General Instructions

- This exam is to be completed in a bluebook – answers not recorded in a bluebook will not be graded.
- Do not start the exam until directed. You will have until 12:30 to complete the exam. Time checks will be provided throughout the exam.
- Place the exam sheets on the inside of your bluebook when finished and hand them in back with the bluebook.
- Put your name on both your blue book and the exam sheet.
- Show your work step-by-step.
- Write legibly, and state any necessary assumptions.
- Draw your cash flow diagrams. State which perspective they are drawn from.
- Cell Phones or any other communications device must be turned off and completely hidden from view for the entire duration of the test.
- If you have a question during any portion of this exam, raise your hand & speak privately to the proctor.

Questions (Total 100 points):

1. [10 points] Describe following terms in relation to construction project management:

   A) Privity of Contract

   Contract can only be enforced against the entities that are party to them. In some cases, a third party beneficiary (such as a bank or loan agency) may become involved in disputes.

   B) Prime Contract

   The Prime Contract is that contract awarded to the GC, Consortium, or other entity that has full responsibility for the project. (e.g. General Contractor will hold a prime contract, not the subcontractor).

   C) Internal Rate of Return

   The internal rate of return is a method of investment analysis where the interest rate is determined at which the costs of the investment is equivalent to the benefits, or the annualized effective interest rate at which the NPV of all cash flows relevant to an investment add up to zero. It is called "Internal" because it tends to neglect externalities, such as the cost of capital. It is not ideal for comparisons between mutually exclusive options.

   D) Fast-Tracking

   Generally, in DB projects, the construction may break ground before the design is complete, allowing the project to be completed in less time.

E) Professional Construction Manager

Owners may hire a professional construction manager to act as an owner's representative. This may be the case when the owner lacks the expertise to make informed judgments regarding the relative strengths and weaknesses of different project opportunities

2. [10 points] Your friends have been arguing, and since you are taking CE167 ask for your help. The argument centers on a supposed contract they made over use of a bicycle. Last night, after having a few too many drinks at Raleigh's your friend Bob needed to rush down to his house because he forgot to study for the C167 exam. He asked your friend Tim if he could use his bike (Tim also having had one too many) so he could get home and start studying as early as possible. Tim grudgingly accepted, on the condition that Bob remember to lock up the bike and buy him another round. Tim consents and walks with Bob to the racks and unlocks the bike for him, but forgets to hand Tim the keys. Tim goes back to the bar as Bob attempts to ride away before being stopped by the UC police department for "Biking Under the Influence". Since Bob now has to walk home now, he decides to leave the bike hidden on campus, with the hope of returning the next day to pick it up. The bike gets stolen. Tim wants money for the bike, and Bob is arguing that the contract is not valid and he was never given the keys anyway.

Is this contract enforceable? Why or Why Not?

You could argue based on the Offer (competence?), Consideration (were good's exchanged?) or the acceptance of the agreement. Were all three components present, or even so, are they valid given the situation?

3. You've just graduated from Berkeley at the young age of 21 and are reviewing your options for the future. You can either get a job in the industry now, in which case you plan on investing $2000 (annually) in a retirement savings account until you are 30. Or you can join the Peace Corps and travel the world, in which case you won't start investing in your retirement until you are ~~40~~ 41 years old. The savings account has an interest rate of 8% compounded annually and you plan to retire at the age of 65.

A) [5 points] If you make payments from the age of 21 to the age of 30, how much will you have to retire on at the age of 65?

A = $2000

F= ?

21   22   29   30   64   65
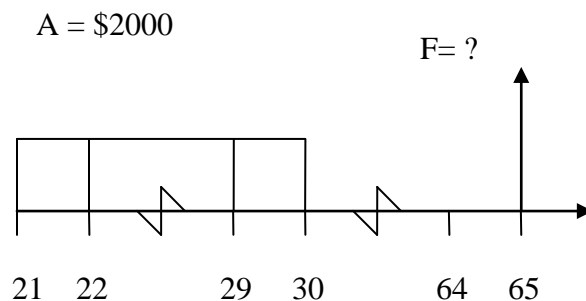
Methodology: Find the Equivalent future sum of the annual payments in year 30, then find the future value of this equivalent sum in year 65 when you wish to withdraw the funds.

F= A(F/A, 8%, 10)(F/P, 8%, 35) = 2000(14.487)(14.785) = \$428,380

B) [10 points] If instead you invest between the ages of 41 and 65, how much must you now invest in the account to have an equivalent sum to retire on?

A = ?

F= \$1353182

41   42   43   44   45   64   65
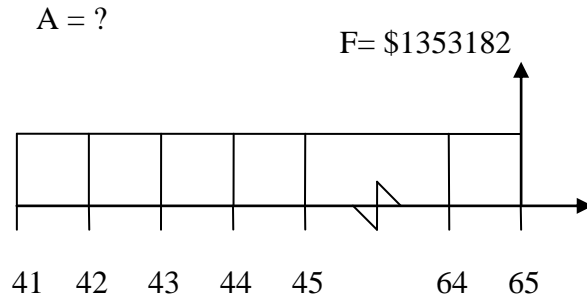
Methodology: Now instead of the future sum being the unknown, the uniform annual payments are unknown. Given F, we now find A for the years 41-65 (inclusive)

A =F(A/F, 8%, 25) = \$428,380*(.0137) = \$5875

4. Your construction company just purchased a bulldozer for \$50,000 and will use it for 5 years, at the end of which you anticipate you can sell the piece of equipment for \$20,000. The improved productivity from the new piece of equipment will result in an increase in revenue of \$12,000 per year. Your company is in the 35% marginal tax bracket, and your interest rate is 12%.

A) [5 points] Calculate the Before Tax NPV

B) [10 points] Calculate the After Tax NPV.

C) [5 points] Is this investment worthwhile once taxes are taken into consideration?

Year	BTCF	Depreciation	Taxable Income	Taxes@35%	ATCF
0	-50,000				
1	12,000	-6000	6000	2100	9900
2	12,000	-6000	6000	2100	9900
3	12,000	-6000	6000	2100	9900
4	12,000	-6000	6000	2100	9900
5	12,000	-6000	6000	2100	9900
Salvage	20,000				

A = $12000

S = $20000

0 1 2 3 4 5
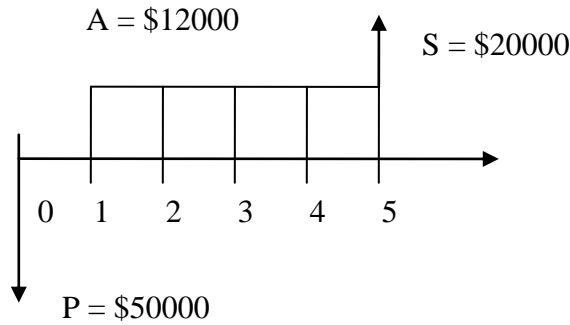
P = $50000

A: NPV$_{btcf}$ = **-\$50000 + \$12000(P/A, 12%,5) + \$20000(P/F,12%,5)**

= **\$4605.85**

B: NPV$_{atcf}$ = **-\$50000 + \$9900(P/A,12%,5) + 20000(P/F,12%,5)**

= **-\$2964.18**

C: The investment is not worthwhile once taxes are taken into account. We see that taxes diminish the annual revenue that is gained from this investment. At a lower interest rate (or lower cost of capital) this may be an appropriate investment.

5. You've graduated and are working on your first job as a project manager for a construction project located in the California Delta. After getting assigned to the proposal team and doing a site walk, you realize that the project is located in an area subject to seasonal flooding. Talking to some farmers, they tell you that "Oh, it floods every now and then." After looking at historical data, you think that there is a 5% chance of severe flooding during the project duration and a 15% chance of minor flooding. You have three choices to mitigate damage to your construction site caused by flooding: Build an earthen levee for $250,000, buy flood insurance for $100,000, or do nothing. The impacts of floods given each alternative are summarized below in Table 1. Your boss has come by your desk and stressed that if you want to have any chance of keeping your job, you had better be the low bidder on this project.

Option	Impacts Given Severe Floods	Impacts Given Minor Floods
Levee	$250,000	$100,000
Flood Insurance	$650,000	$200,000
Do Nothing	$1,500,000	$750,000

A) [5 points] What is the expected monetary value of each decision? Without any additional information, which option looks most promising?

Without any other information, the EMV of buying insurance is the lowest at $(162,500), therefore you would buy the insurance.

B) [10 points] Suppose a meteorologist comes to you with a whizz-bang stochastic model utilizing the latest weather data, and tells you he can tell you what certainty how severe the weather will be next season. How much are you willing to pay for his services? (assume the information is perfect)

The EMV given perfect information is $(70,000), vs. the cheapest option from part A at $(162,500). Therefore, the EVPI = $(70,000)-$(162,500) = $92,500

C) [5 points] Discuss why you would choose another option in spite of the EMV of the options in Part (A).

There may be other externalities not taken into account here, such as site restrictions, past experience, whether or not an insurer will provide a policy, or the owner may have written into the contract that some form of flood protection be required during construction. The information provided may also be imperfect, in which case you should a decision tree with Bayesian probabilities.

6. You are considering purchasing a bond for $80,500 with a face value of $100,000 that was issued 5 years ago. It has a maturity date 10 years from the issue date. This type of bond was sold on the market 5 years ago and carries an interest rate of 6% per quarter (24% per annum). If comparable bonds today carry an interest rate of 8% per quarter, and your broker is going to charge a $500 transaction fee:

A) [5 points] Is this bond worth purchasing at the current market rate?

A = $6000

F = $100,000

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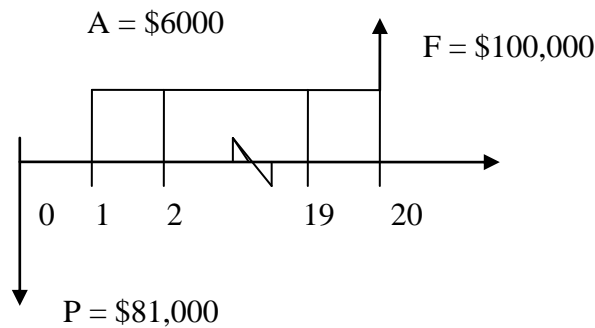
P = $81,000

Coupon = $100,000*(0.06) = $6,000 per quarter

NPV = -$81000 + $6000(P/A, 8%, 20) + $100,000(P/F, 8%, 20)

NPV = -$636.29

NO, The bond is not worth purchasing at the current price.

B) [10 points] Suppose you do purchase the bond, now consider that the rate for comparable bonds falls back to 6% per quarter immediately after you purchased the bond. In present value, how much did you just make on your investment if you were to sell the bond (neglect brokerage fees charged on the sale of bonds) the next day?

If the current rate for comparable bonds drops back down to 6%, then you could potentially sell your bond for $100,000 if brokerage fees are neglected. Thus, you would have made:

$100,000 – $81000 = $19000

Deceptively simple. If you assumed you bought it for the price you should have paid above ($80,363.71) then you still get credit.

7. [10 points] You have just been promoted to the position of equipment manager for a small construction company. You currently have a piece of equipment that you are about to retire, and you plan on purchasing a new one when it is required for a job two years from now. Given the following series of cash flows related to these equipment purchases. If your company demands equipment purchases have an MARR of 12%, will you make this purchase based on the IRR? Discuss the implications of this outcome when considering IRR.

Year	0	1	2	3	4	5
Cash Flow	$1250	$0	-$4000	$1000	$1000	$1000

$1250

$1000 $1000 $1000
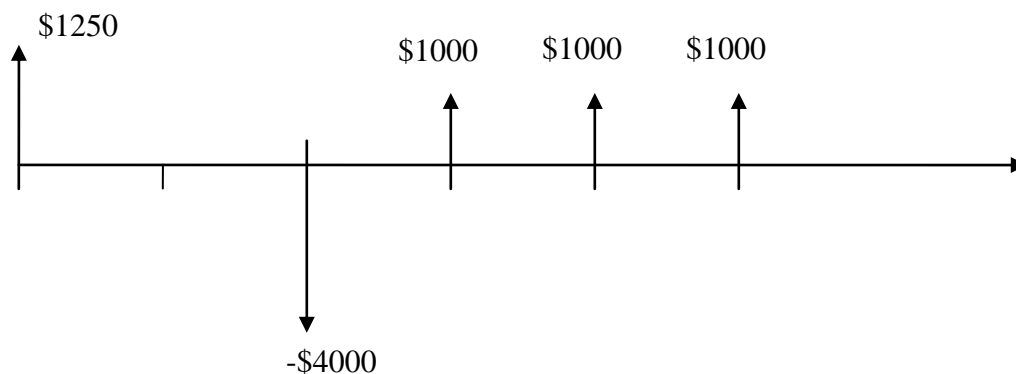
-$4000

Calculate the IRR (e.g. i% for which NPV = 0)

NPV = $1240 - $4000(P/F, i%, 2) + $1000(P/F, i%, 3) + $1000(P/F, i%, 4) + $1000(P/F, i%, 5)

By iteration and similar triangles: IRR = 9.97% or 36.8%

Multiple rates of return are common in projects were one might invest a lot of money, but eventually, over a longer time horizon, might receive more funds. In terms of taxes, it would

be better to have a high rate of return initially, but over longer periods of time, a lower rate of return. In these cases, you might want to assume a separate rate of return for borrowing cash flows vs. the returns on cash flows. More simply, though, you should probably consider alternate methods to analyze projects in conjunction with the IRR.