions.



Probability Tree Approach

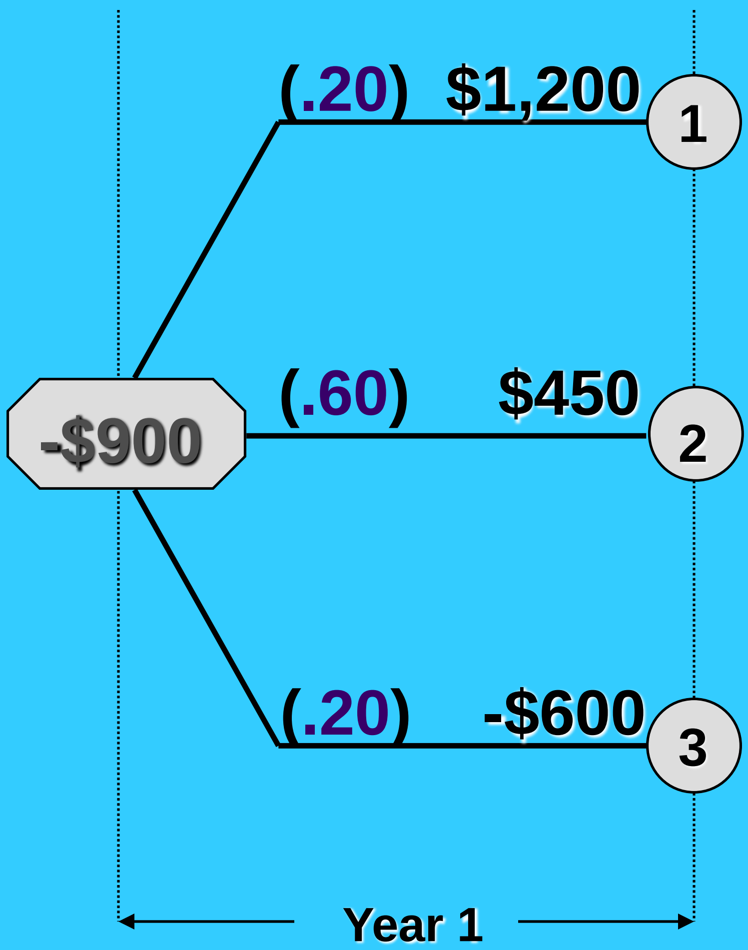
A graphic or tabular approach for organizing the possible cash-flow streams generated by an investment. The presentation resembles the branches of a tree. Each complete branch represents one possible cash-flow sequence.

Probability Tree Approach

-$900

Marico is examining a project that will have an initial cost today of $900. Uncertainty surrounding the first year cash flows creates three possible cash-flow scenarios in Year 1.

Probability Tree Approach

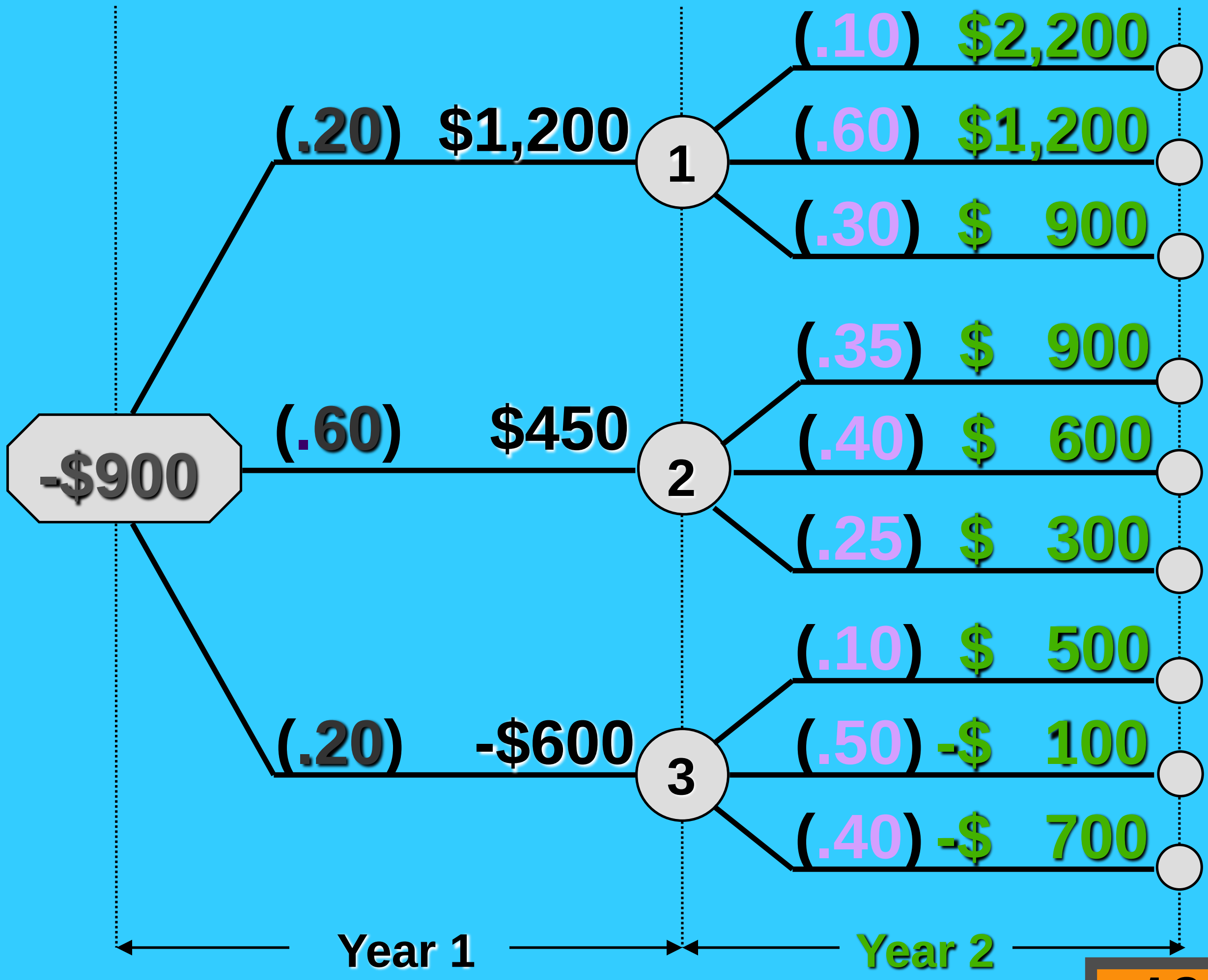


Node 1: 20% chance of a $1,200 cash-flow.

Node 2: 60% chance of a $450 cash-flow.

Node 3: 20% chance of a -$600 (negative) cash-flow.

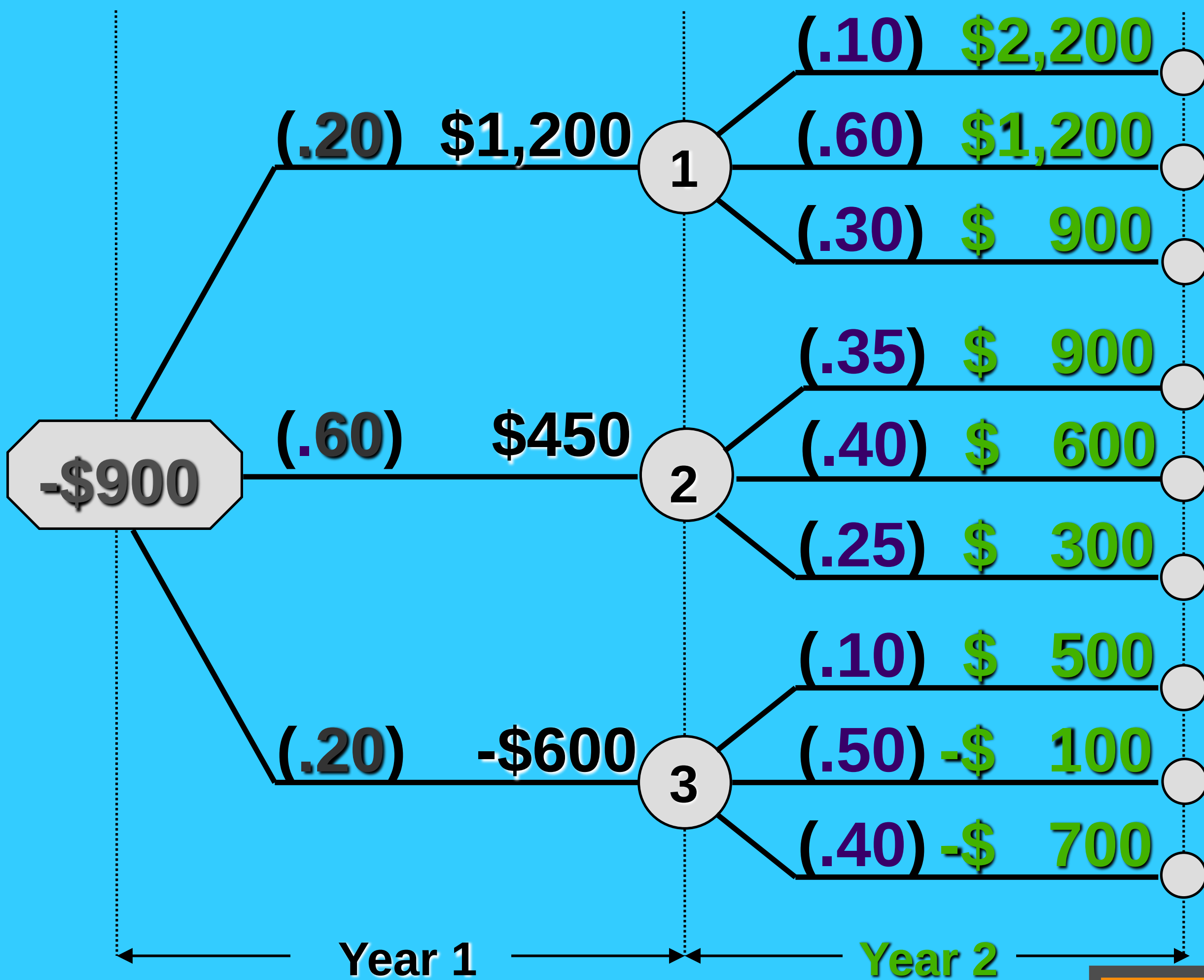
Probability Tree Approach



Each node in Year 2 represents a *branch* of our probability tree.

The probabilities are said to be conditional probabilities.

Joint Probabilities [P(1,2)]



.02	Branch 1
.12	Branch 2
.06	Branch 3
.21	Branch 4
.24	Branch 5
.15	Branch 6
.02	Branch 7
.10	Branch 8
.08	Branch 9

Project NPV Based on Probability Tree Usage

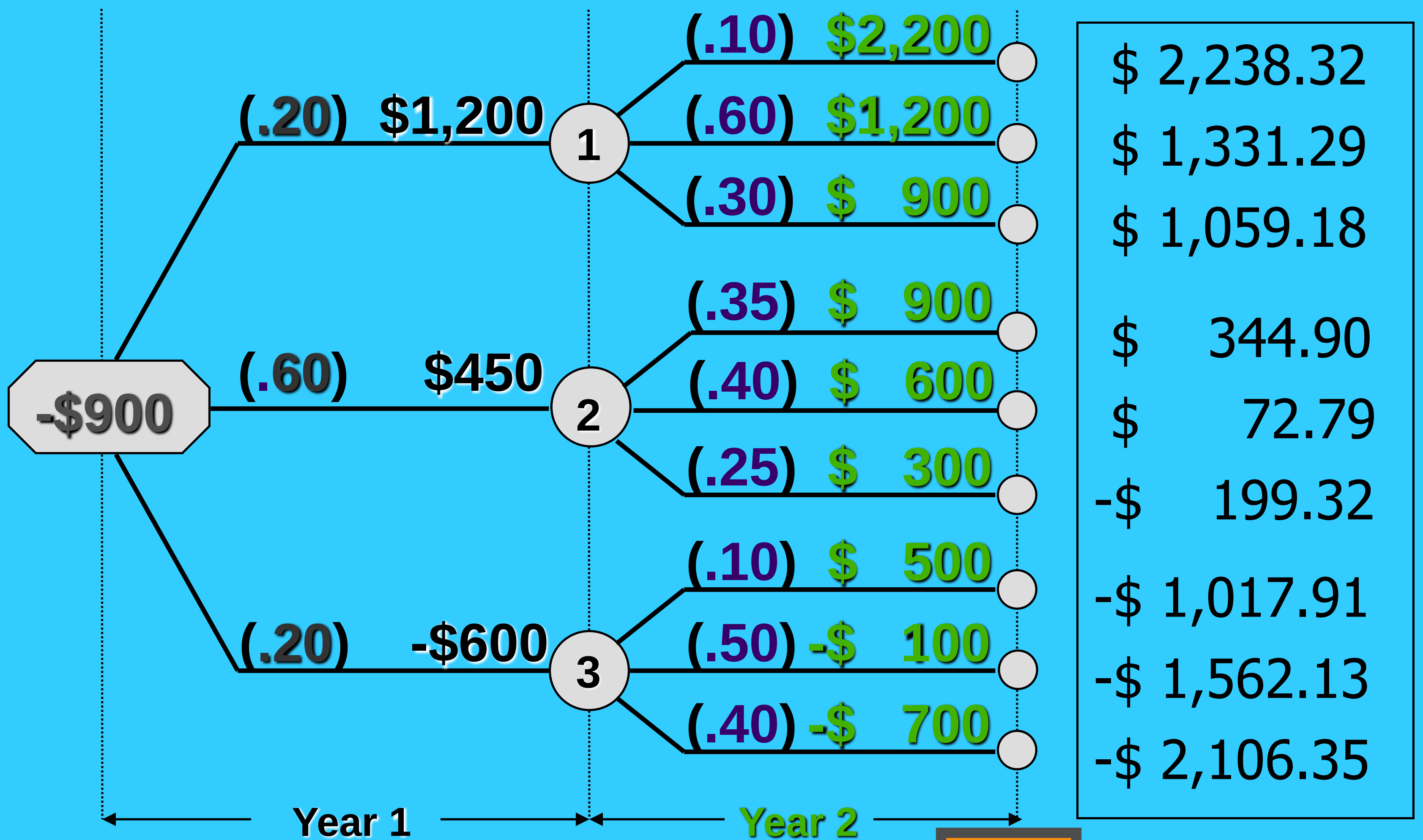
The probability tree accounts for the distribution of cash flows. Therefore, discount all cash flows at *only* the risk-free rate of return.

$$\overline{NPV} = \sum_{i=1}^{z} (NPV_i)(P_i)$$

The NPV for branch i of the probability tree for two years of cash flows is

$$NPV_i = \frac{CF_1}{(1 + R_f)^1} + \frac{CF_2}{(1 + R_f)^2} - ICO$$

NPV for Each Cash-Flow Stream at 5% Risk-Free Rate



Calculating the Expected Net Present Value (NPV)

Branch	NPV_i	P(1,2)	NPV_i * P(1,2)
Branch 1	$ 2,238.32	.02	$ 44.77
Branch 2	$ 1,331.29	.12	$159.75
Branch 3	$ 1,059.18	.06	$ 63.55
Branch 4	$ 344.90	.21	$ 72.43
Branch 5	$ 72.79	.24	$ 17.47
Branch 6	-$ 199.32	.15	-$ 29.90
Branch 7	-$ 1,017.91	.02	-$ 20.36
Branch 8	-$ 1,562.13	.10	-$156.21
Branch 9	-$ 2,106.35	.08	-$168.51

Expected Net Present Value = -$ 17.01

Summary of the Decision Tree Analysis

The standard deviation = SQRT ($1,031,800) = $1,015.78

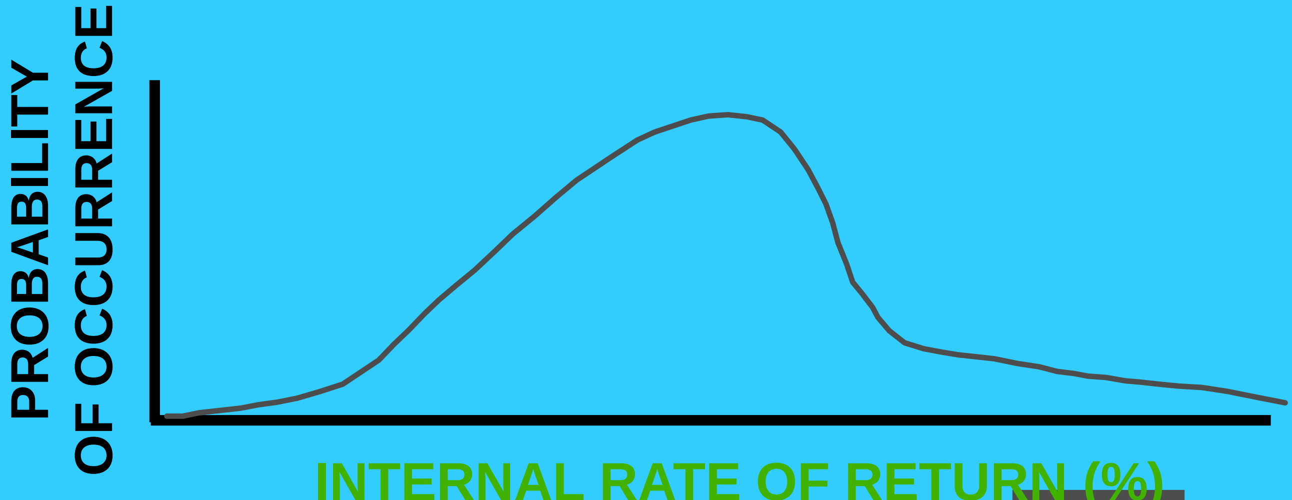
The expected NPV = -$ 17.01

Simulation Approach

An approach that allows us to test the possible results of an investment proposal before it is accepted. Testing is based on a model coupled with probabilistic information.

Simulation Approach

Each proposal will generate an internal rate of return. The process of generating many, many simulations results in a large set of internal rates of return. The distribution might look like the following:



Managerial (Real) Options

Management flexibility to make future decisions that affect a project's expected cash flows, life, or future acceptance.

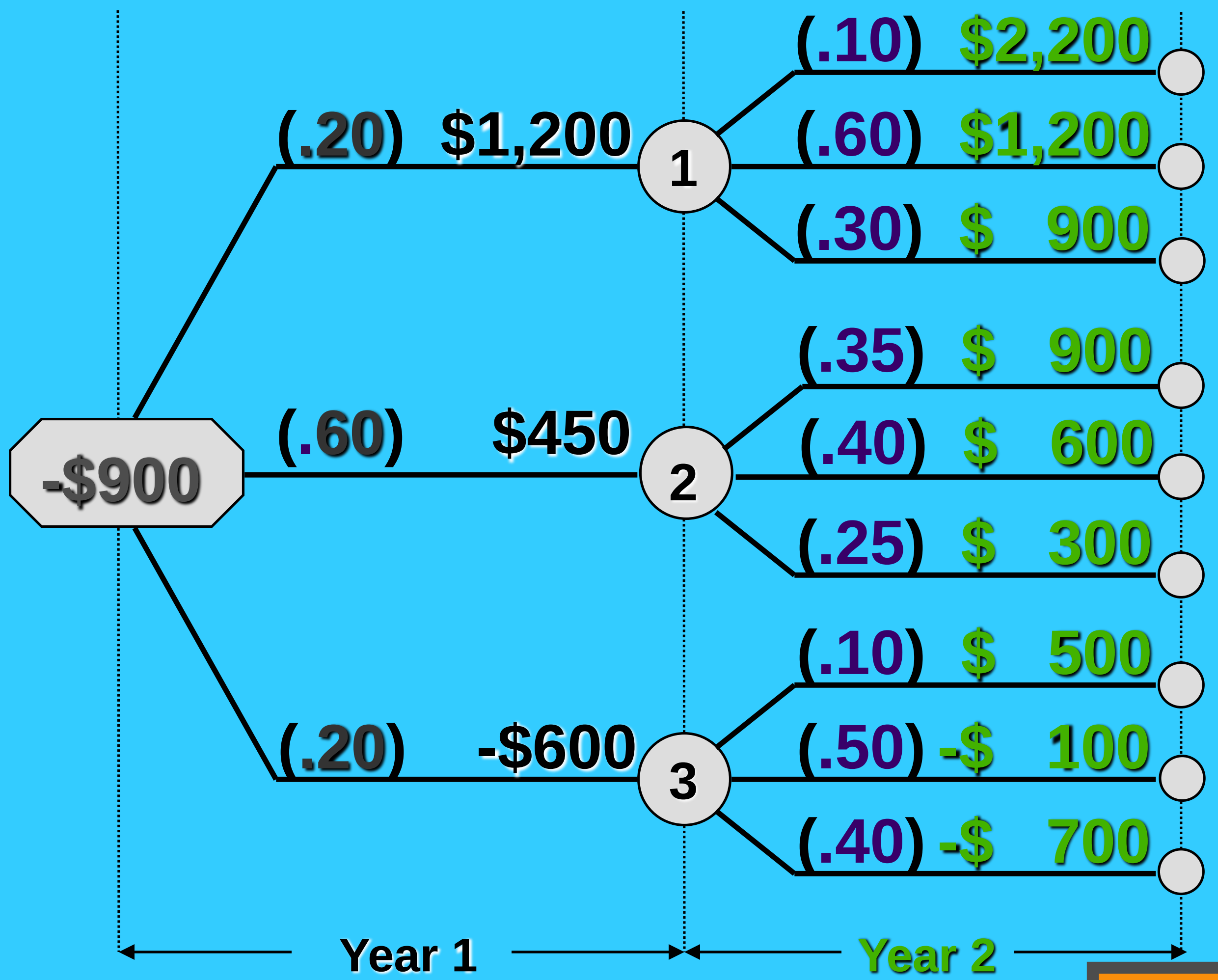
Project Worth = NPV +
Option(s) Value

Managerial (Real) Options

Abandon

- **Allows the project to be terminated early.**

Previous Example with Project Abandonment

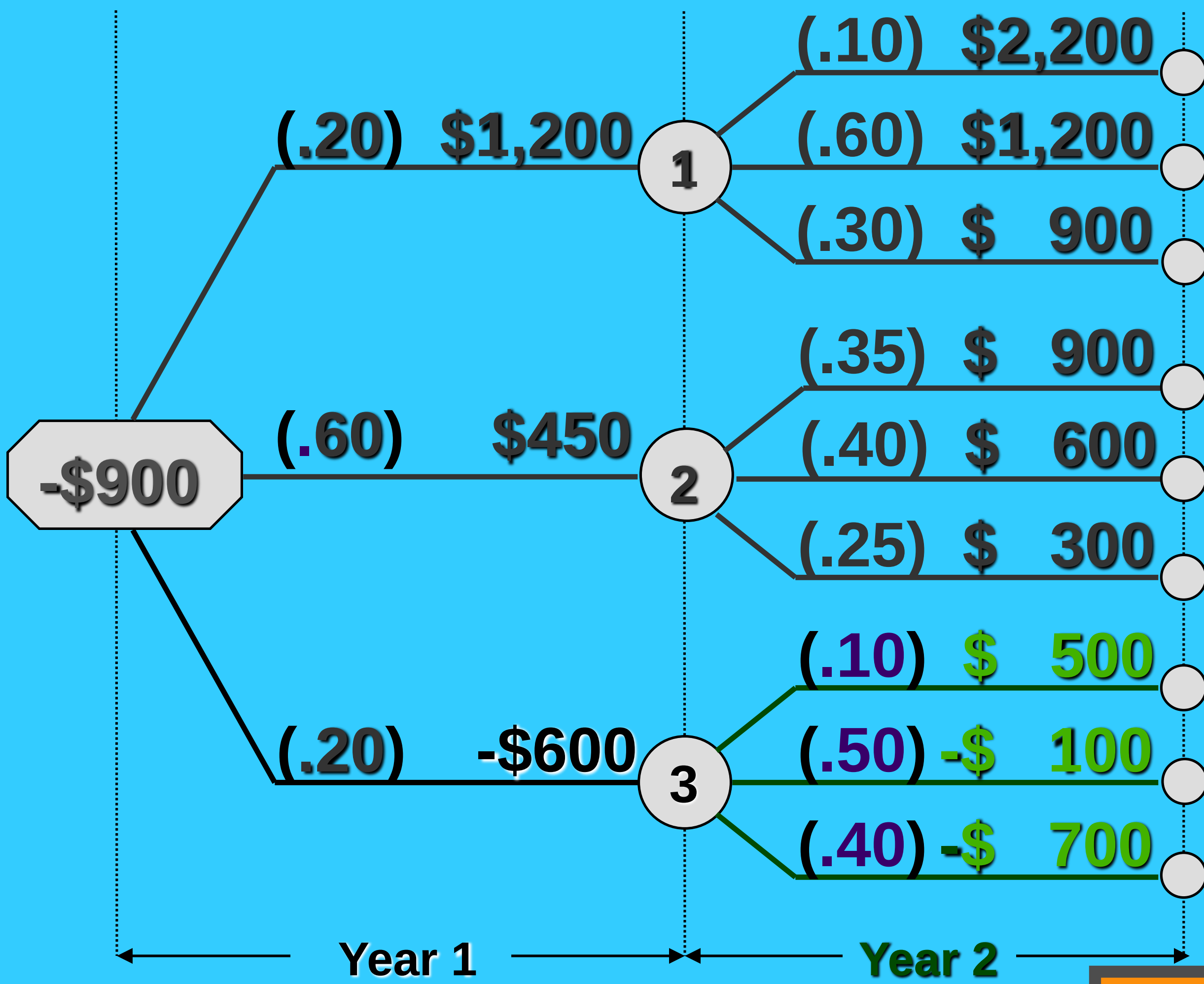


Assume that this project can be abandoned at the end of the first year for $200.

What is the *project worth*?

2009

Project Abandonment



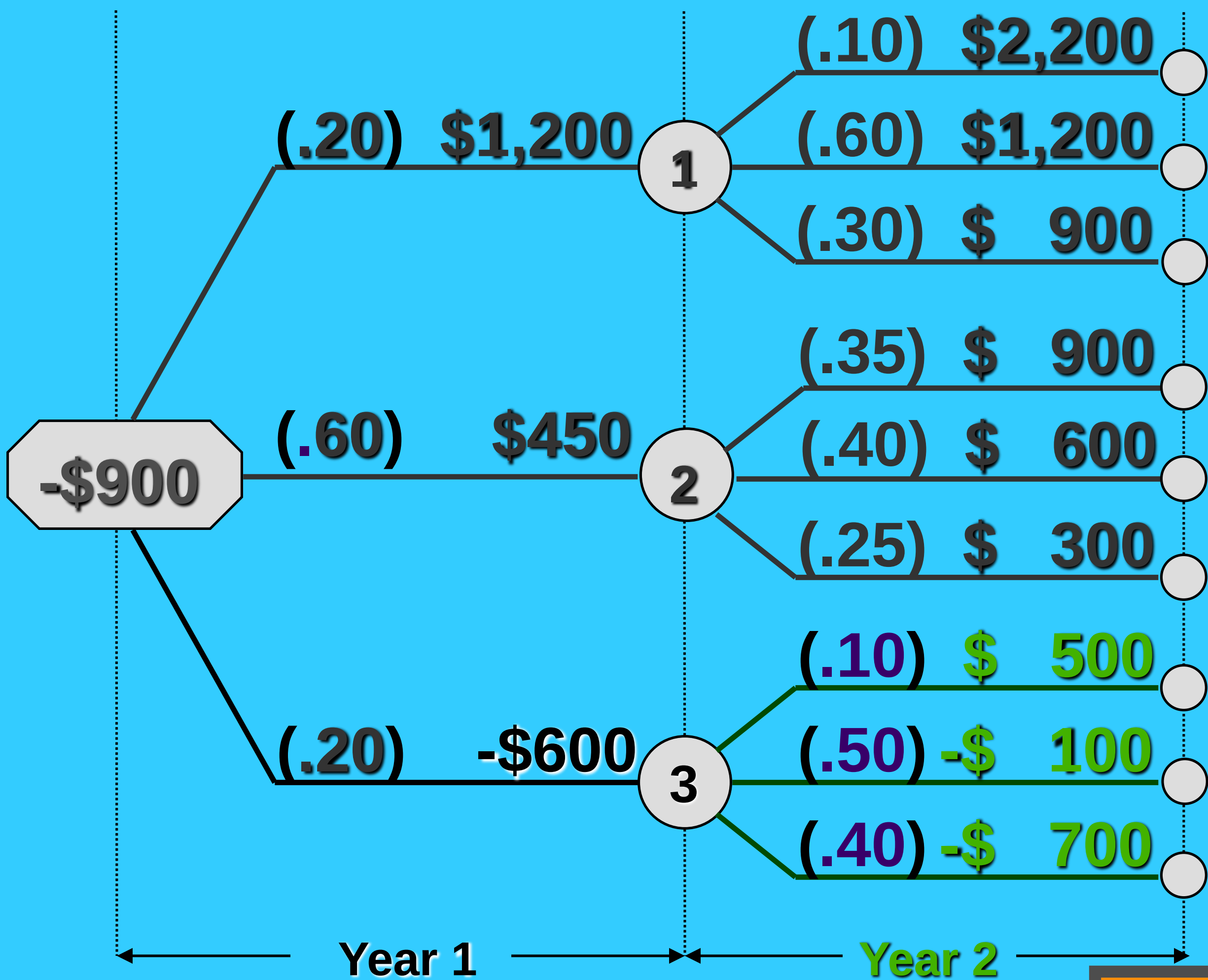
Node 3:

(500/1.05)(.1)+
(-100/1.05)(.5)+
(-700/1.05)(.4)=

($476.19)(.1)+
-($ 95.24)(.5)+
-($666.67)(.4)=

-($266.67)

Project Abandonment



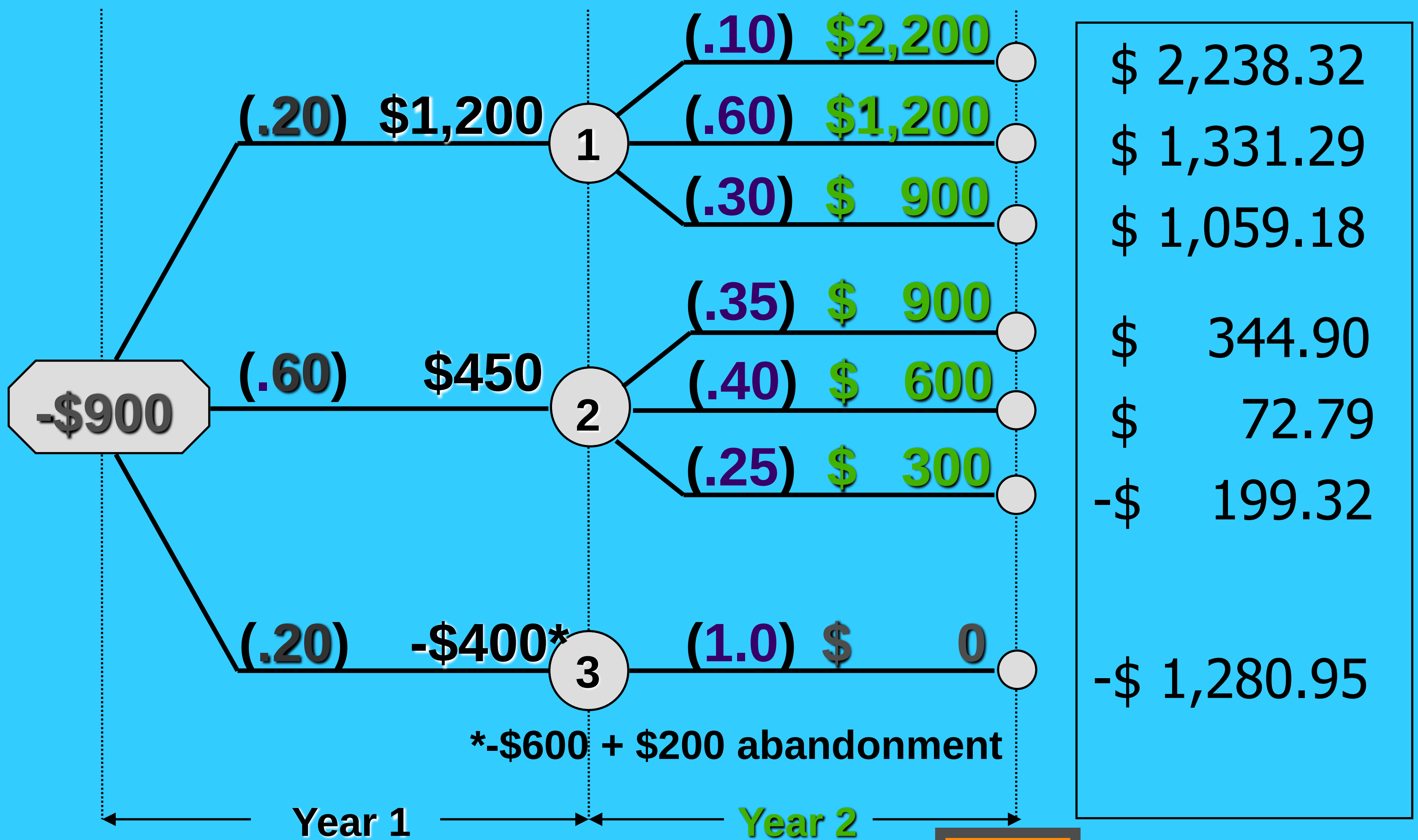
The optimal decision at the end of Year 1 is to abandon the project for $200.

$200 > -($266.67)

What is the "new" project value?

2009

Project Abandonment



Summary of the Addition of the Abandonment Option

The expected NPV* = $ 71.88

NPV* = Original NPV + Abandonment Option

Thus, $71.88 = -$17.01 + *Option*

Abandonment Option = $ 88.89

*** For "True" Project considering abandonment option**

Managerial (Real) Options

Expand (or contract)

- Allows the firm to expand (contract) production if conditions become favorable (unfavorable).

Abandon

- Allows the project to be terminated early.

Postpone

- Allows the firm to delay undertaking a project (reduces uncertainty via new information).