DEBT SECURITIES

Topic 3: Yield spreads

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References

> **Fabozzi F. J. (2007).** *Fixed Income Analysis*. John Wiley & Sons Inc. New Jersey. Chapter 4.

Student learning objectives

3.1 Describe the risk exposures of Treasury securities, the Treasury yield curve and the various shapes of the yield curve;
3.2 Define a Treasury spot rate;
3.3 Explain the different types of yield spread measures (e.g., absolute yield spread, relative yield spread, yield ratio), compute yield spread measures given the yields for two securities, and explain why investors may find a relative yield spread to be a better measure of yield spread than the absolute yield spread;
3.4 Describe a credit spread and discuss the suggested relationship between credit spreads and the economic well-being of the economy;

Objective 3.1

U.S. Treasury securities

> The following securities are issued by the U.S. Treasury
  - **Treasury bills**: zero-coupon securities with a maturity at issuance of one year or less
  - The US Treasury currently issues 1-month, 3-month and 6-month bills
  - **Treasury notes**: coupon securities with a maturity at issuance greater than 1 year but not greater than 10 years
  - The Treasury currently issues 2-year, 3-year, 5-year, 7-year and 10-year notes
  - **Treasury bonds**: coupon securities with a maturity at issuance greater than 10 years
  - The 30-year bond was suspended between 2001 and 2006
  - **Inflation-protection securities**: coupon securities where the principal increases in accordance with the CPI, ensuring that the investor earns the real interest rate that has been quoted

Student learning objectives

3.5 Identify how embedded options affect yield spreads;
3.6 Explain how the liquidity or issue-size of a bond affects its yield spread relative to risk-free securities and relative to other issues that are comparable in all other ways except for liquidity;
3.7 Compute the after-tax yield of a taxable security and the tax-equivalent yield of a tax-exempt security;
3.8 Define LIBOR and explain its role in interest rate swaps and why it is an important measure in relation to funding for investors who borrow short-term.

Objective 3.1

Risks of Treasury securities

> All Treasury securities are exposed to **interest rate risk** – variation in the value of a security because of changes in interest rates
  - The degree of exposure is a function of the maturity and coupon rate
> Treasury securities are not exposed to **credit risk** – the risk that the borrower will default or cash flows will vary because of changes in the creditworthiness of the borrower – because they are backed by the full faith and credit of the U.S. government, and hence they are considered "default-risk free"
> Treasury securities are not exposed to **call and prepayment risk** – the risk that the issuer will call the security or make prepayments of principal – because they do not carry these embedded options

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Objective 3.1

Risks of Treasury securities

- Treasury securities are exposed to **yield curve risk** – exposure of a bond portfolio to how the yield curve shifts
- Treasury securities are not exposed to **volatility risk** - variability in the value of bonds caused by variability in the value of embedded options caused by volatility in bond yields
- Treasury notes and bonds are exposed to **reinvestment risk** – the risk that the proceeds from a bond may have to be reinvested at a lower interest rate – but Treasury bills are not
- Off-the-run Treasury securities are more exposed to **liquidity risk** – the risk that an investor will be forced to sell a bond below its indicated value – than on-the-run securities

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Objective 3.1

Risks of Treasury securities

- U.S. based investors are not exposed to **exchange rate risk** – variability in returns to the investor caused by the bond payments being in a different currency from the investor's domestic currency – though foreign domiciled investors are exposed to exchange rate risk
- Fixed rate Treasury securities are exposed to **inflation risk** – the risk that the value of a security's cash flows will decline as result of inflation
- Inflation-protected securities (TIPS) are not exposed to inflation risk
- Treasury securities are exposed to **political risk** – the risk that there will be an effect on Treasury yields or an adverse price change as a result of U.S. government policy or actions by foreign governments

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Objective 3.1

Treasury yield curve

- As Treasury securities do not expose investors to credit risk, investors look to the yield offered by an on-the-run Treasury security as the minimum interest rate required on a non-Treasury security with the same maturity
- The **Treasury yield curve** depicts the relationship between the yield of on-the-run Treasury securities of different maturities
  - A **normal yield curve** is an upward sloping yield curve (the term normal is used because it is the most commonly observed)
  - An **inverted yield curve** is a downward sloping yield curve
  - For a **flat yield curve**, the yield is approximately the same regardless of maturity

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Example 3.1.1

Treasury yield curve

- **Using the Internet, determine the yields for US Treasury securities as at 5th March 2012**
- **Draw the Treasury yield curve**

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Example 3.1.1

Treasury yield curve

- **Yields for US Treasury securities as at 5th March 2012**

Source: US Department of the Treasury
http://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/default.aspx

Maturity	Yield (%)
1 month	0.07
3 months	0.08
6 months	0.14
1 year	0.17
2 years	0.31
3 years	0.43
5 years	0.87
7 years	1.40
10 years	2.00
20 years	2.78
30 years	3.13

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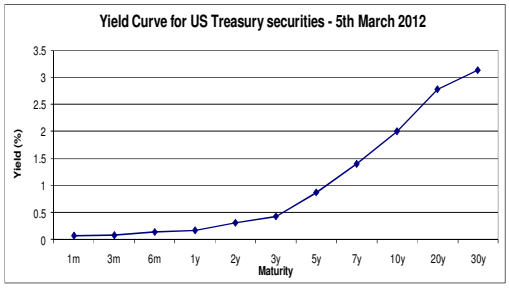
Example 3.1.1

Treasury yield curve



Objective 3.1

Treasury yield curve

- On August 5th 2011, Standard and Poor's downgraded the US Federal Government's credit rating from AAA to AA+. What did this do to Treasury yields:

Date	1Mo	3Mo	6Mo	1Yr	2Yr	3Yr	5Yr	7Yr	10Yr	20Yr	30Yr
04/08/11	0.01	0.02	0.05	0.12	0.27	0.44	1.12	1.78	2.47	3.37	3.70
05/08/11	0.01	0.01	0.05	0.11	0.28	0.49	1.23	1.91	2.58	3.49	3.82
08/08/11	0.02	0.05	0.07	0.12	0.27	0.45	1.11	1.75	2.40	3.31	3.68

- Are these yield movements consistent with what you would expect, or what do they tell you?

Objective 3.1

Treasury yield curve

- Two factors complicate the relationship between yield and maturity:
- The yield of on-the-run issues is distorted by lower financing rates
  - *Repurchase agreements* allow investors to effectively borrow the funds to buy securities, using the securities as collateral to obtain the funding
  - Since dealers want to obtain use of these securities for their own trading activities, they are willing to lend funds at lower interest rates
- On-the-run and off-the-run securities have different interest rate and reinvestment risks
  - On-the-run securities will have a slightly longer maturity, and hence greater interest rate risk
  - If on-the-run and off-the-run securities have different coupon rates, the securities with the lower coupon rates will have greater interest rate risk (because of longer duration) but less reinvestment risk

Objective 3.1

Term Structure of Interest Rates

- Useful here to introduce the common theories explaining the shape of the yield curve (these will be discussed in more detail in Lecture 8):
- Pure expectations theory
  - The yield curve (term structure) reflects market expectations about future short-term interest rates
- Liquidity preference theory
  - Term structure reflects expectations about future interest rates and a premium for interest rate risk. A liquidity premium is required to compensate investors for holding longer maturity bonds that are subject to greater interest rate risk.
- Market segmentation theory
  - Differences in the demand and supply for bonds of different maturities leads to segmented markets in different maturity sectors
  - Related to this is the preferred habitat theory, where investors prefer to invest in particular maturity sectors and require a yield premium to switch sectors

Objective 3.2

Treasury spot rate

- We can remove reinvestment risk from the equation if we just look at the relationship between yield and maturity for **zero-coupon bonds**
- The yield on a zero-coupon bond is called the **spot rate**, and the **Treasury spot rate** is the yield on a Treasury zero-coupon bond
- Although the US Treasury does not issue zero-coupon bonds with maturities greater than one year, the private sector has stepped in to create **Treasury strips** – zero-coupon securities which are effectively guaranteed by the full faith and credit of the US government
- As Treasury strips are zero coupon bonds they do not expose investors to reinvestment risk; hence investors view the yield offered by an on-the-run Treasury strip as the minimum interest rate required on a non-Treasury security with the same maturity

Objective 3.3

Yield spread

- The **absolute yield spread** between any two bond issues, bond X and bond Y, is computed as follows (and measured in basis points):

$$\text{Absolute Yield Spread} = \text{Yield On Bond X} - \text{Yield On Bond Y} \quad \text{(DS 3.3.1)}$$

- The **relative yield spread** between any two bond issues, bond X and bond Y, is computed as follows:

$$\text{Relative Yield Spread} = \frac{\text{Yield On Bond X} - \text{Yield On Bond Y}}{\text{Yield On Bond Y}} \quad \text{(DS 3.3.2)}$$

- The **yield ratio** between any two bond issues, bond X and bond Y, is computed as follows:

$$\text{Yield Ratio} = \frac{\text{Yield On Bond X}}{\text{Yield On Bond Y}} \quad \text{(DS 3.3.3)}$$

where Bond Y is the reference rate, typically a Treasury bond issue

Objective 3.3

Yield spread

- The reason for computing yield spreads in terms of a relative yield spread or yield ratio is that the magnitude of the yield spread is affected by the level of interest rates
  - An absolute yield spread of 40 basis points, when the yield on Treasuries is 3% (as it was in 1957), equals a relative yield spread of 13%
  - An absolute yield spread of 40 basis points, when the yield on Treasuries is 10% (as it was in 1985), equals a relative yield spread of 4%
- Thus, a relative yield spread or yield ratio measure is intuitively appealing for interpretation reasons and also to make comparisons over time

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Example 3.3.1

Yield spread

> On February 24, 2012, the yield on the 10-year on-the-run US Treasury issue was 1.98% and the yield on the 10-year Australian Government bond was 4.19%

> **Calculate the absolute and relative yield spread and the yield ratio, assuming the US Treasury issue is the benchmark.**

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Example 3.3.1

Yield spread

> On February 24, 2012, the yield on the 10-year on-the-run US Treasury issue was 1.98% and the yield on the 10-year Australian Government bond was 4.19%

> Absolute yield spread:

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Example 3.3.1

Yield spread

> On August 3, 2011, the yield on the 10-year on-the-run US Treasury issue was 2.64% and the yield on the 10-year Australian Government bond was 4.78%

> Relative yield spread:

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Example 3.3.1

Yield spread

> On August 3, 2011, the yield on the 10-year on-the-run US Treasury issue was 2.64% and the yield on the 10-year Australian Government bond was 4.78%

> Yield ratio:

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Objectives 3.4 – 3.7

Intermarket and intramarket sector spreads

> **Intermarket sector spread:** the yield spread between the yields offered for the same maturity in two sectors of the bond market
> **Intramarket sector spread:** the yield spread between the yields offered by two issues of the same maturity in a single sector of the bond market
> Factors other than maturity that affect the intermarket and intramarket yield spreads are:
  - Relative credit risk of the two issuers
  - Presence of embedded options
  - Liquidity of the two issues
  - Taxability of interest received by investors

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Objective 3.4

Credit spreads

> **Credit spread** or **quality spread**: This is the yield spread between non-Treasury securities and Treasury securities that are identical in all respects except for credit rating; i.e. the securities have the same maturity and neither have embedded options
  - The lower the credit rating of the non-Treasury security, the higher the credit spread
  - The longer the maturity, the higher the credit spread
> Credit spreads widen in a declining, contracting economy (because investors sell corporate bonds and invest in Treasury securities – the "flight to quality" – forcing corporations to increase yields to attract investors) and narrow during a period of economic expansion (due to greater capacity of firms to meet debt obligations)

Objective 3.4

Credit spreads

EXHIBIT 68-3 Credit Spreads (in Basis Points) in the Corporate Sector on February 8, 2002

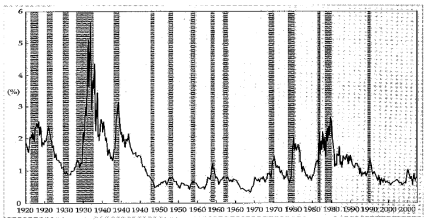
	AA–90-day			A–90-day			BBB–90-day		
Maturity (years)	High	Low	Avg	High	Low	Avg	High	Low	Avg
Industrials									
5	87	58	72	135	85	112	162	117	140
10	102	73	90	158	109	134	180	133	156
30	114	93	106	170	132	152	199	154	175
Utilities									
5	140	0	103	153	112	134	200	163	184
10	160	0	121	168	132	153	220	182	204
30	175	0	132	188	151	171	240	200	222
Finance									
5	103	55	86	233	177	198			
10	125	78	103	253	170	209			
30	148	100	130	253	207	228			
Banks									
5	97	60	81	113	83	100			
10	120	78	95	127	92	110			
30	138	105	121	170	127	145			

Source: Abstracted from *Global Relative Value*, Lehman Brothers, Fixed Income Research, February 11, 2002, p. 133.

Objective 3.4

Credit spreads

EXHIBIT 68-4 Credit Spreads Between Baa and Aaa Corporate Bonds Over the Business Cycle Since 1919



Shaded areas = economic recession as defined by the NBER

Source: Exhibit 1 in Leland E. Crabbe and Frank J. Fabozzi, *Managing a Corporate Portfolio* (Hoboken, NJ: John Wiley & Sons, 2002), p. 154.

Objective 3.5

Embedded options

- Some bonds include option-like provisions, such as the ability of the issuer to call or retire the debt, either partially or fully, before the scheduled maturity date
  - The presence of an embedded option favourable to the issuer (such as a call option) will widen the spread as investors require a larger yield to induce them to invest relative to comparable Treasury securities or non-Treasury securities without such an embedded option
  - The presence of an embedded option favourable to the investor will reduce the yield required by the investor and narrow the spread
  - It is possible for there to be a negative spread on Treasury securities
  - If the call is a deferred call, the longer the deferral period the smaller is the effect of the embedded option on the spread

Objective 3.5

Embedded options

EXHIBIT 68-5 Yield Spreads and Option-Adjusted Spread (OAS) for Ginnie Mae 30-year Passthrough Securities (February 8, 2002)

Coupon Rate (%)	Yield Spread (bps)	Benchmark Treasury	OAS on 2/8/02 (bps)	90-Day OAS (bps) High	Low	Avg.
6.5	203	5 year	52	75	46	59
7.0	212	5 year	57	83	54	65
7.5	155	3 year	63	94	62	74
8.0	105	3 year	78	108	73	88
9.0	244	2 year	131	160	124	139

Source: Abstracted from *Global Relative Value*, Lehman Brothers, Fixed Income Research, February 11, 2002, p.132.

Objective 3.6

Liquidity

- Even within the Treasury sector a spread exists between the off-the-run issues and the on-the-run issue with the same maturity
- This is due to the difference in liquidity
  - On-the-run issues are more liquid than off-the-run issues
  - The larger the issue, the greater the liquidity of the issue
  - The lower the liquidity, the greater the yield spread (because investors will demand a higher yield to compensate them for liquidity risk)
  - The greater the liquidity, the narrower the yield spread

Objective 3.7

Taxability of interest income

- The U.S. federal tax code specifically exempts interest income paid on qualified municipal bond issues from taxation
  - Issues which are exempt from taxation will typically show a negative spread against comparable Treasury securities of the same maturity; hence the spread is usually represented as a yield ratio, which will be less than one
  - The yield spread is a function of the maturity of the issue; the longer the maturity the higher the yield ratio
  - As tax rates change so will the yield spread change over time; the higher the tax rates the lower the yield ratio (the greater the negative spread) because the tax-exempt status of the municipal bonds is more valuable

Objective 3.7

Taxability of interest income

EXHIBIT 68-6 Yield Ratio for AAA General Obligation Municipal Bonds to U.S. Treasuries of the Same Maturity (February 12, 2002)

Maturity	Yield on AAA General Obligation (%)	Yield on U.S. Treasury (%)	Yield Ratio
3 months	1.29	1.72	0.75
6 months	1.41	1.84	0.77
1 year	1.69	2.16	0.78
2 years	2.20	3.02	0.73
3 years	2.68	3.68	0.73
4 years	3.09	4.13	0.75
5 years	3.42	4.42	0.77
7 years	3.86	4.84	0.80
10 years	4.25	4.95	0.86
15 years	4.73	5.78	0.82
20 years	4.90	5.85	0.84
30 years	4.95	5.50	0.90

Source: Bloomberg Financial Markets

Objective 3.7

Taxability of interest income

- After-tax yield:

$$\text{After-tax yield} = \text{Pre-tax yield} \times (1 - \text{Marginal Tax Rate}) \qquad \text{(DS 3.7.1)}$$

- Taxable-equivalent yield:

  This is the yield that must be offered on a taxable bond issue to give the same after-tax yield as a tax-exempt issue

$$\text{Taxable-equivalent yield} = \frac{\text{Tax-exempt yield}}{(1 - \text{Marginal Tax Rate})} \qquad \text{(DS 3.7.2)}$$

Example 3.7.1

Taxability of interest income

- Two investors, Ms High and Mr Low, have marginal tax rates of 40% and 18% respectively
- The two investors are considering investing in a taxable bond that offers a yield of 6.5%

- **Calculate the after-tax yield for each investor.**

Example 3.7.2

Taxability of interest income

- The two investors are considering investing in a tax-exempt bond that offers a yield of 4.5%

- **Calculate the taxable-equivalent yield for each investor.**

Objective 3.8

Interest rate swap

- In an interest rate swap
  - Two parties agree to exchange periodic interest payments
  - The dollar amount of the interest payments is based on a **notional principal** amount multiplied by an agreed periodic interest rate
  - The only cash flows exchanged are the interest payments – not the principal
  - Usually one party, the **fixed-rate payer**, agrees to pay a fixed rate, called the **swap rate**, and the other party, the **fixed-rate receiver**, agrees to pay a variable rate aligned with a reference rate
  - The **reference rate** is usually **LIBOR,** but may also be a Treasury bill rate, commercial paper rate, banker's acceptance rate or the federal funds rate
  - The difference between the swap rate and a Treasury security with the same term to maturity as the swap is the **swap spread**

Example 3.8.1

Interest rate swap

- A swap has the following characteristics
  - Term: 5 years
  - Swap spread: 50 basis points
  - Reference rate: 3-month LIBOR
  - Notional principal: $50 million
  - Frequency of payments: every three months
  - 5-year Treasury rate at time of originating the swap was 5.5%

- **Assuming 3-month LIBOR is 4%, 5%, 6%, 7% and 8% respectively at the beginning of each of the next five quarters, calculate the interest payments.**

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Example 3.8.1

Interest rate swap

Term: 5 years
Swap spread: 50 basis points
Reference rate: 3-month LIBOR
Notional principal: $50 million
Frequency of payments: every three months
5-year Treasury rate at origination of swap: 5.5%

Swap rate = 5-year Treasury rate at origination of swap + Swap spread
= 5.5% + 0.5% = 6%

Fixed payment = Swap rate x Notional principal ÷ 4 (for quarterly payments)
= 6% x $50,000,000 ÷ 4 = $750,000

Floating payment = Reference rate x Notional principal ÷ 4

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Example 3.8.1

Interest rate swap

Term: 5 years
Swap spread: 50 basis points
Reference rate: 3-month LIBOR
Notional principal: $50 million
Frequency of payments: every three months
5-year Treasury rate at origination of swap: 5.5%

Quarter	3-mth LIBOR	Fixed payment	Float payment	Net payment
1	4%	$750,000	$500,000	$250,000
2	5%	$750,000	$625,000	$125,000
3	6%	$750,000	$750,000	$0
4	7%	$750,000	$875,000	-$125,000
5	8%	$750,000	$1,000,000	-$250,000

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Objective 3.8

Role of swap rates

- Swap rates tie together the fixed and floating segments of the bond market
- Investors and issuers with a mismatch of assets and liabilities can use an interest rate swap to better match assets and liabilities, thereby reducing their risk
- For example, an investor with an asset that earns a fixed-interest return and a liability on which it pays a floating rate of interest is subject to interest rate risk – when floating rates are low they earn a high return, but when floating rates are high, they earn a low or negative return
- An interest rate swap can effectively convert the asset from a fixed rate to a floating rate, or convert the liability from floating to fixed

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Example 3.8.2

Role of swap rates

- A financial institution borrows $50 million on a quarterly basis to fund a $50 million purchase of 5-year bonds with a coupon rate of 9% pa selling at par value. The cost of borrowing is 3-month LIBOR plus 50 basis points.

- **Show the annual income spread on 3-month LIBOR at 6.5%, 8.5% and 10.5%.**
- **Show the annual income spread on 3-month LIBOR at 6.5%, 8.5% and 10.5%, if the institution enters a swap, with a notional principal of $50 million as the fixed rate payer, at a swap rate of 6%, in exchange for 3-month LIBOR.**

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Example 3.8.2

Interest rate swap

- A financial institution borrows $50 million on a quarterly basis to fund a $50 million purchase of 5-year bonds with a coupon rate of 9% pa selling at par value. The cost of borrowing is 3-month LIBOR plus 50 basis points.
- **Show the annual income spread on 3-month LIBOR at 6.5%, 8.5% and 10.5%.**

Asset yield	3-mth LIBOR	Funding cost	Annual income spread
9.00%	6.50%	7.00%	2.00%
9.00%	8.50%	9.00%	0.00%
9.00%	10.50%	11.00%	-2.00%

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Example 3.8.2

Interest rate swap

- **Show the annual income spread on 3-month LIBOR at 6.5%, 8.5% and 10.5%, if the institution enters a swap, with a notional principal of $50 million as the fixed rate payer, at a swap rate of 6%, in exchange for 3-month LIBOR.**

Asset yield	3-mth LIBOR	Funding cost	Swap rate paid	Swap 3-mth LIBOR rec'd	Annual income spread
9.00%	6.50%	7.00%	6.00%	6.50%	2.50%
9.00%	8.50%	9.00%	6.00%	8.50%	2.50%
9.00%	10.50%	11.00%	6.00%	10.50%	2.50%

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Objective 3.8

Determinants of swap spread

- Since: $\text{Swap Rate} = \text{Treasury Rate} + \text{Swap Spread}$

  and since the parties are swapping the future reference rate for the swap rate:

  $$\text{Reference Rate} = \text{Treasury Rate} + \text{Swap Spread}$$
- Solving for the swap spread we have:

  $$\text{Swap Spread} = \text{Reference Rate} - \text{Treasury Rate}$$

  and since the most common reference rate is LIBOR:

  $$\text{Swap Spread} = \text{LIBOR} - \text{Treasury Rate}$$
- Hence, the swap spread is the spread of the global cost of short-term borrowing over the Treasury rate

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Tutorial assessment task 1 in Tutorial 3 (Next week)

- Tutorial assessment task 1 will relate to a corporate debt security issue undertaken by an Australian Stock Exchange (ASX) listed company
  - Full details will be provided regarding the details of the company and the issue, such as security par value, issue size, maturity term, coupon interest rate determination, and any embedded options attached or other features
  - You will be required to answer a number of short-answer questions associated with identifying particular aspects of the issue and their implications for the company or investors, the risks that security investors may face, and issuing company decision-making relating to aspects of the debt security issue
  - There will be no calculation components in the assessment task questions
  - The additional question set for Tutorial 2 is the best representation of the structure and content of the tutorial assessment task