Chennai Mathematical Institute
Financial Modelling Using Python
Quiz Set 1

Note: You may use calculator but writing the proper formula will be enough.

Q1: Total Marks 1
What is the PV of an annuity that pays $200 per year at the end of each of the next 13 years given a 6% discount rate?

Q2: Total Marks 2
A perpetuity is a financial instrument that pays a fixed amount of money at set intervals over an infinite period of time. In essence, a perpetuity is a perpetual annuity.
What will be the formula of PV of perpetuity?

Q3: Total Marks 3 (2 + 1)
Suppose you have rented out your house for an infinite number of years. You will get C mount after 1st year and then the rent will be increased by g% every year. Assume the interest rate is r%.
What is the PV of all future rents when
1. $r > g$
2. $r < g$

Q4: Total Marks 2 (0.5 + 0.5 + 1)
Compute the FV of Rs 100 single sum for an investment horizon of one year using a stated annual interest rate of 6.0% with a range of compounding periods.
1. Annual
2. Semiannual
3. Continuous

Q5: Total Marks 2
Suppose you have created a portfolio consisting of two one-year zero-coupon bonds with yields of y1 and y2. Prove that yield of the portfolio lies between individual yields.
Hint: you may use continuous compounding framework.

Q6: Total Marks 2
Show that the convexity of a 'n' year zero-coupon bond is $n(n+1)/(1+y)^2$ where y is interest rate or yield. OR prove that "The lower a bond's coupon, the longer its duration (Macaulay Duration)"

Q7: Total Marks 3
Prove that greater convexity translates into greater price gains as interest rates fall and lessened price declines as interest rates rise.

Q8: Total Marks 5 (2 + 3)
Write down 3 facts about the term structure of interest rates. Show that `Expectations Theory` explain only two facts about the term structure of interest rates.

write a correct answer in notes

Chennai Mathematical Institute
Financial Modelling Using Python
Quiz Set 2

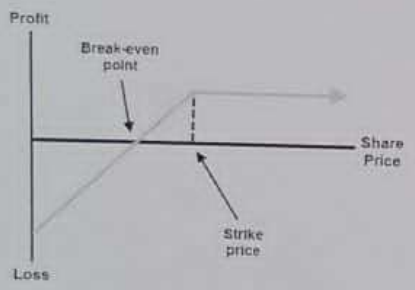
Q1: Total Marks 3

Suppose that the time to expiration is 6 months, the strike price is $105, the call premium is $9, the put premium is $7, the current stock price is $94, and the continuously compounded annual interest rate is 10%. Is there any opportunity for riskless profit? If yes, then how to earn a riskless profit?

Q2: Total Marks 3 (use 3 decimal places)

A stock price follows the Geometric Brownian motion with an expected return of 21% and a volatility of 46.35%. The current price is 38. What is the probability that a European call option on the stock with an exercise price of 40 and a maturity date in 6 months will be exercised?

Q3: Total Marks 3



Write down the name of the strategy (based on position of options) for the above profit-loss function. As an investor when you would like to follow this strategy. Explain the pros and cons of this strategy.

Q4: Total Marks 3

Consider a 2-year European call with a strike price of 52 on a stock whose current price is 50. In each time step (of one year) the stock price either moves up by 20% or moves down by 20%. Let the risk-free interest rate be 5%. Calculate the premium of the call option.

Q5: Total Marks 3

A bank's position in options on a stock has a delta of 200 and a gamma of 200. An option X that is being traded has a delta of 0.50 and a gamma of 0.80. How to make the portfolio delta and gamma neutral?

Q6: Total Marks 3

Explain the following 5 Greeks related to options
Delta, Gamma, Theta, Vega and Rho

Q7: Total Marks 3

The price of a commodity moves according to a BM, $X(t) = \sigma B(t) + \mu t$, with variance term $\sigma^2 = 4$ and drift $\mu = -3$. Given that the price is 4 at time $t = 8$, what is the probability that the price is below 1 at time $t = 9$?

cmi

Chennai Mathematical Institute
Financial Modelling Using Python
MidSem Exam, 2023

Name:

Roll Number:

Total Number Pages used:

List of the questions you have answered:

Note:

- Filling up the above fields are mandatory.
- Please write Roll Number in every pages
- Use of scientific calculator is allowed.
- All questions are carrying 5 marks.
- Answer any 7 questions.

Q1:

Explain the following: -
When the spot rate curve is normal, the forward rate dominates the spot rates:
i.e. $f(i, j) > S(j) > \cdots > S(i)$. for $j > i$.

Q2:

A financial instrument pays C dollars per year for n years. The investor interested in the instrument expects the cash flows to be reinvested at an annual rate of r and is asking for a yield of y. What should this instrument be selling for in order to be attractive to this investor?

Q3:

Establish the Put-Call parity
$c + Ke^{-rT} = p + S_0$
Where all symbols have standard meaning

Q4:

Explain the "Liquidity Premium Theory". Show that it explains all 3 facts of term structure of interest rates.

write its answer

cmi

Chennai Mathematical Institute
Financial Modelling Using Python
MidSem Exam, 2023

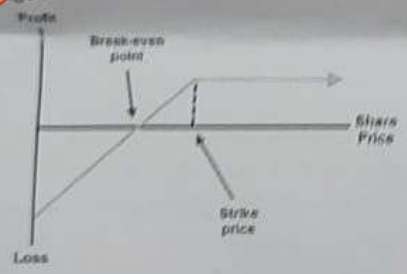
Q5:
For three otherwise identical calls with strike prices $X_1 < X_2 < X_3$,
Prove that: -
$C_{X2} \leq \omega C_{X1} + (1-\omega) C_{X3}$,
Here $\omega \equiv (X_3 - X_2) / (X_3 - X_1)$

Q6:
The difference in the values of two otherwise identical call options cannot be greater than the difference in their strike prices.

Q7:
A European capped call option is like a European call option except that the payoff is $H - X$ instead of $S - X$ when the terminal stock price S exceeds H. Construct a portfolio of European options with an identical payoff.

Q8:
Consider a 2-year European call with a strike price of 52 on a stock whose current price is 50. In each time step (of one year) the stock price either moves up by 20% or moves down by 20%. Let the risk-free interest rate be 5%. The current price of the call option.

Q9:



Write down the name of the strategy (based on position of options) for the above profit-loss function. As an investor when you would like to follow this strategy. Explain the pros and cons of this strategy.