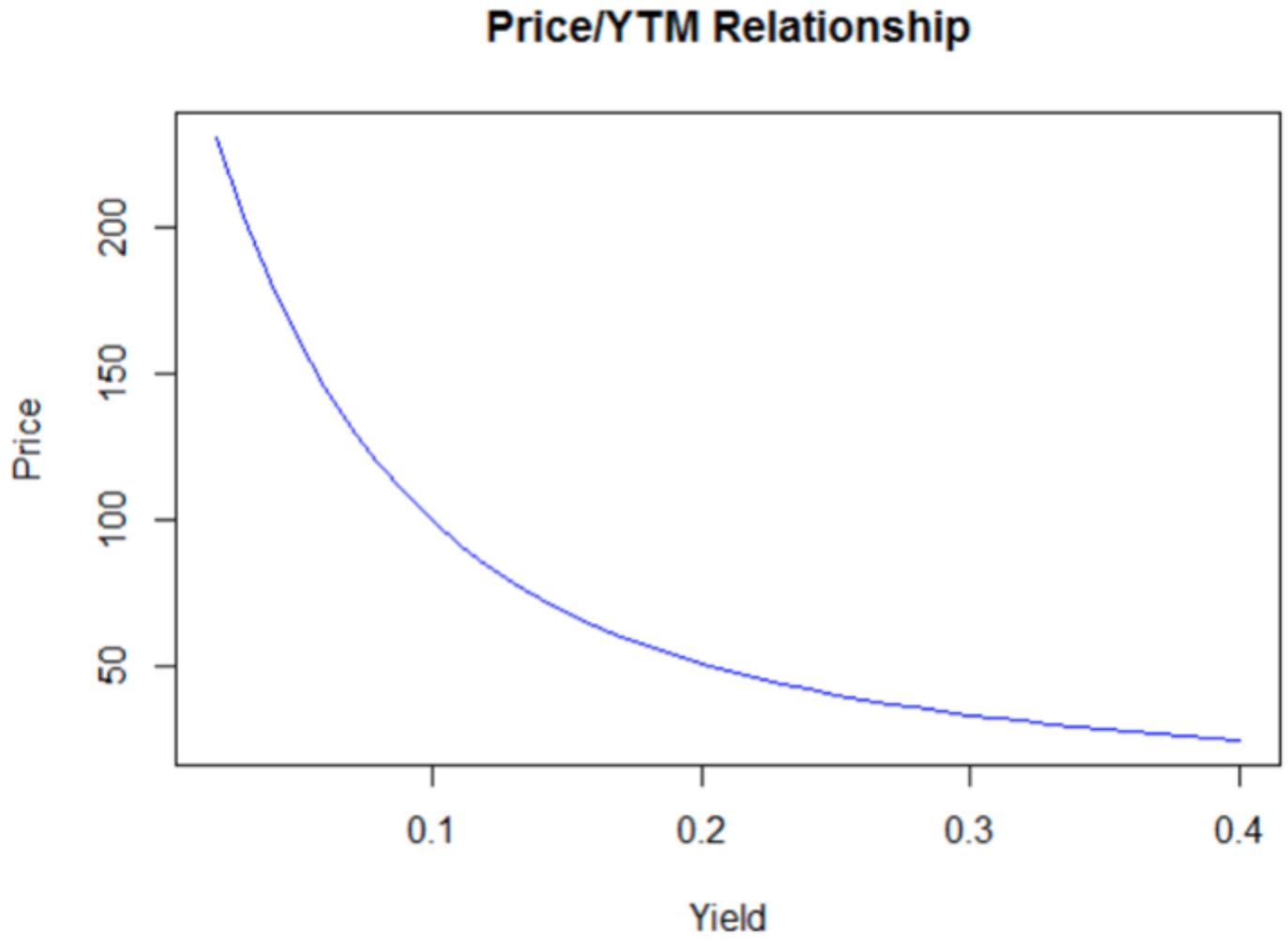
Price-yield relationship

BOND VALUATION AND ANALYSIS IN R

Clifford Ang
Senior Vice President, Compass Lexecon

Inverse relationship



Credit ratings

	S&P	Fitch	Moody's
Investment grade	AAA	AAA	Aaa
	AA	AA	Aa
	A	A	A
	BBB	BBB	Baa
High yield	BB	BB	Ba
	B	B	B
	CCC-Lower	CCC-Lower	Caa-Lower

Determining a bond's yield

- Use yields of bonds with same credit rating
- If we want to value a Baa-rated bond, we can get the data from `Quandl`

```
library(Quandl)
baa <- Quandl("MOODY/DBAAYLD")
head(baa)
```

```
        DATE VALUE
1 2016-10-07  4.36
2 2016-10-06  4.36
3 2016-10-05  4.36
4 2016-10-04  4.35
5 2016-10-03  4.29
6 2016-09-30  4.29
```

Let's practice!

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Components of yield

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Baseline component of yield

- Risk-free yield (baseline rate)
  - Yield on recently issued US Treasury with similar maturity
- Risk-free yield is not constant
  - Affected by economy, market interest rates, and inflation

Obtaining treasury data

- Use `quantmod` package
- Obtain 10-Year Treasuries (`"DGS10"`) from FRED

```
library(quantmod)
t10yr <- getSymbols("DGS10", src = "FRED", auto.assign = FALSE)
head(t10yr)
```

```
           DGS10
1962-01-02  4.06
1962-01-03  4.03
1962-01-04  3.99
1962-01-05  4.02
...
```

Spread component of yield

- Spread
  - Primarily the credit spread = risk that issuer will default
  - May contain premiums for other risks

Risks of investing in bonds

- *Credit Risk*: Risk of default by issuer
- *Inflation Risk*: Risk that inflation eats up value of cash flows received from bond
- *Call Risk*: Risk that issuer will buyback the bond at a time that is disadvantageous to the investor
- *Liquidity Risk*: Risk that you cannot sell the bond for a price that is at or near its value

Time-varying risk premiums

- Depends on market's current appetite for risk
  - Nervous markets → larger risk premium
- One measure is Investment Grade spread (i.e., difference in Baa and Aaa yields)
- Obtain Moody's Aaa and Baa Index yields from the `Quandl` package

Let's practice!

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Estimating the yield of a bond

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datacamp

Finding the yield by trial-and-error

- For traded bonds, we can imply the yield
- If you know the price and the bond's cash flows, you can make "guesses" as to the yield
- The "correct" yield equates the price of the bond with the PV of the bond's cash flows

Iterating through different guesses

- Consider bond with $100 par value, 5% coupon rate, 10 years to maturity, and a price of $92.64
- 1st Guess: 5% → Price is $100 (too high)
- 2nd Guess: 7% → Price is $85.95 (too low)
- 3rd Guess: 6% → Price is $92.64 (correct)

Automating the process

- Trial-and-error is inefficient
- Fortunately, we can use the `uniroot()` function in R to help us automate the process

Create function using uniroot()

```
ytm <- function(cf) {
    uniroot(bval, c(0, 1), cf = cf)$root
}
```

- Create the `ytm()` function using `uniroot()`
- Function takes a modified cash flow vector (`cf`) and uses a modified bond valuation function (`bval`)
- `c(0,1)` limits the interval for the search to a yield between 0% and 100%

Modified cash flow vector

```
cf <- c(-92.64, 5, 5, 5, 5, 5, 5, 5, 5, 5, 105)
```

- First element is bond's price entered as a negative number
- Second element onwards are the bond's cash flows - coupons plus par value
- Same bond: Price is -$92.64, par value is $100, 5% coupon rate, and 10 years to maturity

Modified bond valuation function

```
bval <- function(i, cf, t = seq(along = cf))  sum(cf / (1 + i)^t)
```

- Need to create bond valuation function `bval()` that uses the modified cash flow vector (`cf`)
- Same logic as our `bondprc()` function
- Create time indicator (`t`)
- Discount cash flow using interest rate (`i`)

Let's practice!

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