Question 2: Typo: Should be $ 1.2 million

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MIDTERM 1

You will be given a sheet of formulas. You can have a calculator, but the calculator cannot have a programmable memory or formula feature. Those of you who do have a programmable feature will have to prove to me that the calculator memory is empty.

Please read all the questions before you start on the exam. Think before you answer. Also, keep in mind that the more you write, the more likely it is that you will make a mistake. Show all work. Carry all percentages to second decimal place. That is .15323 = 15.32%. Assume all cash flow arrive at the end of the relevant period, unless specified otherwise

Unless specified otherwise, assume well functioning (normal) capital markets with no taxes. You must show all work. Anything you want me to read must be written on the exam papers.

The exam will last for 120 minutes.

1. (25 points) You have a portfolio consisting of one share in each of three securities. You are uncertain about how the economy will do over the year, but expect that at the end of the year, each security will have the following payoffs, conditional on either a weak or a strong economy:

	Weak Economy	Strong Economy
A	0	30
B	30	0
C	30	30

You don't care about what happens after the first year since you (and the rest of the world) expect that life, as we know it, will end in 1 year. In addition, you believe that the probability of a weak economy equals the probability of a strong economy, at 1/2 each.

a. If the risk free rate of interest is 5%, what should security C sell for?
b. If the required (or expected) return to security A is 15%, what should it be selling for?
c. What is the value of Security B in a normal market?
d. What is the required (or expected) return to Security B?
e. Why is the required (expected) return of Security B less than 5%, the return on risk free securities (HINT: it is!)?
f. You are considering buying a fourth security, which you estimate, will return 60 in a weak economy and 90 in a Strong Economy. What is the maximum you would be willing to pay for that security?

a. $P_C = \frac{C.F}{(1+r_f)} \Rightarrow r_f = \frac{CF}{P_C}$.

$= \frac{30}{1.05} = 28.57$

b. $P_A = \frac{E[CF]}{(1+r)} = \frac{15}{1.15} = 13.04$

c. P_B: $P_A + P_B = P_C$ by law of one price

$\therefore P_B = -P_A + P_C = 28.57 - 13.04 = 15.53$

d. $\frac{15}{15.53} - 1 =$ Return $= -3.39\%$

e. In fact it is negative. This in because it pays off in the weak economy State, when other securities are doing poorly. i.e. it is like insurance & people are willing to buy it at a very low yield

f. The replicating portfolio would be:

2 of Security B & 3 of security A,

that returns 60 in weak State, and 90 in strong state.

So, by the law of one price or no arbitrage condition:

$$2P_B + 3P_A = P_D \text{ (the fourth security)}$$

$$2 \cdot 15.53 + 3 \cdot 1304 = 1$$

$$31.06 + 39.12 = 70.18$$

2. (25 points) As Division Head of Maximus Corp., you are requested by central administration to recommend some investment opportunities. You have identified the following ten possible projects. The column "RANK" is there only for your convenience. The Cost of Capital is 10%

PROJECT	INVESTMENT	NPV	IRR	PAYBACK	PROFITABILITY INDEX	RANK
A	405,000	18,000	18%	30	.044 ✓	8
B	600,000	90,000 ✓	7%	25	.150 ✓	2
C	375,000	60,000 ✓	20%	20	.160	1
D	450,000	6,000	16%	15	.013	9
E	525,000	30,000	5%	10	.057 ✓	7
F	225,000	30,000	25%	5	.133 ✓	3
G	240,000	27,000	12%	10	.113 ✓	4
H	600,000	60,000 ✓	19%	15	.100 ✓	5
I	150,000	12,000	8%	20	.080 ✓	6
J	270,000	30,000	11%	25	.011	10

INV
975
-375
1.2 M
1.44

a. Calculate the profitability index for each project (to the third decimal place). Central has asked you to recommend projects under the following alternative scenarios. How do you respond?

b. Which project(s) would you recommend if you had an unlimited budget and the projects were not mutually exclusive? Why?
c. Which project(s) would you recommend if you could only recommend one (that is if all projects were mutually exclusive)? Why?
d. Which project(s) would you recommend if you could recommend a maximum of three projects? Why?
e. Which project(s) would you recommend if you could recommend any number but you had a maximum capital budget of $1.2 million? Why?

a) Profitability Index = $\frac{NPV}{INV}$ =

b) All, since they all have positive NPV, so each one would increase stockholders' wealth.

c) B. It has the highest NPV, so taking it would Maximize S.H. wealth

d) B, C, H. Again, these 3 have the Highest NPV.

e) C, B, A. It has the highest combined assets that fit within the budget constraint. We know that since we ranked by Profitability Index.

3. (30 points) You are CFO of a large manufacturer of prepared foods. Your firm is considering introducing a new dessert. The R&D has already been done (and so R&D is a sunk cost). The project will require an initial investment of $8 million today. You expect that incremental sales from this product will be $4 million, and will last for 25 years. The gross profit margin from this project is estimated as 25% (Gross Profit Margin is the ratio of Gross Profits to Sales). You can depreciate this investment over 16 years with depreciation equal to $500,000 per year. You will have to increase net working capital as a result of the project, by $$700,000 immediately (today at time 0). The Cost of Capital is 10%, and the effective tax rate for this project is zero. There are no other incremental cash flows resulting from this project.

a. Fill in the table ($ in Millions)

Year	0	1	2	…	24	25
Capital Expenditure	-8					
Gross Profits		1	1	…	1	1
Depreciation		.5	.5	…	.0	.0
EBIT (operating income)		.5	.5	…	1	1
Change in Working Capital	+.7			…		-.7
Operating Income		.5	.5	…	1	1
Free Cash Flow	-8.7	1	1	…	1	1.7

b. What is the Net Present Value of this project, what should you do and why?

c. After 1 year, your marketing people explain that the project has eaten into (cannibalized) the sale of other profitable desserts the firm sells, so that total incremental sales are only $2 million (operating margin remains at 25%). If you abandon the project, you can sell the Plant and Equipment for $5 million. What should you do and why?

OPERATING INCOME = Gross Profits − DEP = EBIT

= 1−.5

FCF = EBIT − ΔWC + Cap Ex.

= (EBIT)(1−t) − ΔWC − Cap Ex + DEP

=

b. NPV = − Cap Ex + $\overbrace{PVA(1, 10\%, 25)}^{PMT}$ + $\overbrace{PV_{LS}(.7, 10, 25)}^{FV}$

= −8.7 + 9.14 = 441,600

c. NPV = $-5^{+.7}$ + PVA (.5, 10%, 24) + PV_{LS} (.7, 10%, 24)

= -4.3 + (+4.6) = 0.3

4. (20 points) Congratulations! It is your 30th birthday. You are looking forward to retirement at age 65 (35 years from today). You estimate that you will need a "nest egg" of $2.5 million to live in a fashion to which you are accustomed. You wonder how much, per year you will have to save to have that required amount

a. How much will you have to save, if you can get 6% return on your money, and your first payment (saving) is made 1 year from today?
b. Congratulations again! You have reached your 65th birthday and have accumulated the $2.5 million. Suppose you believe that you will live for another 25 years. How much could you spend yearly, for the rest of your life, from that saving of $2.5 million, given the same interest rate of 6%?

a. NP = 35
I = 6
PV = 0
PMT = ??
FV = 2,500,000

} PMT => 22,434.65

b. 172,435