

Risk and Managerial Options in Capital Budgeting

An Illustration of Total Risk (Discrete Distribution)

ANNUAL CASH FLOWS: YEAR 1 PROPOSAL A

<u>State</u>	<u>Probability</u>	<u>Cash Flow</u>
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

<u>State</u>	<u>Probability</u>	<u>Cash Flow</u>
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**

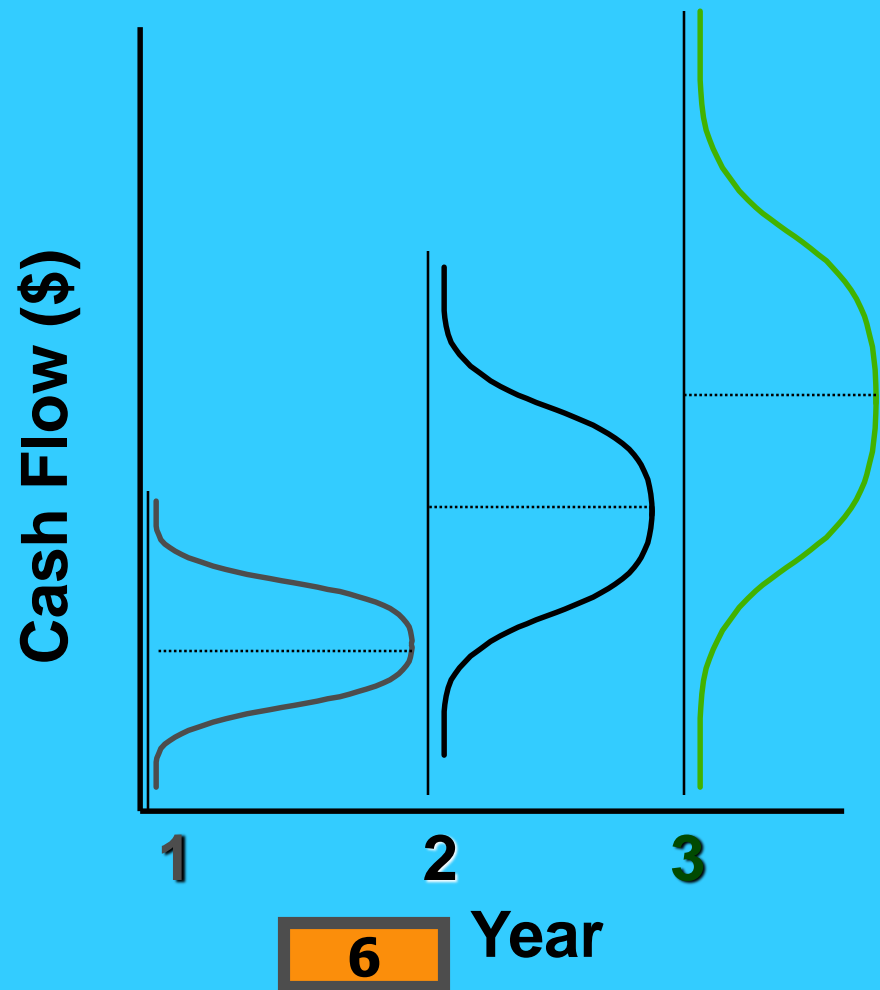
The **expected cash flow** = **\$5,000**

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.

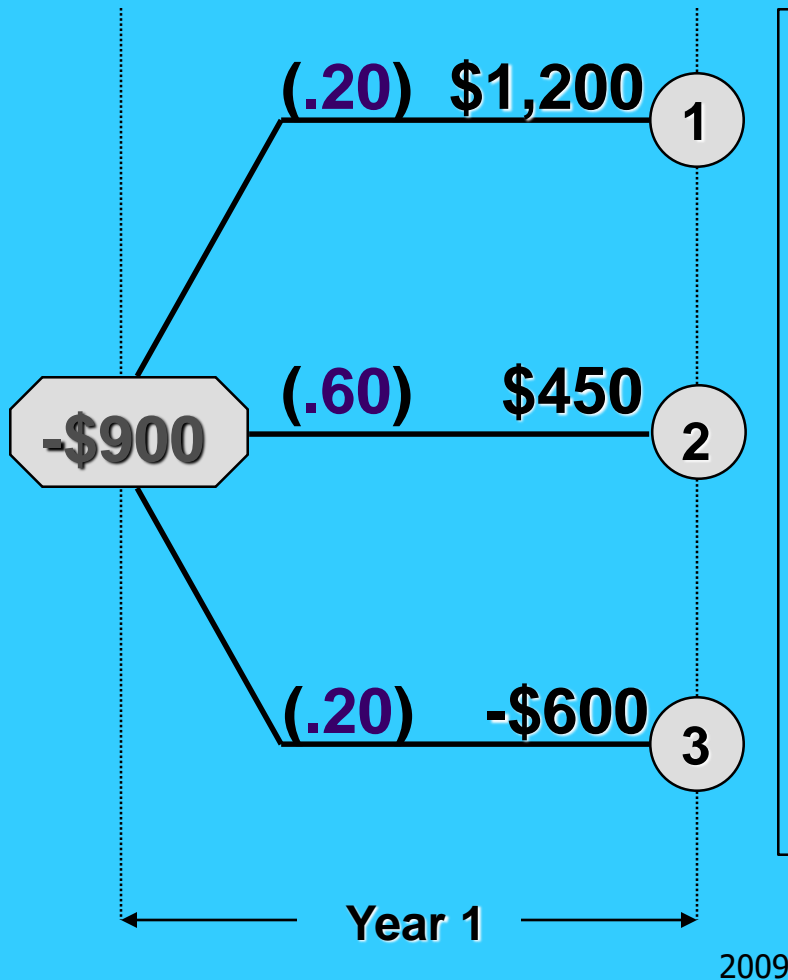
Probability Tree Approach

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.



-\$900

Probability Tree Approach

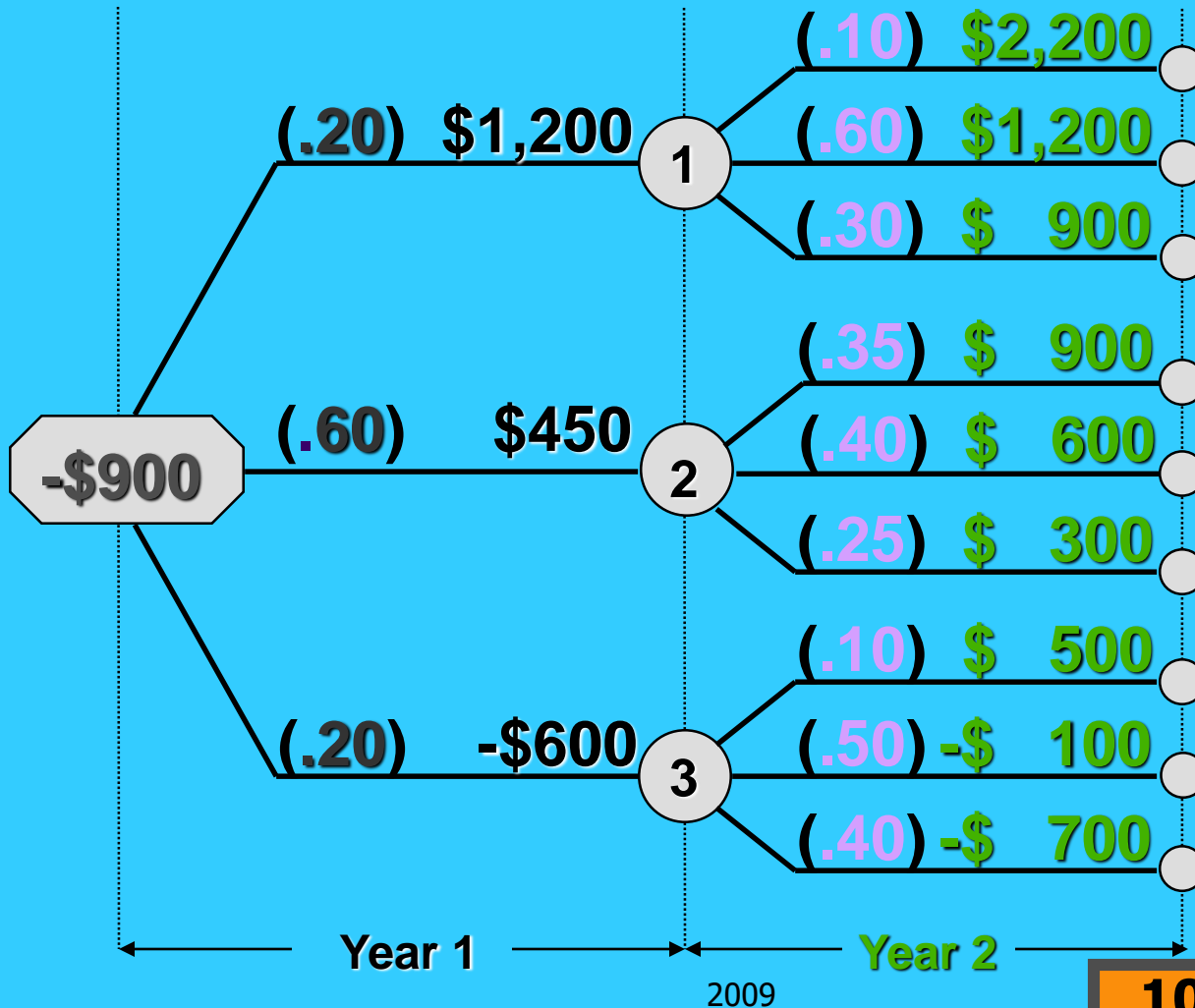


Node 1: 20% chance of a \$1,200 cash-flow.

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

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

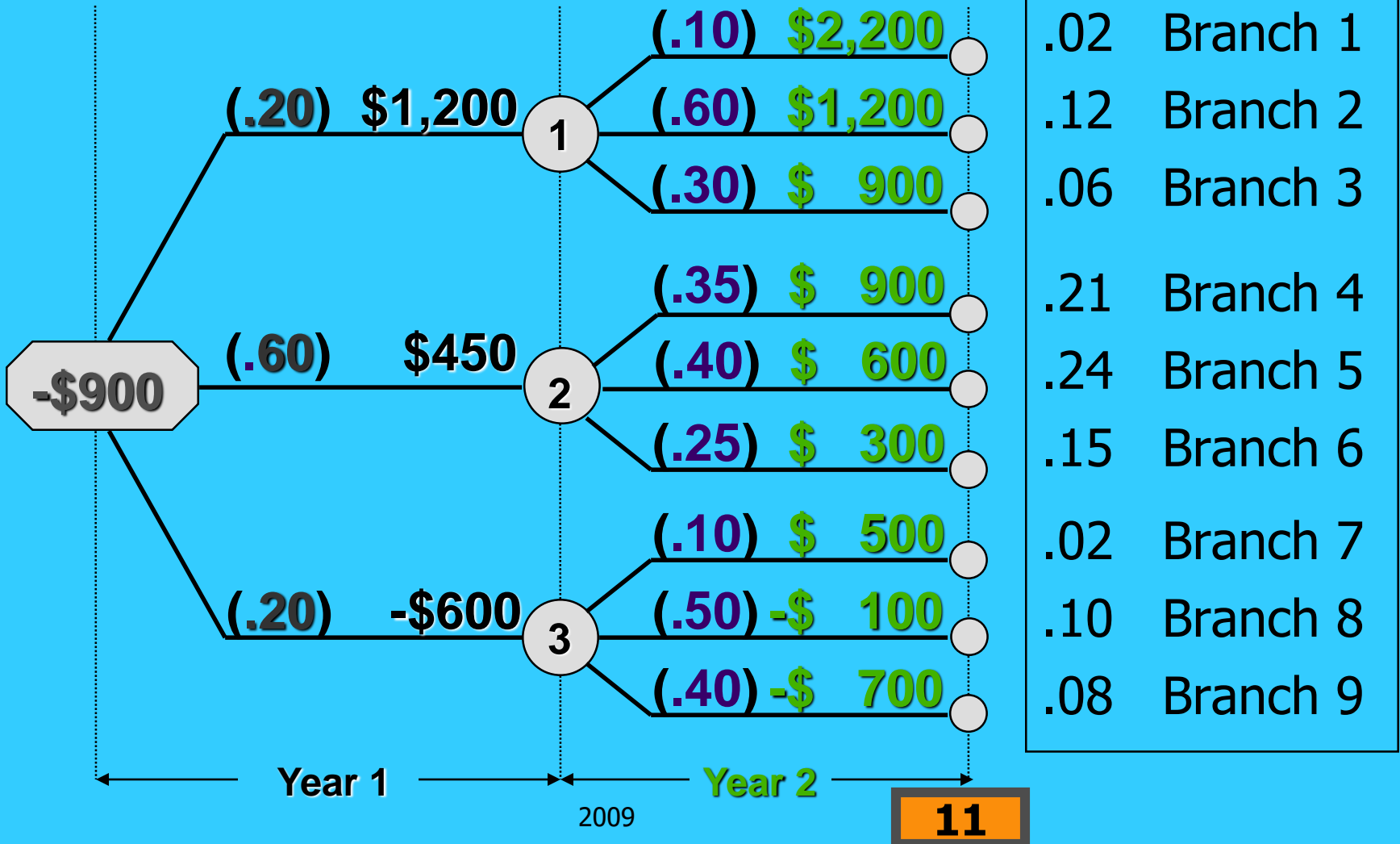
Probability Tree Approach



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)]



Project NPV Based on Probability Tree Usage

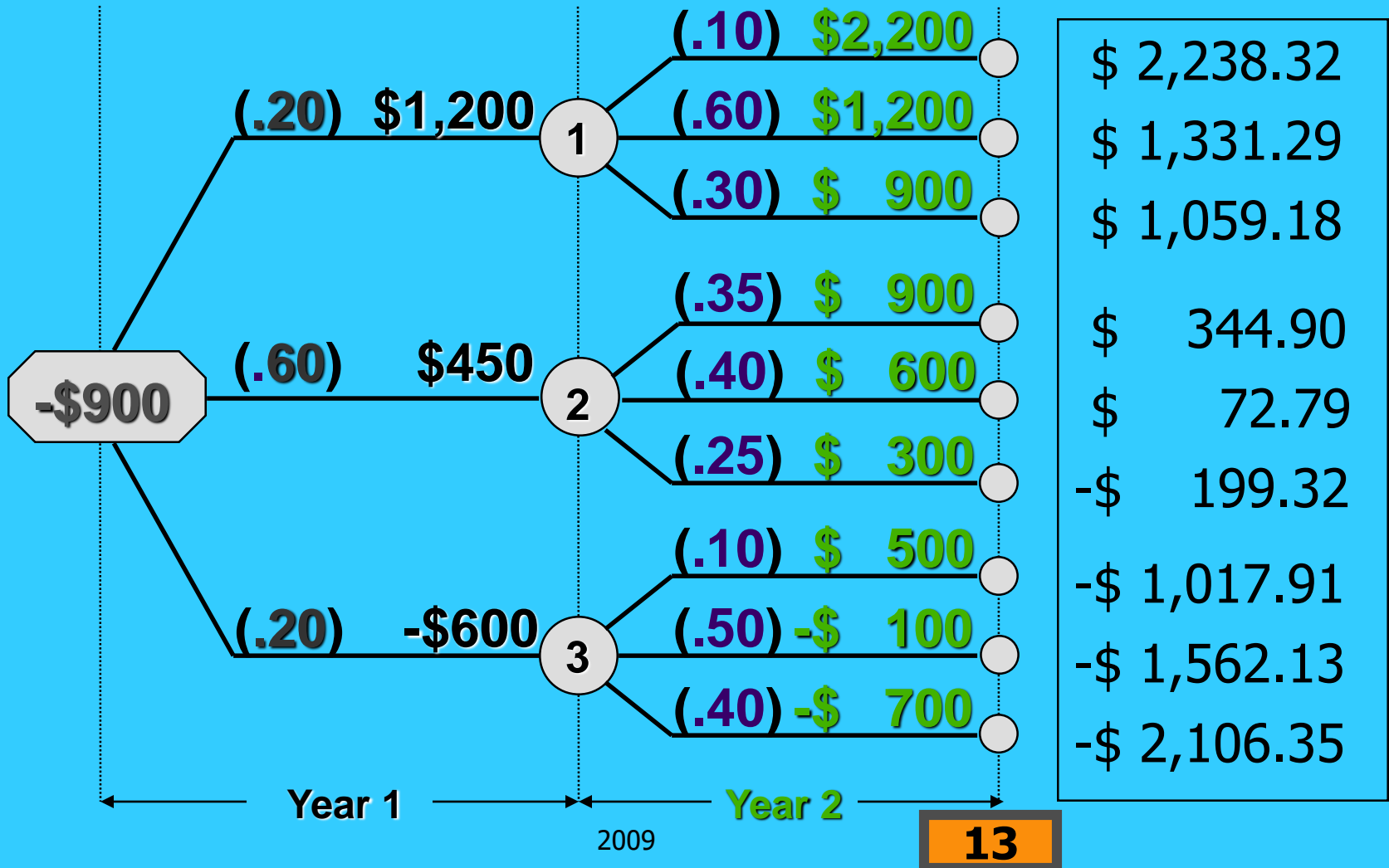
The probability tree accounts for the distribution of cash flows. Therefore, discount all cash flows at *only* the **risk-free** rate of return.

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

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

$$\text{NPV}_i = \frac{\text{CF}_1}{(1 + R_f)^1} + \frac{\text{CF}_2}{(1 + R_f)^2} - \text{ICO}$$

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

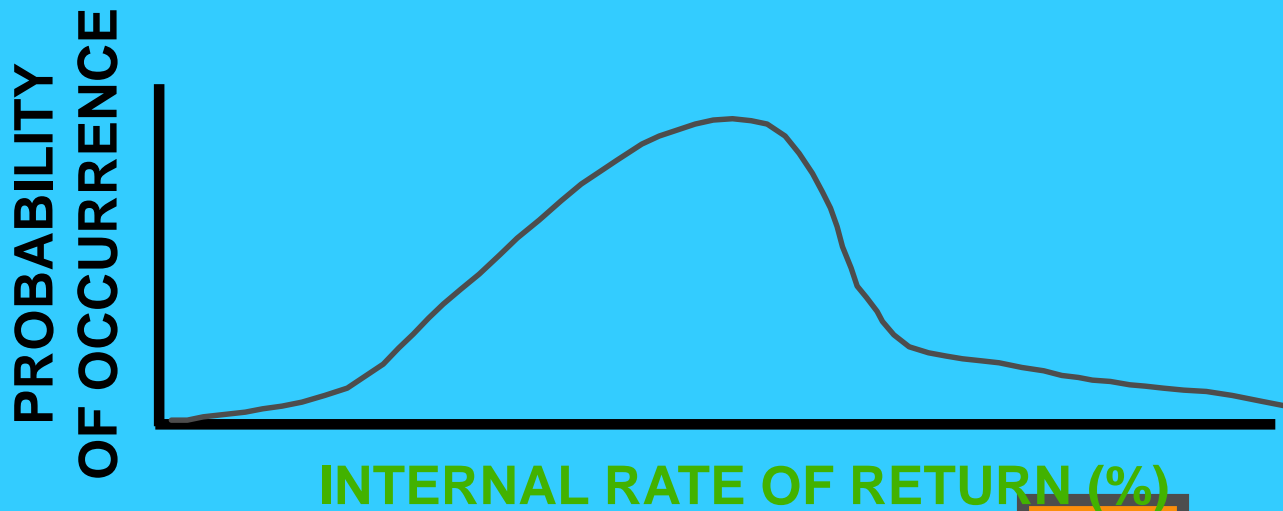
The **expected NPV** = **-\$ 17.01**

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:



2009

17

Managerial (Real) Options

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

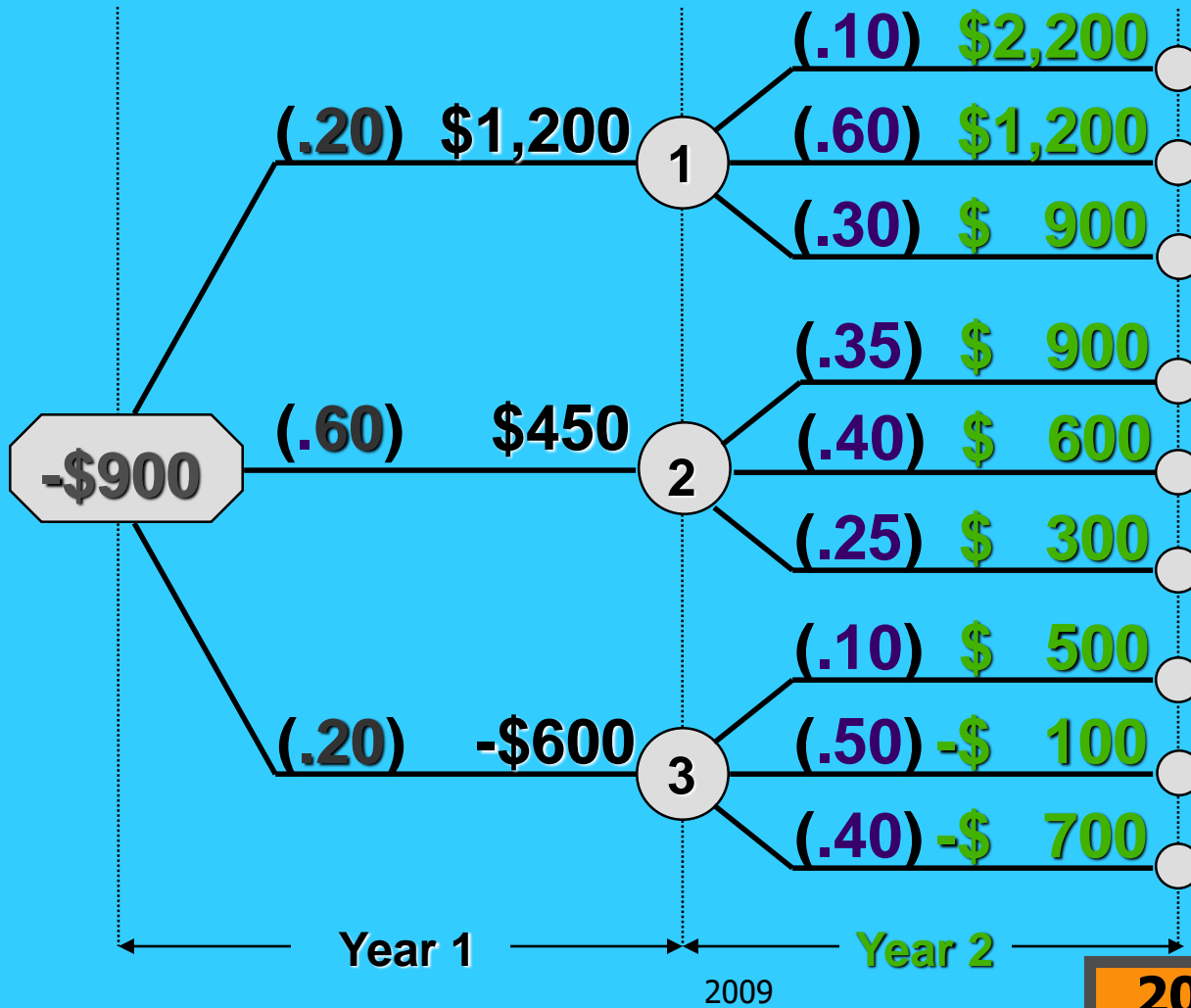
$$\text{Project Worth} = \text{NPV} + \text{Option(s) Value}$$

Managerial (Real) Options

Abandon

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

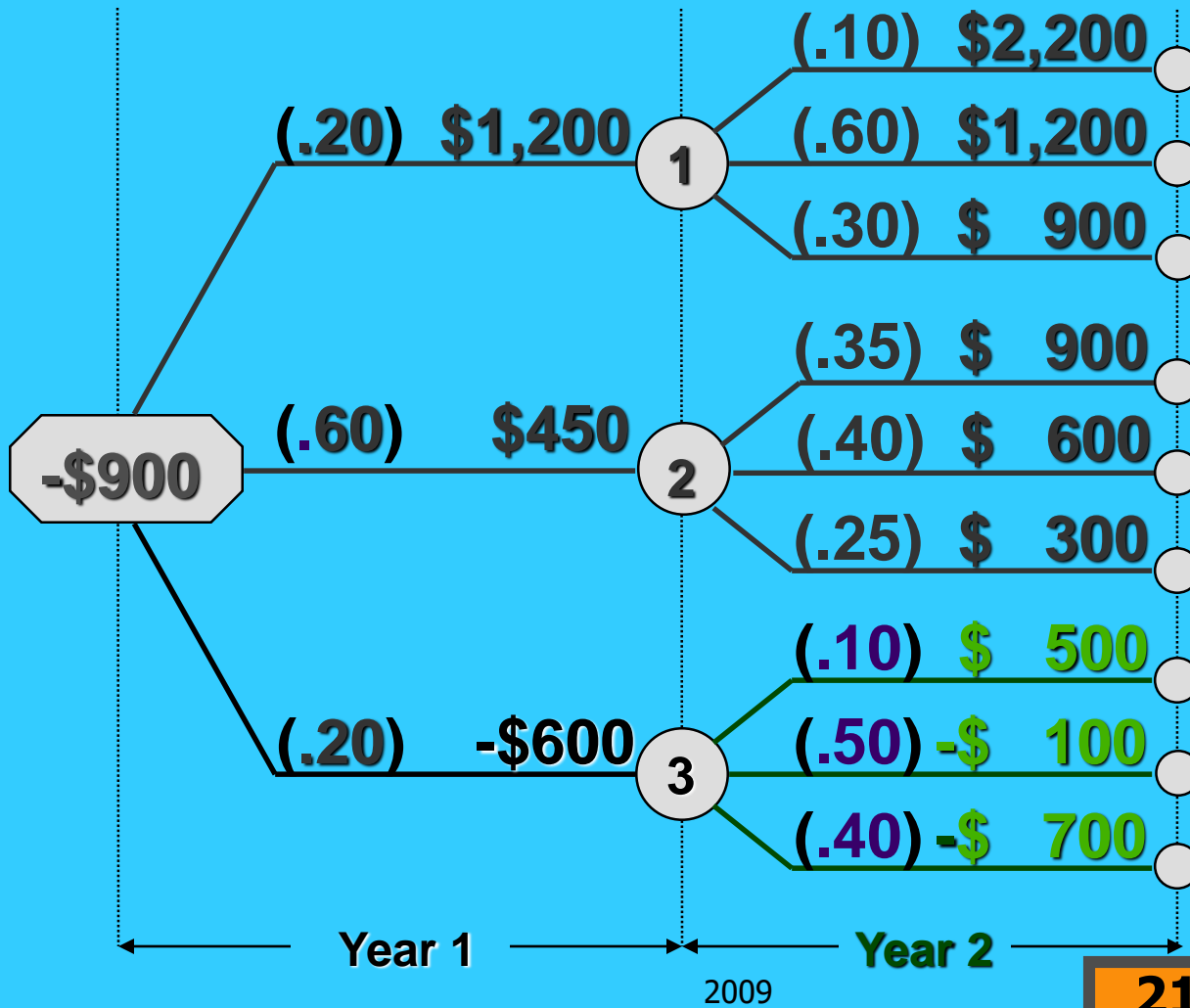
Previous Example with Project Abandonment



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

What is the *project worth*?

Project Abandonment



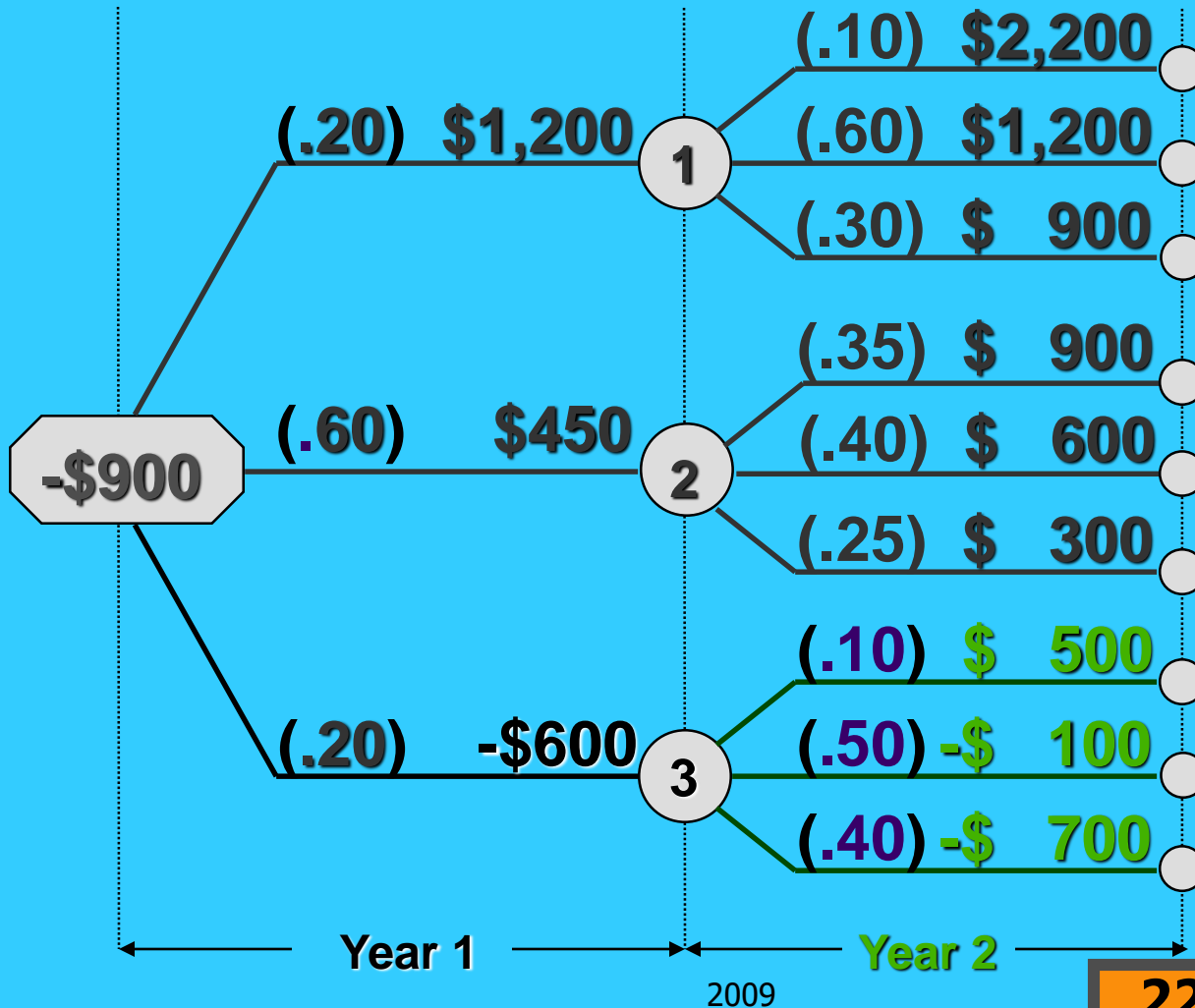
Node 3:

$$\begin{aligned}
 & (500/1.05)(.1) + \\
 & (-100/1.05)(.5) + \\
 & (-700/1.05)(.4) =
 \end{aligned}$$

$$\begin{aligned}
 & (\$476.19)(.1) + \\
 & -(\$95.24)(.5) + \\
 & -(\$666.67)(.4) =
 \end{aligned}$$

-\$266.67

Project Abandonment

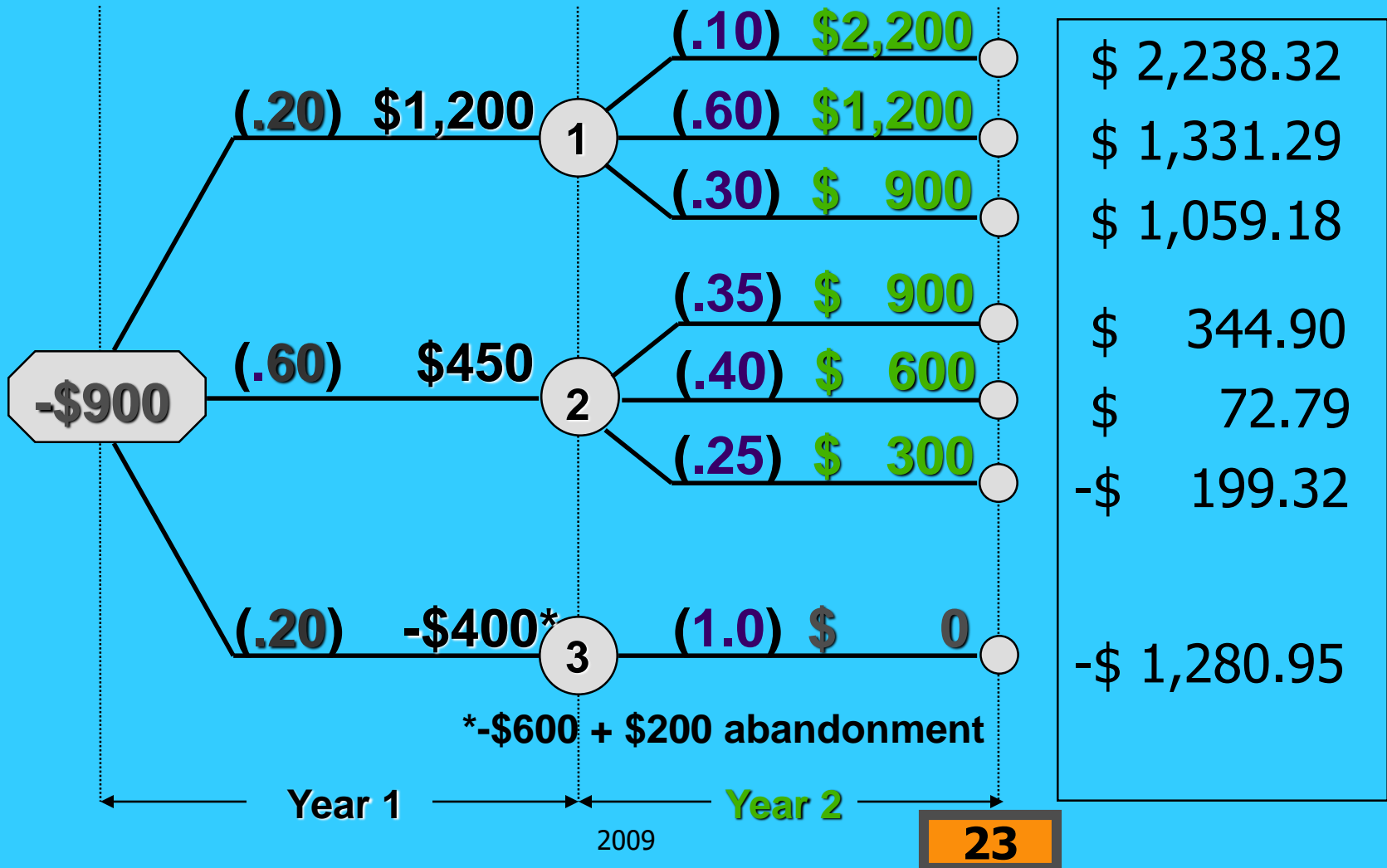


The optimal decision at the end of Year 1 is to abandon the project for \$200.

$$\$200 > -(\$266.67)$$

What is the "new" project value?

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).