Assignment 1

Table of contents

0.1 Instructions

This problem set is based on Lectures 1-6. It contains 30 hard, multi-step questions. Each lecture contributes five questions. The questions use original scenarios and data designed in the style of professional fixed-income practice problems. They are intended to teach the reasoning process, not only test final formulas.

For each question:

1. Read the scenario carefully.
2. Identify the cash flows, risks, or market conventions involved.
3. Work through each part in order.

1 Lecture 1: Bond Features, Structures, Markets, and Risks

1.1 Question 1

A private wealth client is considering three newly issued securities. The client understands stock investing but is new to bonds. You are asked to explain the cash-flow mechanics and risk profile before the client chooses one.

Security	Face value	Coupon structure	Maturity	Embedded feature	Other information
A	USD 1,000	5.20 percent fixed annual coupon	8 years	None	Bullet repayment at maturity

Security	Face value	Coupon structure	Maturity	Embedded feature	Other information
B	USD 1,000	3-month SOFR + 1.40 percent, quarterly reset	5 years	Coupon cap at 7.00 percent	Bullet repayment at maturity
C	USD 1,000	6.00 percent fixed annual coupon	10 years	Callable at 102 after year 4	Issuer is expected to refinance if rates decline

Answer the following:

a. For each security, describe the promised cash-flow pattern before considering default or option exercise.

b. Identify which security has the most predictable nominal cash flows and explain why.

c. Identify which security gives the issuer an economically valuable option and explain when that option is most likely to be used.

d. Explain why Security B may trade close to par after a reset, but still may not be risk-free.

e. Rank the securities from lowest to highest cash-flow uncertainty for the investor.

1.2 Question 2

A junior analyst summarizes bond risks for an investment committee. The committee asks the analyst to classify each event below using the fixed-income risk categories from Lecture 1.

Event	Description
1	Market Treasury yields rise by 90 bps and the price of a fixed-rate bond falls.
2	A BBB industrial bond's spread over Treasuries widens from 140 bps to 220 bps even though Treasury rates are unchanged.

Event	Description
3	A callable utility bond is redeemed after interest rates fall. The investor must reinvest at lower yields.
4	A high-coupon bond pays coupons as expected, but the investor reinvests those coupons at only 2 percent instead of the 5 percent assumed at purchase.
5	A Canadian investor owns a USD corporate bond and the USD depreciates against CAD.
6	A callable agency bond loses value when expected interest-rate volatility rises.

Answer the following:

a. Assign the main risk category to each event.

b. For Events 2 and 3, explain why the bond can lose value even if no contractual default occurs.

c. Explain which two risks can partly offset each other for a buy-and-hold coupon bond.

d. Identify one event that illustrates risk from an embedded option.

e. Explain why understanding the security's structure is itself a risk-control tool.

1.3 Question 3

An insurance company is comparing a bullet corporate bond with an amortizing asset-backed security. Both securities have final maturities of five years and face values of USD 10,000,000.

Year	Bullet bond principal repayment	ABS principal repayment
1	0	1,200,000
2	0	1,600,000
3	0	2,100,000
4	0	2,500,000
5	10,000,000	2,600,000

Answer the following:

a. Compute the weighted average life of the bullet bond.

b. Compute the weighted average life of the ABS.

c. Explain why the ABS has less principal-timing exposure than the bullet bond even though final maturity is the same.

d. Explain one risk that could make the realized life of the ABS differ from the scheduled life.

e. Discuss why a liability-driven investor might prefer the ABS even if its quoted yield is lower.

1.4 Question 4

A portfolio manager is comparing four bond sectors for a balanced fixed-income mandate.

Sector	Typical issuer/collateral	Main compensation required by investors	Liquidity comment
Treasury	Sovereign government	Time value and inflation expectations	Very liquid
Municipal revenue bond	Local project revenue	Project credit, tax status, liquidity	Often less liquid
Investment-grade corporate	Corporate issuer	Credit spread, liquidity, downgrade risk	Moderate liquidity
Leveraged loan	Senior secured corporate loan	Credit risk, liquidity risk, covenant risk	Can be weak in stress

Answer the following:

a. Explain why Treasury yields are often used as benchmark rates.

b. Explain why the corporate bond should normally trade at a positive spread over Treasuries.

c. Explain why the municipal bond cannot be compared to a corporate bond only by pretax yield.

d. Explain why the leveraged loan requires analysis beyond a simple issuer rating.

e. Recommend two due-diligence questions the manager should ask before buying the leveraged loan.

1.5 Question 5

A high-net-worth investor wants to buy a convertible bond issued by a technology company. The bond has a 2.25 percent coupon, 7-year maturity, and can be converted into 18 shares of the issuer's common stock. A straight 7-year bond from the same issuer would require a 6.00 percent coupon.

Answer the following:

a. Explain why the convertible can be issued with a lower coupon than straight debt.

b. Identify the embedded option and who owns it.

c. Explain how the bond behaves if the issuer's stock price rises sharply.

d. Explain how it behaves if the stock price falls and credit quality weakens.

e. Compare this convertible bond with an exchangeable bond.

2 Lecture 2: Bond Pricing, Yield Measures, and Total Return

2.1 Question 6

A student analyst prices a 4-year annual-pay bond with face value USD 1,000 and coupon rate 5.50 percent. The market yield is 6.25 percent.

Answer the following:

a. Write the cash-flow timeline.

b. Compute the bond price.

c. State whether the bond trades at a premium, discount, or par.

d. Explain the economic reason for the result in part c.

e. If the yield remains at 6.25 percent, explain the expected direction of the bond's price as maturity approaches.

2.2 Question 7

A bond trader is evaluating a semiannual-pay bond with the following terms:

Item	Value
Face value	USD 1,000
Annual coupon rate	7.20 percent
Years to maturity	6
Yield to maturity	6.40 percent
Coupon frequency	Semiannual

Answer the following:

a. Convert the annual coupon and yield into period values.

b. Compute the number of remaining coupon periods.

c. Compute the bond price.

d. Explain why semiannual compounding changes the calculation.

e. Explain whether this bond should trade above or below par before doing the arithmetic.

2.3 Question 8

A bond is purchased between coupon dates. It has a 5.00 percent annual coupon paid semiannually on USD 1,000 face value. The quoted clean price is 101.40 percent of par. Settlement occurs 72 days after the last coupon, and the coupon period has 180 days.

Answer the following:

a. Compute the semiannual coupon payment.

b. Compute accrued interest.

c. Compute the clean dollar price.

d. Compute the full or dirty price.

e. Explain why the buyer pays accrued interest to the seller.

2.4 Question 9

A client buys a 3-year annual-pay bond for USD 980. The bond has face value USD 1,000 and coupon rate 6.00 percent. The client plans to sell after two years, not hold to maturity. The client expects to reinvest the first coupon at 4.00 percent for one year and expects the bond's yield at sale to be 5.50 percent.

Answer the following:

a. Compute the coupon cash flows received during the two-year horizon.

b. Compute the future value at year 2 of the first coupon after reinvestment.

c. Compute the expected sale price at year 2.

d. Compute total future dollars at year 2.

e. Compute the two-year horizon return.

2.5 Question 10

A firm has issued a floating-rate note with quarterly coupons. The coupon rate each quarter is 3-month SOFR plus a quoted margin of 1.25 percent. The note has face value USD 5,000,000. There is a coupon floor of 2.00 percent and a cap of 6.50 percent. The next three SOFR reset rates are assumed to be:

Quarter	SOFR at reset
1	0.50 percent
2	3.80 percent
3	6.10 percent

Answer the following:

a. Compute the uncapped annual coupon rate for each quarter.

b. Apply the floor and cap.

c. Compute each quarterly coupon payment.

d. Explain how the cap changes investor exposure.

e. Explain why discount margin is more natural than yield-to-maturity for this security.

3 Lecture 3: Duration, Convexity, and Portfolio Strategies

3.1 Question 11

A risk manager studies two annual-pay option-free bonds, each with face value USD 1,000 and yield of 5.00 percent.

Bond	Coupon rate	Maturity
X	2.00 percent	10 years
Y	8.00 percent	10 years

Answer the following:

a. Before calculating, predict which bond has greater duration.

b. Explain the cash-flow timing intuition behind your prediction.

c. Compute the approximate price of each bond.

d. Explain why the lower-coupon bond is more volatile.

e. State one case where this ranking could fail.

3.2 Question 12

A portfolio contains three bonds. The manager wants to estimate portfolio duration.

Bond	Market value	Modified duration
Treasury note	USD 4,000,000	3.8
Corporate bond	USD 3,500,000	6.2
Callable agency note	USD 2,500,000	4.4

Answer the following:

a. Compute each bond's market-value weight.

b. Compute portfolio modified duration.

c. Estimate the portfolio dollar price change for a 35 bp parallel increase in yields.

d. Explain one limitation of this estimate for the callable agency note.

e. Explain how key rate duration could improve the analysis.

3.3 Question 13

A bond's current price is 104.60. If yield decreases by 50 bps, the model price is 108.90. If yield increases by 50 bps, the model price is 100.55.

Answer the following:

a. Estimate empirical modified duration.

b. Estimate empirical convexity.

c. Use duration alone to approximate the price change for a 75 bp yield increase.

d. Use duration plus convexity for the same 75 bp increase.

e. Explain why the two approximations differ.

3.4 Question 14

A benchmark-aware manager has the same total duration as the benchmark but different key-rate exposures.

Portfolio	2-year KRD	5-year KRD	10-year KRD	30-year KRD	Total
Benchmark	0.8	1.7	2.0	1.0	5.5
Manager	0.2	2.8	1.1	1.4	5.5

The manager expects a curve steepening where 2-year yields fall 30 bps, 5-year yields fall 10 bps, 10-year yields rise 15 bps, and 30-year yields rise 35 bps.

Answer the following:

a. Compute the approximate percentage return impact for the benchmark.

b. Compute the approximate percentage return impact for the manager.

c. Determine which performs better under this scenario.

d. Explain why equal total duration was not enough.

e. Identify what active view the manager has implicitly expressed.

3.5 Question 15

A pension plan has liabilities with present value USD 100 million and modified duration 9.0. The asset portfolio has present value USD 100 million and modified duration 6.5. The CIO considers adding Treasury futures to increase duration.

Answer the following:

a. Explain the duration gap.

b. Estimate asset value change and liability value change if yields fall by 50 bps.

c. Explain why the plan's funded status changes.

d. Compute the additional dollar duration needed to match liability duration.

e. Explain why leverage through futures introduces risk beyond duration matching.

4 Lecture 4: Benchmark Spreads and Term Structure

4.1 Question 16

A credit analyst observes the following bonds, each with 7-year maturity:

Bond	Issuer type	Yield	7-year Treasury yield
A	Federal agency	4.42 percent	4.10 percent
B	A-rated utility	5.05 percent	4.10 percent
C	BB industrial	7.35 percent	4.10 percent

Answer the following:

a. Compute each benchmark spread in basis points.

b. Explain why spreads differ across issuer types.

c. Identify which spread may include the largest credit-risk premium.

d. Identify one non-credit reason spreads may differ.

e. Explain why spread is not the same as expected default loss.

4.2 Question 17

You are given annual-pay Treasury securities with face value 100.

Maturity	Coupon rate	Price
1 year	0.00 percent	96.6184
2 years	4.00 percent	99.1375
3 years	5.00 percent	100.1150

Answer the following:

a. Bootstrap the 1-year spot rate.

b. Bootstrap the 2-year spot rate.

c. Bootstrap the 3-year spot rate.

d. Explain why coupon-bond yields are not enough to construct the spot curve directly.

e. Explain how bootstrapping avoids double counting.

4.3 Question 18

A 3-year annual-pay corporate bond has face value 100, coupon rate 6.00 percent, and market price 101.20. Treasury spot rates are:

Year	Treasury spot rate
1	3.40 percent
2	4.00 percent
3	4.60 percent

Answer the following:

a. Compute the Treasury-curve value using spot rates and no credit spread.

b. Explain whether the corporate bond is rich or cheap relative to Treasury discounting alone.

c. Find an approximate constant spread over the spot curve by trial using 60 bps and 90 bps.

d. Explain why this constant spread is conceptually better than comparing only to the 3-year Treasury yield.

e. Name one limitation of a constant spread.

4.4 Question 19

The annual spot curve is:

Maturity	Spot rate
1 year	3.20 percent
2 years	3.80 percent
3 years	4.30 percent
5 years	4.90 percent

Answer the following:

a. Compute the 1-year forward rate beginning one year from now.

b. Compute the 1-year forward rate beginning two years from now.

c. Compute the 2-year forward rate beginning three years from now.

d. Explain the break-even interpretation of the forward rate.

e. Explain why the forward curve may differ from the market's actual expected future short rates.

4.5 Question 20

A curve strategist observes the following Treasury yields:

Maturity	Current yield
2 years	4.90 percent
5 years	4.45 percent
10 years	4.15 percent
30 years	4.05 percent

The strategist believes the central bank will cut short rates aggressively while long-term inflation uncertainty will keep 30-year yields stable or slightly higher.

Answer the following:

a. Classify the current curve shape.

b. Describe the expected curve movement.

c. Propose a duration-neutral curve trade that benefits from the view.

d. Explain the main risk if the view is wrong.

e. Explain why total duration neutrality does not eliminate curve risk.

5 Lecture 5: Treasury and Corporate Debt Markets

5.1 Question 21

A money-market portfolio buys a 182-day Treasury bill with face value USD 5,000,000 and bank discount yield of 4.80 percent.

Answer the following:

a. Compute the purchase price using the bank discount formula.

b. Compute the dollar discount.

c. Compute the bond-equivalent yield using a 365-day year.

d. Explain why the bond-equivalent yield is higher than the bank discount yield.

e. Explain why T-bills are still not riskless for every investor even though they are default-free.

5.2 Question 22

A Treasury note is quoted at 102-18+. The position has face value USD 2,000,000. The note has a 4.50 percent annual coupon paid semiannually. Settlement occurs 58 days after the last coupon in a 181-day coupon period.

Answer the following:

a. Convert the Treasury quote into decimal percent of par.

b. Compute the clean dollar price.

c. Compute the semiannual coupon.

d. Compute accrued interest.

e. Compute the full settlement amount.

5.3 Question 23

A corporate issuer has the following capital structure before entering Chapter 11:

Claim	Amount outstanding	Seniority/collateral
Revolving credit facility	USD 200 million	Senior secured
First-lien term loan	USD 600 million	Senior secured
Senior unsecured bonds	USD 700 million	Senior unsecured
Subordinated notes	USD 300 million	Subordinated
Preferred equity	USD 100 million	Equity-like

Estimated enterprise value in reorganization is USD 1.25 billion.

Answer the following:

a. Allocate recovery by seniority using a strict priority waterfall.

b. Compute recovery percentage for each debt class.

c. Explain why actual Chapter 11 outcomes can differ from strict priority.

d. Explain why secured debt usually has lower required spreads than subordinated debt.

e. Identify one covenant that could have protected unsecured bondholders before distress.

5.4 Question 24

A firm is choosing between commercial paper and a 5-year medium-term note to finance operations.

Instrument	Maturity	Rate type	Intended use	Investor concern
Commercial paper	90 days	Discount	Working capital	Rollover and liquidity support
Medium-term note	5 years	Fixed coupon	Long-term funding	Credit spread and covenants

Answer the following:

a. Explain why commercial paper is usually issued at a discount.

b. Explain why backup bank lines matter for commercial paper issuers.

c. Explain why an MTN program gives the issuer flexibility.

d. Explain which instrument creates more refinancing risk.

e. Explain why the 5-year MTN likely requires a higher yield than 90-day commercial paper for the same issuer.

5.5 Question 25

A credit portfolio includes a leveraged loan and a high-yield bond from the same issuer.

Instrument	Coupon	Seniority	Security	Rate type	Market price
Leveraged loan	SOFR + 375 bps	Senior	Secured	Floating	98.50
High-yield bond	7.75 percent	Senior subordinated	Unsecured	Fixed	94.00

Answer the following:

a. Compare their interest-rate sensitivity.

b. Compare expected recovery in default.

c. Explain why the high-yield bond may offer a higher coupon.

d. Explain one risk in the leveraged loan that is not solved by floating-rate coupons.

e. Explain how a CLO can transform a pool of leveraged loans into securities with different risks.

6 Lecture 6: Bond Portfolio Construction

6.1 Question 26

A manager compares two candidate portfolios against the same benchmark.

Portfolio	Expected active return	Predicted tracking error
A	45 bps	60 bps
B	70 bps	140 bps

Answer the following:

a. Define tracking error.

b. Compute the information ratio for each portfolio using expected active return divided by tracking error.

c. Identify which portfolio has the higher active return per unit of active risk.

d. Explain why Portfolio B may still be chosen by an active manager.

e. Explain why a passive mandate would reject both portfolios if the tracking error budget is 25 bps.

6.2 Question 27

A portfolio has active returns of 12 bps, -8 bps, 5 bps, 22 bps, -18 bps, and 4 bps over six months.

Answer the following:

a. Compute the mean active return.

b. Compute the sample monthly tracking error.

c. Annualize the tracking error.

d. Explain whether this is backward-looking or forward-looking tracking error.

e. Explain why this measure may be misleading if the manager changed the portfolio today.

6.3 Question 28

A benchmark is divided into cells using duration, sector, and credit quality.

Dimension	Number of categories
Duration bucket	3
Sector	5
Credit quality	4

Answer the following:

a. Compute the total number of cells.

b. Explain how a passive manager would use the cells.

c. Explain how an active manager could express a view using the cells.

d. Give one transaction-cost problem created by too many cells.

e. Give one risk-control problem created by too few cells.

6.4 Question 29

A factor model reports the following active exposures and monthly factor volatilities.

Factor	Active exposure	Factor volatility
Treasury curve	0.20	24 bps
Corporate spread	0.50	16 bps
Securitized spread	-0.10	20 bps

Answer the following:

a. Compute isolated tracking error for each factor.

b. Assuming zero correlations, compute total systematic tracking error.

c. Explain why simply adding isolated tracking errors is incorrect.

d. Explain what information a covariance matrix adds.

e. Identify which factor contributes the most isolated risk.

6.5 Question 30

A portfolio manager rebalances a USD 100 million bond portfolio. Before rebalancing, predicted tracking error is 14.8 bps per month, duration gap is 0.32 years, and bank-sector active weight is 8.0 percent. The client limits are 12.0 bps tracking error, 0.25 years duration gap, and 5.0 percent bank active weight. A proposed package of trades costs 7 bps and changes the metrics to 10.6 bps tracking error, 0.18 years duration gap, and 5.0 percent bank active weight.

Answer the following:

a. Identify which constraints are violated before rebalancing.

b. Identify whether the proposed trades bring the portfolio inside the constraints.

c. Compute the reduction in monthly tracking error.

d. Explain why the manager should compare the risk reduction with transaction cost.

e. Explain why rebalancing should not automatically eliminate every active view.