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CDIAC

CALIFORNIA  
DEBT AND  
INVESTMENT  
ADVISORY  
COMMISSION

## Group Exercise & Discussion: Bond Math

October 26, 2016

# KNN Team

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## **Joanna Bowes Managing Director, Partner**

- Manager of KNN Education Group
- 23 plus years of experience in public finance
  - Financial Advisor
  - Underwriter
  - Investment Banker
- Expertise with complex financing issues
- MBA, University of Connecticut; BA, Northwestern University
- Series 50 Municipal Advisor Representative

## **Erwin Tam Vice President**

- Quantitative lead for KNN Education Group
- 14 plus years of experience in public finance
  - Financial Advisor
  - Investment Banker
  - Public-Private Partnerships
- Prior experience with RBC Capital Markets, Bear, Stearns & Co. Inc., and PFM
- BA, University of California, Berkeley
- Series 50 Municipal Advisor Representative

# Bond Terminology

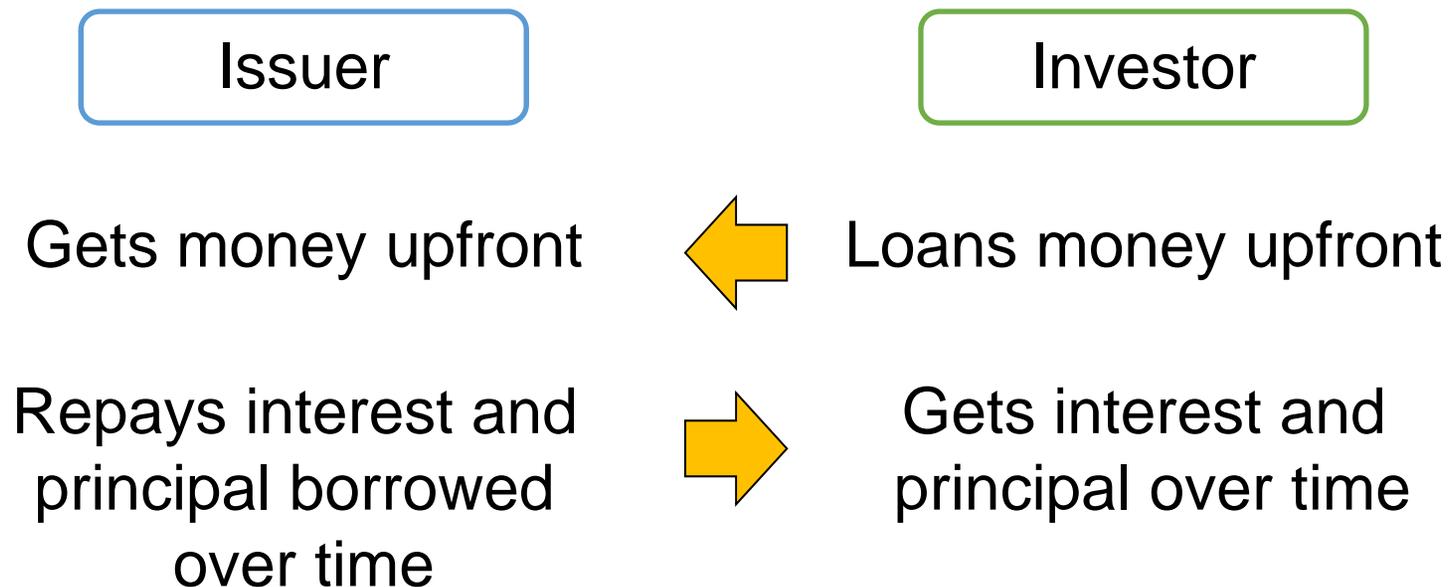
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- Dated Date                      Date from which an investor is entitled to receive interest
- Delivery Date                  Settlement date of the bond (closing date for primary bond issuance)
- Principal or Par                Face value of the bond
- Coupon                          Interest due to the investor, typically paid semiannual
- Yield                              Rate of return to the investor
- Price                                The price an investor will pay to receive the yield
- Maturity                          Date at which principal is due to the bondholder
- Call Date                         Redemption date of a bond prior to maturity at the option of the issuer
- Call Premium                    Dollar amount over 100% which is paid to the investor when bonds are called

# Time Value of Money

- A core principle of finance: money has more value in the present compared to the future
- Investor: What rate of return are you willing to receive over time to lend money today?
- Issuer: What rate of return are you willing to pay over time to receive money today?



# Bond Price Formula



- The dollar price of a bond is the present value of the future cashflows at the market yield
- Coupon, yield, and time are the only factors in price
- There are several methods to derive bond price, including:

**Bond Dollar Price**

$$= \frac{100}{\left(1 + \frac{\text{Yield}}{2}\right)^{\# \text{ of semi-annual periods}}} + 100 \times \text{Coupon} \times \frac{1 - \left(1 + \frac{\text{Yield}}{2}\right)^{-\# \text{ of semi-annual periods}}}{\left(\frac{\text{Yield}}{2}\right)}$$

Present value of the principal at maturity
Present value of the interest payments over time

# Bond Price Formula: Example



- What is the price of a municipal bond assuming:
  - 10 Year Maturity
  - 5.00% Coupon
  - 4.00% Yield

$$\text{Bond Price} = \frac{100}{\left(1 + \frac{\text{Yield}}{2}\right)^{\# \text{ of semi-annual periods}}} + 100 \times \text{Coupon} \times \frac{1 - \left(1 + \frac{\text{Yield}}{2}\right)^{-\# \text{ of semi-annual periods}}}{\left(\frac{\text{Yield}}{2}\right)}$$

# Bond Price Formula: Example



- What is the price of a municipal bond assuming:

- 10 Year Maturity (20 semi-annual periods)
- 5.00% Coupon
- 4.00% Yield

Bond Price =  $\frac{100}{\left(1 + \frac{\text{Yield}}{2}\right)^{20}}$  +  $100 \times \text{Coupon} \times \frac{1 - \left(1 + \frac{\text{Yield}}{2}\right)^{-20}}{\left(\frac{\text{Yield}}{2}\right)}$

# Bond Price Formula: Example



- What is the price of a municipal bond assuming:
  - 10 Year Maturity (20 semi-annual periods)
  - 5.00% Coupon
  - 4.00% Yield

Bond Price =  $\frac{100}{\left(1 + \frac{\text{Yield}}{2}\right)^{20}} + 100 \times .05 \times \frac{1 - \left(1 + \frac{\text{Yield}}{2}\right)^{-20}}{\left(\frac{\text{Yield}}{2}\right)}$

# Bond Price Formula: Example



- What is the price of a municipal bond assuming:
  - 10 Year Maturity (20 semi-annual periods)
  - 5.00% Coupon
  - 4.00% Yield

Bond Price =  $\frac{100}{\left(1 + \frac{.04}{2}\right)^{20}} + 100 \times .05 \times \frac{1 - \left(1 + \frac{.04}{2}\right)^{-20}}{\left(\frac{.04}{2}\right)}$

# Bond Pricing Formula: Example

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- Municipal bond convention for pricing is truncation at the 3<sup>rd</sup> decimal
- No rounding!

Bond Price = 108.1757166

# Bond Price Terminology

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- **Par Bond**
  - Coupon and Yield are equal
  - Price equal to 100.000
  - Every \$1,000 of bonds issued will produce \$1,000 in proceeds
  
- **Premium Bond**
  - Coupon is greater than Yield
  - Price greater than 100.000
  - Every \$1,000 of bonds issued will produce over \$1,000 in proceeds
  
- **Discount Bond**
  - Coupon is less than Yield
  - Price less than 100.000
  - Every \$1,000 of bonds issued will produce less than \$1,000 in proceeds

# Bond Price and Bond Proceeds



- An issuer wants \$1,000,000 for a new project. How much does it need to issue to receive that amount, assuming the following bond prices:
  - 100.000 (par bond)
  - 105.000 (premium bond)
  - 95.000 (discount bond)

$$\text{Amount Required} = \frac{\text{Proceeds}}{(\text{Price}/100)}$$

# Bond Price and Bond Proceeds



- 100.000 (par bond)

$$\frac{\$1,000,000}{(100 / 100)} = \$1,000,000$$

Par bonds result in the same amount of bonds and proceeds

- 105.000 (premium bond)

$$\frac{\$1,000,000}{(105 / 100)} = \$952,381$$

Premium bonds require less bonds to be issued to receive the same proceeds

- 95.000 (discount bond)

$$\frac{\$1,000,000}{(95 / 100)} = \$1,052,632$$

Discount bonds require more bonds to be issued to receive the same proceeds

# Bond Price: Callable Premium Bonds



- Investors will always pay the lowest price for the bond
- Bond price needs to be calculated assuming bonds are redeemed on the call date and at maturity
- Whatever results in the lower bond price, is the price of the bond
- What is the price of a municipal bond assuming:
  - 20 Year Maturity (40 semi-annual periods)
  - 5.00% Coupon
  - 4.00% Yield
  - 10 Year Call at 100%

**Bond Price = 108.175**  
**to Call Date**

**~~Bond Price~~ = 113.677**  
**to Maturity**

- A callable (at par) premium bond will always have its lowest price at the call date

# Group Activity: Introduction

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**\$300,000,000**  
**CITY OF KING'S LANDING**  
**CERTIFICATES OF PARTICIPATION**  
**(KING'S LANDING RECONSTRUCTION PROJECT)**  
**2016 SERIES A**

- The City of King's Landing is issuing \$300 million in Certificates of Participation (COPs) to fund capital improvement projects
- The City needs your help in determining the bond price of its securities

# Group Activity: Questions

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- Question 1: What's your team name?
- Question 2: Identify all of the factors involved in pricing on the OS handout (Dated Date, Delivery Date, Principal, Coupon, Yield, Maturity, Call Date, and Call Premium)
- Question 3: For the each of the bonds, calculate the bond price assuming a call date on January 1, 2026.
- Question 4: Based on the prices you calculated, what would be the amount of bonds needed to generate \$100 million in proceeds for each bond? (Round up to the nearest \$5,000)
- Question 5: For the each of the bonds, calculate the bond price assuming no call.
- Question 6: Based on the prices you calculated, what would be the amount of bonds needed to generate \$100 million in proceeds for each bond? (Round up to the nearest \$5,000)

# Group Activity: Review



- Question 2: Identify all of the factors involved in pricing on the OS handout (Dated Date, Delivery Date, Principal, Coupon, Yield, Maturity, Call Date, and Call Premium)

**\$300,000,000**  
CITY OF KING'S LANDING  
CERTIFICATES OF PARTICIPATION  
(KING'S LANDING RECONSTRUCTION PROJECT)  
2016 SERIES A

Dated: Date of Delivery      Due: July 1, as shown on the inside cover

The City of King's Landing Certificates of Participation, 2016 Series A (the "Certificates") are being executed and delivered pursuant to a Trust Agreement, dated as of May 1, 2016, by and among Iron Bank N.A., as trustee (the "Trustee"), the City of King's Landing (the "City") and the King's Landing Public Facilities Corporation (the "Corporation"). The Certificates evidence proportionate undivided interests in the base rental payments (the "Base Rental Payments") to be made by the City pursuant to that certain Facility Lease, dated as of May 1, 2016, to be entered into by the City and the Corporation, pursuant to which the City will sublease from the Corporation certain real property and all the improvements thereon, as more particularly described herein. See "Security and Sources of Payment for the Certificates – Base Rental Payments" herein.

Interest evidenced by the Certificates is payable on January 1 and July 1 of each year, commencing on January 1, 2017. The Certificates will be delivered in book-entry form only and, when delivered, will be registered in the name of Littlefinger & Co., as nominee of The Gold Cloaks Trust Company, King's Landing ("CTC"), which will act as securities depository for the Certificates. Individual purchases of the Certificates will be made in book-entry form only. Purchasers of the Certificates will not receive certificates representing their ownership interests in the Certificates purchased. Principal and interest payments evidenced by the Certificates are payable directly to CTC by the Trustee from Base Rental Payments. Upon receipt of payments of principal and interest, CTC will in turn distribute such payments to the beneficial owners of the Certificates. See Appendix D – "Book-Entry System" attached hereto.

The Series 2016A Certificates are subject to optional, extraordinary and mandatory sinking fund prepayment, as described herein. See "The Certificates – Prepayment" herein.

**THE OBLIGATION OF THE CITY TO MAKE BASE RENTAL PAYMENTS AND TO PAY ADDITIONAL PAYMENTS DOES NOT CONSTITUTE AN OBLIGATION OF THE CITY FOR WHICH THE CITY IS OBLIGATED TO LEVY OR PLEDGE ANY FORM OF TAXATION OR FOR WHICH THE CITY HAS LEVIED OR PLEDGED ANY FORM OF TAXATION. NEITHER THE CERTIFICATES NOR THE OBLIGATION TO MAKE BASE RENTAL PAYMENTS AND TO PAY ADDITIONAL PAYMENTS CONSTITUTES AN INDEBTEDNESS OF THE CITY, THE SEVEN KINGDOMS OR ANY POLITICAL SUBDIVISION THEREOF WITHIN THE MEANING OF ANY CONSTITUTIONAL OR STATUTORY DEBT LIMITATION OR RESTRICTION.**

This cover page contains information for quick reference only. It is not a summary of this issue. Potential purchasers must read the entire Official Statement to obtain information essential to making an informed investment decision.

*The Certificates will be offered when, as and if executed, delivered, and received by the Underwriter, subject to the approval as to their legality by Eddard Stark & Sons LLP, King's Landing, Special Counsel to the City, and certain other conditions. Certain legal matters will be passed upon for the City and the Corporation by the City Counsel. It is anticipated that the Certificates in definitive form will be available for delivery through the facilities of DTC in King's Landing, on or about July 1, 2016.*

**MATURITY SCHEDULE**

**\$300,000,000**  
CITY OF KING'S LANDING  
CERTIFICATES OF PARTICIPATION,  
2016 SERIES A

BASE No.: 000001

Maturity (July 1)	Principal Amount	Interest Rate	Yield	Price
2036*	100,000,000	3.00	3.00	
2036*	100,000,000	4.00	3.00	
2036*	100,000,000	2.00	3.00	

\*Subject to optional prepayment date of July 1, 2026 at par.

**Dated Date** →

**Delivery Date** →

**Maturity** →

**Principal** →

**Coupon** →

**Yield** →

**Call Date** →

**Call Premium** →



Dated: May 1, 2016

# Group Activity: Review



- Question 3: For the each of the bonds, calculate the bond price assuming a call date on July 1, 2026
- Question 4: Based on the prices you calculated, what would be the amount of bonds needed to generate \$10 million in proceeds for each bond? (Round up to \$5,000)

Coupon	Yield	Price	Bond Size
3.0%	3.0%	100.000	\$100,000,000
4.0%	3.0%	108.584	\$92,095,000
2.0%	3.0%	85.042	\$117,590,000

# Group Activity: Review



- Question 5: For the each of the bonds, calculate the bond price assuming no call
- Question 6: Based on the prices you calculated, what would be the amount of bonds needed to generate \$10 million in proceeds for each bond?

Coupon	Yield	Price	Bond Size
3.0%	3.0%	100.000	\$100,000,000
4.0%	3.0%	114.957	\$86,990,000
2.0%	3.0%	85.042	\$117,590,000

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# Q&A

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# MSRB Rule G-42 Disclosures

# MSRB Rule G-42: Disclosure of Conflicts of Interest and Legal or Disciplinary Events



Pursuant to Municipal Securities Rulemaking Board (“MSRB”) Rule G-42, on Duties of Non-Solicitor Municipal Advisors, Municipal Advisors are required to make certain written disclosures to clients which include, amongst other things, Conflicts of Interest and any Legal or Disciplinary events of KNN Public Finance, LLC (“KNN Public Finance”) and its associated persons.

## **Conflicts of Interest**

KNN Public Finance represents that in connection with the issuance of municipal securities, KNN Public Finance may receive compensation from an Issuer or Obligated Person for services rendered, which compensation is contingent upon the successful closing of a transaction and/or is based on the size of a transaction. Consistent with the requirements of MSRB Rule G-42, KNN Public Finance hereby discloses that such contingent and/or transactional compensation may present a potential conflict of interest regarding KNN Public Finance’s ability to provide unbiased advice to enter into such transaction. This conflict of interest will not impair KNN Public Finance’s ability to render unbiased and competent advice or to fulfill its fiduciary duty to the Issuer.

If KNN Public Finance becomes aware of any additional potential or actual conflict of interest after this disclosure, KNN Public Finance will disclose the detailed information in writing to the Issuer in a timely manner.

## **Legal or Disciplinary Events**

KNN Public Finance, LLC, has never been subject to any legal, disciplinary or regulatory actions nor was it ever subject to any legal, disciplinary or regulatory actions previously, when it was a division of Zions First National Bank or Zions Public Finance, Inc.

A regulatory action disclosure has been made on Form MA-I for one of KNN Public Finance municipal advisory personnel relating to a 1998 U.S. Securities and Exchange Commission (“SEC”) order that was filed while the municipal advisor was employed with a prior firm, (not KNN Public Finance). The details of which are available in Item 9; C(1), C(2), C(4), C(5) and the corresponding regulatory action DRP section on Form MA and Item 6C; (1), (2), (4), (5) and the corresponding regulatory action DRP section on Form MA-I. Issuers may electronically access KNN Public Finance’s most recent Form MA and each most recent Form MA-I filed with the Commission at the following website: [www.sec.gov/edgar/searchedgar/companysearch.html](http://www.sec.gov/edgar/searchedgar/companysearch.html).

The SEC permits certain items of information required on Form MA and Form MA-I to be provided by reference to such required information already filed on a regulatory system (e.g., FINRA CRD). The above noted regulatory action has been referenced on both Form MA and MA-I due to the information already filed on FINRA’s CRD system and is publicly accessible through BrokerCheck at <http://brokercheck.finra.org>. For purposes of accessing such BrokerCheck information, the Municipal Advisor’s CRD number is 4457537.