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CALIFORNIA DEBT AND INVESTMENT ADVISORY COMMISSION

THE PUBLIC INVESTMENT PORTFOLIO: INVESTING IN TREASURIES

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- Local Agency Investment Guidelines: Update for 2015 http://www.treasurer.ca.gov/cdiac/laig/guideline.pdf
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May 21, 2015 10:00 AM – 11:00 AM

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THE PUBLIC INVESTMENT PORTFOLIO:
INVESTING IN TREASURIES

KENT MORRIS, CHIEF INVESTMENT OFFICER, CITY OF SAN DIEGO

KEVIN WEBB, CFA, DIRECTOR, CANTOR FITZGERALD

A Brief History of U.S. Treasury Debt

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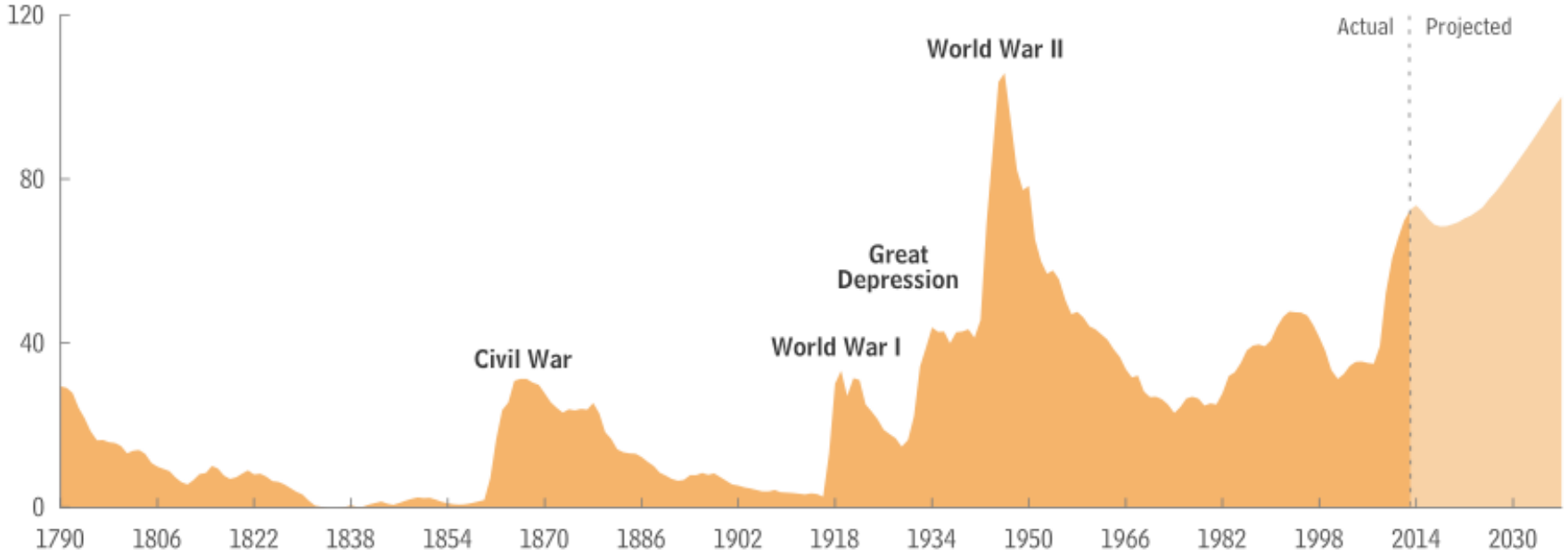
- In 1790, Congress passed a law that had the Federal Government assuming State debts



Federal Debt held by the public as a percent of GDP (1790-2013)

A Brief History of U.S. Treasury Debt

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- In 2000, the U.S. debt level was $5.7 Trillion
  - In 2014, it was $17.8 Trillion
- In 1929, U.S. Treasury shifted to auction process for T-bills
- In 1959, regular issuance of 26 week and 1 year bills
- In 1963, the competitive bidding on Treasury Bonds was first introduced for dealers and banks
- In 1974, Cash Management bills were introduced
- In 1979, Book-entry form was required for all Treasury bills issued
- In 1982, Bearer form was eliminated for New Treasury notes and bonds

Bond Basics (Vocabulary)

- Term to Maturity: number of years over which the issuer has promised to meet the conditions of their obligation
- Par Value: The amount that the issuer agrees to repay the bondholder by the maturity date.
  - A bond with a par value of $5,000 is selling at $5,500 the bond is said to be selling for 110
- Coupon Rate: the interest rate that the issuer/borrower agrees to pay each year.
  - Semi-Annual Coupon Payment: the interest for a bond with a par value of $1,000 and a coupon rate of 7% would be (1,000x.07/2) $35 every six months.
  - Fixed Rate – The coupon rate does not change over the life of the bond
  - Variable Rate (Floating Rate) – has a coupon that periodically resets according to some reference rate.
    - Reference rate +/- Quoted Margin (i.e. 3 month Libor + 15 basis points)

      The quoted margin is the amount that the issuer agrees to pay above or below the reference rate.

Bond Basics (Issue Types)

- On The Run – name given to the most recently auctioned issue or current issue
  - Most liquid
  - Tighter bid/ask spread
  - More demand to be in current issue
- Off the Run – Security that is replaced by the on the run issue
  - Slightly wider bid/ask spread
  - Still very liquid
- When Issued – a trade based on a security that has been announced, but not yet issued

The Basics of U.S. Treasury Securities (Bills, Notes, and Bonds)

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- Issued by the U.S Department of the Treasury
  - Has the Full Faith and Credit of the U.S. government
  - All securities are issued through an auction process
    - Bills: 1M, 3M, 6M, 1 year
    - Notes: 2, 3, 5, 7, 10 year Floating Rate (2 year)
    - Bond: 30 year
- Two types of Treasury Securities
  - Discount: Issued at discount to par value, no coupon, and mature at par value
    - Issued at a price of 99 and then matures at 100
    - U.S. Treasury Bills
      - 1 day to 1 year
  - Fixed Rate: issued at approximately at par, have a coupon rate, and matures at par value
    - Maturities range from 2, 3, 5, 7, 10, 30 years
    - Auction determines the coupon rate

The Basics of U.S. Treasury Securities (TIPS)

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- Treasury Inflation-Protected Securities (TIPS)
  - Effective way to eliminate inflation risk
    - Principal is adjusted for inflation by a CPI index
  - Still has a semiannual coupon
    - Coupon applies to the inflation adjusted principal
  - Amount at maturity will be based on inflation adjusted amount
  - New issues price are determined by auction
- Must have time forecast inflation
- Be careful of final maturity if buying at auction

When Do TIPS Make Sense
(5 year breakeven rates)

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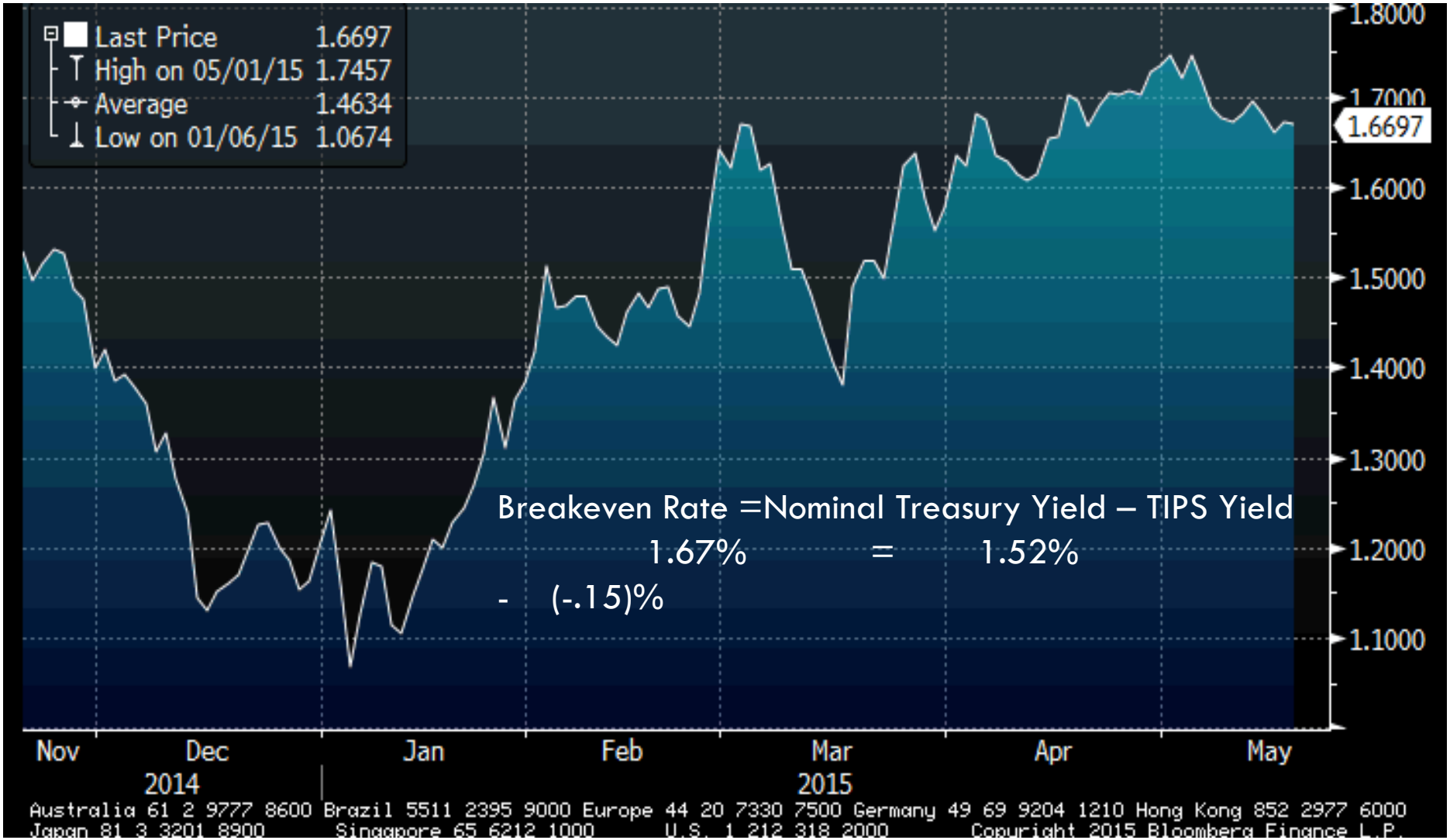

The Basics of U.S. Treasury Securities (STRIPS)

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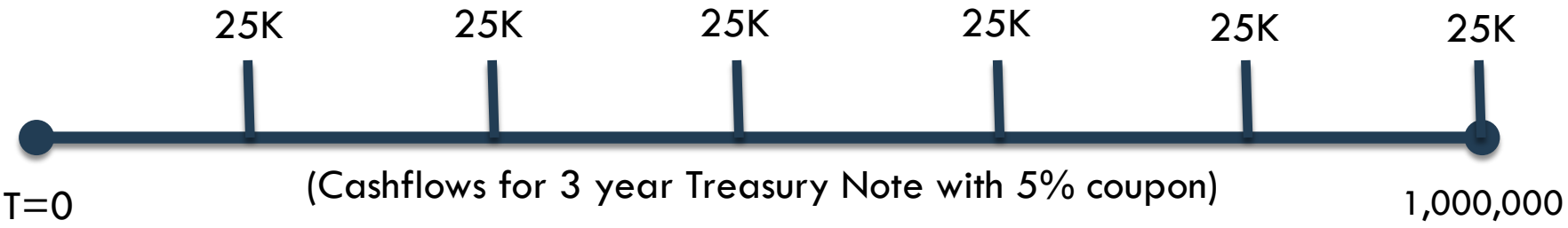
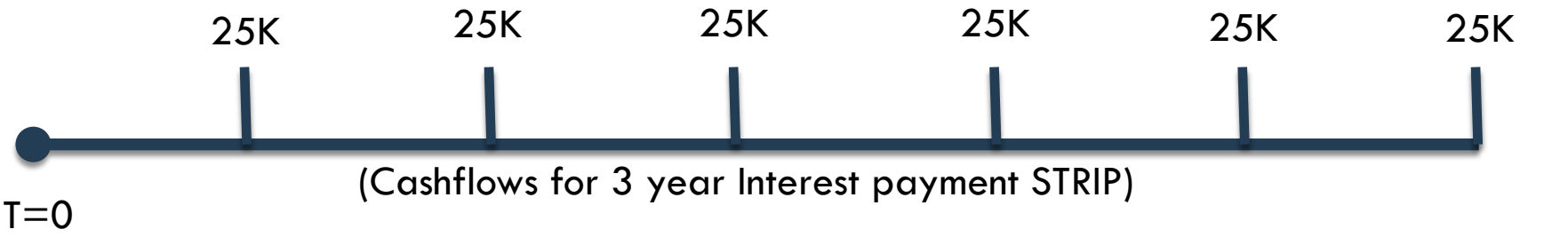
- What is a U.S. Treasury STRIPS?
  - Separate Trading of Registered Interest and Principal of Securities aka STRIPS (1985)
  - The interest and principal cashflows of a U.S. Treasury Bond as separate Securities
    - U.S. Treasury Coupon STRIPS
      - Contains only the coupon payments of the associated Treasury Bond
    - U.S. Treasury Principal STRIPS (aka "Zero coupon" security)
      - Contains only the principal payment of the associated U.S. Treasury Bond
      - Sold at a discount and matures to Face Value

How are STRIPS Created?

$1 million Par of the 3 year Treasury Note, 5% coupon





Characteristics of Treasury Securities

- Seen as risk free
  - No default risk
  - Heavily purchased during times of crisis and uncertainty
- No credit risk
  - Full faith and credit of U.S. Government
- Very liquid
  - Visible in the small (Bid/Ask) spread
- Benchmark for interest rates around the world
- Still has interest rate risk
  - Be mindful of a bond's duration

Understanding Price & Yield

- Time Value of Money Circle of Life
- What is Price?
- What is Yield?
- Treasury Price/Yield Information

Framework for Understanding…

"The Theory of Economics does not furnish a body of settled conclusions immediately applicable to policy. It is a method rather than a doctrine, an apparatus of the mind, a technique of thinking, which helps its possessor to draw correct conclusions." – John Maynard Keynes

[H.D. Henderson, Supply and Demand (New York: Harcourt, Brace and Company, 1922), v.]

The Treasury Yield Curve Framework

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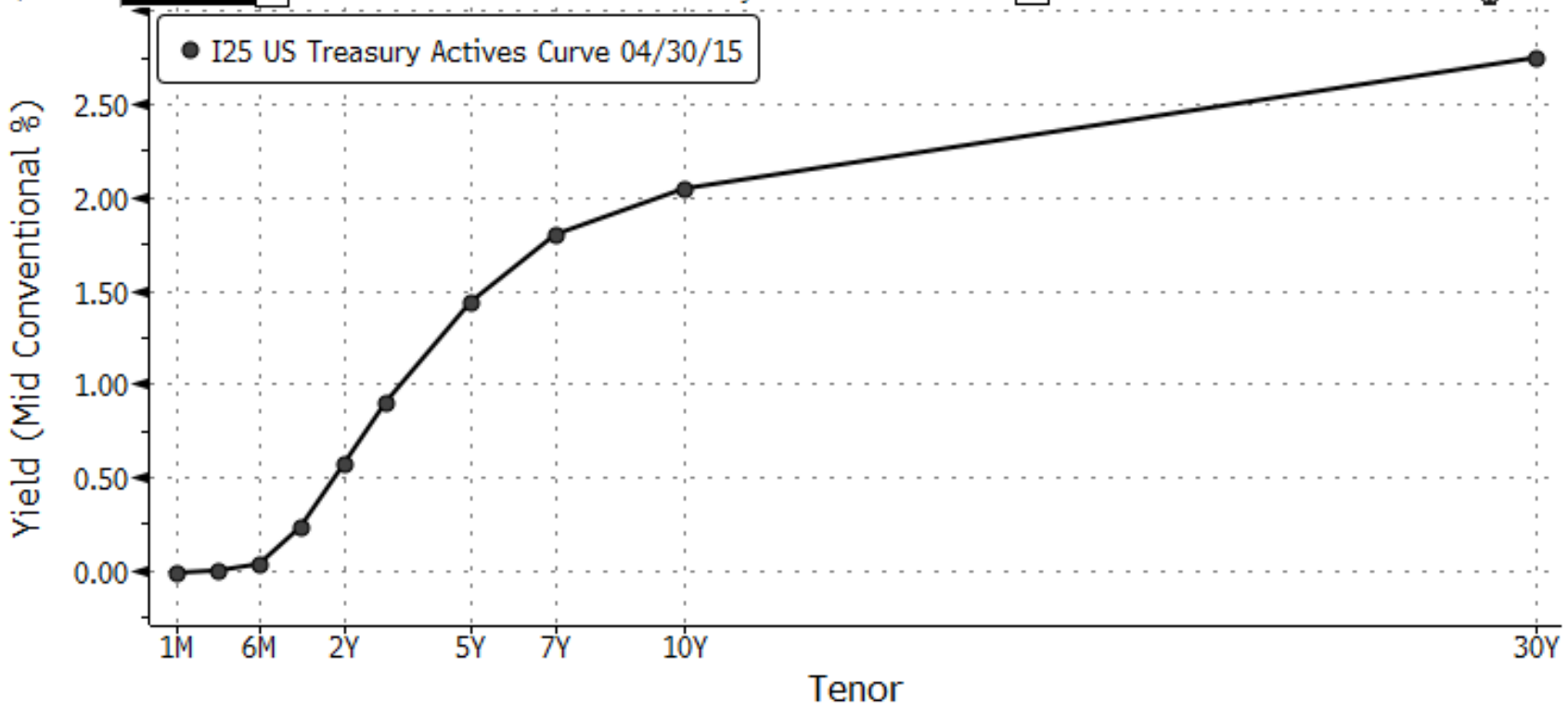
<HELP> for explanation.

US Treasury Actives Curve | 97) Actions | 98) Table | Graph Curves

X-axis Tenor | Y-axis Yield | PCS MULT | Lower Chart Table

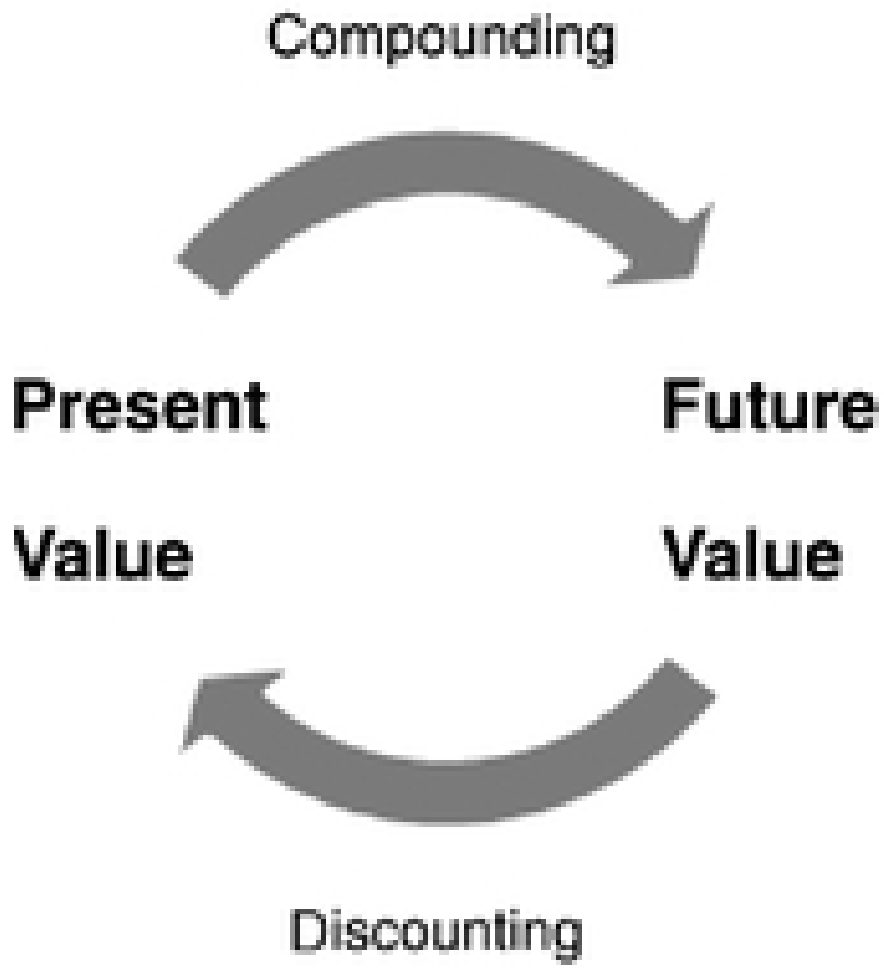
Specific 04/30/15 | Relative | Last | 1D | 1W | 1M | Modify | « | Curves & Relative Value



3) Show Key Tenors <

Curve ID	1M	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y	30Y
I25	-0.013	0.003	0.038	0.227	0.573	0.904	1.434	1.798	2.038	2.745

Time Value of Money Circle of Life



Time Value of Money Math

$$FV = PV*(1+i)^n$$

"The basic valuation equation is the foundation of all the financial mathematics that involves compounding, and if you understand this equation, you understand most everything in financial mathematics: where: FV = the future value PV = the present value i = the rate of interest n = is the number of compounding periods"

Peterson Drake, Pamela; Fabozzi, Frank J. (2009-07-30). Foundations and Applications of the Time Value of Money (Frank J. Fabozzi Series) (Kindle Locations 316-318). Wiley. Kindle Edition.

Time Value of Money Circle of Life

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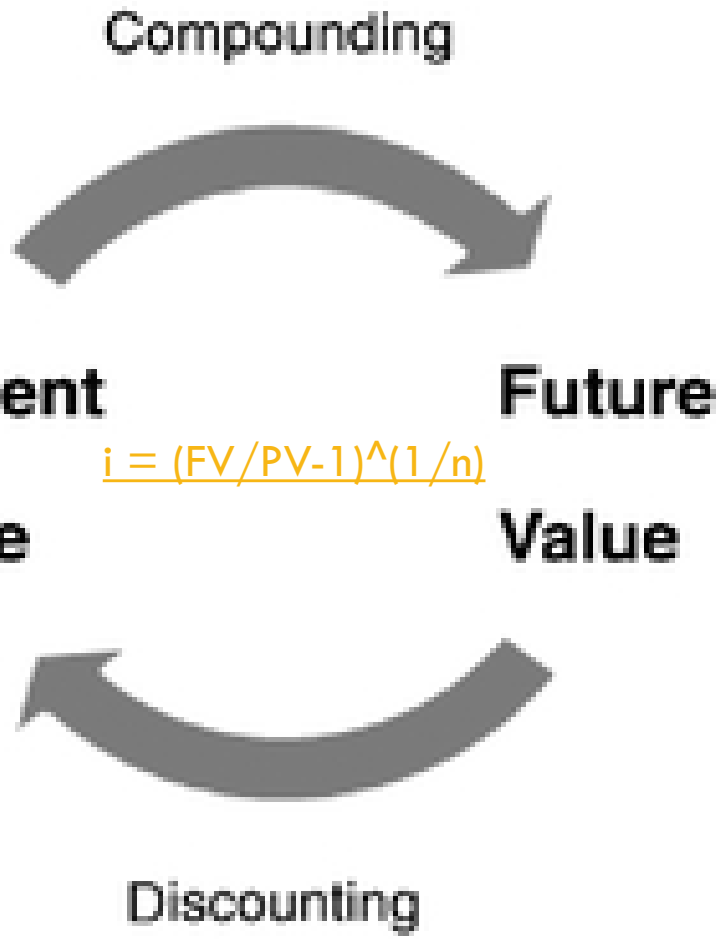

PV= FV / (1+i)^n

i = (FV/PV-1)^(1/n)

FV = PV*(1+i)^n

Price vs Yield: Which Came First?

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Settlement:	4/30/2015
Maturity:	4/30/2020
Par Amount:	1,000,000.00
Price:	99.716307
Coupon:	1.375%
Payment Frequency:	2
Yield:	1.434%
Modified Duration:	4.814
Convexity:	0.260

$$\text{Price} = \frac{\text{Total Present Value}}{\text{Par Amount}}$$

$$\text{Present Value} = \frac{\text{Cash Flow}}{(1 + \text{Yield} / \text{Frequency})^{\text{Period}}}$$

Cash Flow = Par*(Coupon / Frequency)

Time Period	Cash Flow	Present Value
1	6,875.00	6,826.06
2	6,875.00	6,777.46
3	6,875.00	6,729.21
4	6,875.00	6,681.31
5	6,875.00	6,633.75
6	6,875.00	6,586.52
7	6,875.00	6,539.63
8	6,875.00	6,493.08
9	6,875.00	6,446.85
10	1,006,875.00	937,449.21
Total	1,068,750.00	997,163.07

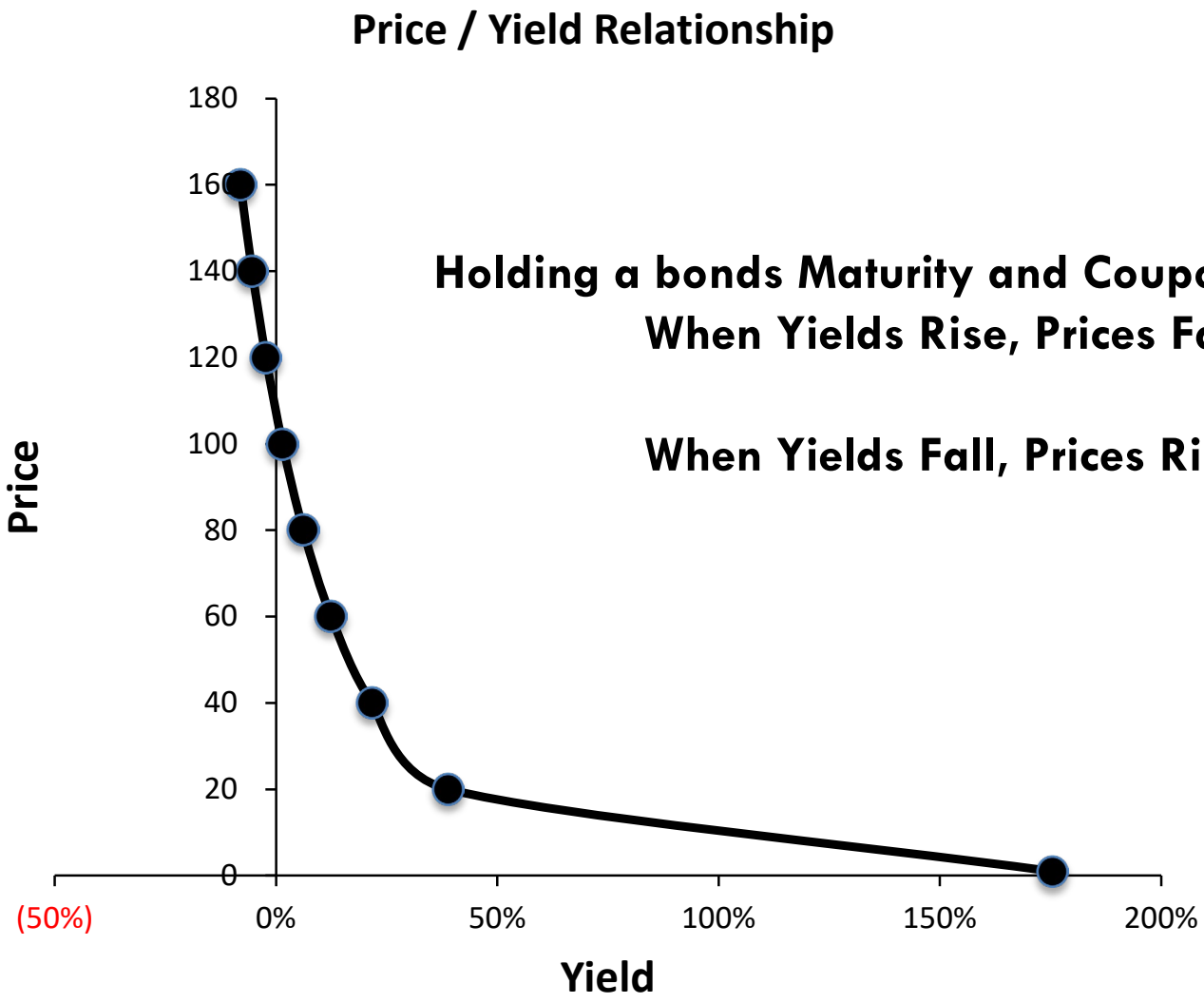
PRICE is expressed as a percentage of face value. Thus a bond quoted at 99.716307 has a dollar price of $997,163.07, which is 99.716307% of $1,000,000.

YIELD is simply a bond's internal rate of return. Specifically, the yield to maturity is the interest rate that will make the present value of the bond's cash flows equal to its market price plus accrued interest (i.e., the full price).

"There is a which-comes-first aspect to bond prices and yields: Do prices drive yields, or do yields drive prices? If we know an investor's required rate of return for a particular bond, we can calculate the bond price. If instead we observe the price, we can calculate the yield to maturity and thereby infer the required rate of return."

Smith, Donald J. (2011-07-05). Bond Math: The Theory Behind the Formulas (Wiley Finance) (Kindle Locations 1033-1035). Wiley. Kindle Edition.

Price & Yield Relationship



Question

Settlement:	4/30/2015
Maturity:	4/30/2020
Par Amount:	1,000,000.00
Price:	99.716307
Coupon:	1.375%
Payment Frequency:	2
Yield:	1.434%
Modified Duration:	4.814
Convexity:	0.260

What will the bond PRICE do if the YIELD on the bond moves from 1.434% to 2.434%?

Answer

Settlement:	4/30/2015
Maturity:	4/30/2020
Par Amount:	1,000,000.00
Price:	95.042827
Coupon:	1.375%
Payment Frequency:	2
Yield:	2.434%
Modified Duration:	4.786
Convexity:	0.257

$$\text{Price} = \frac{\text{Total Present Value}}{\text{Par Amount}}$$

$$\text{Present Value} = \frac{\text{Cash Flow}}{(1 + \text{Yield} / \text{Frequency})^{\text{Period}}}$$

Cash Flow = Par*(Coupon / Frequency)

Time Period	Cash Flow	Present Value
1	6,875.00	6,792.34
2	6,875.00	6,710.67
3	6,875.00	6,629.98
4	6,875.00	6,550.26
5	6,875.00	6,471.51
6	6,875.00	6,393.70
7	6,875.00	6,316.82
8	6,875.00	6,240.87
9	6,875.00	6,165.83
10	1,006,875.00	892,156.30
Total	1,068,750.00	950,428.27

The price of the bond will go down because the interest rate used to discount the cash flows (the yield) is higher. The higher yield makes the present value of the future cash flows lower; therefore making the price lower.

Treasury Yield Data Sources

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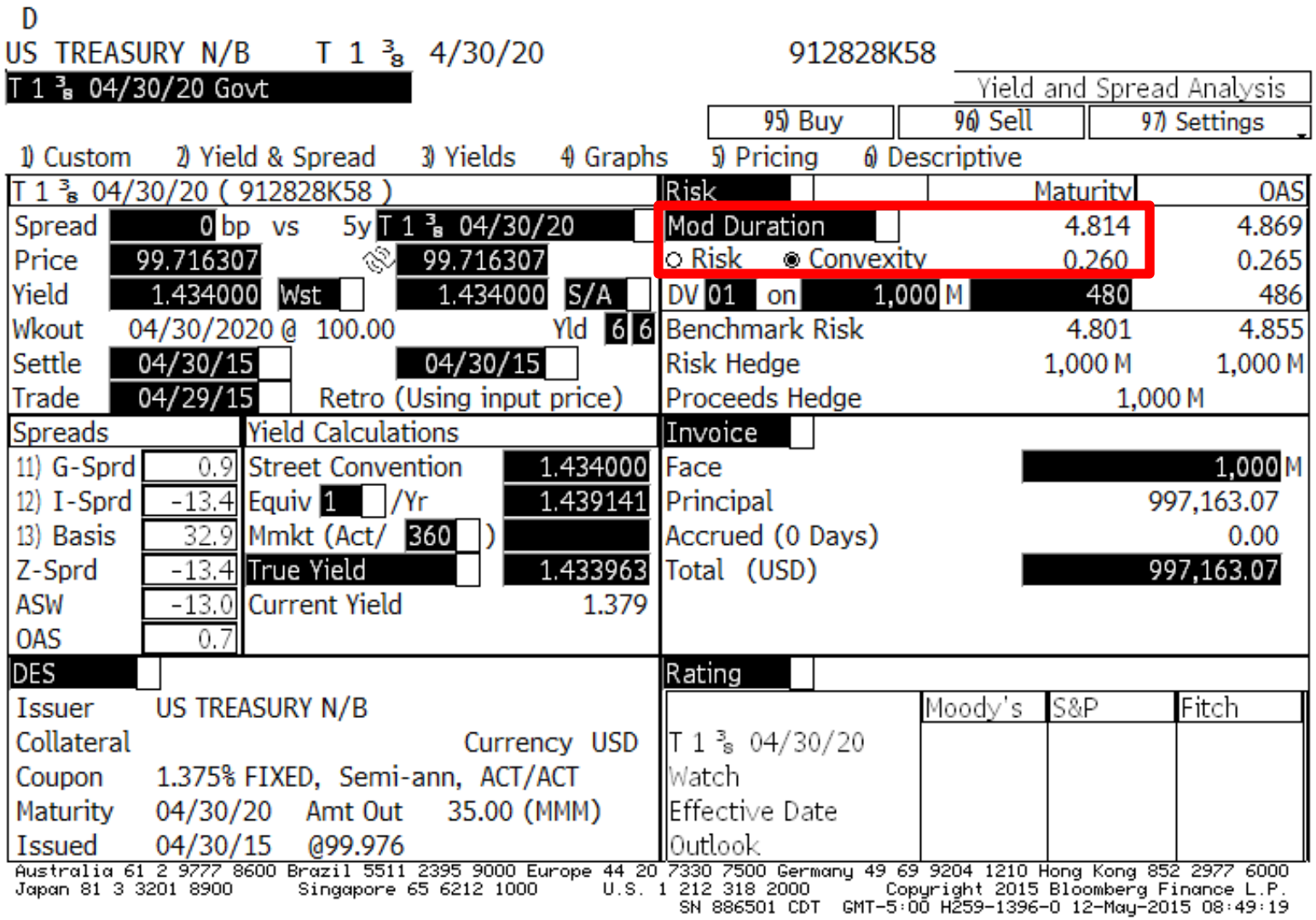
* US Department of the Treasury:
    1. http://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/Historic-Yield-Data-Visualization.aspx
    2. http://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=realyield
    3. http://www.treasury.gov/resource-center/data-chart-center/Pages/index.aspx
* Yahoo Finance:
    http://finance.yahoo.com/bonds/composite_bond_rates
* Wall Street Journal Market Data Center:
    http://www.wsj.com/mdc/public/page/mdc_bonds.html
* Wolfram Alpha:
    http://www.wolframalpha.com/input/?i=treasury+yield+curve
* Bloomberg US Treasury Yields:
    http://www.bloomberg.com/markets/rates-bonds/government-bonds/us

Primary Risks Associated with Bonds

- **Interest Rate Risk:** The risk that bond prices will fall as interest rates rise.
- **Reinvestment Risk:** The risk that proceeds from the bond will be reinvested at a rate lower than the yield when purchased.
- **Call Risk:** The risk that a bond with a call provision will be called (redeemed before the stated maturity date) by the issuer.
- **Default Risk:** The risk that the bond issuer will be unable to pay the interest and principal as promised.

Interest Rate Risk: Duration



The Price-Yield-Duration Connection

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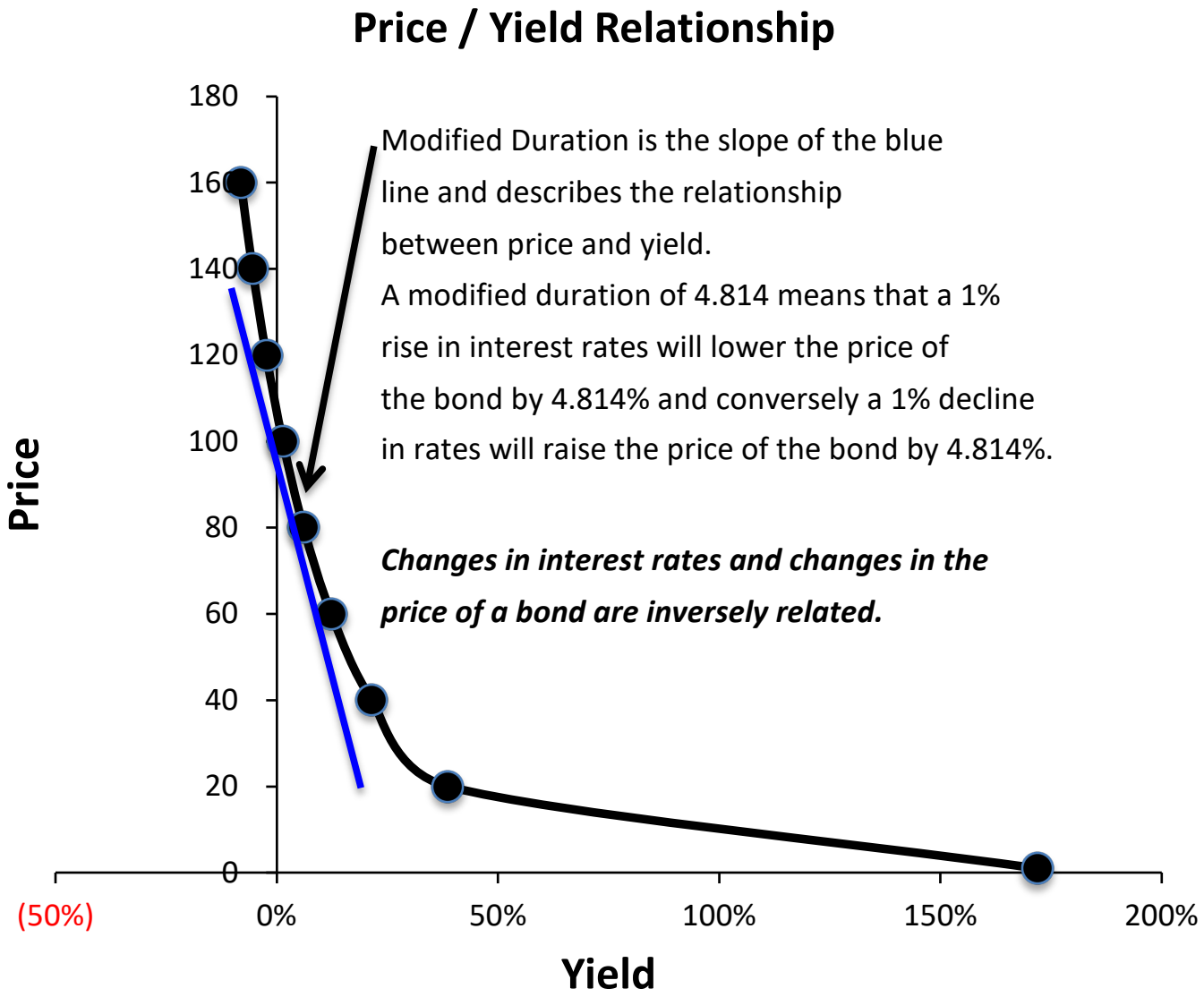
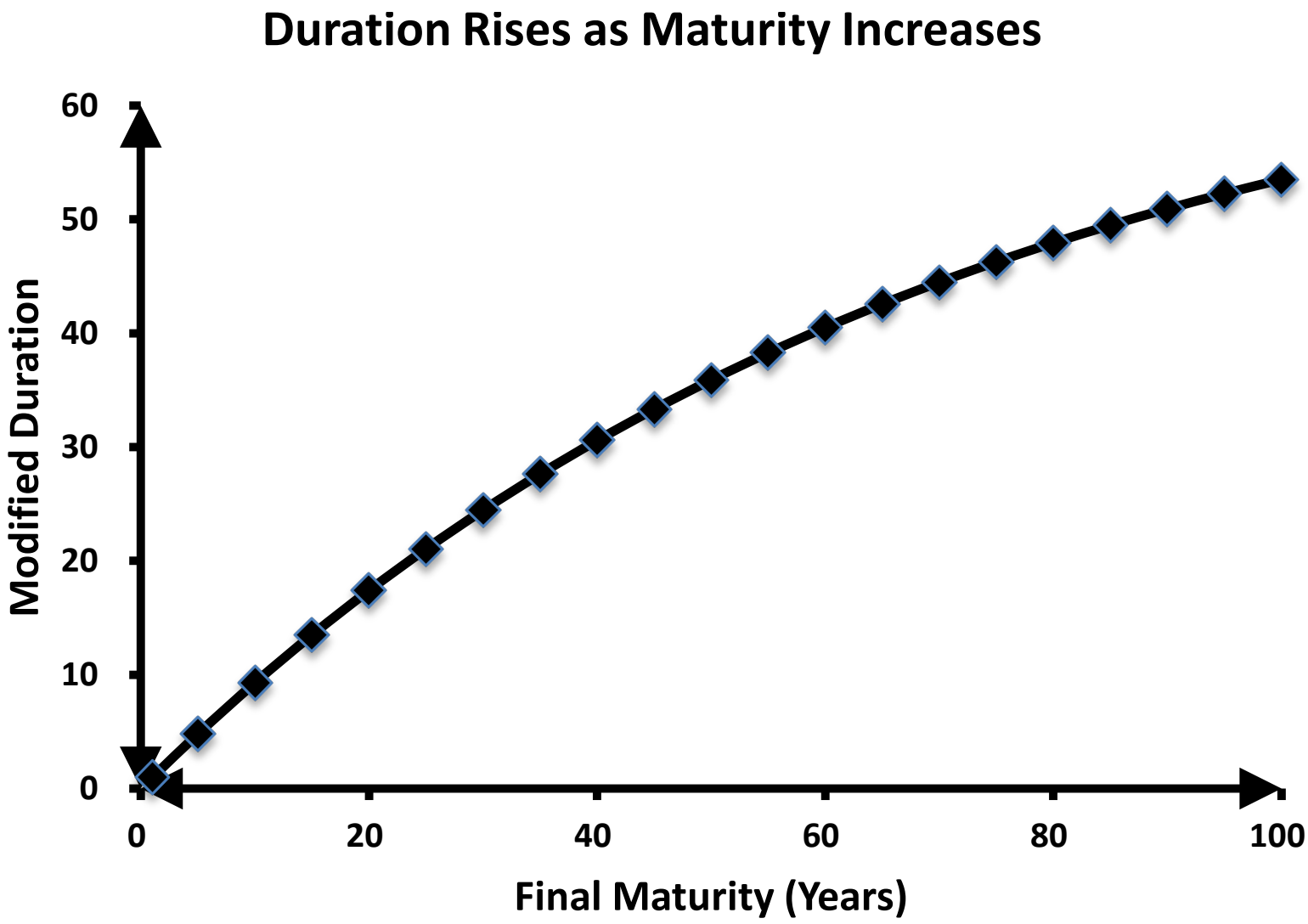
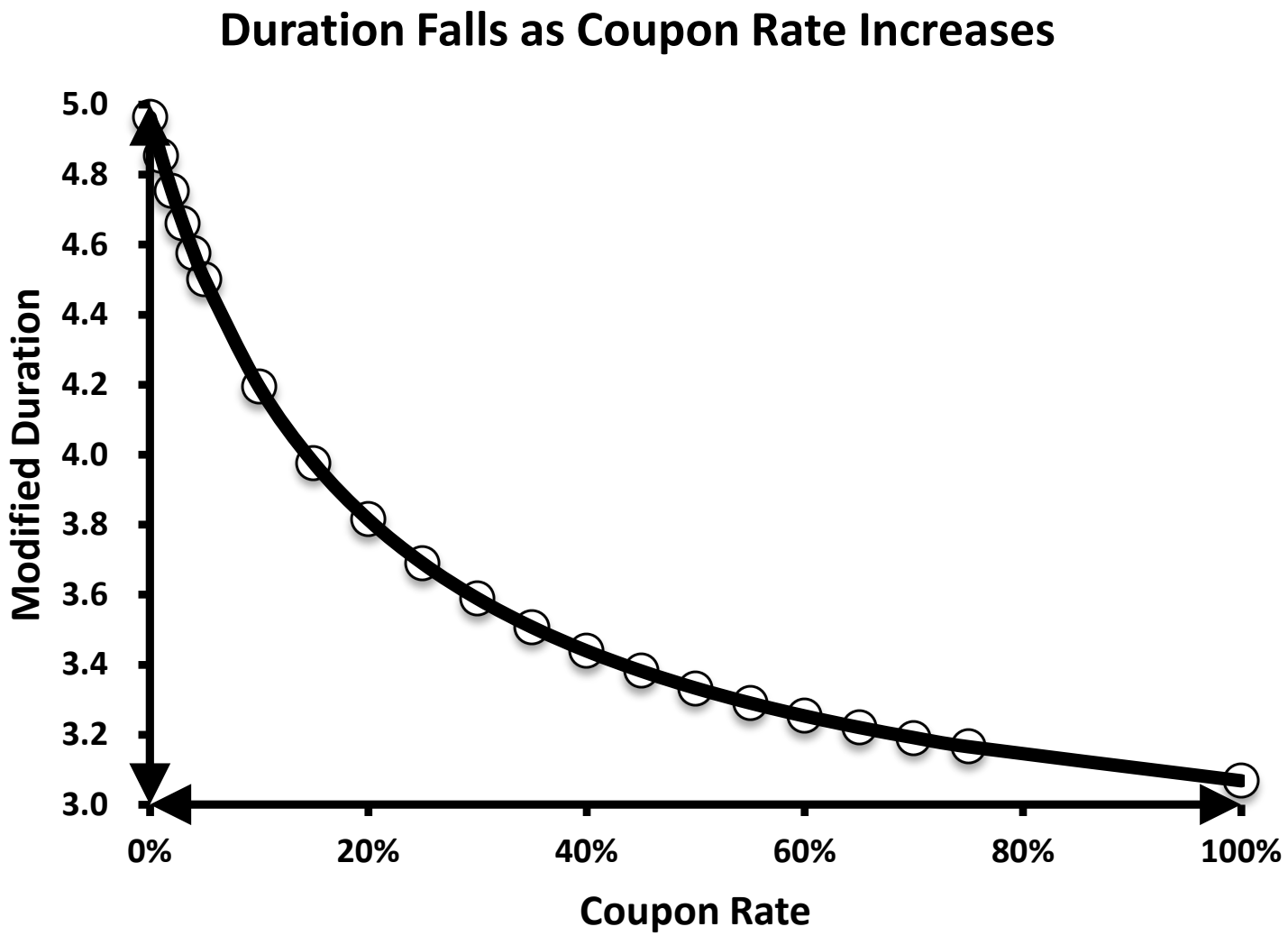


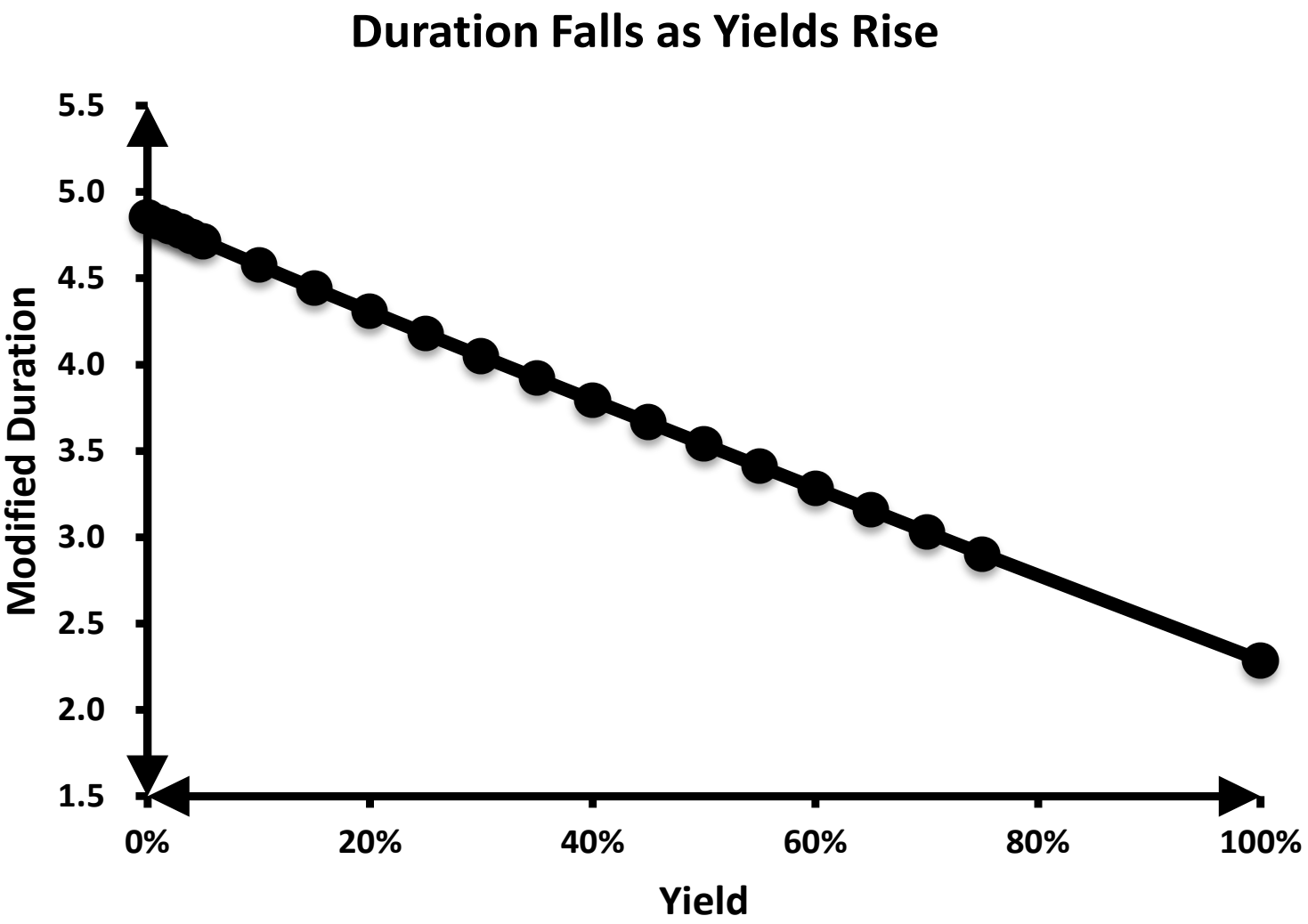
Duration & Final Maturity



Duration & Coupon Rate



Duration & Yield



Excel'ing @ Bonds!

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Settlement:	4/30/2015
Maturity:	4/30/2020
Par Amount:	1,000,000.00
Price:	99.716
Coupon:	1.375%
Payment Frequency:	2
Yield:	1.434%
Modified Duration:	4.814
Convexity:	0.260

$$\text{Price} = \frac{\text{Total Present Value}}{\text{Par Amount}}$$

$$\text{Present Value} = \frac{\text{Cash Flow}}{(1 + \text{Yield} / \text{Frequency})^{\text{Period}}}$$

$$\frac{\text{Present Value}}{\text{Total Present Value}}$$

Time Period * Weight

Cash Flow = Par*(Coupon / Frequency)

Time Period	Cash Flow	Present Value	Weight	Weighted Value Time To Receipt	Convexity Calc
1	6,875.00	6,826.06	0.0068	0.0068	13,458.43
2	6,875.00	6,777.46	0.0068	0.0136	40,087.86
3	6,875.00	6,729.21	0.0067	0.0202	79,604.94
4	6,875.00	6,681.31	0.0067	0.0268	131,730.40
5	6,875.00	6,633.75	0.0067	0.0333	196,188.93
6	6,875.00	6,586.52	0.0066	0.0396	272,709.17
7	6,875.00	6,539.63	0.0066	0.0459	361,023.69
8	6,875.00	6,493.08	0.0065	0.0521	460,868.88
9	6,875.00	6,446.85	0.0065	0.0582	571,984.97
10	1,006,875.00	937,449.21	0.9401	9.4012	101,656,433.38
Total	1,068,750.00	997,163.07	1.000	9.698	103,784,090.65

Macaulay Duration:	4.849	<--- Is the sum of the weighted time to receipt divided by the coupon frequency.
Modified Duration:	4.814	<--- Is the Macaulay Duration divided by (1+ Bond Yield/2) which converts the weighted time to receipt into a percentage change.

Wolfram Alpha Duration Calculator

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Calculate: modified duration

- settlement date: 4/30/2015
- maturity date: 4/30/2020
- annual yield: 1.434
- annual coupon rate: 1.375
- coupon frequency: semi-annual
- day count convention: actual/actual

Assuming modified duration | Use Macaulay duration instead

Input information:

bond duration	
settlement date	Thursday, April 30, 2015
maturity date	Thursday, April 30, 2020
annual yield	1.434%
annual coupon rate	1.375%
coupon frequency	semi-annual
day count convention	actual/actual

Results:

modified duration	4.814
convexity	0.2602 yr/% (years per percent)

Calculate: modified duration

- settlement date: 4/30/2015
- maturity date: 4/30/2020
- annual yield: 2.434
- annual coupon rate: 1.375
- coupon frequency: semi-annual
- day count convention: actual/actual

Assuming modified duration | Use Macaulay duration instead

Input information:

bond duration	
settlement date	Thursday, April 30, 2015
maturity date	Thursday, April 30, 2020
annual yield	2.434%
annual coupon rate	1.375%
coupon frequency	semi-annual
day count convention	actual/actual

Results:

modified duration	4.786
convexity	0.2573 yr/% (years per percent)

California Government Code 53601
(U.S. Treasuries Securities)

"(b) United States Treasury notes, bonds, bills, or certificates of indebtedness, or those for which the faith and credit of the United States are pledged for the payment of principal and interest."

CA Government Code 53601 Guidelines

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Investment Type	Maximum Maturity [C]	Max Specified % of Portfolio [D]	Minimum Quality Requirements
U.S. Treasury Obligations	5 Years	None	None

[C] *Section 53601 provides that the maximum term of any investment authorized under this section, unless otherwise stated, is five years. However, the legislative body may grant express authority to make investments either specifically or as a part of an investment program approved by the legislative body that exceeds this five year maturity limit. Such approval must be issued no less than three months prior to the purchase of any security exceeding the five-year maturity limit.*

[D] Percentages apply to all portfolio investments regardless of source of funds. For instance, cash from a reverse repurchase agreement would be subject to the restrictions.

Where Do Treasuries Fit in Your Portfolio

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- Match your risk profile
- Provides diversifications
  - Lower volatility
  - Increased liquidity
- Helps manage credit risk exposure
- Passive Investment strategy
  - Passive or enhanced indexing to Treasury benchmark
- Active Investment strategy
  - Relative value opportunities
  - Market timing

Relative Value

(2 year Fannie Mae Note vs 2 year Treasury Note)

May 2001 – December 2001

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Market Anomalies

(Looming Government Shutdown 2013)

1 month T-Bill Rates (January 2013 – September 2014)

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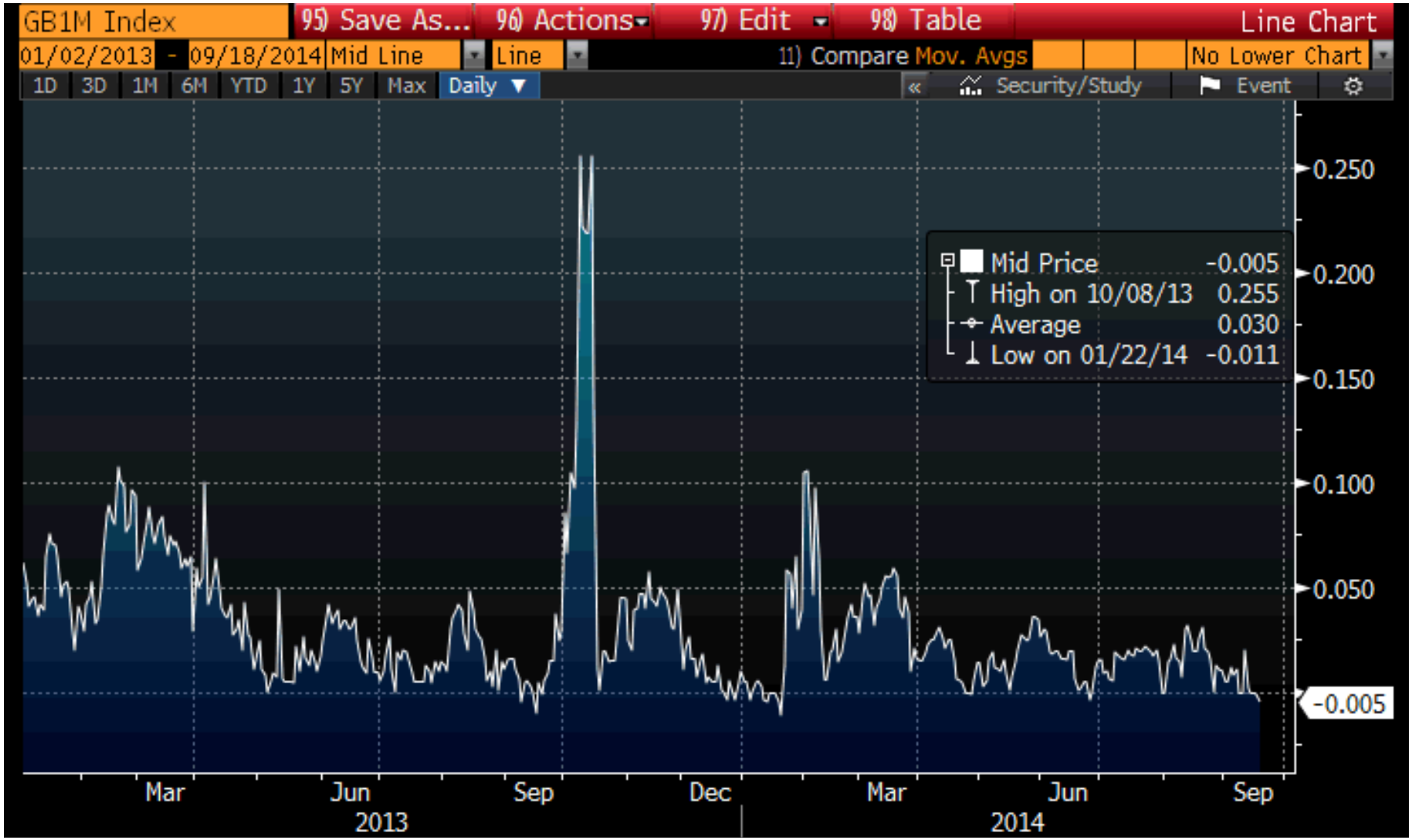

QUESTIONS

Public Investment Webinar Series: The Public Investment Portfolio

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Webinar 2:	Agencies	June 17
Webinar 3:	Municipals	June 24
Webinar 4:	Money Markets	
	Part 1: Banker's Acceptances, Commercial Paper	July 8
	Part 2: CDs, Deposit Placement Services and Collateralized Bank Deposits	July 22
	Part 3: Repurchase Agreements, Reverse Repos and Securities Lending	August 5
Webinar 5:	Corporates	August 19
Webinar 6:	Asset-Backed Securities, Mortgage-Backed Securities and Collateralized Mortgage Obligations	Sept 2
Webinar 7:	Mutual Funds, Money Market Mutual Funds and Local Government Pooled Investments	Sept 16

For more information or to register, go to
http://www.treasurer.ca.gov/cdiac/webinars/2015/portfolio/description.asp

Thank you for your participation.

A Certificate of Attendance will be emailed to you within a week.