HOW TO CALCULATE BOND YIELDS BY INVESTOPEDIA.COM

The general definition of yield is the return an investor will receive by holding a bond to maturity. So if you want to know what your bond investment will earn, you should know how to calculate yield. Required yield, on the other hand, is the yield or return a bond must offer in order for it to be worthwhile for the investor. The required yield of a bond is usually the yield offered by other plain vanilla bonds that are currently offered in the market and have similar credit quality and maturity.

Once an investor has decided on the required yield, he or she must calculate the yield of a bond he or she wants to buy. Let's proceed and examine these calculations.

Calculating Current Yield
A simple yield calculation that is often used to calculate the yield on both bonds and the dividend yield for stocks is the current yield. The current yield calculates the percentage return that the annual coupon payment provides the investor. In other words, this yield calculates what percentage the actual dollar coupon payment is of the price the investor pays for the bond. The multiplication by 100 in the formulas below converts the decimal into a percentage, allowing us to see the percentage return:

$$\text{Current Yield} = \frac{\text{Annual Dollar Interest Paid}}{\text{Market Price}} * 100\%$$

So, if you purchased a bond with a par value of $100 for $95.92 and it paid a coupon rate of 5%, this is how you'd calculate its current yield:

$$= \frac{(0.05 * \$100)}{\$95.92} * 100\% = 5.21\%$$

Notice how this calculation does not include any capital gains or losses the investor would make if the bond were bought at a discount or premium. Because the comparison of the bond price to its par value is a factor that affects the actual current yield, the above formula would give a slightly inaccurate answer - unless of course the investor pays par value for the bond. To correct this, investors can modify the current yield formula by adding the result of the current yield to the gain or loss the price gives the investor: [(Par Value – Bond Price)/Years to Maturity]. The modified current yield formula then takes into account the discount or premium at which the investor bought the bond. This is the full calculation:

$$\text{Adjusted Current Yield} = \left[\frac{\text{Annual Coupon}}{\text{Market Price}}\right] * 100 + \left[\frac{(100 - \text{Market Price})}{\text{Years to Maturity}}\right]$$

Let's re-calculate the yield of the bond in our first example, which matures in 30 months and has a coupon payment of $5:

$$= \frac{\$5}{\$95.92} * 100 + \frac{(100 - 95.92)}{2.5} = 6.84\%$$

The adjusted current yield of 6.84% is higher than the current yield of 5.21% because the bond's discounted price ($95.92 instead of $100) gives the investor more of a gain on the investment.

One thing to note, however, is whether you buy the bond between coupon payments. If you do, remember to use the dirty price in place of the market price in the above equation. The dirty price is what you will actually pay for the bond, but usually the figure quoted in U.S. markets is the clean price.

Now we must also account for other factors such as the coupon payment for a zero-coupon bond, which has only one coupon payment. For such a bond, the yield calculation would be as follows:

$$\text{Yield} = \left(\frac{\text{Future Value}}{\text{Purchase Price}}\right)^{\frac{1}{n}} - 1$$

n = years left until maturity

If we were considering a zero-coupon bond that has a future value of $1,000 that matures in two years and can be currently purchased for $925, we would calculate its current yield with the following formula:

$$\text{Yield} = \left(\frac{\$1000}{\$925}\right)^{\frac{1}{2}} - 1$$

$$= 0.03975 \text{ or } 3.98\%$$

Calculating Yield to Maturity

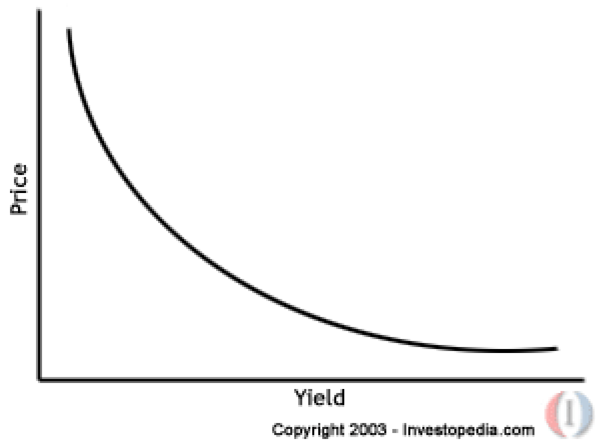
The current yield calculation we learned above shows us the return the annual coupon payment gives the investor, but this percentage does not take into account the time value of money or, more specifically, the present value of the coupon payments the investor will receive in the future. For this reason, when investors and analysts refer to yield, they are most often referring to the yield to maturity (YTM), which is the interest rate by which the present values of all the future cash flows are equal to the bond's price.

An easy way to think of YTM is to consider it the resulting interest rate the investor receives if he or she invests all of his or her cash flows (coupons payments) at a constant interest rate until the bond matures. YTM is the return the investor will receive from his or her entire investment. It is the return that an investor gains by receiving the present values of the coupon payments, the par value and capital gains in relation to the price that is paid.

The yield to maturity, however, is an interest rate that must be calculated through trial and error. Such a method of valuation is complicated and can be time consuming, so investors (whether professional or private) will typically use a financial calculator or program that is quickly able to run through the process of trial and error. If you don't have such a program, you can use an approximation method that does not require any serious mathematics.

To demonstrate this method, we first need to review the relationship between a bond's price and its yield. In general, as a bond's price increases, yield decreases. This relationship is measured using the price value of a basis point (PVBP). By taking into account factors such as the bond's coupon rate and credit rating, the PVBP measures the degree to which a bond's price will change when there is a 0.01% change in interest rates.

The charted relationship between bond price and required yield appears as a negative curve:



This is due to the fact that a bond's price will be higher when it pays a coupon that is higher than prevailing interest rates. As market interest rates increase, bond prices decrease.

The second concept we need to review is the basic price-yield properties of bonds:

> ***Premium bond: Coupon rate is greater than market interest rates.***
> ***Discount bond: Coupon rate is less than market interest rates.***

Thirdly, remember to think of YTM as the yield a bondholder receives if he or she reinvested all coupons received at a constant interest rate, which is the interest rate that we are solving for. If we were to add the present values of all future cash flows, we would end up with the market value or purchase price of the bond.

The calculation can be presented as:

$$\text{Bond Price} = \frac{\text{Cashflow 1}}{(1+\text{yield})^1} + \frac{\text{Cashflow 2}}{(1+\text{yield})^2} + \ldots + \frac{\text{Last Cashflow}}{(1+\text{yield})^n}$$

OR

$$\text{Bond Price} = \text{Cashflow} * \frac{1-\left(\frac{1}{(1+\text{int erest rate})^n}\right)}{\text{int erest rate}} + \left[\text{Maturity Value} * \frac{1}{(1+\text{int erest rate})^n}\right]$$

Example 1: You hold a bond whose par value is $100 but has a current yield of 5.21% because the bond is priced at $95.92. The bond matures in 30 months and pays a semi-annual coupon of 5%.

1. Determine the Cash Flows: Every six months you would receive a coupon payment of $2.50 (0.025*100). In total, you would receive five payments of $2.50, plus the future value of $100.

2. Plug the Known Amounts into the YTM Formula:

$$\$95.92 = 2.5 * \left(\frac{1 - \frac{1}{(1+i)^5}}{i} \right) + 100 * \left(\frac{1}{(1+i)^5} \right)$$

Remember that we are trying to find the semi-annual interest rate, as the bond pays the coupon semi-annually.

3. Guess and Check: Now for the tough part: solving for “i,” or the interest rate. Rather than pick random numbers, we can start by considering the relationship between bond price and yield. When a bond is priced at par, the interest rate is equal to the coupon rate. If the bond is priced above par (at a premium), the coupon rate is greater than the interest rate. In our case, the bond is priced at a discount from par, so the annual interest rate we are seeking (like the current yield) must be greater than the coupon rate of 5%.

Now that we know this, we can calculate a number of bond prices by plugging various annual interest rates that are higher than 5% into the above formula. Here is a table of the bond prices that result from a few different interest rates:

Annual Interest Rate	Semi-annual Interest Rate	Bond Price
10.0%	5.0%	$89
9.0%	4.5%	$91
8.0%	4.0%	$93
7.0%	**3.5%**	**$95**
6.0%	**3.0%**	**$98**

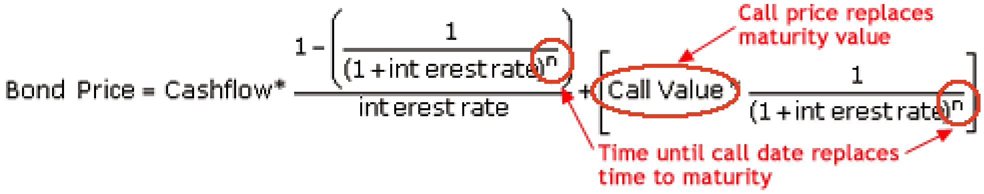
Because our bond price is $95.92, our list shows that the interest rate we are solving for is between 6%, which gives a price of $95, and 7%, which gives a price of $98. Now that we have found a range between which the interest rate lies, we can make another table showing the prices that result from a series of interest rates that go up in increments of 0.1% instead of 1.0%. Below we see the bond prices that result from various interest rates that are between 6.0% and 7.0%:

Annual Interest Rate	Semi-annual Interest Rate	Bond Price
7.0%	3.50%	$95.48
6.9%	3.45%	$95.70
6.8%	**3.40%**	**$95.92**
6.7%	3.35%	$96.15
6.6%	3.30%	$96.37

We see then that the present value of our bond (the price) is equal to $95.92 when we have an interest rate of 6.8%. If at this point we did not find that 6.8% gives us the exact price that we are paying for the bond, we would have to make another table that shows the interest rates in 0.01% increments. You can see why investors prefer to use special programs to narrow down the interest rates - the calculations required to find YTM can be quite numerous!

Calculating Yield for Callable and Puttable Bonds
Bonds with callable or puttable redemption features have additional yield calculations. A callable bond's valuations must account for the issuer's ability to call the bond on the call date and the puttable bond's valuation must include the buyer's ability to sell the bond at the pre-specified put date. The yield for callable bonds is referred to as yield-to-call, and the yield for puttable bonds is referred to as yield-to-put.

Yield to call (YTC) is the interest rate that investors would receive if they held the bond until the call date. The period until the first call is referred to as the call protection period. Yield to call is the rate that would make the bond's present value equal to the full price of the bond. Essentially, its calculation requires two simple modifications to the yield-to-maturity formula:



Note that European callable bonds can have multiple call dates and that a yield to call can be calculated for each.

Yield to put (YTP) is the interest rate that investors would receive if they held the bond until its put date. To calculate yield to put, the same modified equation for yield to call is used except the bond put price replaces the bond call value and the time until put date replaces the time until call date.

For both callable and puttable bonds, astute investors will compute both yield and all yield-to-call/yield-to-put figures for a particular bond, and then use these figures to estimate the expected yield. The lowest yield calculated is known as yield to worst, which is commonly used by conservative investors when calculating their expected yield. Unfortunately, these yield figures do not account for bonds that are not redeemed or are sold prior to the call or put date.

Now you know that the yield you receive from holding a bond will differ from its coupon rate because of fluctuations in bond price and from the reinvestment of coupon payments. In addition, you are now able to differentiate between current yield and yield to maturity. In our next section we will take a closer look at yield to maturity and how the YTMs for bonds are graphed to form the term structure of interest rates, or yield curve.

Next: Advanced Bond Concepts: Term Structure of Interest Rates

Table of Contents