

**PGDM, 2019-21**  
**Fixed Income Securities**  
**DM-511/IB-512**  
**Trimester – V, End-Term Examination: December 2020**

Time allowed: 2 Hrs 30 Min  
 Max Marks: 50

Roll No: _____
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**Instruction:** Students are required to write Roll No on every page of the question paper, writing anything except the Roll No will be treated as **Unfair Means**. All other instructions on the reverse of Admit Card should be followed meticulously.

Sections	No. of Questions to attempt	Marks	Total Marks
A	Minimum 3 question with internal choices and CILO (Course Intended Learning Outcome) covered	3*10	30
B	Compulsory section with 2 questions	20	20
			<b>50</b>

**A. Please attempt any 3 questions out of the 5 questions given below. Each question carry 10 marks**

**A1.** Estimate the percentage price change in bond price from a 25 basis point increase in yield on a bond with a duration of 6 and a convexity of 250. (CILO1)

**A2.** Mr. X, is an investor with a short position and is preparing to deliver a bond for this position. The bond to purchase for delivery is based on a settlement price of \$97.00 ( also known as the quoted future price). Which of the following four bonds is cheapest to deliver. (CILO3)

Bond	Quoted Bond Price	Conversion Factor
A	102	1.03
B	115	1.12
C	104	1.07
D	125	1.23

**A3.** Use the following information to calculate the missing forward and spot rates. (CILO2)

Maturity	STRIP Price	Spot Rate	Forward Rate
0.5	99.2556	1.50%	1.50%
1.0	98.2240	1.80%	2.10%
1.5	96.7713	2.20%	?
2.0	95.1524	?	3.40%

**A4.** A bond with a \$ 100 par value pays a 6% coupon annually for 4 years. The spot rates corresponding to the payment dates are as follows; Year 1: 4.2%, year 2: 4.5%, year 3: 5.0% and year 4: 5.5%. Assume the price of the bond is \$ 98.47. Show the calculation of the price of the bond using spot rates and determine the Yield to maturity (YTM) for the bond. (CILO2)

**A5.** Suppose there is a 15-year option free non callable bond with an annual coupon of 7% trading at par. If interest rates rise by 50 basis point, the estimated price of the bond is 95.586%. If interest rates fall by 50 basis points, the estimated price of the bond is 104.701%. Calculate the convexity of this bond. (CILO3)

**B. These two questions are compulsory**

**B1.** Table below shows selected T-bond prices for semiannual coupon \$100 face value bonds . Prices are from 5/14/06 with t+1 settlement. Generate the discount factors for the dates indicated. (CILO2)

Bond	Coupon	Maturity	Price
1	4.25%	11/15/06	101-16
2	7.25%	5/15/07	105-31+
3	2.00%	11/15/07	101-07
4	12.00%	5/15/08	120-30
5	5.75%	11/15/08	110-13+

**B2.** Cooper industries (Cooper) is the fixed counterpart in an interest rate swap. The swap is based on the 6-month Honk Kong interbank offered rate (HIBOR). Cooper pays a fixed rate of 7% semiannually. The swap has the remaining period of 14 month with pay dates at 2, 8 and 14 months. The HIBOR at the last payment date was 6.2%. Spot HIBOR rates are as follows: 2 month at 6.4%, 8 months at 6.6% and 14 months at 6.8%. Calculate the value of the swap to the fixed rate receiver using the FRA methodology. (CILO3)

## Formulas

1. To determine the future value of any sum of money invested today the following equation is used.

$$P_n = P_0(1 + r)^n$$

Where:

- $n$  = number of periods
- $P_n$  = future value  $n$  periods from now (in dollars)
- $P_0$  = original principal (in dollars)
- $r$  = interest rate per period (in decimal form)

2. Future Value of an ordinary annuity  $P_n = A \left[ \frac{(1+r)^n - 1}{r} \right]$
3. Present Value formula  $PV = P_n \left[ \frac{1}{(1+r)^n} \right]$
4. Present value of a series of future values  $PV = \sum_{t=1}^n \frac{P_t}{(1+r)^t}$
5. Present value of an ordinary annuity  $PV = A \left[ \frac{1 - \frac{1}{(1+r)^n}}{r} \right]$
6. Pricing a Bond-Formula

In general the price of a bond can be computed using the following formula

$$P = \sum_{i=1}^n \frac{C}{(1+r)^i} + \frac{M}{(1+r)^n} \text{ Where,}$$

- $P$  = price (in dollars)
- $n$  = number of periods
- $C$  = semiannual coupon payment
- $r$  = periodic interest rate
- $M$  = Maturity value
- $t$  = time period when the payment is to be received.

or Since, the semiannual coupon payments are equivalent to an ordinary annuity, applying the formula for the present value of an ordinary annuity gives the present value of the coupon payments,

$$P = C \left[ \frac{1 - \frac{1}{(1+r)^n}}{r} \right] + \frac{M}{(1+r)^n}$$

7. Pricing a Bond-Zero Coupon Bond  $P = \frac{M}{(1+r)^n}$
8. Yield or internal rate of return on any investment

$$P = \sum_{t=1}^N \frac{CF_t}{(1+y)^t}$$

where

- $CF_t$  = Cash flow in year  $t$

- P= Price of the investment
  - N= Number of years
9. Yield - Special case (Investment with only one future cash flow)  

$$P = \frac{CF_n}{(1+y)^n}$$
10. Annualizing Yields  
 effective annual yield=  $(1 + \text{periodic interest rate})^m - 1$
- where, m is the frequency of payments per year.
11. Current Yield  
 current yield=  $\frac{\text{annual-dollar-coupon-interest}}{\text{price}}$
12. Macaulay Duration Macaulay duration=  $\frac{\frac{1C}{1+y} + \frac{2C}{(1+y)^2} + \dots + \frac{nC}{(1+y)^n} + \frac{nM}{(1+y)^n}}{P}$   
 where,
- P= price of the bond
  - C= semiannual coupon interest (in dollars)
  - y= one-half the yield to maturity or required yield.
  - n= number of semiannual periods (number of years\*2)
  - M= maturity value ( in dollars)
  - the term in brackets is the weighted average average term to maturity of the cash flows from the bond, where the weights are the present value of the cash flow.
13. Modified Duration  
 Modified Duration=  $[\text{Macaulay Duration}/(1 + \frac{YTM}{n})]$
14. dollar duration=-(modified duration)P
15.  $R = m(e^{\frac{R_c}{m}} - 1)$ , where R is discrete time compounding rate equal to  $R_c$ (continuous time interest rate)
16.  $R_{Forward} = \frac{R_2 T_2 - R_1 T_1}{T_2 - T_1}$  Where,
- $R_i$ = the spot rate corresponding with  $T_i$  periods.
  - $R_{Forward}$ =the forward rate between  $T_1$  and  $T_2$