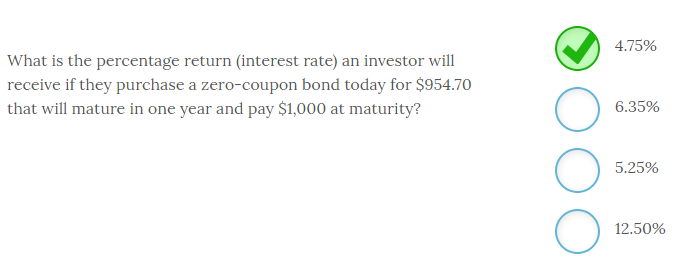
# Chapter 3



The percentage return (interest rate) an investor will receive if they purchase a zero-coupon bond today for $954.70 that will mature in one year and pay $1,000 at maturity is **4.75%**.

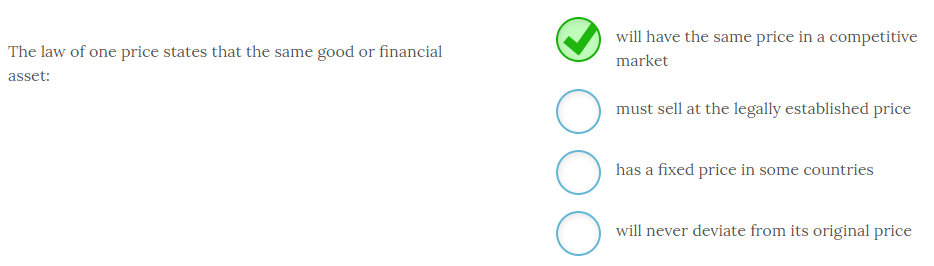
Given the time value of money, we know that the $1,000 we expect to receive in the future (FV) has a value today (PV) of $954.70. Since we know that the holding period is only one year, you can easily calculate that rate with your financial calculator using the following key strokes:

PV = -954.70; FV = $1,000; N=1; PMT = 0; CPT I/Y and you will get 4.75%

In addition, you know that the rate will be somewhere close to 5% since the $45.30/$954.70 is slightly less than 5%. For one year periods, you can use this simple method to approximate the rate. The other interest rate choices above are arbitrary.

In later modules, you will discover this calculation is known as the yield to maturity or YTM. It is also the same process, we will use to calculate an internal rate of return (IRR).

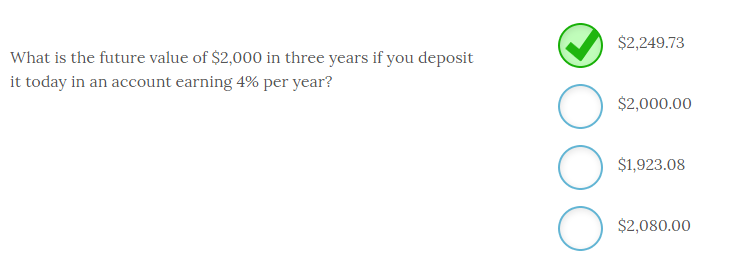
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The law of one price states that the same good or financial asset **will have the same price in a competitive market**.

The reason this is true is not because the law requires this condition to hold, or that a country fixes a specific price, but that the act of arbitrage will keep prices equal. If the selling price is higher than the buying price an arbitrager will simultaneously buy and sell the asset, which moves the prices back to the same level. In competitive markets, these price discrepancies will be very short lived.

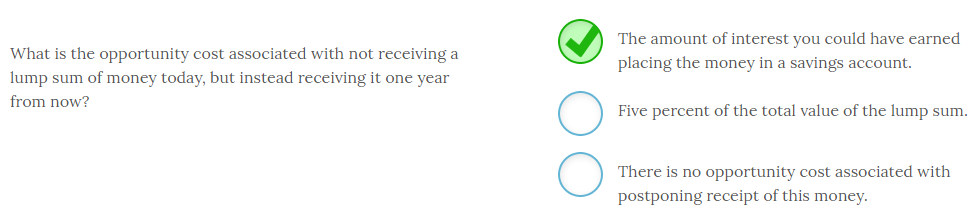
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The future value of $2,000 in three years if you deposit it today in an account earning 4% per year is **$2,249.73**.

You can calculate this using the formula FV = PV(1 + i)n where, i = interest rate and n = number of periods. Therefore, FV = $2,000(1 + .04)3 = $2,249.73. The future value will always exceed the present value for any interest rate above zero. The $2,000 lump sum will be worth $2,080 in one year assuming a 4% return.

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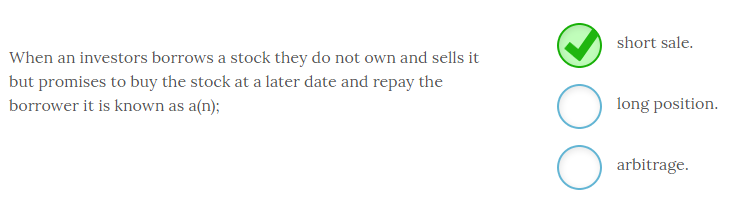


The opportunity cost associated with not receiving a lump sum of money today, but instead receiving it one year from now is equivalent to **the amount of interest you could have earned placing the money in a savings account**.

The opportunity cost is the cost associated with the next best option. In this case, you could have received the money today and earned some rate of return. That foregone return is the opportunity cost. Since the lost income depends on the market rate of interest at the time, we have no way of knowing whether it is 5% or not. As long as the market rate exceeds zero, holding all else constant, there will be an opportunity cost associated with postponing receipt of this cash flow.

The lost opportunity for investing these funds is one of the primary reasons there is a time value of money. Another potential opportunity cost is the cost associated with the loss of purchasing power due to inflation. If you received the money today, you could spend it and buy more goods and services with that amount than you would be able to buy with that amount in one year, assuming an inflation rate greater than zero.

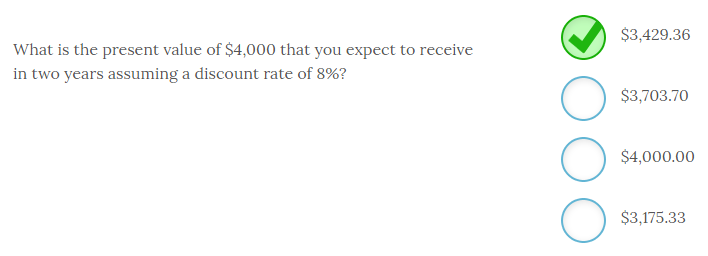
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When an investor borrows a stock they do not own and sells it with a promise to buy the stock at a later date and repay the borrower it is known as a **short sale**. Investors who believe a stock will fall in value may short the stock (i.e. borrow it and sell it) and buy the stock after it falls in value. The investor will profit based on the difference between the selling price and the buying price minus any transaction costs.

An investor has a long position when they buy a stock to sell at some later date. Arbitrage occurs when you buy and sell simultaneously and therefore incur no risk.

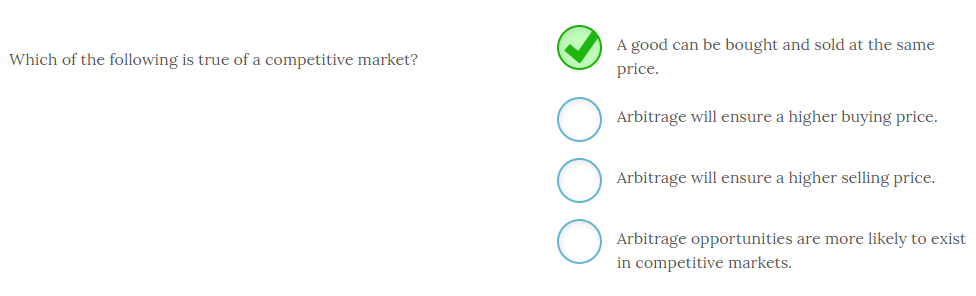
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The present value of $4,000 that you expect to receive in two years assuming a discount rate of 8% is equal to **$3,429.36**.

The present value would be $3,703.70 if you expected to receive the cash flow at the end of one year and $3,175.33 if you expected to receive the $4,000 at the end of three years. The easy method to make the calculation is to use a financial calculator and input the following keystrokes:

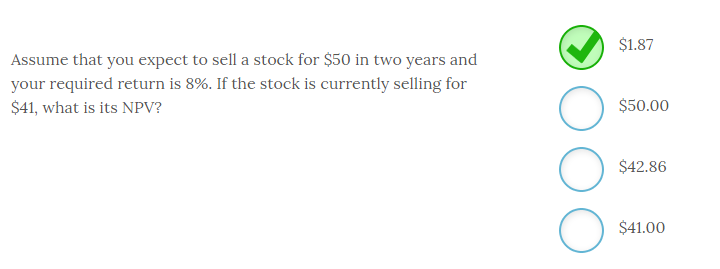
FV = -$4,000; N = 2; I/Y = 8%; CPT PV

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In a competitive market, **a good can be bought and sold at the same price**.

The valuation principle in finance ensures that there is only one price for a product in a competitive market. Arbitrage will eliminate any deviations from one price as soon as it is identified. If you can buy at a lower price and sell at a higher price, there will be an increase in demand that pushes the buy price higher and an increase in supply at the higher selling price that pushes it lower until a new equilibrium price is established. The quest for profits by arbitragers will cause the prices to converge instantly. So, in a pure competitive market arbitrage opportunities will be rapidly eliminated and the buy and sell price will be one price.

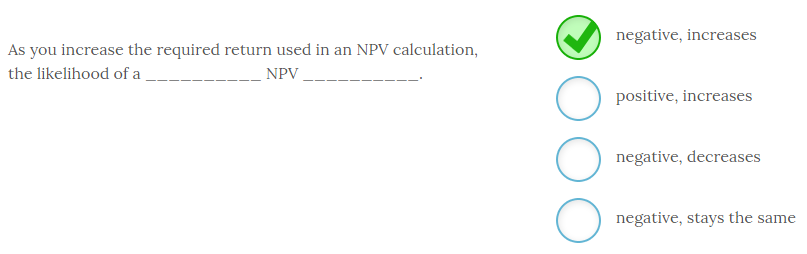
Arbitragers buy low and sell high to make a profit and quickly eliminate any price differential through this activity. For it to be true arbitrage, the buying and selling must happen simultaneously. If the asset is held for a period of time, it is not a riskless transaction and becomes investing or speculation.

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Assume that you expect to sell a stock for $50 in two years and your required return is 8%. If the stock is currently selling for $41, the NPV is **$1.87**.

The only expected cash flow in this example is the forecasted selling price of the stock which is $50. So, the NPV is equal to the present value of the expected cash flows minus the current price which is: NPV = [$50/(1.08)2] - $41 = $42.87 - $41 = $1.87.

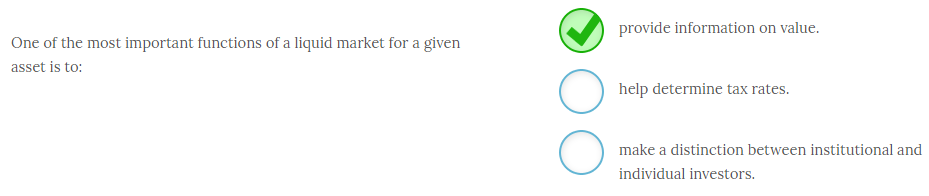
Keep in mind that if these cash flows were certain and the market was competitive, the stock should have an NPV = 0. However, forecasting future selling prices or cash flows is not an exact science.

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As you increase the required return used in an NPV calculation, the likelihood of a **negative** NPV **increases**.

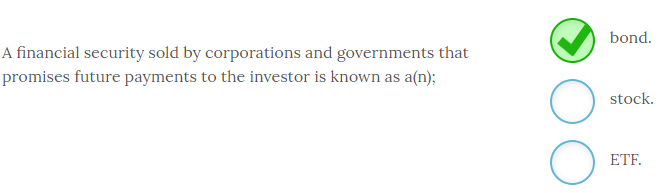
Increasing the required return decreases the present value of the cash flows. This, in turn, decreases the NPV which increases the chance that the NPV will be negative. Higher discount rates always reduce the present value of the cash flows.

The discount rate used in the NPV calculation should be commensurate with the level of risk of the project. That way a higher risk project has a lower likelihood of being accepted, all things equal.

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One of the most important functions of a liquid market for a given asset is to **provide information on value.** Competitive markets need a large number of buyers and sellers in order to provide sufficient liquidity. When markets are liquid they provide a clear signal of the value of an asset that thinly traded or illiquid markets cannot provide. Competitive liquid markets are therefore critical since the goal of the firm is to maximize shareholder wealth and the stock price is the metric managers monitor to see if they are achieving their goal.

Governments, not markets, determine tax rates. Institutional investors and individual investors both benefit from liquid markets but there is no distinction made between these investor types.



A financial security sold by corporations and governments that promises future payments to the investor is known as a **bond**. Bonds are essentially IOUs that promise to pay investors the face value of the bond at some future date. In most cases they also pay investors annual or semiannual interest payments.

Stocks and ETF (exchange traded funds) make no promise of repayment and are also not issued by governments.

Some bonds, known as zero coupon bonds or zeros, pay no interest and are simply sold at a discount.

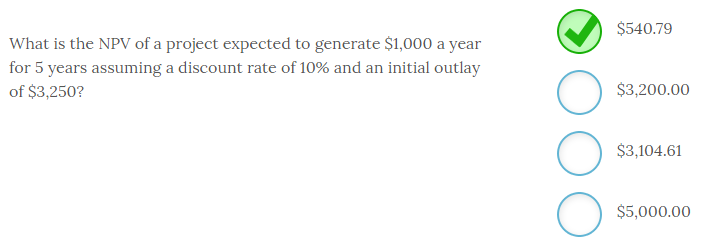
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In general, a dollar received today **is worth more than a dollar received tomorrow**.

As long as there is a positive interest rate, you can invest money you have today and it will increase in value. Because of the opportunity cost of this foregone interest earned, you would place a higher value on receiving the dollar today instead of tomorrow or next year. This difference in value over time is known as the time value of money.

This concept should be intuitive to you. Most of you would prefer to receive $100 today instead of $100 in one year. Why? Because of the time value of money. Even if you did not invest it, but instead wanted to spend the money, you would prefer it now since inflation would reduce the purchasing power of the $100 you expect to receive in one year. You would rather get it today and spend it or invest it because money has a time value.

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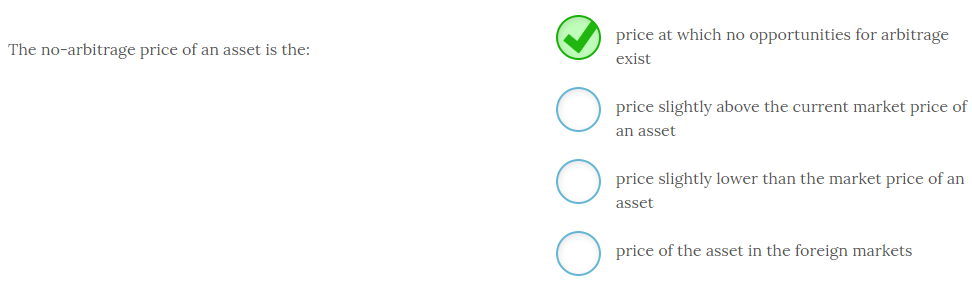
The NPV of a project expected to generate $1,000 a year for 5 years assuming a discount rate of 10% and an initial outlay of $3,250 is **$540.79**.

The easiest way to solve this problem is to use a financial calculator with the following inputs:

PMT = -$1,000; N = 5; I / Y = 10%; CPT PV. PV is equal to $3,790.79 - $3,250 = $540.79. Since the NPV is positive, the project should be accepted.

Remember that when NPV = 0 the project generated a return that was exactly equal to the required return.

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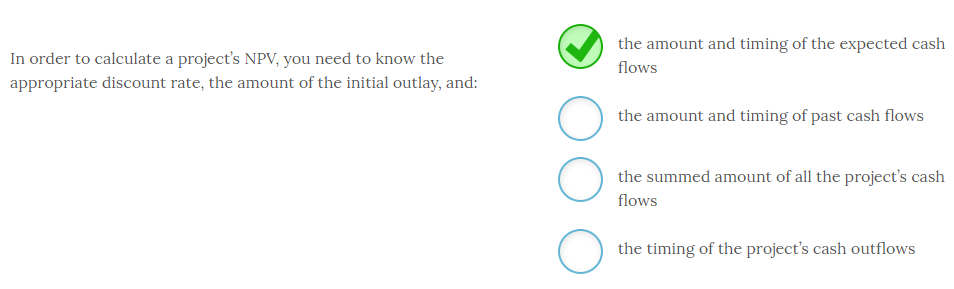


The no-arbitrage price of an asset is the **price at which no opportunities for arbitrage exist**.

At any asset price above or below the current market price, there would be an opportunity to simultaneously buy and sell the asset to make a profit. Only when the price is exactly at the point where no arbitrage profits exist is the asset priced at the no-arbitrage price. Foreign markets may present arbitrage opportunities depending on their level of competitiveness.

In a competitive market, the no-arbitrage price will be the prevailing market price.

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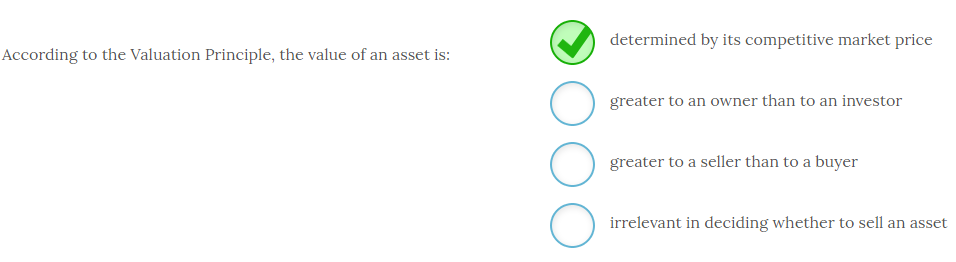


In order to calculate a project’s NPV, you need to know the appropriate discount rate, the amount of the initial outlay, and **the amount and timing of the expected cash flows**.

To calculate an NPV, you need to calculate the present value of the project’s expected cash flows. In order to make that calculation, you need to forecast the amount and timing of these cash flows. The next step is to subtract the initial outlay from this amount and see if the result is positive or negative. If the NPV is positive, you should accept the project since it generates your required return at a minimum.

Past cash flows are irrelevant since the NPV should be based on future cash flows. The timing of when these cash flows will occur is critical to the present value as well, so summing the cash flows is incorrect since you will lose the timing in that process. And, you need the timing of all cash flows, not just outflows.

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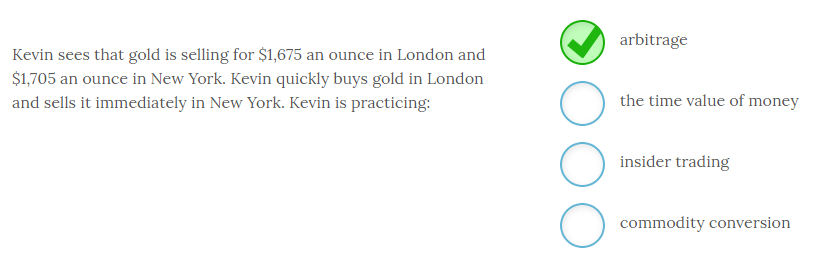
According to the Valuation Principle, the value of an asset is **determined by its competitive market price**.

Anyone conducting cost vs. benefit analysis should use the competitively determined market price. If the benefits are greater than the costs, then an asset should be acquired. As it relates to the firm, this action will increase shareholder wealth.

The only asset value that is relevant is the one determined by the competitive market, and this price is the same to the buyer and the seller. This is the price that should be used for decision making purposes.

The Valuation Principle is an application of the marginal cost vs. marginal benefit analysis you learned about in economics. The decision rule is still the same. If the benefits are greater than the costs, it is a good decision. In this case, good decisions add value to the firm in the form of increased shareholder wealth.

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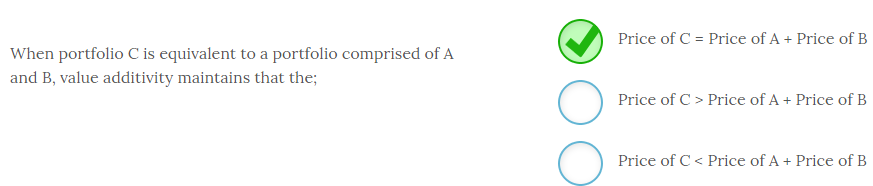


Kevin sees that gold is selling for $1,675 an ounce in London and $1,705 an ounce in New York. Kevin quickly buys gold in London and sells it immediately in New York. Kevin is practicing **arbitrage**.

Arbitrage is the immediate buying and selling of some asset where the arbitrager finds a price discrepancy. Since this activity occurs instantaneously, the time value of money is not a factor. Kevin is also not an insider and is trading with publicly available information. No commodities are converted in this practice.

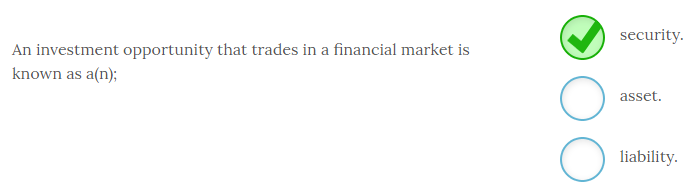
This practice will cause the price to converge in both markets and the opportunity to profit from this transaction will rapidly disappear as enough buyers and sellers take advantage of it and the prices become equivalent.

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When portfolio C is equivalent to a portfolio comprised of A and B, value additivity maintains that **Price of C = Price of A + Price of B**. The law of one price states that value is neither created nor destroyed by simply combining two assets into one portfolio. The value of the portfolio is still the present value of all future cash flows which has not changed. If the value differed then investors would arbitrage the profits away until the equality held.

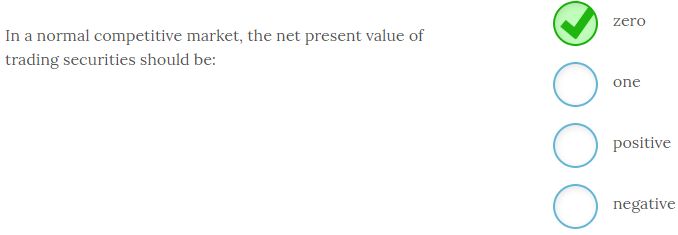
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An investment opportunity that trades in a financial market is known as a **security**, or financial security. Stocks, bonds, futures, mutual funds and other derivative securities are all examples of financial assets.

Financial securities are assets but there are many assets that are not financial securities and do not trade in financial markets.

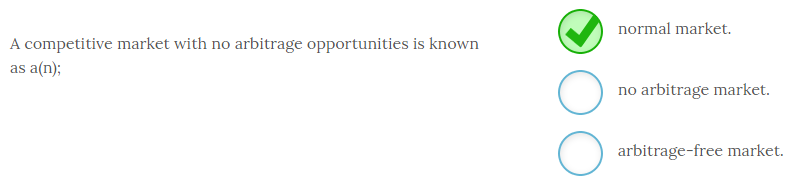
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In a normal competitive market, the net present value of trading securities should be **zero**.

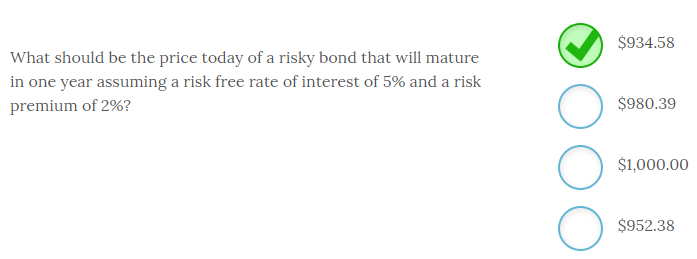
If buying a stock or bond presented a positive NPV, then investors would jump on that opportunity and push the price higher until the NPV was zero. So, any deviation from an NPV of zero will not last long due to arbitrage.

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A competitive market with no arbitrage opportunities is known as a **normal market**. Most markets with a number of participants are normal markets since arbitrage opportunities are acted on rapidly and therefore disappear almost as soon as they appear. A market with arbitrage opportunities is therefore not the norm.

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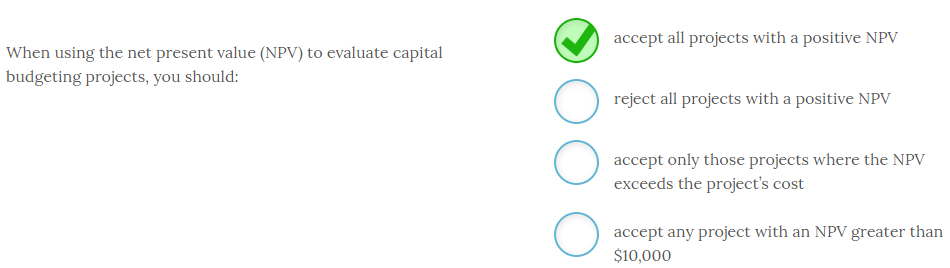


The price today of a risky bond that will mature in one year assuming a risk free rate of interest of 5% and a risk premium of 2% should be **$934.58**.

Since risky bonds do not pay interest, the value is merely the present value of the $1,000 cash flow you expect to receive in one year discounted back to the present using an interest rate commensurate with the bond’s risk. Since this bond is a risky bond, you need to use a discount rate of 7%, which is the sum of the risk free rate of 5% and the 2% risk premium. So, $1,000/1.07 = $934.58.

The risk free bond would be priced at $952.30 or $1,000/1.05. The bond would be priced at $1,000 assuming a zero percent discount rate and $980.39 if the interest rate was 2%.

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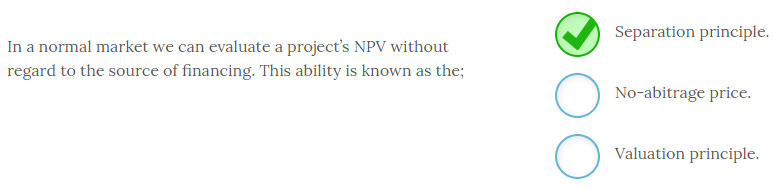


When using the net present value (NPV) to evaluate capital budgeting projects, you should **accept all projects with a positive NPV**.

NPV calculates the present value of the project’s expected cash flows and then subtracts the initial project cost or initial outlay. To calculate the present values, you should use a discount rate equivalent to the return you demand for that project. Therefore, when NPV = 0, you are earning exactly your required return. Any positive NPV means you are earning your required return plus some additional premium. For this reason, the decision rule for NPV is to accept all projects that have positive NPVs.

NPV is the best project evaluation tool to use in capital budgeting. It will always give the correct accept or reject decision given your cash flow projections. However, keep in mind that whether the decision is ultimately good or bad depends on the accuracy of the cash flow projections. In most cases, you will not know the answer to that until the life of the project is completed or well underway.

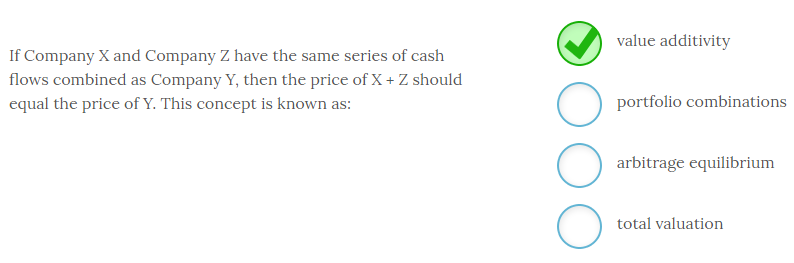
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In a normal market we can evaluate a project’s NPV without regard to the source of financing. This ability is known as the **Separation principle**. In other words we can separate the financing and investment decision. This ability is due to the fact that the cost of financing is already factored into the discount rate used to compute the NPV.

The no-arbitrage price is the price of an asset in a normal market with no arbitrage opportunities.

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If Company X and Company Z have the same series of cash flows combined as Company Y, then the price of X + Z should equal the price of Y. This concept is known as **value additivity**.

Since Y has the same cash flows as X + Z, the value of Y has to be equal to the value of X + Z in a competitive market assuming the same level of risk. If these prices were out of balance, then an opportunity for arbitrage would exist. If prices are consistent with value additivity, then it is a no-arbitrage price that is in equilibrium.

The phrases ‘portfolio combinations’ and ‘total valuation’ have no meaning in this context.

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