University of Kelaniya - Sri Lanka
Centre for Distance and Continuing Education
Bachelor of Science (External) Degree Examination
- SEMESTER I
APPLIED MATHEMATICS
AMAT 36603 (R) - Mathematics for Finance I

June 2025 Time Allowed: 2.5 hours

INSTRUCTIONS

1. This paper contains SEVEN (7) questions and comprises FOUR (4) pages.
2. Answer only FIVE (5) questions.
3. All questions carry equal marks.
4. Scientific calculators are allowed.
5. Unless otherwise mentioned assume compound interest throughout.
6. Use correct currency symbols and units of measurements where applicable.
7. Unless otherwise specified all options are European style.

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1. Suppose you invest $ 300 in a fund earning simple interest at the simple interest rate of 6%. Three years later, you withdraw the entire balance from that account and invest it in another fund earning 8% simple discount.

   (a) What is the balance at the end of the first three years in the simple interest account?

   (b) How much time (including the three years in the simple interest account) will be required for the original $300 to accumulate to $650?

   (c) At what annual effective rate of compound interest would $300 accumulate to $650 in the same amount of time?

2. (a) Find the accumulated value of $500 invested for five years at 8% interest rate per annum convertible quarterly.

   (b) Find the accumulated value of $1000 at the end of 15 years if the effective rate of interest is 5% for the first 5 year, 4.5% for the second 5 years, and 4% for the third 5 years.

   (c) In return for a promise to receive $600 at the end of 8 years, a person agrees to pay $100 at once, $200 at end of 5 years and to make a further payment at end of 10 years. Find the payment at end of 10 years if the nominal rate of interest is 8% convertible semiannually.

3. (a) Find the present value of an annuity which pays $500 at end of each half-year for 20 years if the rate of interest is 9% convertible semiannually.

   (b) Calculate the total amount of interest that would be paid on a $1000 loan over 10-year period, if the effective rate of interest is 9% per annum for the following three repayment methods:

      (i) The entire loan plus accumulated interest is paid in one lump-sum at end of 10 years.

      (ii) Interest is paid each each year as accrued and the principal is repaid at the end of 10 years.

      (iii) The loan is repaid by level payments over the 10 years.

4. (a) An investor wishes to accumulate $1000 in a fund at end of 12 years. To accomplish this the investor plans to make deposits at the end of each year, the final payment to be made one year prior to the end of the investment period. How large should each deposit be if the fund earns 7% effective.

(b) Find the accumulated value of a 10-year annuity-immediate of \$100 per year if the effective rate of interest is 5% for the first 6 years and 4% for the last 4 years.

(c) Create an amortization schedule for a loan of \$1,000 repaid over four years if the annual effective rate of interest is 8%.

5. You are a junior financial analyst at Phoenix Capital Advisors, a firm that manages risk and investment portfolios for various clients. One of your clients, GreenFarm Ltd., is a large agricultural exporter concerned about price volatility in commodities. Another client, NovaTech Investments, is an active trader looking for profit opportunities in the equity and derivatives markets.

(a) GreenFarm Ltd. is worried about falling orange juice prices before their next harvest is ready for market. What type of financial derivative could they use to protect themselves, and how would it work in this context? (Hint: Define hedging and provide an example.)

(b) Explain the difference between a forward contract and a futures contract. Based on GreenFarm's needs, which would be more suitable and why?

(c) NovaTech Investments is interested in trading derivatives on individual stocks. What kind of derivative would you recommend, and how does it work? (Hint: Refer to stock options.)

(d) GreenFarm Ltd. is considering a customized derivative agreement directly with a counterparty. What are the main differences between over-the-counter (OTC) contracts and exchange-traded contracts that they should be aware of?

(e) List and briefly describe at least three major types of financial derivatives. Include examples for each.

(f) As part of your research for both clients, summarize the core uses of derivatives in financial markets. Why are they important tools for both hedgers and speculators?

6. (a) What are the key differences between holding a long forward and a short forward position?

(b) In financial markets, how are hedging, speculation, and arbitrage distinguished?

(c) What design details matter most when introducing a new futures contract to the market?

(d) A trader takes a short position in two October futures contracts on crude oil. Each contract represents 1,000 barrels of oil. The current futures price is \$85 per barrel. The initial margin is \$7,000 per contract, and the maintenance margin is \$5,000 per contract.

i. What price increase would lead to a margin call?

ii. Under what circumstances could \$2,000 be withdrawn from the margin account?

7. An investor has bought a European call option from a bank for \$2.50. The option is to buy IBM shares at a strike price of\$50 and is held until maturity.

   (a) Under what circumstances would the investor exercise her option? Under what circumstances would the investor realise a profit? Draw a diagram illustrating the variation of investors' profit/loss with the stock price at maturity.

   (b) Draw an equivalent diagram for the Bank (the writer of the option) showing its profit/loss against the stock price at maturity.

   (c) Draw both of these diagrams in the general case for a call option costing c with a strike price of K.