Yield-bearing Financial Assets (YBFAs)

The quiet market (until lately)

Primary YBFA markets

• Note and Bond
  – U.S. Treasury notes and bonds
  – Corporate notes and bonds
  – Muncipal (tax free) notes and bonds
  – Asset-backed securities (ABS)

• Money Market (maturities less than 1 year)
  – U.S. Treasury bills
  – Corporate commercial paper
  – Bank certificates of deposit
Some interesting facts about notes and bonds (hereafter bonds) ...

- Bonds are debt obligations of the party that issues them. They are a debt contract that promises to pay periodic interest payments over so many years then the full principal at the end.
- Bonds are bought and sold on a huge secondary market.
- Bonds are first issued by the agency that issues them at or very near par (100), but thereafter trade above or below par.
- Bond values on the secondary market move in opposite directions of interest rates! When interest rates rise, bond values fall! This is called market risk.

### U.S. Treasury Securities

<table>
<thead>
<tr>
<th>Security</th>
<th>U.S Treasury Securities Offered to the Public</th>
<th>Maturity</th>
<th>Now Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bills:</td>
<td>Less than one year</td>
<td>4, 13, 26 and 52 weeks</td>
<td></td>
</tr>
<tr>
<td>Notes:</td>
<td>More than one to ten years</td>
<td>2, 3, 5, 7, 9 and 10</td>
<td></td>
</tr>
<tr>
<td>Bonds:</td>
<td>20 to 30 years</td>
<td>30 years*</td>
<td></td>
</tr>
<tr>
<td>Inflation Indexed:</td>
<td>5, 10, and 20 years</td>
<td>All*</td>
<td></td>
</tr>
</tbody>
</table>

*These are sometimes approximate. E.g. a 30 year bond might have a maturity of 29 years and 11 months.

The budget deficit is financed by the sale of interest-bearing U.S. Treasury securities to the public, including corporations, financial institutions, and foreign investors. The securities differ largely by the maturities. After a 5-year hiatus, the Treasury began selling 30 year bonds in February 2006. The Treasury in recent years has sold 20 year bonds also, but is not currently selling them. Inflation-indexed securities are called TIPS, and are described in the reading material for this section.
What is the level of U.S government debt?

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketable</td>
<td>11,375.9</td>
</tr>
<tr>
<td>Bills</td>
<td>1,568.1</td>
</tr>
<tr>
<td>Notes</td>
<td>7,574.0</td>
</tr>
<tr>
<td>Bonds</td>
<td>1,320.6</td>
</tr>
<tr>
<td>Inflation-indexed</td>
<td>913.2</td>
</tr>
<tr>
<td>Non-Marketable</td>
<td>5,357.1</td>
</tr>
<tr>
<td>Government Account</td>
<td>4,831.7</td>
</tr>
<tr>
<td>Non-marketable privately held</td>
<td>525.4</td>
</tr>
<tr>
<td><strong>TOTAL PUBLIC DEBT:</strong></td>
<td><strong>16,763.2</strong></td>
</tr>
<tr>
<td><strong>NET PUBLIC DEBT:</strong></td>
<td><strong>11,931.5</strong></td>
</tr>
</tbody>
</table>

(Net is total less govt. account but not less FRS holdings)

Source: US Treasury Bulletin September 2013 Tables FD-1 FD-2

Who owns the U.S. Treasury Debt?

<table>
<thead>
<tr>
<th>Ownership of Privately Held U.S. Treasury Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 1995</td>
</tr>
<tr>
<td>Billions $</td>
</tr>
<tr>
<td>Deposit institutions</td>
</tr>
<tr>
<td>US Savings Bonds</td>
</tr>
<tr>
<td>Private pension funds</td>
</tr>
<tr>
<td>S&amp;L govt pension funds</td>
</tr>
<tr>
<td>Insurance companies</td>
</tr>
<tr>
<td>Mutual funds</td>
</tr>
<tr>
<td>State &amp; local governments</td>
</tr>
<tr>
<td>Foreign holdings</td>
</tr>
<tr>
<td>Other (mostly individuals)</td>
</tr>
<tr>
<td><strong>Total privately held</strong></td>
</tr>
</tbody>
</table>

Memo:
- Total Debt: 16,771.6
- Held by FRS & IG accounts: 6,656.8

Source: U.S. Treasury Bulletin, September 2013, Table OFS-2
### October 2013 new data

<table>
<thead>
<tr>
<th>Country</th>
<th>August 2013</th>
<th>% Tot</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>China, Mainland</td>
<td>1,268.1</td>
<td>22.7%</td>
<td>5,588.8</td>
</tr>
<tr>
<td>Japan</td>
<td>1,149.1</td>
<td>20.6%</td>
<td></td>
</tr>
<tr>
<td>Oil Exporters 3/</td>
<td>246.4</td>
<td>4.4%</td>
<td></td>
</tr>
<tr>
<td>Carb Boring Cites 4/</td>
<td>300.5</td>
<td>5.4%</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>252.9</td>
<td>4.5%</td>
<td></td>
</tr>
<tr>
<td>Taiwan</td>
<td>183.6</td>
<td>3.3%</td>
<td></td>
</tr>
<tr>
<td>United Kingdom 2/</td>
<td>159.1</td>
<td>2.8%</td>
<td></td>
</tr>
<tr>
<td>Russia</td>
<td>136.0</td>
<td>2.4%</td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>166.8</td>
<td>3.0%</td>
<td></td>
</tr>
<tr>
<td>Hong Kong</td>
<td>126.5</td>
<td>2.3%</td>
<td></td>
</tr>
<tr>
<td>Luxembourg</td>
<td>143.8</td>
<td>2.6%</td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>179.7</td>
<td>3.2%</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>117.3</td>
<td>2.1%</td>
<td></td>
</tr>
<tr>
<td>All Other</td>
<td>1,139.0</td>
<td>20.7%</td>
<td></td>
</tr>
<tr>
<td>Grand Total</td>
<td>5,588.8</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>


Not available this year because of the shutdown: deficit should equal around $750 billion.

### Original Treasury Issue: Dutch Auctions

When U.S. Treasury securities first come to the market, they are sold at scheduled auctions throughout the year. The frequency of the auction varies by the type of security, ranging from once a week (every Thursday) for 13- and 26-week bills to twice a year for 30-year bonds. See [http://www.treasurydirect.gov](http://www.treasurydirect.gov) under institutions for the calendar of Treasury auctions.

Prior to the auction, the Treasury will set the size of the subscription for the type of security and announce it publicly (e.g. $10 billion of 2-year notes will be sold on March 15). A private investor can buy some of the subscription by submitting a non-competitive tender for an amount up to $5 million through [Treasury Direct](http://www.treasurydirect.gov).

Larger investors are required to submit a competitive bids tender to participate in a Dutch auction. The competitive bidder will submit based upon the lowest yield that she is willing to accept up to three decimal places.
How the Dutch Auction Works

In this example, the Treasury is selling $10 billion worth of 2-year notes. Tenders are received for $2 billion of non-competitive bids (gray area).

Tenders are also shown for the competitive bids (green and yellow) totaling $15 billion. Each bidder bids the minimum yield that he will accept up to 3 decimal places. Starting with the lowest bid, the auction works up until the competitive subscription is filled at $8 billion. Winners (green) are awarded the highest yield accepted. Those who bid at the cutoff are pro-rated.

<table>
<thead>
<tr>
<th>Amount</th>
<th>Bids</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4.389</td>
<td>Rejected</td>
</tr>
<tr>
<td>3</td>
<td>4.388</td>
<td>Rejected</td>
</tr>
<tr>
<td>4</td>
<td>4.387</td>
<td>Pro-rated 50% at 4.387</td>
</tr>
<tr>
<td>2</td>
<td>4.386</td>
<td>Accepted at 4.387</td>
</tr>
<tr>
<td>1</td>
<td>4.385</td>
<td>Accepted at 4.387</td>
</tr>
<tr>
<td>2</td>
<td>4.384</td>
<td>Accepted at 4.387</td>
</tr>
<tr>
<td>1</td>
<td>4.383</td>
<td>Accepted at 4.387</td>
</tr>
<tr>
<td>2</td>
<td>NC</td>
<td>Accepted at 4.387</td>
</tr>
</tbody>
</table>

Auction Scheduling ... (see Treasury Direct)

There are 2 or 3 auctions every week ...

... and the longer-term maturities like the 10-yr shown here, once per month or less.
### Treasury Bond/Note Quotations

<table>
<thead>
<tr>
<th>Type</th>
<th>Issue</th>
<th>Price</th>
<th>Coupon(%)</th>
<th>Maturity</th>
<th>YTM(%)</th>
<th>Yield(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treas</td>
<td>T-NOTE 4.000 15-Nov-2012</td>
<td>95.99</td>
<td>4.000</td>
<td>15-Nov-12</td>
<td>4.706</td>
<td>4.167</td>
</tr>
<tr>
<td>Treas</td>
<td>T-NOTE 3.875 15-Feb-2013</td>
<td>95.11</td>
<td>3.875</td>
<td>15-Feb-13</td>
<td>4.709</td>
<td>4.074</td>
</tr>
</tbody>
</table>

These notes have a **par** value of 100.

1. The **coupon rate** is the annual interest payment based upon par.
2. The **price** is the ask that you will pay (per $100) if you buy this bond.
3. The **yield to maturity** is the yield that you will earn if you buy at this **price** and are paid this **coupon rate**. It includes the yield that is implicit in the price appreciation of this bond (i.e. if you buy it for 95.11 and it matures at 100).
4. The **current yield** is the **price** divided by the **coupon rate**, which does not take into account any price appreciation or depreciation.

These notes are trading at **discount** because their price is below par. When they trade above par they are trading at a **premium**.

<table>
<thead>
<tr>
<th>Type</th>
<th>Issue</th>
<th>Price</th>
<th>Coupon(%)</th>
<th>Maturity</th>
<th>YTM(%)</th>
<th>Yield(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treas</td>
<td>T-BOND 4.750 15-Feb-2041</td>
<td>121.62</td>
<td>4.750</td>
<td>15-Feb-2041</td>
<td>3.511</td>
<td>3.905</td>
</tr>
</tbody>
</table>

October 29, 2013

### Bond Values and Interest Rates

As this slide will show later in the lecture, even U.S. Treasury Bonds have market risk.

... a contrary relationship
YBFA yields

• Two types of payouts
  – Coupon payment (bonds and notes)
  – Discount (bills, where yield is implicit)

• Three yield calculations that you must know
  – Coupon yield (not calculated, stated)
    1. Discount yield and discount price (bills only)
    2. Current yield
    3. Yield to maturity (also called Ask Yield)

Coupon Yield
U.S. Treasury Notes and Bonds

A note or bond’s coupon rate is the rate declared when the bond is issued, expressed as a percentage of par. U.S. Treasury Notes and Bonds pay interest twice per year, according to the following formula:

\[
\text{Coupon payment} = \left( \text{par value} \times \text{coupon rate} \right) / 2
\]

The interest payment for the 3.875 Feb 2013 note would be

\[
(100 \times 0.03875)/2 = $1.9375 \text{ semi-annually per 100}
\]
1. Discount yield

for bills (money market financial assets)

Discounting MMFAs: Buy at a discounted price (below par, 100), sell at par, interest is implicit in the appreciation.

\[
Yield = \frac{100 - \text{price}}{\text{price}} \times \frac{365}{\text{days to maturity}}
\]

For example, a 26-week bill selling at 96.16 yields 8%:

\[
8\% = \frac{100 - 96.16}{96.16} \times \frac{365}{182}
\]

Discount price (when yield is known)

for money market financial assets (continued)

The formula for determining price when the yield is known:

\[
P = \frac{\text{Par}}{\left(\text{yield} \times \left(\frac{\text{dtm}}{365}\right)\right) + 1}
\]

Same example:

\[
\text{Price} = \frac{100}{\left(\text{yield} \times \left(\frac{\text{dtm}}{365}\right)\right) + 1} = \frac{100}{0.08 \times \left(\frac{182}{365}\right) + 1} = 96.16
\]
2. Current yield

Because you will not be paying par value for the bond or note that you buy, your short-term yield is current yield:

\[
\text{Current yield} = \frac{\text{coupon rate} \times \text{par}}{\text{ask price}}
\]

Using our example of the Feb note with a coupon of 3.875% priced at 110.30:

\[
4.074\% = \frac{3.875\%}{95.11}
\]
A question ....??

- Ten years ago you bought a new bond with the following features:
  - $1000 even (par 100)
  - 30 year bond (20 years remaining)
  - Coupon rate was 5% ($50 yearly)
- Today 20 year bonds are yielding 10%
- Question: Can you resell your bond today ..
  - at par ($1,000)?
  - at any price?

Price/Yield Tradeoff
... an example

Suppose you buy a newly-issued 30-year bond which has a coupon of 8%.

Ten years pass. Your 30-bond is now the equivalent of a 20-year bond (it has the same cashflow characteristics). Therefore if you wish to sell it on the secondary market, it must offer an ask yield, also called yield to maturity, that is competitive with a newly-issued 20-year bond.

What if the 20-year bond coupon is 6%? Or 11%? What will your old 30-year bond be worth?

The range of possibilities is shown on the next slide.
A bond or note is nothing more than a future stream of cash. **A bond or note is worth the present discounted value of all future cash payments.** That’s it! And this is not an approximation, this is a mathematical certainty that defines the relationship between a bond’s market price and its effective yield.

Sometimes the value of future cash payments is known (Treasuries) and sometimes estimated (bonds with default possibilities).

Therefore, to understand the pricing of bonds and notes, you must understand the math of compounding and present value calculations.
The Compounding Formula

What is the formula for calculating the future value $X_f$ of the present value $X_p$ invested at interest rate $r$ (compounded annually) for $n$ years?

$$X_f = (1 + r)^n \times X_p$$

$10$ invested for $5$ years at an $8\%$ compounded rate will be worth:

$$10(1.08)^5 = $14.69$$

The Present Value Formula

What is the present value $X_p$ of some guaranteed future value $X_f$, assuming the opportunity to invest money today at some compound interest rate $r$?

$$X_p = \frac{X_f}{(1 + r)^n}$$

For example, what is the present value of a promise to pay $10$ all at once at a date $5$ years in the future, if money today can be expected to earn $8\%$ between now and then?

$$6.81 = \frac{10}{(1.08)^5}$$
The present value of a payments stream

What is the present value of a promise to pay two payments of $100 each at a date 5 years in the future and again 10 years in the future if money today can be expected to earn 12% between now and then?

\[ PV = \sum_{i=1}^{2} \frac{100}{(1+.12)^i} = \frac{100}{1.12^5} + \frac{100}{1.12^{10}} = 88.94 \]

What is a bond or note worth?

To be precise, a bond or note is worth the value of every cash payment that it will make, individually discounted to the present and summed.

For example, a newly issued U.S. Treasury $10,000 ten year note with a coupon of eight percent (8%) will be paying to the holder twenty payments of $400 each every six months and a single payment of $10,000 at the end of ten years.

This note will therefore be worth the present discounted value of these 21 payments, summed.
Valuing a bond (simple example)

To value a bond (or note) on the secondary market, you will need to know the coupon rate (cr), the time remaining in the life of the bond (t), and the present day yield (y) of equivalent bonds.

What would be today’s value of a 30-year bond issued 10 years ago at a coupon rate of 12% (cr) if other bonds with 20 years (t) remaining until maturity today yield only 6% (y)? (Assume annual rather than semi-annual interest payments).

\[
PV = \sum_{i=1}^{20} \frac{cr \times 100}{(1+y)^i} + \frac{100}{(1+y)^{20}} = \sum_{i=1}^{20} \frac{12}{1.06^i} + \frac{100}{1.06^{20}}
\]

The simple bond valuation formula

\[
MV = \sum_{i=1}^{n} \frac{C}{(1+r)^i} + \frac{Par}{(1+r)^n}
\]

where
MV = market value presently of the bond
n = number of years to maturity
C = coupon payment (par times the coupon interest rate)
r = present yield of this bond (market determined)

This formula assumes that there is only one interest payment per year and that this bond was priced on the day after the most recent interest payment was made.
... another way of writing it

\[ MV = \frac{C}{(1 + r)} + \frac{C}{(1 + r)^2} + \frac{C}{(1 + r)^3} + \ldots + \frac{C}{(1 + r)^n} + \frac{Par}{(1 + r)^n} \]

The present discounted value of each of the coupon interest payments.

The present discounted value of the redemption value of the bond at par.

A yield-bearing financial asset is worth the present discounted value of its future cashflow, which consist of interest payments and redemption value.

The elementary bond formula (reduced form)

\[ MV = (CR \times 100) \times \left( \frac{1 - \frac{1}{(1 + r)^n}}{r} \right) + \left( 100 \times \frac{1}{(1 + r)^n} \right) \]

where

MV: the present market value of the bond
CR: coupon rate (original yield) of the bond
r: current market rate on equivalent bonds
n: number of remaining years to maturity

Note: This formula cannot be used to value an actual bond because it assumes only one interest payment per year and that the bond is being bought on the day of the coupon payment. For actual bond pricing a more complicated version of this is shown at the end of this lecture.

The original formula is a geometric series and this is a reduced-form equation. To see its justification and derivation, read the appendix in the reading assigned for this lecture.
… a bond at premium

\[
137.39 = (0.08 \times 100) \times \left( 1 - \frac{1}{(1 + 0.05)^{20}} \right) + \left( 100 \times \frac{1}{(1 + 0.05)^{20}} \right)
\]

where
- MV: 137.39
- CR: 8%
- r: 5%
- n: 20

This shows the current market value (137.39) of a 30-year bond that was issued 10 years ago (and hence has 20 years of life left) and pays a coupon interest rate of 8% per year (determined at its time of issue) given that interest rates now on an equivalent bond (a 20-year bond) are only 5%.

… a bond at discount

\[
82.97 = (0.08 \times 100) \times \left( 1 - \frac{1}{(1 + 0.10)^{20}} \right) + \left( 100 \times \frac{1}{(1 + 0.10)^{20}} \right)
\]

where
- MV: 82.97
- CR: 8%
- r: 10%
- n: 20

This shows the current market value (82.97) of a 30-year bond that was issued 10 years ago (and hence has 20 years of life left) and pays a coupon interest rate of 8% per year (determined at its time of issue) given that interest rates now on an equivalent bond (a 20-year bond) are now 10%.
You must understand the message of these next two slides.

### Maturity and Volatility (Risk)

<table>
<thead>
<tr>
<th>Security</th>
<th>Original Par</th>
<th>Original Yield</th>
<th>One Year Later</th>
<th>Value</th>
<th>% loss of Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-year note:</td>
<td>100</td>
<td>5%</td>
<td>6%</td>
<td>96.53</td>
<td>3.47</td>
</tr>
<tr>
<td>10-year bond:</td>
<td>100</td>
<td>5%</td>
<td>6%</td>
<td>93.20</td>
<td>6.80</td>
</tr>
<tr>
<td>30-year bond:</td>
<td>100</td>
<td>5%</td>
<td>6%</td>
<td>86.41</td>
<td>13.59</td>
</tr>
</tbody>
</table>

Using our formula, this shows that the longer the maturity of the bond, given any interest rate increase, the greater the percentage of the capital loss.

We assume that all three of these notes and bonds were originally issued at 5%.

We assume one year later that yields on equivalent securities increased to 6%.

Look at the percentage value of the capital loss.

This implies that the longer the maturity of a note or bond, the greater its sensitivity to interest rate changes, hence the higher its perceived risk.

---

### ... a more realistic example

( typical yield curve)

<table>
<thead>
<tr>
<th>Security</th>
<th>Original Par</th>
<th>Original Yield</th>
<th>One Year Later</th>
<th>Value</th>
<th>% loss of Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-year note:</td>
<td>100</td>
<td>5%</td>
<td>6%</td>
<td>96.53</td>
<td>3.47</td>
</tr>
<tr>
<td>10-year bond:</td>
<td>100</td>
<td>6%</td>
<td>7%</td>
<td>93.48</td>
<td>6.52</td>
</tr>
<tr>
<td>30-year bond:</td>
<td>100</td>
<td>7%</td>
<td>8%</td>
<td>88.48</td>
<td>11.52</td>
</tr>
</tbody>
</table>

This shows the more realistic example of these three securities being issued at coupon rates consistent with a typical yield curve. It is then assumed that the entire yield curve shifts up by one percent.

You get the same general result: the longer the maturity the greater the sensitivity to interest rates changes.
The formula when interest is paid semi-annually

\[
MV = \sum_{i=1}^{m} \frac{C}{(1 + r/2)^i} + \frac{Par}{(1 + r/2)^m}
\]

where
- \(MV\) = market value
- \(C\) = coupon interest payment (\(\text{par} \times r/2\))
- \(r\) = present market yield
- \(m\) = number of coupon payments remaining (years \(\times 2\))

3. The final formula … ask yield (ytm)

\[
MV = \frac{C}{m} \sum_{i=1}^{n} \frac{1}{\left(1 + \frac{r}{m}\right)_{i/a}} + \frac{Par}{\left(1 + \frac{r}{m}\right)^{(n-1)/m} \left(\frac{p-a}{365}\right)} - \left(\frac{C \times \frac{a}{m}}{\frac{p}{m}}\right)
\]

This term represents an adjustment for accrued interest.

- \(MV\) = market value, the quoted ask price of the bond,
- \(C\) = the annual coupon payment, equal to the coupon rate times par,
- \(Par = 100\)
- \(r\) = the prevailing annual market yield, expressed as ask yield or yield to maturity,
- \(m\) = the number of coupon payments per year,
- \(n\) = the number of remaining coupon payments,
- \(p\) = the number of days in this coupon period (between 181-184, use 182 if unknown),
- \(a\) = the number of days between the last coupon payment and the settlement day.
What is this term?

\[
\left[ \frac{C}{m} \times \frac{a}{p} \right]
\]

When you buy a bond, you will owe accrued interest to the seller. It will be the interest accrued since the last coupon payment and it will be equal to the value of a single coupon times the portion of the coupon period since the last coupon was paid. This value is added to the bonds quoted value so that bond prices will not exhibit a saw-tooth pattern, rising as the coupon payment date approaches then plunging the day after.

an example

You are buying a 30-yr bond that was issued on September 15, 1999:

Purchase date: February 8, 2009 (146 days since last coupon payment, 36 to next),
Next coupon date: March 15, 2009 (the first of 42 coupons remaining),
Redemption date: September 15, 2029 (for par and last coupon),
Coupon rate/amount: 8% yielding $4 per coupon payment,
Present market rate (ask yield): 10%.

\[
a = \frac{146}{182} = 0.8022
\]

\[
MV = \frac{8\sum_{i=1}^{42} \left( \frac{1}{1 + \frac{.10}{2}} \right)^{i-0.8022} + \frac{100}{(1 + .10)^{20.5 + 0.99}} - \left( \frac{8}{2} \times 0.8022 \right)}{\frac{1}{(1.05)^{0.8022}} + \frac{100}{(1.10)^{20.60}} - (3.21)} = 83.31
\]
Reduced-form Version of the Complex Formula

\[
MV = \frac{C}{m} \left[ \frac{1}{1 + \left( \frac{r}{m} \right)} \left( \frac{1}{1 + \left( \frac{r}{m} \right)^{\frac{n-1}{m}}} \right) \right] + \left( \frac{Par \times \frac{1}{1 + \left( \frac{r}{m} \right)^{\frac{n-1}{m}}} \times \frac{1}{1 + \left( \frac{r}{m} \right)^{\frac{n-1}{m}} \times \frac{365}{365}} \right) - \left( \frac{C \times \frac{a}{p}}{m} \right)
\]

Solving the same problem from the last slide (rounding error explains the difference):

\[
MV = 4 \left[ \frac{1}{\left( \frac{1.05}{1.05} \right)^{2}} \frac{0.05}{(1.05)^{0.8022}} \right] + \left( 100 \times \frac{1}{(1.10)^{20.5+0.099}} \right) - \left( 4 \times 0.8022 \right) = 83.31
\]

Using the Bond Formula Calculator in your Homework

Using the Bond Formula Calculator in your Homework.