

CORPORATE FINANCE > FINANCIAL ANALYSIS

Using Decision Trees in Finance

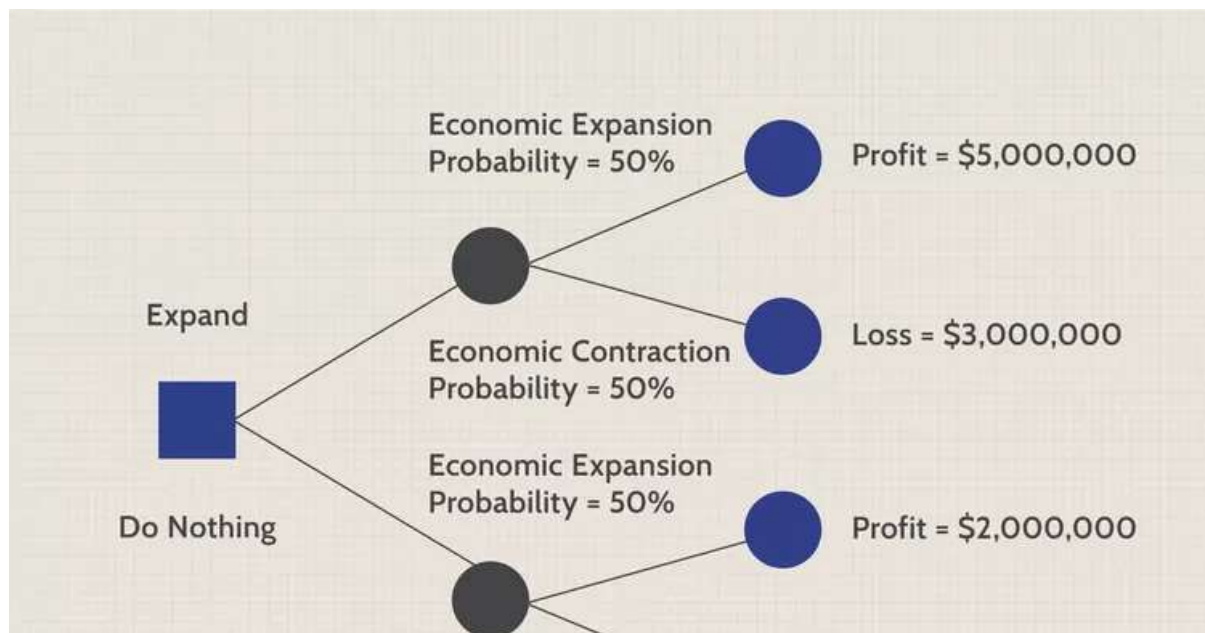
By ARTHUR PINKASOVITCH Updated May 24, 2021

Reviewed by DAVID KINDNESS

[Decision trees](#) are major components of finance, philosophy, and [decision analysis](#) in university classes. Yet, many students and graduates fail to understand their purpose, even though these statistical representations play an integral role in corporate finance and economic forecasting.

Decision Tree Basics

Decision trees are organized as follows: An individual makes a big decision, such as undertaking a [capital project](#) or choosing between two competing ventures. These decisions, which are often depicted with decision nodes, are based on the expected outcomes of undertaking particular courses of action. An example of such an outcome would be something like, "earnings are expected to increase by \$5 million." But since the events indicated by end nodes are speculative in nature, chance nodes also specify the probability of a specific projection coming to fruition.



Probability = 50%

As the list of potential outcomes, which are contingent upon prior events, becomes more dynamic with complex decisions, [Bayesian probability](#) models must be implemented to determine [priori probabilities](#).

Using Decision Trees In Finance

Binomial Option Pricing in Decision Tree Analysis

Decision tree analysis is often applied to option pricing. For example, the [binomial option pricing model](#) uses discrete probabilities to determine the value of an option at expiration. The most basic binomial models assume that the value of the underlying asset will rise or fall based on calculated probabilities at the maturity date of the [European option](#).

 Image

However, the situation becomes more complex with [American options](#), wherein the option can be exercised at any point until maturity. The [binomial tree](#) would factor in multiple paths that the underlying asset's price can take over time. As the number of nodes in the binomial decision tree increases, the model eventually converges onto the Black-Scholes formula.



Black Scholes.
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Although the Black-Scholes formula provides an easier alternative to option pricing over decision trees, computer software can create [binomial](#) option pricing models with "infinite" nodes. This type of calculation often provides

Using Decision Trees for Real Option Analysis

Valuing real options, such as [expansion options](#) and [abandonment options](#), must be done with the use of decision trees, as their value cannot be determined via the Black-Scholes formula. Real options represent actual decisions a company may make, such as whether to expand or contract operations. For example, an oil and gas company can purchase a piece of land today, and if drilling operations are successful, it can cheaply buy additional lots of land. If drilling is unsuccessful, the company will not exercise the option and it will expire worthless. Since real options provide significant value to corporate projects, they are an integral part of capital budgeting decisions.



Real Option Analysis.
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Individuals must decide whether or not to purchase the option prior to the project's initiation. Fortunately, once the probabilities of successes and failures are determined, decision trees help clarify the [expected value](#) of potential capital budgeting decisions. Companies often accept what initially seems like

Decision Tree Applications for Competing Projects

Similarly, decision trees are also applicable to business operations. Companies are constantly making decisions regarding issues like product development, staffing, operations, and mergers and acquisitions. Organizing all considered alternatives with a decision tree allows for simultaneous systematic evaluation of these ideas.

This is not to suggest that decision trees should be used to contemplate every micro decision. But decision trees do provide general frameworks for determining solutions to problems, and for managing the realized consequences of major decisions. For example, a decision tree can help managers determine the expected financial impact of hiring an employee who fails to meet expectations and must be fired.

Pricing of Interest Rate Instruments With Binomial Trees

Although not strictly a decision tree, a binomial tree is constructed in a similar fashion and is used for the similar purpose of determining the impact of a fluctuating/uncertain variable. The upward and downward movement of interest rates has a significant impact on the price of fixed income securities and interest rate [derivatives](#). Binomial trees let investors accurately evaluate bonds with embedded call and [put provisions](#) using uncertainty regarding future interest rates.

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Because the Black-Scholes model is not applicable to valuing bonds and interest rate-based options, the binomial model is the ideal alternative. Corporate projects are often valued with decision trees that factor various possible alternative states of the economy. Likewise, the value of bonds, [interest rate floors](#) and caps, [interest rate swaps](#), and other types of investment tools can be determined by analyzing the effects of different interest rate environments.

Decision Trees and Corporate Analysis

Decision trees let individuals explore the ranging elements that could materially impact their decisions. Prior to airing a multimillion-dollar Super Bowl commercial, a firm aims to determine the different possible outcomes of their [marketing campaign](#). Various issues can influence the final success or failure of the expenditure, such as the appeal of the commercial, the economic outlook, the quality of the product, and competitors' advertisements. Once the impact of these variables has been determined and the corresponding probabilities assigned, the company can formally decide whether or not to run the ad.

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The Bottom Line

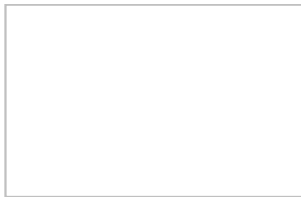
These examples provide an overview of a typical assessment, which can benefit from utilizing a decision tree. Once all of the important variables are determined, these decision trees become very complex. However, these instruments are often an essential tool in the [investment analysis](#) or management decision-making process.

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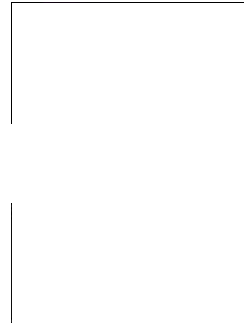
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Related Terms

Binomial Option Pricing Model

A binomial option pricing model is an options valuation method that uses an iterative procedure and allows for the node specification in a set period. [more](#)

Black-Scholes Model: What It Is, How It Works, Options Formula

The Black-Scholes model is a mathematical equation used for pricing options contracts and other derivatives, using time and other variables. [more](#)



may take at different nodes or time periods. [more](#)

Trinomial Option Pricing Model

The trinomial option pricing model is an option pricing model incorporating three possible values that an underlying asset can have in one time period. [more](#)

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Option pricing theory uses variables (stock price, exercise price, volatility, interest rate, time to expiration) to theoretically value an option. [more](#)

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