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MIME 310 ENGINEERING ECONOMY

Class Test #2 – Thursday, 16 November, 2006 – 90 minutes

PRINT your family name / initial and record your student ID number in the spaces provided below.

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This test consists of 15 multiple-choice questions, and two problems requiring a full solution. Each correct multiple-choice question is worth 5 points. There are no penalties for incorrect answers. The problems are worth a total of 25 points.

MULTIPLE-CHOICE QUESTIONS

Circle the correct answer on this test paper and record it on the computer answer sheet.

Use the following information to answer questions 1 to 3.

A fiberglass boat producer with a maximum production rate of 130 units per month has the following production variables: Fixed Cost (FC) \$16 000 per month; constant average variable cost (vc) \$350; selling price (p) \$500.

- By how much must the fixed cost be reduced if the break-even rate is to be 50 units per month?
 - A) \$7500
 - B) \$8500**
 - C) \$3500
 - D) \$12 500
 - E) None of the choices given above

$\begin{aligned} \text{New B/E: } FC / (500 - 350) &= 50 \\ FC &= 150 (50) = 7500 \\ \text{FC must be reduced by } (16\,000 - 7500) &= \underline{\$8500} \end{aligned}$
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- Determine the contribution margin if the fixed cost is reduced to \$12 000, the average variable cost is increased to \$450, and the selling price is increased to \$600.

- A) \$150**
- B) \$600
- C) \$450
- D) \$100
- E) None of the choices given above

<p>The contribution margin primarily applies to linear cost functions and it is defined as $(p - vc)$. Thus, the contribution margin is $(600 - 450)$ or <u>\$150</u>.</p>
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3. Which of the statement(s) below is/are correct when the situation in question 2 above is compared to the situation in the problem statement?

- I. More flexible operation
 II. Less risk
 III. Lower profit growth

Yes, lower B/E rate (from 107 to 80 units)
 Yes, B/E rate easier to achieve within plant constraints
 No, contribution margin is \$150 in both situations

- A) I
B) I & II
 C) II & III
 D) I, II & III
 E) None of the choices given above

4. Stephenson & Sons has a capital structure consisting of 20 percent equity and 80 percent debt. The company expects to report \$3 million in net income this year, and 60 percent of this amount will be paid out in dividends. How large can the firm's capital budget (i.e. the amount it can invest) be this year without having to issue any new stock?

- A) \$1.20 million
 B) \$13.00 million
 C) \$1.50 million
 D) \$0.24 million
E) \$6.00 million

Earnings retained: $3(1 - 0.6) = 1.2$
 This amount represents the equity component of the budget, i.e. 20% of the total, according to the capital structure.
 \ total budget: $1.2 / 0.2 = \underline{\$6.0}$

Use the following information to answer questions 5 to 7.

Warrick Winery is considering two mutually exclusive projects, Project Red and Project White. The company has no budget constraint and its cost of capital is 10 percent. The projects have the following distributions of cash flows:

Year	Project Red	Project White
Time 0	-\$1000	-\$1000
1	100	700
2	200	400
3	600	200
4	800	100

5. What is the internal rate of return of the project that has the higher net present value?

- A) 14.30 %
 B) 21.83 %
C) 18.24 %
 D) 10.00 %
 E) 21.96 %

Enter cash flows into cash flow worksheet of BA II Plus.
 Project Red: CPT NPV with $I=10\%$ → 253.40; CPT IRR → 18.24 %
 Project White: CPT NPV with $I=10\%$ → 185.51; CPT IRR → 21.83 %

6. At what cost of capital rate do the two projects have the same net present value?

- A) 10.00 %
 B) 0.00 %
 C) 20.04 %
D) 14.30 %
 E) 24.96 %

If the projects have equal NPVs, then the distribution of cash flows resulting from subtracting the cash flows of one project from those of the other has a present value of zero.
 Enter CF differences into cash flow worksheet of BA II Plus, i.e. $CF_0=0$, $CF_1=-600$, $CF_2=-200$, $CF_3=400$, $CF_4=700$.
 Compute discount rate that yields a NPV of zero, i.e. CPT IRR → 14.30 %

7. Given a minimum acceptable return on investment of 15 percent, which of the following statements is true?
- A) The preferred project cannot be determined because both have IRRs above 15 %.
 - B) Project Red is preferred because it has the higher NPV at a discount rate of 10 %.
 - C) Project White is preferred because it has the higher IRR.
 - D) Project Red is preferred because it has the higher PI at a discount rate of 10 %.
 - E) Project White is preferred because for discounts rates above 14.3 %, it has a higher NPV than that of project Red.**

Use the following information to answer questions 8 to 10.

Woodgate Inc., with a cost of capital of 10 percent, is considering a project that has the following cash flows (in millions of dollars):

Year	Cash Flow
Time 0	-\$300
1	125
2	75
3	200
4	100

8. What is the project's payback period?

- A) 2.00 years
- B) 2.50 years**
- C) 2.65 years
- D) 2.83 years
- E) 3.00 years

Cumulative cash flow at the end of year 2: $-300 + 125 + 75 = -100$
 Cumulative cash flow at the end of year 3: $-100 + 200 = 100$
 PP: $2 + [0 - (-100)] / 200 = 2.5$

9. What is the project's discounted payback period?

- A) 2.00 years
- B) 2.50 years
- C) 2.65 years
- D) 2.83 years**
- E) 3.00 years

Discounted CFs at 10%: -300, 113.64, 61.98, 150.26 and 68.30
 Cumulative DCF at the end of year 2: $-300 + 113.64 + 61.98 = -124.38$
 Cumulative DCF at the end of year 3: $-124.38 + 150.26 = 25.88$
 DPP: $2 + [0 - (-124.38)] / 150.26 = 2.83$

10. What is the project's profitability index (PI)?

- A) 0.31
- B) 16.83 %
- C) 19.12 %
- D) 1.31**
- E) 26.32 %

Enter cash flows into cash flow worksheet of BA II Plus.
 CPT NPV with $I=10\% \rightarrow 94.18$
 PI: $94.18 / 300 + 1 = 1.31$

11. A project that requires an initial investment of \$100 000 has a useful life of 4 years and no salvage value. The net after-tax income in each of these 4 years is \$15 000, \$20 000, \$20 000 and \$25 000, respectively. The project's accounting rate of return is:

- A) 20 %
- B) 40 %**
- C) 80 %
- D) 160 %
- E) Cannot determine the project's accounting rate of return without a discount rate.

Average annual net income ('000 \$): $(15 + 20 + 20 + 25) / 4 = 20$
 ARR: $20\ 000 / [100\ 000 / 2] = 40\ %$

12. A company with a cost of capital of 10 percent is considering a project with the following distribution of cash flows:

Year	Cash Flow
Time 0	-\$X
1	175
2	175
3	300

If the project has a payback period of 2 years, what is its net present value (NPV)?

- A) \$179.11
 B) \$204.11
 C) \$229.11
 D) \$254.11
 E) \$279.11

If the payback period is 2 years, then $X = 175 + 175 = 350$
 Enter cash flows into cash flow worksheet of BA II Plus.
 CPT NPV with $I=10\%$ → 179.11

13. The Global Advertising Company has a corporate tax rate of 40 percent. The company can raise debt at a 12 percent coupon rate and the last annual dividend paid by Global was \$0.90. Global's common stock is selling for \$8.59 per share, and its expected annual growth rate in earnings and dividends is 5 percent. If Global issues new common stock, the issuing expenses would be 10 percent of market price. Global plans to finance all capital expenditures with 30 percent debt and 70 percent equity. What is Global's cost of retained earnings if it can use its current retained earnings rather than issue new common stock?

- A) 12.2 %
 B) 17.2 %
 C) 10.3 %
 D) 9.7 %
 E) 16.0 %

$$K_e: 0.90 (1.05) / 8.59 + 0.05 = \underline{0.1600}$$

14. Which one of the following statements is true?
 A) The NPV criterion assumes that cash flows are reinvested at the internal rate of return.
 B) The IRR criterion assumes that cash flows are reinvested at the NPV rate of return.
 C) The NPV criterion assumes that cash flows are reinvested at the discount rate used to determine the NPV.
 D) The IRR criterion assumes that cash flows are reinvested at the cost of capital.
 E) None of the choices given above
15. The principle of diminishing marginal returns states that the:
 A) marginal return derived from making successive units of investment eventually declines.
 B) additional satisfaction derived from consuming successive units of a product eventually declines.
 C) additional satisfaction derived from consuming successive units of a product is limited by the amount of disposable income.
 D) additional satisfaction derived from consuming successive units of a product can be increased by reducing its price.
 E) None of the choices given above.

FULL-SOLUTION PROBLEMS

For full marks, show the complete solutions on the lines provided and record the answers in the boxes.

16. Elfe Inc. manufactures and markets security gates for kids and pets. The selling price of \$30 per unit is stable throughout a wide range of sales volume. The total monthly production costs (TC) of the process is given by:

$$TC = 6 + 22Q + 2Q^2$$

in which TC is in thousands of dollars, and Q is the monthly production rate in thousands of units.

- 16.1 Determine the production rate at which monthly profits are maximised. (5 points)

VERSION 1

Profits are maximised at the rate at which MR=MC.

MR: 30

MC: $dTC/dQ = 22 + 4Q$

$$22 + 4Q = 30$$

\ Q=2, i.e. 2000 units

VERSION 2

Profits are maximised at the rate at which MR=MC.

MR: 30

MC: $dTC/dQ = 20 + 4Q$

$$20 + 4Q = 30$$

\ Q=2, i.e. 2500 units

ANSWER

2000 units

- 16.2 Determine the monthly production rate at which the average cost is minimised. (5 points)

VERSION 1

Minimum AC at $dAC/dQ = 0$ or at $AC=MC$

AC: $6/Q + 22 + 2Q$

$dAC/dQ: -6/Q^2 + 2$

$$-6/Q^2 + 2 = 0$$

$$Q^2 = 3$$

\ Q=1.732, i.e. at 1732 units

VERSION 2

Minimum AC at $dAC/dQ = 0$ or at $AC=MC$

AC: $8/Q + 20 + 2Q$

$dAC/dQ: -8/Q^2 + 2$

$$-8/Q^2 + 2 = 0$$

$$Q^2 = 4$$

\ Q=2, i.e. at 2000 units

ANSWER

1732 units

17. To finance a new project, a company plans to issue both common equity at market price and bonds at par. In doing so, the company plans to maintain its debt to equity ratio of **0.25 : 1**. The company just released its annual financial statements, which shows a net income of zero. The company's income tax rate is 40 percent. The following characteristics apply to the new issues of equity and debt

COMMON EQUITY – Over the past few years, the market price of the company's common shares and associated dividend have been growing steadily at an average annual rate of 6 percent. The shares now have a market price of \$50 and an annual dividend of \$3 was just paid. Issuing expenses of \$4 per share will be incurred.

DEBT – The bonds will be sold at a par value of \$1000, will have an annual coupon of 7 percent payable semi-annually, and will mature in 15 years. Issuing expenses of \$30 per bond will be incurred.

- 17.1 Determine the after-tax cost associated with the funds raised through the issue of *new common stock*. (5 points)

<p>VERSION 1 $K_e = 3 (1.06) / [50 - 4 (1 - 0.4)] + 0.06$ $= (3.18 / 47.60) + 0.06 = \underline{0.1268}$</p>	<p>VERSION 2 $K_e = 3 (1.07) / [50 - 5 (1 - 0.4)] + 0.07$ $= (3.21 / 47.00) + 0.07 = \underline{0.1383}$</p>
<p>ANSWER 12.7 %</p>	

- 17.2 Determine the after-tax cost associated with the funds raised through the issue of *new debt*. (5 points)

<p>VERSION 1 NP: $1000 - 30 (1 - 0.4) = 982$ After-tax coupon payment: $35 (1 - 0.4) = 21$ N: $2 (15) = 30$ Use the TVM functions in the BA II Plus with: N=30, PV=982, PMT = -21 and FV = -1000, CPT I/Y → 2.1824 → Effective rate: 4.4124 $K_d = \underline{4.4 \%}$</p>	<p>VERSION 2 NP: $1000 - 35 (1 - 0.4) = 979$ After-tax coupon payment: $40 (1 - 0.4) = 24$ N: $2 (15) = 30$ Use the TVM functions in the BA II Plus with: N=30, PV=979, PMT = -24 and FV = -1000, CPT I/Y → 2.5003 → Effective rate: 5.0632 $K_d = \underline{5.1 \%}$</p>
<p>4.4 %</p>	

- 17.3 Given that the company needs a total of \$50 million for the new project, and ignoring issuing expenses, how many shares and bonds need to be issued? (8 points)

<p>VERSION 1 D / E = 0.25 / 1 Debt: $0.25 / 1.25 = 20 \%$ Equity: $1 / 1.25 = 80 \%$ Shares: $50 \text{ mil. } (0.80) / 50 = \underline{800\,000}$ Bonds: $50 \text{ mil. } (0.20) / 1000 = \underline{10\,000}$</p>	<p>VERSION 2 D / E = 0.28 / 1 Debt: $0.28 / 1.28 = 21.875 \%$ Equity: $1 / 1.28 = 78.125 \%$ Shares: $50 \text{ mil. } (0.78125) / 50 = \underline{781\,250}$ Bonds: $50 \text{ mil. } (0.21875) / 1000 = \underline{10\,938}$</p>
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<p>VERSION 1 If issuing expenses were considered... Let S be #shares and B #bonds. $47.60 S + 982 B = 50 \text{ mil.}$ $50 S = 4 (1000) B$ Shares: 835 074 Bonds: 10 439</p>	<p>Shares: 800 000 Bonds: 10 000</p>
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Answer Key for Version 2

1. C
2. D
3. C
4. B
5. E
6. A
7. C
8. E
9. A
10. A
11. C
12. D
13. B
14. B
15. C