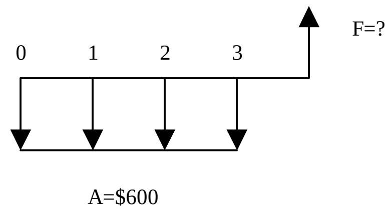
CE 167 Midterm #1
Fall 2000
Prof. C.W. Ibbs

Question #1 [15 Points]

The amount of $600 per year is to be paid into an account over each of the next 4 years. The nominal interest rate is 15% per year. Determine the total amount the account will eventually contain under the following conditions:

(a) Deposits are made at the beginning of the year with interest compounding yearly:

NFV = [$600 (F/A, 15%, 4)](1+i)



NFV = $600 $\left[\dfrac{(1+i)^n - 1}{i}\right](1+i)$

Because the equations are set up so that payment are made at the <u>end of the year</u>, you have to account for the one extra year's worth of interest made by making the deposit at the beginning of the year!

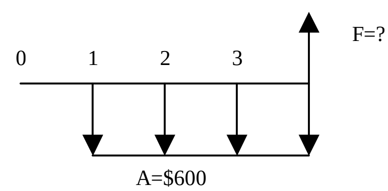
NFV = $600 $\left[\dfrac{(1+0.15)^4 - 1}{0.15}\right](1+0.15)$

<u>NFV = $344.45.43</u>

(b) Deposits at the end of the year with interest compounding yearly:

NFV = [$600(F/A, 15%, 4)]

This is the same as the Part (a), except you do not have to account for the extra year of interest



NFV = $600 $\left[\dfrac{(1+0.15)^4 - 1}{0.15}\right]$ = <u>$2996.03</u>

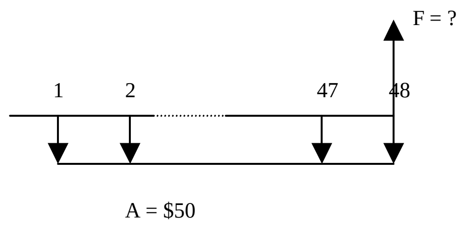
For Parts (a) & (b), 3 points were awarded for the correct usage of the formula, and 2 points for the correct answer.

(c) $50 deposits are made at the end of each month with interest compounding monthly:

Since i = 15% is a <u>nominal yearly rate</u>, you must find $i_{effective}$:

$i_{effective} = \left[1+\dfrac{r}{m}\right]^m - 1 = \left[1+\dfrac{0.15}{12}\right]^{12} - 1 = 16.08\%$

$i_{effective}$ = 16.08% per year = 1.34% per month This part was worth 1 point



NFV = [$50(F/A, $i_{effective}$, 48)] (48 payments = 12 months/year times 4 years)

$$NFV = \$50\left[\frac{(1+0.0134)^{48}-1}{0.0134}\right] = \underline{\$3337.50}$$

The use of the correct equation (after finding $i_{effective}$) was worth 3 points; the correct answer was worth 1 point.

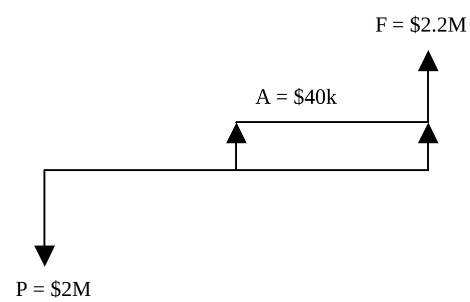
Question #2 [15 Points]

You are considering buying office space. You can buy two small office buildings or one large office building. The small buildings cost $1,000,000 apiece and have a resale value of $1,100,000 apiece after two years. The large office building costs $2,200,000 and has a resale value of $2,350,000 after two years. The purchase of the two small buildings will provide a total of $40,000 of net income per year. The purchase of the large office will provide a total of $50,000 of net income per year. Your MARR is 4%. On the basis of an internal rate of return comparison, which option would you choose? Why? (Net income is accrued at the end of the year.)

Option	**2 Small Buildings**	**1 Large Building**
Initial Cost	$2,000,000	$2,200,000
Yearly Benefit	$40,000	$50,000
Salvage	$2,200,000	$2,350,000

MARR = 4%

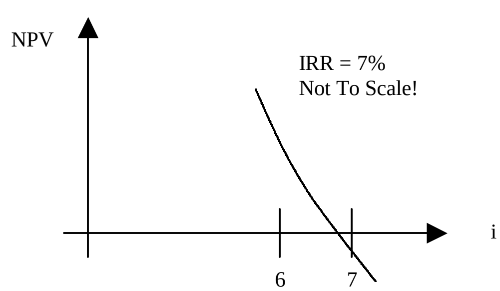
2 Small Buildings:



$$NPV = 0 = -\$2M + \left(\frac{\$40k}{(1+i)^1}\right) + \left(\frac{\$40k}{(1+i)^2}\right) + \left(\frac{\$2.2M}{(1+i)^2}\right)$$

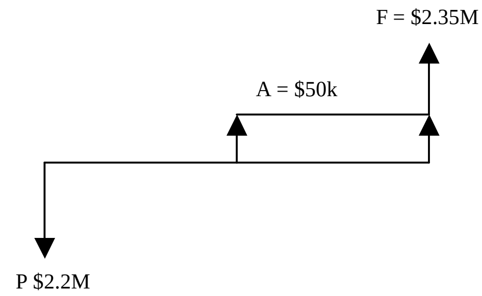
NPV is approximately 0 when i = 7%, therefore the IRR_{2small} = 7% > MARR; this is a viable option!

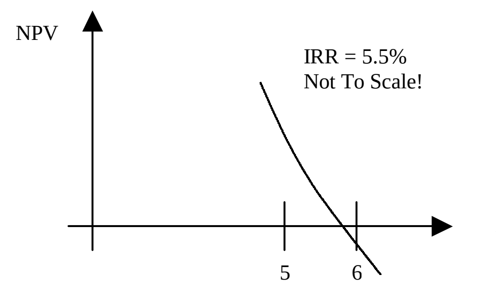
Solving for the IRR = 5 points



__1 Large Building__:

NPV = 0 = -\$2.2M + $\left(\dfrac{\$50k}{(1+i)^1}\right)+\left(\dfrac{\$50k}{(1+i)^2}\right)+\left(\dfrac{\$2.35M}{(1+i)^2}\right)$





NPV is approximately 0 when i = 7%, therefore the IRR_{2small} = 5.5% > MARR; this is a viable option!

Solving for the IRR = 5 points

Since both options have IRRs > MARR, it is necessary to compare ∆IRRs!

Since 2 Small Buildings is the option with the smallest initial cost, it begins as the defender:

$\Delta IRR_{2buildings} = IRR_{2buildings} = 7\%$

NPV = 0 = -∆investment + $\left(\dfrac{\Delta benefit1}{(1+i)^1}\right)+\left(\dfrac{\Delta benefit2}{(1+i)^2}\right)+\left(\dfrac{\Delta salvage}{(1+i)^2}\right)$

0 = -\$200k + $\left(\dfrac{\$10k}{(1+i)^1}\right)+\left(\dfrac{\$10k}{(1+i)^2}\right)+\left(\dfrac{\$150k}{(1+i)^2}\right)$

Plug in 4% (MARR) for i → NPV =\$42,456

Therefore, $\Delta IRR_{1building} < 4\%$ → The additional capital needed for the large building __is not justified__!

Buy the 2 Small Buildings

5 points for the correct comparison of ∆IRRs; 0 points if you simply said one IRR was better than another without an incremental analysis.

Question #3 [35 points total]

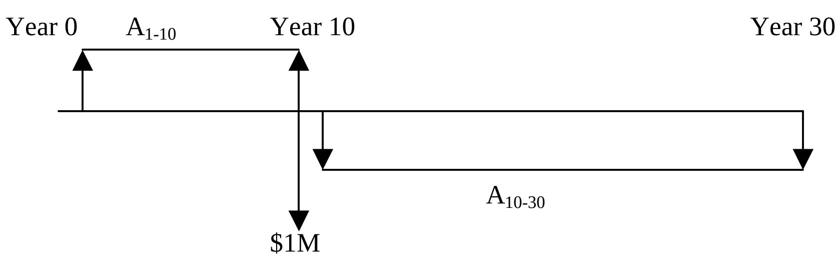
Part A [15 points]

A small municipality determines that it will cost $1,000,000 to build a water treatment plant in 10 years (end of year 10). The municipality also expects the plant to last for 20 years. The municipality currently has no money set aside for the plant and estimates that it will take $75,000 per year to cover operating expenses. How much does the municipality need to set aside from its budget per year (uniform amount) for the next 10 years in order to afford this plant. Assume i = 8%.

Water treatment plant will cost $1M at EOY 10 → F_{10} =$1M

Operating costs will be $75k for 20 years → $A_{10\text{-}30}$ = $75k/year

Find $A_{1\text{-}10}$



In year 10: $A_{1\text{-}10}$(F/A, 8%, 10) = $1M + $A_{10\text{-}30}$(P/A, 8%, 20)

I used tables for simplicity: $A_{1\text{-}10}$(14.486) - $1M + $75k(9.8181)

$$A_{1\text{-}10} = \left[\frac{\$1M + \$75k(9.8181)}{14.486}\right] = \$119,865$$

The municipality must save $119,865 per year for ten years (year 1 through year 10) to be able to afford the plant & maintenance.

5 points each for both of the annuity equations; 5 points for the correct answer

Part B [20 points]

Conduct a sensitivity analysis on key variables, except number of years. Briefly discuss your results.

The most important variable to vary is the interest rate, so it was necessary to vary it. We would have given credit for a correct sensitivity analysis of any of the other variables. Vary by 10-30%.

I varied by 25%. Therefore, i +/-25% = 6%, 10%

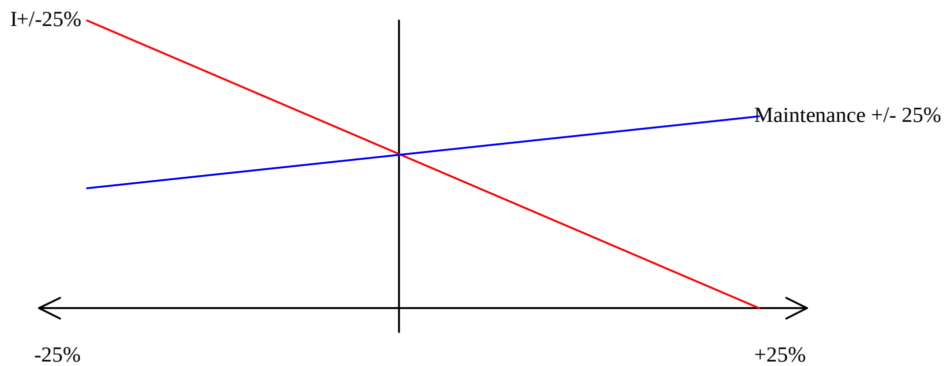
For i = 6%: $A_{1\text{-}10}$(F/A, 6%, 10) = $1M + $75k(P/A, 6%, 20)
$A_{1\text{-}10}$(13.180) = $1M + $75k(11.47)
$A_{1\text{-}10}$ = $141,142 per year

For i = 10%: $A_{1\text{-}10}(F/A, 10\%, 10) = \$1M + \$75k(P/A, 10\%, 20)$
$A_{1\text{-}10}(15.937) = \$1M + \$75k(8.5436)$
$A_{1\text{-}10} = \$102,954$ per year

Maintenance +/- 25% = $56,250, $93,750

For $56,250: $A_{1\text{-}10}(F/A, 8\%, 10) = \$1M + \$56,250(P/A, 8\%, 20)$
$A_{1\text{-}10}(14.486) = \$1M + \$56,250(9.8181)$
$A_{1\text{-}10} = \$102,954$ per year

For $93,750: $A_{1\text{-}10}(F/A, 8\%, 10) = \$1M + \$93,750(P/A, 8\%, 20)$
$A_{1\text{-}10}(14.486) = \$1M + \$93,750(9.8181)$
$A_{1\text{-}10} = \$132,573$ per year



This diagram is <u>Not To Scale</u>!

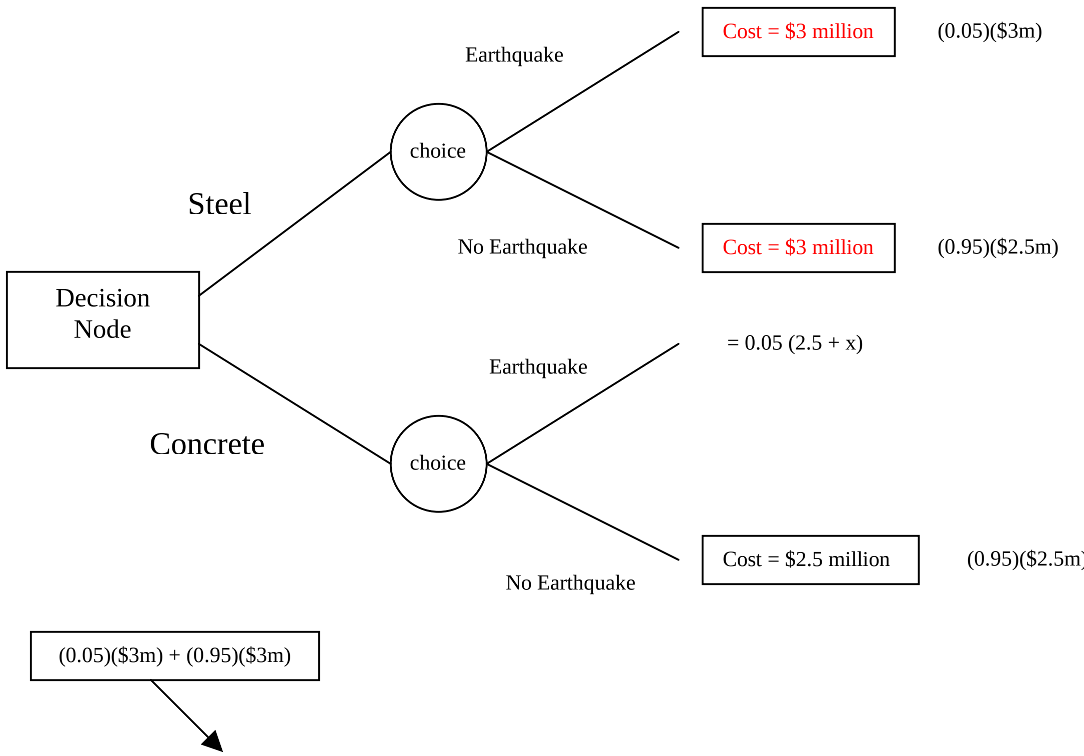
The slope of the i +/- 25% line is steeper, so changes in i will affect the project more severly than changes in maintenance costs.

4 points were given for each individual part of the sensitivity analysis (+ and – for two variables) and 4 points were given for at least a basic interpretation of your results.

Question #4 [10 points]

A designer has two choices for a building frame. A steel frame costs \$3 million. A concrete frame costs \$2.5 million. If no earthquake occurs, both systems are safe. However, there is a 5% chance that an earthquake will occur. Steel is safe in earthquakes, but concrete will suffer significant damage (no loss of life, but the building will be beyond repair).

Under which condition would concrete be your choice?



\$3 million < 0.05(2.5 + x) + 0.95(2.5m)

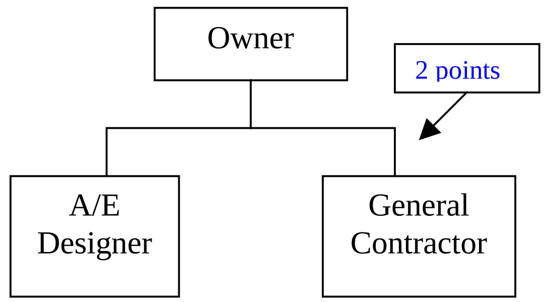
x must be greater than or equal to \$10 million

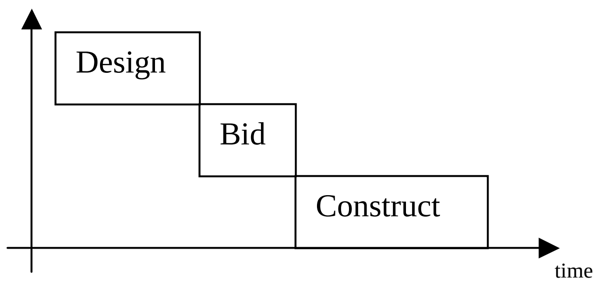
You would have to be able to pay \$10 million to repair/rebuild the concrete system if you chose that system (you have to pay to fix the entire building).

A qualitative analysis was given 2 points. An attempt at a quantitative analysis was given 5 points. If a correct answer accompanied the quantitative analysis, another 5 points were awarded (10 points total)

Question #5 [10 points total – 5 point each]

Draw the relationship for a Design-Bid-Build contract. Identify and discuss 3 advantages to the client of the Design-Bid-Build method of construction.

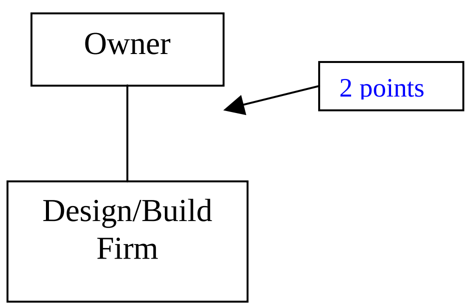


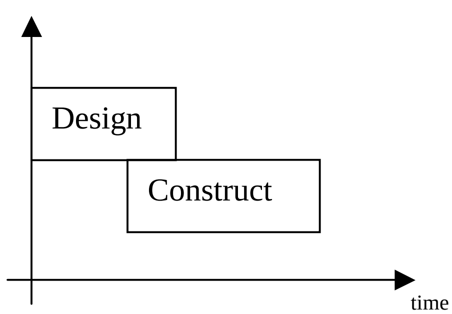


- Well established method of contracting
- Specialization of the involved parties (design, construction, etc.)
- Design is completed prior to construction, which leads to…
- …A final estimated cost can be determine prior to construction
- Bidding leads to more competitive bids

3 points total

Draw the relationship for a Design-Build contract. Identify and discuss 3 advantages to the client of the Design-Build method of construction.



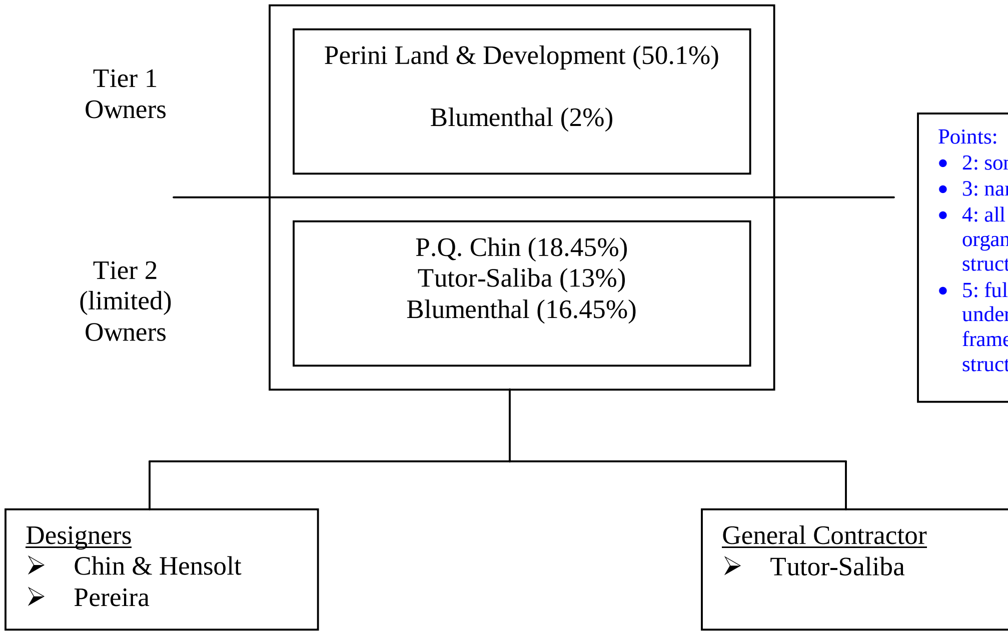


- Integrated team—improves communication (designers and contractors on same team, so they should be in communication with each other)
- Owner is dealing with only one contract (owner is saved from designer/contractor disputes)
- Fast-tracking due to overlap of design and construction (saves time)
- Designs are created with the builder in mind (or at least more so than Design-Bid-Build)

3 points total

Question #6 [15 points total] Be specific!

Who were the original owners of Rincon Center? How were they organized? Draw the contractual relationship of the major parties. [5 Points]



Points:
- 2: some names
- 3: names only
- 4: all names, no organizational structure
- 5: fully understood framework and structure

What was Tutor-Saliba's (and its owner Ron Tutor's) role in Rincon Center? How did this arrangement hurt and/or hinder the construction of Rincon Center? [10 Points]

Tutor-Saliba's role in Rincon Center was two-fold. First, Tutor-Saliba was brought in as an owner, and second, they were made the general contractor. The prevailing wisdom was that having the GC as part owner would help keep construction costs down. However, Tutor-Saliba's organizational role *hindered* the project. Tutor-Saliba did not have adequate experience with this type of project, and advised the other owners incorrectly. Tutor insisted on concrete, and did not accurately estimate the cost of building with concrete. The other owners were too easily persuaded by Tutor and accepted his input without sufficient proof. An outsider (like an agency construction management firm) should have been employed to provide an objective opinion, and also keep an eye on costs. The project should have gone out to open bid, or a professional construction manager, independent project accountant, engineer, or other knowledgeable consultant should have been hired. This way Tutor's organizational position could not have been abused.

Also, Tutor-Saliba's position created a conflict of interest that experienced owners or a construction manager would have caught. Tutor had the motivation to low-ball the expected costs because then he gets a larger percentage of the ownership pie (if he is investing a fixed amount, $X, then $X is a larger percentage of a smaller number). But, when he actually started building, he could recoup costs through mark ups (he was providing capital to be an owner, but he was being paid as a contractor to construct Rincon Center, so he also makes money by jacking up the construction costs). For Tutor, it was a win-win situation, despite the fact that the escalating construction costs were pinching the other owners.

- 2 points were given if the fact that Tutor (or Tutor-Saliba) were part owners <u>and</u> the general contractor
- 1 point each were given if the fact that Tutor insisted on concrete over steel (and the subsequent events), Tutor hindered the construction, and Tutor's lack of experience for this type of construction were mentioned
- The remaining 5 points came from discussing Tutor's conflict of interest (more detail on the owner/GC conflict) and grader discretion (your overall grasp of the question).