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November 2001

Course 2

Interest Theory, Economics and Finance

Society of Actuaries/Casualty Actuarial Society

1. Ernie makes deposits of 100 at time 0, and X at time 3 . The fund grows at a force of

$$\text{interest } \delta_t = \frac{t^2}{100}, t > 0 .$$

The amount of interest earned from time 3 to time 6 is X .

Calculate X .

- (A) 385
- (B) 485
- (C) 585
- (D) 685
- (E) 785

2. The production of a good requires two inputs, labor and capital. At its current level of daily output, a competitive firm employs 100 machine hours of capital and 200 labor hours. The marginal product of machine hours is 10 units. The marginal product of labor hours is 5 units. The rental rate, or “price,” of capital is 20 per machine hour.

If the firm minimizes its costs, what is the hourly wage rate?

- (A) 2.5
- (B) 5.0
- (C) 10.0
- (D) 20.0
- (E) 40.0

3. Last year, a country's output increased 2.6%. The country's capital stock increased 4.0% while its labor hours increased 2.0%. The labor share of total income was 70%.

What was the country's total factor productivity growth last year?

- (A) -0.8
- (B) 0.0
- (C) 2.3
- (D) 5.2
- (E) 6.0

4. Consider a project lasting one year. The initial outlay is 100,000 at the beginning of the year and the expected inflow is 120,000 at the end of the year. The opportunity cost of capital for the project is 20%, the borrowing rate is 8%, and the marginal tax rate is 35%.

Calculate the adjusted present value if the company borrows 54% of the project's required investment.

- (A) 800
- (B) 1260
- (C) 1400
- (D) 3150
- (E) 3500

5. Mike buys a perpetuity-immediate with varying annual payments. During the first 5 years, the payment is constant and equal to 10. Beginning in year 6, the payments start to increase. For year 6 and all future years, the current year's payment is $K\%$ larger than the previous year's payment.

At an annual effective interest rate of 9.2%, the perpetuity has a present value of 167.50.

Calculate K , given $K < 9.2$.

- (A) 4.0
- (B) 4.2
- (C) 4.4
- (D) 4.6
- (E) 4.8

6. A 10-year loan of 2000 is to be repaid with payments at the end of each year.

It can be repaid under the following two options:

- (i) Equal annual payments at an annual effective rate of 8.07% .
- (ii) Installments of 200 each year plus interest on the unpaid balance at an annual effective rate of i .

The sum of the payments under option (i) equals the sum of the payments under option (ii) .

Determine i .

- (A) 8.75%
- (B) 9.00%
- (C) 9.25%
- (D) 9.50%
- (E) 9.75%

7. The demand curve for Product X is steep, whereas the demand curve for Product Y is almost flat. The supply curves for the two products are identical. Equilibrium price and quantity are the same for the two products. Consider a 5% excise tax on both products.

Which of the following statements about the impact of the tax is FALSE?

- (A) Equilibrium quantity will decrease less for Product X than for Product Y .
- (B) Consumers face a larger price increase for Product X than for Product Y .
- (C) The tax burden experienced by producers is larger for Product Y than for Product X .
- (D) The government collects more taxes from Product Y than from Product X .
- (E) In each market, the economic incidence of the tax would be the same if the 5% excise tax were replaced by a 5% sales tax.

8. A corporation is considering an investment in one of two potential projects. Each project requires an initial investment of 5000 .

Project X will produce cash flows of 300 at the end of each 6-month period. The cash flows are expected to continue forever. The first cash flow is expected 6 months after the initial investment.

Project Y will have a single cash flow of Z, which will be received exactly 5 years after the initial investment.

The IRR on both projects is the same.

Calculate the profitability index on Project Y, using an annual effective interest rate of 10% .

- (A) 8.5%
- (B) 9.4%
- (C) 10.3%
- (D) 11.2%
- (E) 12.1%

9. A loan is amortized over five years with monthly payments at a nominal interest rate of 9% compounded monthly. The first payment is 1000 and is to be paid one month from the date of the loan. Each succeeding monthly payment will be 2% lower than the prior payment.

Calculate the outstanding loan balance immediately after the 40th payment is made.

- (A) 6751
- (B) 6889
- (C) 6941
- (D) 7030
- (E) 7344

- 10.** Five self-interested colleagues are dining together at a restaurant where desserts cost 5.0 each. If dining alone, one of the colleagues would be willing to pay 3.5 for a dessert. Two of the colleagues would be willing to pay 4.5 for a dessert while the other two would be willing to pay 5.5 . The restaurant will not give individual checks, so the colleagues have agreed to split the bill evenly.

If the five colleagues each act out of their own self-interest, how many desserts will be ordered?

- (A) 0
- (B) 2
- (C) 3
- (D) 4
- (E) 5

- 11.** In Country X, the effect of a one-unit increase in income is to increase consumption by 0.70 and to decrease net exports by 0.10 . Changes in income do not affect tax payments.

What is the government expenditure multiplier in Country X?

- (A) 0.91
- (B) 1.43
- (C) 2.50
- (D) 3.33
- (E) 5.00

- 12.** To accumulate 8000 at the end of $3n$ years, deposits of 98 are made at the end of each of the first n years and 196 at the end of each of the next $2n$ years.

The annual effective rate of interest is i . You are given $(1 + i)^n = 2.0$.

Determine i .

- (A) 11.25%
- (B) 11.75%
- (C) 12.25%
- (D) 12.75%
- (E) 13.25%

13. Marvin has the following newspaper excerpt of option listings:

		Strike Price	January		April		Closing Price
			Vol	Last	Vol	Last	
Pfizer	Call	25	18	2	3	4	26
Pfizer	Call	30	5	0.50	9	1	26
Philip Morris	Put	50	77	14	2	15	63
Philip Morris	Put	80	75	18	459	22	63

Assuming an option contract is for 100 shares, and no transaction costs, which of the following is worth the most at market closing?

- (A) Selling his holding of 2 Philip Morris January put contracts at a strike price of 80
- (B) Selling his holding of 50 shares of Philip Morris stock
- (C) Selling his holding of 30 Pfizer April call contracts at a strike price of 30
- (D) Exercising his 35 Pfizer April call contracts at a strike price of 25 and instantly selling the stock
- (E) Exercising his 5000 Pfizer April call contracts at a strike price of 30 and instantly selling the stock

- 14.** Firms in a particular industry purchase inputs in perfectly competitive markets and sell their output in a perfectly competitive market. The current market price is 3.50 per unit. The minimum long-run average total cost is 4.00 .

Over time, what will happen to the number of firms in this industry and the equilibrium price?

- (A) The number of firms will decrease, and price will rise.
- (B) The number of firms will decrease, and price will fall.
- (C) The number of firms will increase, and price will rise.
- (D) The number of firms will remain unchanged, but they will raise their prices.
- (E) The number of firms will remain unchanged, but they will lower their costs.

15. Which of the following will lead to a decrease in the money supply?

- (A) The central bank reduces its bond portfolio.
- (B) The central bank reduces reserve requirements.
- (C) The central bank reduces the discount rate.
- (D) The demand for currency declines.
- (E) There is an exogenous increase in market interest rates.

16. Olga buys a 5-year increasing annuity for X .

Olga will receive 2 at the end of the first month, 4 at the end of the second month, and for each month thereafter the payment increases by 2.

The nominal interest rate is 9% convertible quarterly.

Calculate X .

(A) 2680

(B) 2730

(C) 2780

(D) 2830

(E) 2880

17. An investor is considering opening one of two equally risky franchises, Shop X or Shop Y. This investor has collected the following information:

	Investment at time zero	Expected Sales	Probability of Expected Sales	Expected Annual Cash Flow beginning at time 1
Shop X	300	high	0.6	perpetuity of 120
		low	0.4	perpetuity of 40
Shop Y	200	high	0.5	perpetuity of 100
		low	0.5	perpetuity of 50

The expected net present value of investing in Shop X is 800 .

What is the expected net present value of investing in Shop Y?

- (A) 550
- (B) 616
- (C) 682
- (D) 710
- (E) 738

18. Preventing market entry is one of the key motivations behind the actions of a monopolist.

Which of the following actions by a monopolist is least likely to prevent entry?

- (A) Spending considerable amounts on research and development
- (B) Hiring the industry's best and brightest people
- (C) Lobbying policy makers to prevent the removal of tariffs
- (D) Advertising to shift the industry demand curve out
- (E) Lowering the price below the monopoly price and providing customers good quality products

- 19.** If there is an imbalance between supply and demand, firms might choose to adjust the quantity produced rather than the price of the output.

When would firms most likely make this choice?

- (A) When the period is short-run
- (B) When output is perishable
- (C) When price elasticity of demand is known precisely
- (D) When consumers are informed quickly of price changes
- (E) When all output is homogeneous and markets are perfectly competitive

20. You are given the following information about the activity in two different investment accounts:

Account K			
Date	Fund value before activity	Activity	
		Deposit	Withdrawal
January 1, 1999	100.0		
July 1, 1999	125.0		X
October 1, 1999	110.0	2X	
December 31, 1999	125.0		

Account L			
Date	Fund value before activity	Activity	
		Deposit	Withdrawal
January 1, 1999	100.0		
July 1, 1999	125.0		X
December 31, 1999	105.8		

During 1999, the dollar weighted return for investment account K equals the time weighted return for investment account L, which equals i .

Calculate i .

- (A) 10%
- (B) 12%
- (C) 15%
- (D) 18%
- (E) 20%

21. In a perfectly competitive market, the market supply and demand functions are:

$$\begin{array}{ll} \text{Supply:} & P = 4Q \\ \text{Demand:} & P = 100 - Q \end{array}$$

where P is price and Q is quantity.

The total variable cost function (TVC) for an individual firm is:

$$TVC = 76q + q^2$$

where q is the quantity produced by the firm.

What is the output for the firm?

- (A) 0
- (B) 2
- (C) 8
- (D) 20
- (E) 38

22. A firm's market value balance sheet is as follows:

Asset Value	500		Debt	200
			Equity	300
Firm Value	500		Firm Value	500

The risk-free rate of interest is 3.5%, β_{equity} is 1.2, β_{debt} is 0.2, and the return on the market portfolio is 14.4% .

Calculate the company's cost of capital.

- (A) 5.7%
- (B) 7.2%
- (C) 10.0%
- (D) 12.2%
- (E) 16.6%

- 23.** Suppose purchasing power parity exists between the United States and the United Kingdom. The current inflation rates are 3.0% in the U.S. and 5.0% in the U.K. The current nominal exchange rate is 2.0 dollars per pound.

What is the expected exchange rate one year from now?

- (A) 1.20
- (B) 1.96
- (C) 2.00
- (D) 2.04
- (E) 3.33

24. David can receive one of the following two payment streams:

(i) 100 at time 0, 200 at time n , and 300 at time $2n$

(ii) 600 at time 10

At an annual effective interest rate of i , the present values of the two streams are equal.

Given $v^n = 0.75941$, determine i .

(A) 3.5%

(B) 4.0%

(C) 4.5%

(D) 5.0%

(E) 5.5%

25. A stock currently has a price of 45.00 and pays no dividends. One year from now, there is a 50% probability that the price of the stock will be 30.00 and 50% that it will be greater than 40.00 .

The risk-free rate is 4% .

Calculate the price of a one-year European call option with an exercise price of 40.00 .

- (A) 4.81
- (B) 6.35
- (C) 9.81
- (D) 10.00
- (E) 11.35

26. Joe's budget line is defined by the equation $y = -0.5x + 18$, where y is the quantity of meat and x is the quantity of bread.

If Joe's income increases, what will happen to the slope and the y -intercept of his budget line?

- (A) Both the slope and the y -intercept will increase.
- (B) The slope will increase while the y -intercept will remain unchanged.
- (C) The slope will decrease while the y -intercept will remain unchanged.
- (D) The slope will remain unchanged while the y -intercept will decrease.
- (E) The slope will remain unchanged while the y -intercept will increase.

27. A man turns 40 today and wishes to provide supplemental retirement income of 3000 at the beginning of each month starting on his 65th birthday. Starting today, he makes monthly contributions of X to a fund for 25 years. The fund earns a nominal rate of 8% compounded monthly.

Each 1000 will provide for 9.65 of income at the beginning of each month starting on his 65th birthday until the end of his life.

Calculate X .

- (A) 324.73
- (B) 326.89
- (C) 328.12
- (D) 355.45
- (E) 450.65

28. Payments are made to an account at a continuous rate of $(8k + tk)$, where $0 \leq t \leq 10$.

Interest is credited at a force of interest $\delta_t = \frac{1}{8+t}$.

After 10 years, the account is worth 20,000 .

Calculate k .

- (A) 111
- (B) 116
- (C) 121
- (D) 126
- (E) 131

- 29.** Suppose a consumer's income increases and, at the same time, the price of X decreases. Further suppose that in the new situation the consumer purchases less X than before.

Which of the following must be true?

- (A) X is a normal good.
- (B) X is an inferior good.
- (C) X is a Giffen good.
- (D) X is a luxury good.
- (E) X is a good for which the compensated demand curve is steeper than the uncompensated demand curve.

30. Nate intends to invest in two different stocks, X and Y .

Stock X has an expected return of 10% and a standard deviation of Z .

Stock Y has an expected return of 20% and a standard deviation of $1.5Z$.

After investing in both stocks, the expected return on Nate's two-stock portfolio is 12% and the standard deviation is Z .

Calculate the correlation between the returns on Stocks X and Y .

- (A) 0.50
- (B) 0.53
- (C) 0.56
- (D) 0.60
- (E) 0.63

31. You have decided to invest in two bonds. Bond X is an n -year bond with semi-annual coupons, while bond Y is an accumulation bond redeemable in $\frac{n}{2}$ years. The desired yield rate is the same for both bonds. You also have the following information:

Bond X

- Par value is 1000 .
- The ratio of the semi-annual bond rate to the desired semi-annual yield rate, $\frac{r}{i}$, is 1.03125 .
- The present value of the redemption value is 381.50 .

Bond Y

- Redemption value is the same as the redemption value of bond X .
- Price to yield is 647.80 .

What is the price of bond X?

- (A) 1019
- (B) 1029
- (C) 1050
- (D) 1055
- (E) 1072

32. A monopoly faces the following demand and marginal cost functions:

$$\begin{array}{ll} \text{Demand:} & P = 10 - Q \\ \text{Marginal Cost:} & MC = 3Q \end{array}$$

where P is price, Q is quantity, and MC is marginal cost.

Now suppose the monopolist is “broken up” by a federal judge such that the marginal cost function becomes the competitive supply function.

What will be the difference between the equilibrium price in the competitive market and the monopoly price?

- (A) 0.0
- (B) 0.5
- (C) 1.0
- (D) 1.5
- (E) 2.0

- 33.** A company's common stock is currently selling for 25 per share. All of the financial analysts following the firm are surprised when the company unexpectedly announces that it expects its future economic income to be lower after the next quarter. Assume that the stock market is semi-strongly efficient.

How should this news affect the stock price?

- (A) The price should not change at all.
- (B) The price should not change until the next quarter.
- (C) The price should fall immediately to adjust for the expected slowing earnings growth.
- (D) The price should fall gradually over the next quarter.
- (E) The price should go up following the announcement.

34. You are given the following data from the national income and product accounts of a country:

<u>Account</u>	
Personal Consumption Expenditure	4.5
Gross private domestic investment	2.1
Producer's durable equipment	
and nonresidential structures	1.0
Residential structures	0.7
Changes in business inventories	0.4
Exports	1.1
Imports	0.9
Government purchases of goods and services	3.1

What is the Gross Domestic Product of this country?

- (A) 9.5
- (B) 9.7
- (C) 9.9
- (D) 11.6
- (E) 12.0

35. At time $t = 0$, Sebastian invests 2000 in a fund earning 8% convertible quarterly, but payable annually.

He reinvests each interest payment in individual separate funds each earning 9% convertible quarterly, but payable annually.

The interest payments from the separate funds are accumulated in a side fund that guarantees an annual effective rate of 7%.

Determine the total value of all funds at $t = 10$.

- (A) 3649
- (B) 3964
- (C) 4339
- (D) 4395
- (E) 4485

36. Jack has an equally weighted portfolio of stocks X and Y . The beta of his portfolio is 0.9 . Jill has an equally weighted portfolio of stocks X, Y, and Z . The beta of stock Z is 1.2, the Treasury bill rate of return is 6%, and the expected return on the market portfolio is 14.4% .

What is the expected risk premium on Jill's portfolio?

- (A) 6.0%
- (B) 7.6%
- (C) 8.4%
- (D) 8.8%
- (E) 10.1%

37. A company's dividend per share is expected to grow indefinitely at a rate of 5% per year. Suppose the current stock price is 500 and the next annual dividend, payable one year from now, is 10. Assume the opportunity cost of capital is constant.

Three investors, Alex, Bill, and Carl, each invest in the company. Alex invests for one year, Bill invests for two years, and Carl invests for three years.

Who expects the highest annualized rate of return?

- (A) Alex
- (B) Bill
- (C) Carl
- (D) Alex, Bill, and Carl all have the same expected rate of return.
- (E) Not enough information is given here to answer the question.

38. A competitive industry is composed of identical firms.

Which of the following statements about long-run equilibrium in the industry are true?

- I. Firms' accounting profits are equal to their opportunity costs.
- II. Firms produce the quantity at which average costs are minimized.
- III. Firms produce the quantity at which marginal costs are minimized.

- (A) II only
- (B) I and II only
- (C) I and III only
- (D) II and III only
- (E) I, II, and III

- 39.** Suppose there is a simultaneous increase in the money supply and an increase in government purchases.

Based on the IS-LM model, what will be the effect on real output and interest rates in the short run?

- (A) Real output will decrease, and interest rates will increase.
- (B) Real output will increase, and interest rates will increase.
- (C) Real output will increase, and interest rates will decrease.
- (D) Real output will increase, but the effect on interest rates cannot be determined.
- (E) The effect on real output cannot be determined, but interest rates will increase.

40. A company stock is currently trading at 50 . Over the next year, this stock will either increase in value by 10% or decrease by $x\%$. The risk-free rate is 4%. The value of a one-year European put option for this stock at an exercise price of 50 is 1.28 .

Calculate x .

- (A) 0
- (B) 2
- (C) 4
- (D) 6
- (E) 8

- 41.** Linda consumes two goods, X and Y. At the point of equilibrium for X, Linda's uncompensated demand curve for X has a larger negative slope than does her compensated demand curve for X. At the point of equilibrium for Y, Linda's uncompensated demand curve for Y has a positive slope while her compensated demand curve for Y has a negative slope.

What does this information tell us about X and Y?

- (A) Both X and Y are normal goods.
- (B) Neither X nor Y is a normal good.
- (C) X is a normal good, but Y is an inferior good.
- (D) Y is a normal good, but X is an inferior good.
- (E) X is a substitute good, but Y is a complementary good.

- 42.** A copier costs X and will have a salvage value of Y after n years.
- (i) Using the straight line method, the annual depreciation expense is 1000 .
 - (ii) Using the sum of the years digits method, the depreciation expense in year 3 is 800 .
 - (iii) Using the declining balance method, the depreciation expense is 33.125% of the book value in the beginning of the year.

Calculate X .

- (A) 4250
- (B) 4500
- (C) 4750
- (D) 5000
- (E) 5250

43. A firm has an annual dividend yield of 7.5% and a constant dividend growth rate of 3% per year. It also has five-year bonds outstanding that have an annual coupon rate of 8% and are selling at par. The firm has a 40% marginal tax rate and a debt-to-assets ratio of 0.30 .

Calculate the firm's after-tax weighted average cost of capital.

- (A) 6.9%
- (B) 7.8%
- (C) 8.8%
- (D) 9.2%
- (E) 9.8%

44. Which of the following statements is most consistent with the predictions of the rational expectations model?

- (A) A fully anticipated monetary policy will have no effect on either the level of real income or the price level.
- (B) In the short run, unanticipated policy might affect the aggregate price level, but not real income.
- (C) Expected and actual inflation will always differ by a constant, predictable amount.
- (D) The unemployment rate will differ from the natural rate of unemployment only when actual inflation differs from expected inflation.
- (E) Monetary policy is preferred to fiscal policy for permanently changing the level of real income.

45. A manufacturer buys a machine for 20,000. The manufacturer estimates that the machine will last 15 years. It will be depreciated using the constant percentage method with an annual depreciation rate of 20%.

At the end of each year, the manufacturer deposits an amount into a fund that pays 6% annually. Each deposit is equal to the depreciation expense for that year.

How much money will the manufacturer have accumulated in the fund at the end of 15 years?

- (A) 29,663
- (B) 34,273
- (C) 36,329
- (D) 38,509
- (E) 46,250

46. Two lawyers, Smith and Jones, each practice two types of law, criminal law and divorce law. To prepare a brief, it takes Smith 14 hours in a criminal case and 16 hours in a divorce case. It takes Jones 20 hours in a criminal case and 18 hours in a divorce case.

Suppose Smith and Jones merged their practices and each handled only the cases in which they possessed a comparative advantage. Further suppose that prior to the merger they each handled one criminal and one divorce case a week and that their new firm handles two of each case a week.

How many hours would Smith and Jones gain in efficiency from the merger—i.e., how much less time per week would they collectively require to handle their caseload?

- (A) 0 hours
- (B) 2 hours
- (C) 4 hours
- (D) 6 hours
- (E) 8 hours

47. Project P requires an investment of 4000 at time 0 . The investment pays 2000 at time 1 and 4000 at time 2 .

Project Q requires an investment of X at time 2 . The investment pays 2000 at time 0 and 4000 at time 1 .

Using the net present value method and an interest rate of 10%, the net present values of the two projects are equal.

Calculate X .

- (A) 5400
- (B) 5420
- (C) 5440
- (D) 5460
- (E) 5480

48. The after-tax earnings and dividends of a company are expected to increase at a constant rate. The market capitalization rate is 15.5% and is expected to stay constant. Details of the company's financial statements for the year 2000 are as follows:

After-tax earnings	150
Dividends	45
Average book equity	1000

Calculate the expected dividend yield, y .

- (A) $y \leq 4.5\%$
- (B) $4.5\% < y \leq 6.5\%$
- (C) $6.5\% < y \leq 8.5\%$
- (D) $8.5\% < y \leq 10.5\%$
- (E) $10.5\% < y$

- 49.** A company has one plant that uses technology from 1990 to manufacture good X. It has recently developed a new patented technology to manufacture good X and plans to build a new plant to use its improved technology.

Which of the following statements about the company's economic rents are correct?

- I. If the company has some degree of monopoly power, its economic rents will be temporary.
 - II. The company expects to receive economic rents during the term of its patent.
 - III. When the company predicts its economic rents, it will need to consider the impact on its original plant of building the new plant.
-
- (A) I only
 - (B) II only
 - (C) III only
 - (D) I and III only
 - (E) II and III only

50. You are given the following information from the financial statements of Company X:

	<u>2001</u>	<u>2000</u>
<u>Income Statement:</u>		
Net sales	10,000	8,500
Earnings before interest and taxes (EBIT)	1,000	950
Earnings available for common stockholders	600	575
<u>Balance Sheet:</u>		
Total current assets	5,000	5,500
Total assets	7,500	8,500
Common shareholders equity	6,000	7,000
<u>Other Financial Information:</u>		
Market value of equity	7,000	7,500
Earnings per share	2.69	2.13
Dividend per share	0.85	0.50

What is the return on equity for Company X for 2001?

- (A) 8.3%
- (B) 9.2%
- (C) 10.0%
- (D) 15.4%
- (E) 16.7%

Course 2
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Final Answer Key

1	E	26	E
2	All	27	A
3	B	28	A
4	C	29	B
5	A	30	C
6	B	31	D
7	D	32	B
8	D	33	C
9	B	34	C
10	E	35	E
11	C	36	C
12	C	37	D
13	A	38	B
14	A	39	D
15	A	40	E
16	B	41	B
17	E	42	D
18	D	43	C
19	A	44	D
20	C	45	C
21	B	46	C
22	D	47	D
23	B	48	B
24	A	49	E
25	E	50	B