FIN 2004 Finance Tutorial 7 :

Capital Budgeting I

Conducted by : Mr Chong Lock Kuah, CFA

NPV – Decision Rule

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - CF_0$$

- If projects are independent, **accept all the projects which have NPV >0**
- If projects are mutually exclusive, **accept project with the highest positive NPV** for a fixed discount rate.
- NPV > 0 means:
  - Project is expected to add value to the firm
  - Will increase the wealth of the owners
- NPV is a direct measure of how well this project will meet the goal of increasing shareholder wealth.

Computing NPV for the Project
Using the TI BAII+ CF Worksheet

Cash Flows:

CF0	**=**	**-165000**
CF1	**=**	**63120**
CF2	**=**	**70800**
CF3	**=**	**91080**

Display	You Enter
	CF, 2nd,CLR WORK
CF_0	-165000 Enter, Down
C01	63120 Enter, Down
F01	1 Enter, Down
C02	70800 Enter, Down
F02	1 Enter, Down
C03	91080 Enter, Down
F03	1 Enter, NPV
I	12 Enter, Down
NPV	CPT
12,627.41	

Internal Rate of return (IRR)

- Definition:

$$\text{NPV} = 0 = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - CF_0$$

IRR = discount rate that makes the NPV = 0 or

it is the discount rate that equate initial investment outlay to the present value of cash inflows generated by project.

- Decision Rule:
  - Accept the project if the IRR is greater than the required return

Computing IRR for the Project
Using the TI BAII+ CF Worksheet

Cash Flows:

CF0	**=**	**-165000**
CF1	**=**	**63120**
CF2	**=**	**70800**
CF3	**=**	**91080**

Display	You Enter
	CF, 2nd, CLR WORK
CF_0	**-165000 Enter, Down**
C01	**63120 Enter, Down**
F01	**1 Enter, Down**
C02	**70800 Enter, Down**
F02	**1 Enter, Down**
C03	**91080 Enter, Down**
F03	**1 Enter, IRR**
IRR	**CPT**
16.1322	

IRR - Advantages

- Preferred by executives
  - Intuitively appealing
  - Easy to communicate the value of a project
- If the IRR is high enough, may not need to estimate a required return
- Considers all cash flows
- Considers time value of money
- Provides indication of risk

IRR - Disadvantages

- Can produce multiple answers
- Cannot rank mutually exclusive projects
  - –Ranking conflict between NPV and IRR
- Reinvestment assumption flawed
  - –IRR assumes reinvestment at IRR

NPV vs. IRR

- In general, NPV and IRR will generally give the same decision
- Exceptions
  - **Non-conventional cash flows**
    - Cash flow sign changes more than once
  - **Mutually exclusive projects**
    - Initial investments are substantially different
    - Timing of cash flows is substantially different
    - Will not reliably rank projects

Example of Mutually Exclusive Projects

Year	Cash Flow (A)	Cash Flow (B)
0	-$43,000	-$43,000
1	23,000	7,000
2	17,900	13,800
3	12,400	24,000
4	9,400	26,000

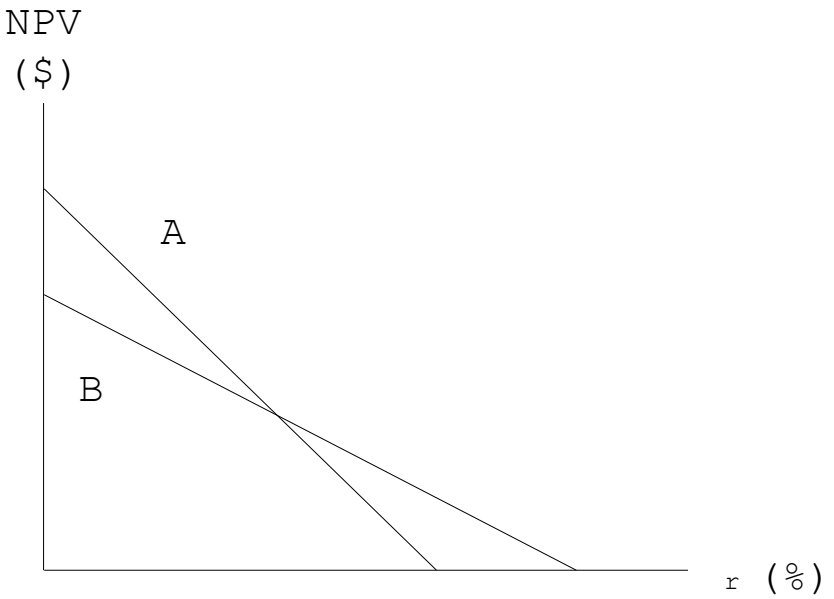
NPV	7,507.61	9,182.29
IRR	20.44%	18.84%

The required return for both projects is 11%.

Which project should you accept and why?

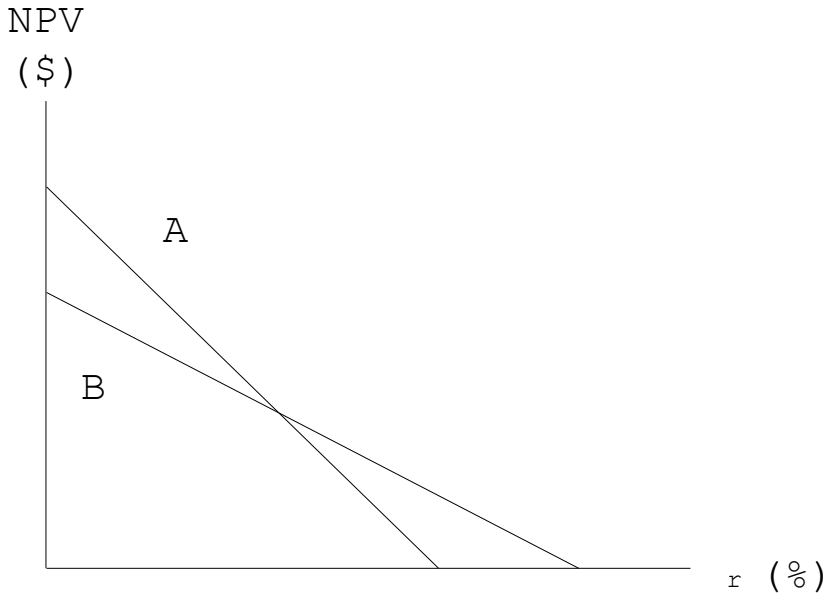
Project B should be accepted. NPV is more realistic as it assumes the reinvestment rate is at cost of capital.

Two Reasons NPV Profiles Cross



- **Size (scale) differences.**
  - The smaller project frees up funds at t=0 for investment.
  - The higher the WACC, the more valuable these funds, so a high WACC favors small projects

Two Reasons NPV Profiles Cross



- Timing differences.
  - This is because the impact of an increase in the cost of capital is much greater on distant than on near-term cash flows.
  - If a project has most of its cash flows coming in the early years, its NPV will not decline very much if the cost of capital increases but a project whose cash flows come later will be severely penalized by high capital costs.

IRR & Non-Conventional Cash Flows

- "Non-conventional"
  - Cash flows change sign more than once
  - Most common:
    - Initial cost (negative CF)
    - A stream of positive CFs
    - Negative cash flow to close project.
    - For example, nuclear power plant or mining project.
  - More than one IRR ….
  - Which one do you use to make your decision?

Modified IRR

- The modified IRR (MIRR) method corrects some of the problems associated with multiple IRRs. There are several different ways of calculating a modified IRR.

- **Discounting Approach:** Discount all negative cash flows back to the present at the required rate of return and add them to the initial cost. Then, calculate the IRR.

- **Reinvestment Approach:** Compute the future value of all cash flows except the initial cash flow at the end of the project and then calculate the IRR. In a sense, we are reinvesting the cash flows and not taking them out of the project until the very end. The rate used is the required rate on the project.

- **Combination Approach:** Negative cash flows are discounted back to the present, and positive cash flows are compounded to the end of the project using the cost of capital. Then, calculate the MIRR.

Reinvestment Rate Assumption

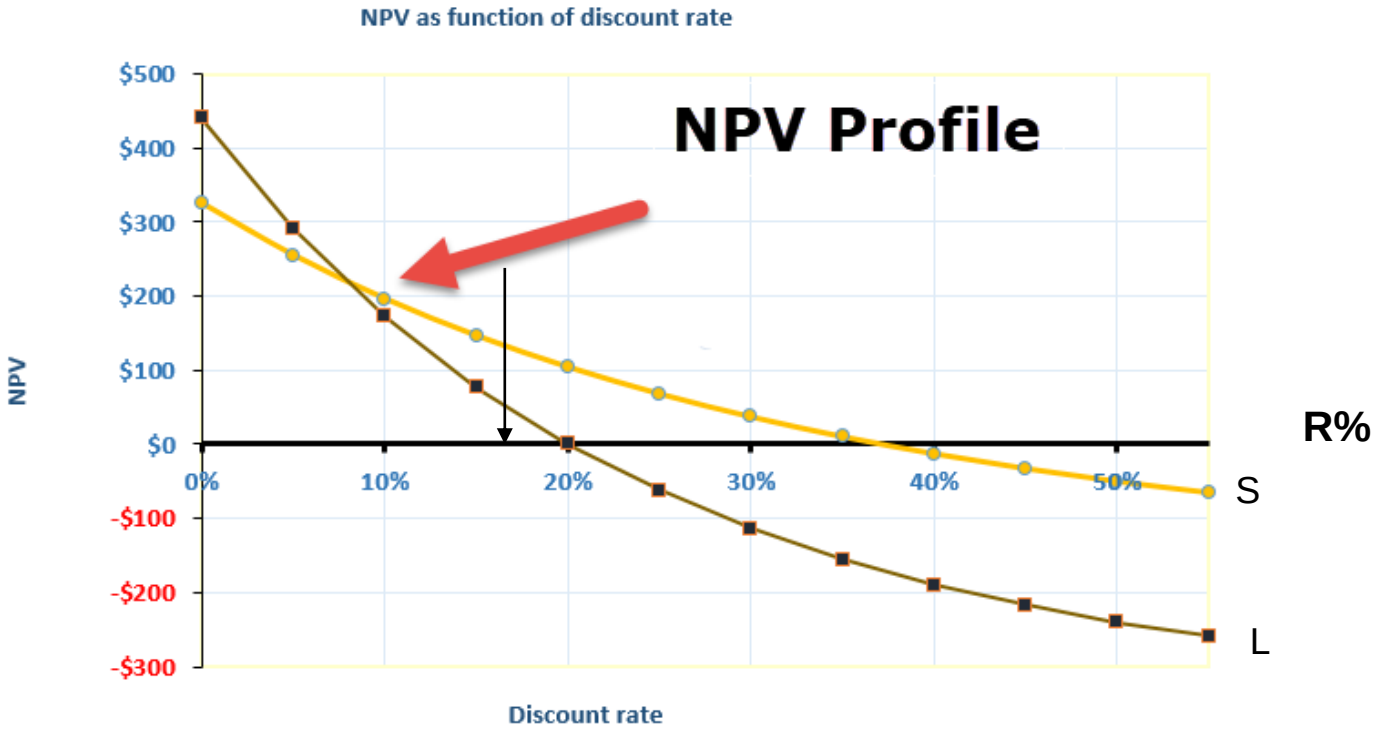
- IRR assumes reinvestment at IRR
- NPV assumes reinvestment at the firm's weighted average cost of capital(opportunity cost of capital)
  - More realistic
  - NPV method is best
- NPV should be used to choose between mutually exclusive projects

Conflicts Between NPV and IRR

- NPV directly measures the increase in value to the firm
- Whenever there is a conflict between NPV and another decision rule, **always** use NPV for a given discount rate.
- IRR is unreliable in the following situations:
  - Non-conventional cash flows
  - Mutually exclusive projects

NPV Profile : Cross Over Rate

In capital budgeting analysis exercises, the crossover rate is used to show when one investment project becomes superior to another as a result of a change in the rate of return (cost of capital). If two projects are mutually exclusive, **the discount rate is considered as the deciding factor to differentiate between the projects.**



At discount rates above crossover rate choose project S; for discount rates below crossover rate choose project L; indifferent between L and S at a crossover rate.

Weighted Average Cost of Capital (WACC)

- Capital is obtained in three primary forms: debts, preferred stock , and common equity, with equity coming from issuing new stock and by retained earnings.
- The investors who provide that capital do so expecting to earn at least their required rate of return on that capital, and the required return represents the cost of capital to the firm.
- The cost of equity is the return required by equity investors given the risk of the cash flows from the firm. The ROE depends on both business risk and financial risk

WACC – Cont'd

- There are two major methods for determining the cost of equity, R_E
  - ❖ Dividend growth model $P_0 = \frac{D_1}{R_E - g}; \quad R_E = \frac{D_1}{P_0} + g$
  - ❖ SML or CAPM $R_E = R_f + \beta_E[R_M - R_f]$
- The cost of debt is the required return on our company's debt.
- We usually focus on the cost of long-term debt or bonds.
- The required return is best estimated by computing the yield-to-maturity on the existing debt.
- We should consider after-tax cost of debt.

WACC – Cont'd

- In addition to equity and debt, firms can also use preferred stock to finance their investments.
  - Preferred stock generally pays a constant dividend each period
  - Dividends are expected to be paid every period forever
- Preferred stock is a perpetuity, so the cost of preferred stock is:

$$R_P = D_1/P_0$$

WACC – Cont'd

- A firm may employ a mix of equity and debt in its capital structure.
- We can use the individual costs of capital that we have computed to get our "average" cost of capital for the firm.
- This "average" is the required return on our assets, based on the market's perception of the risk of those assets
- The weights are determined by how much of each type of financing we use

$$\text{WACC} = w_E R_E + w_D R_D (1 - t) + w_P R_P$$

WACC – Cont'd

- Using the WACC as our discount rate is only appropriate for projects that have the same risk as the firm's current operations and the capital structure remains unchanged.
- If we are looking at a project that does NOT have the same risk as the firm, then we need to determine the appropriate discount rate for that project
- Divisions also often require separate discount rates

#1:

Suppose a project has conventional cash flows and a positive NPV. What do you know about its payback? Its discounted payback? Its profitability index? Its IRR? Explain.

If a project has a positive NPV for a certain discount rate, then it will also have a positive NPV for a zero discount rate; thus, the payback period must be less than the project's life.

Since discounted payback is calculated at the same discount rate as is NPV, if NPV is positive, the discounted payback period must be less than the project's life.

If NPV is positive, then the present value of future cash inflows is greater than the initial investment cost; thus PI must be greater than 1.

If NPV is positive for a certain discount rate R, then it will be zero for some larger discount rate R*; thus the IRR must be greater than the required return.

#2:

Mahjong, Inc., has identified the following two mutually exclusive projects:

Year	Cash Flow (A)	Cash Flow (B)
0	-$43,000	-$43,000
1	23,000	7,000
2	17,900	13,800
3	12,400	24,000
4	9,400	26,000

a. What is the IRR for each of these projects? Using the IRR decision rule, which project should the company accept? Is this decision necessarily correct?

b. If the required return is 11%, what is the NPV for each of these projects? Which project will you choose if you apply the NPV decision rule?

c. Over what range of discount rates would you choose Project A? Project B? At what discount rate would you be indifferent between these two projects? Explain.

2(a)

Computing IRR for the Project Using the TI BAII+ CF Worksheet

Project A

Cash Flows:

CF0	**=**	**-43,000**
CF1	**=**	**23,000**
CF2	**=**	**17,000**
CF3	**=**	**12,400**
CF4	**=**	**9,400**

Display	You Enter
	CF, 2nd, CLR WORK
C00	**-43000 Enter, Down**
C01	**23000 Enter, Down**
F01	**1 Enter, Down**
C02	**17000 Enter, Down**
F02	**1 Enter, Down**
C03	**12400 Enter, Down**
F03	**1 Enter, Down**
C04	**94000 Enter, IRR**
IRR	**CPT**
20.44	

2(a)

Computing IRR for the Project Using the TI BAII+ CF Worksheet

Project B

Cash Flows:

CF0	=	-43,000
CF1	=	7,000
CF2	=	13,800
CF3	=	24,000
CF4	=	26,000

Display	You Enter
	CF, 2nd, CLR WORK
CF_0	-43000 Enter, Down
C01	7000 Enter, Down
F01	1 Enter, Down
C02	13800 Enter, Down
F02	1 Enter, Down
C03	24000 Enter, Down
F03	1 Enter, Down
C04	26000 Enter, IRR
IRR	CPT
18.84	

Using the IRR decision rule, the company should accept project A. This may not be a correct decision; however, because the IRR criterion has a ranking problem for mutually exclusive projects

2(b)

Computing NPV for the Project Using the TI BAII+ CF Worksheet

Project A

Cash Flows:

CF0 = -43,000

CF1 = 23,000

CF2 = 17,000

CF3 = 12,400

CF4 = 9,400

Display	You Enter
	CF, 2nd,CLR WORK
CF_0	-43000 Enter, Down
C01	23000 Enter, Down
F01	1 Enter, Down
C02	17000 Enter, Down
F02	1 Enter, Down
C03	12400 Enter, Down
F03	1 Enter, Down
C04	94000 Enter, NPV
I	11 Enter, Down
NPV	CPT
7507.61	

2(b)

Computing NPV for the Project Using the TI BAII+ CF Worksheet

Project B

Cash Flows:

CF0	=	**-43,000**
CF1	=	**7,000**
CF2	=	**13,800**
CF3	=	**24,000**
CF4	=	**26,000**

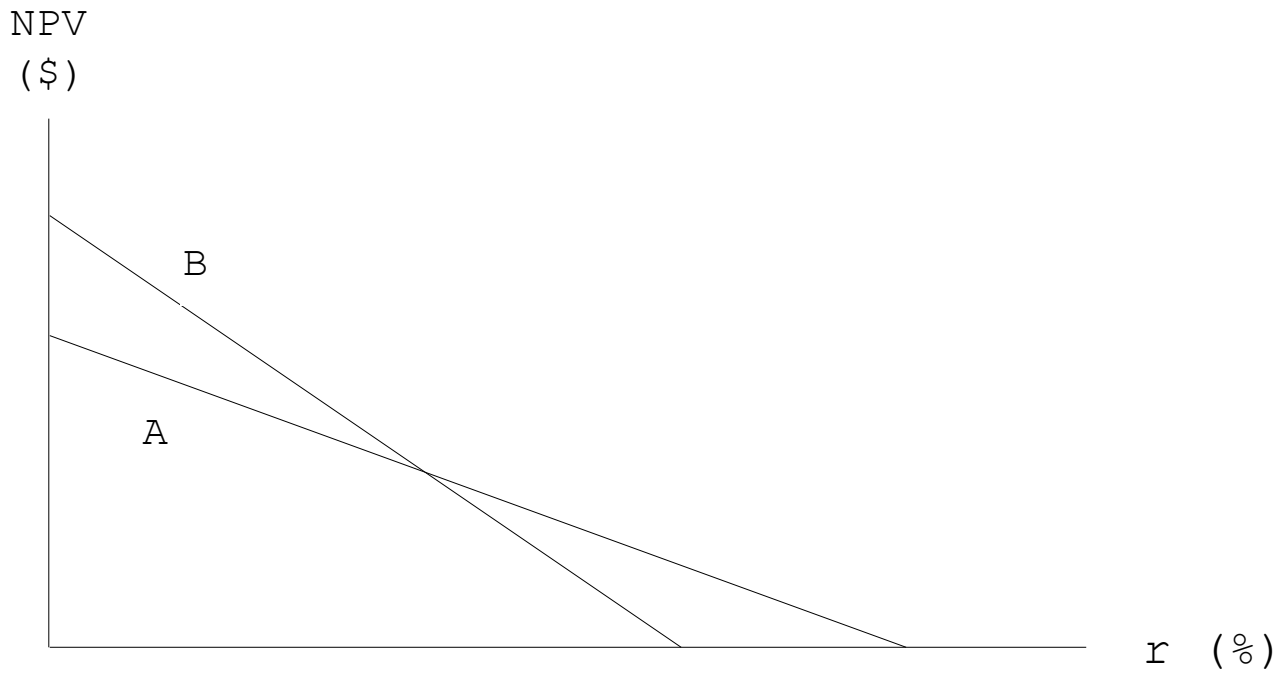
Display	You Enter
	CF, 2nd,CLR WORK
CF_0	-43000 Enter, Down
C01	7000 Enter, Down
F01	1 Enter, Down
C02	13800 Enter, Down
F02	1 Enter, Down
C03	24000 Enter, Down
F03	1 Enter, Down
C04	26000 Enter, NPV
I	11 Enter, Down
NPV	CPT
9185.29	

Using the NPV decision rule, the company should accept project B since NPV_B is greater than the NPV_A

2(c)

Crossover rate is the discount rate where two projects have the **same net present values (NPV)** or where their NPV profiles intersect.

This calculation is often used to show when one investment project becomes superior to another as a result of a change in the rate of return (cost of capital).



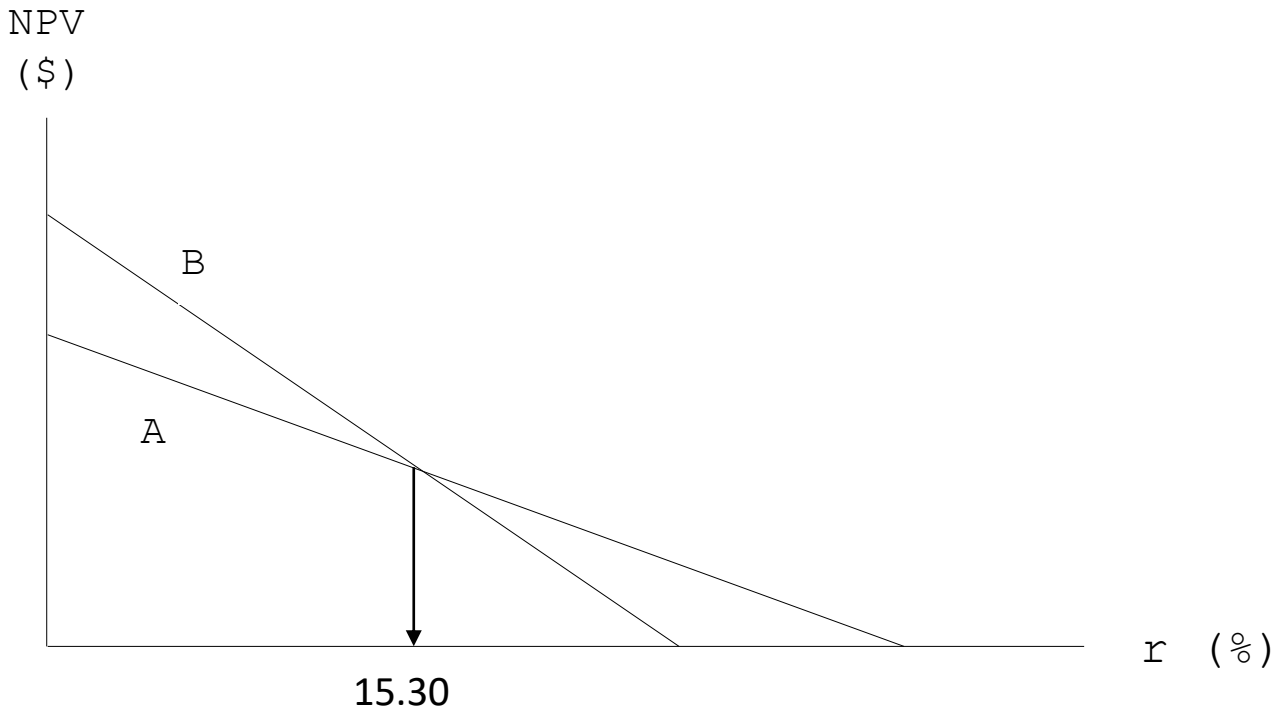
To find the crossover rate, we subtract the cash flows from one project from the cash flows of the other project. Here, we will subtract the cash flows for Project B from the cash flows of Project A. Once we find these differential cash flows, we find the IRR.

Year	Cash Flow (A)	Cash Flow (B)	$CF_A - CF_B$
0	-$43,000	-$43,000	0
1	23,000	7,000	16,000
2	17,900	13,800	4,100
3	12,400	24,000	-11,600
4	9,400	26,000	-16,600

Cash Flows:

CF0	=	0
CF1	=	16000
CF2	=	4100
CF3	=	-11600
CF4	=	-16600

Display	You Enter
	CF, 2nd, CLR WORK
CF_0	0 Enter, Down
C01	16000 Enter, Down
F01	1 Enter, Down
C02	4100 Enter, Down
F02	1 Enter, Down
C03	-11600 Enter, Down
F03	1 Enter, Down
C04	-16600 Enter, IRR
IRR	CPT
15.30	



At discount rates above 15.30% choose project A; for discount rates below 15.30% choose project B; indifferent between A and B at a discount rate of 15.30%.

#3:

Consider the following two mutually exclusive projects:

Year	Cash Flow (A)	Cash Flow (B)
0	-$300,000	-$40,000
1	20,000	19,000
2	50,000	12,000
3	50,000	18,000
4	390,000	10,500

Whichever project you choose, if any, you require a 15% return on your investment.

a. If you apply the payback criterion, which investment will you choose? Why?
b. If you apply the discounted payback criterion, which investment will you choose? Why?
c. If you apply the NPV criterion, which investment will you choose? Why?
d. If you apply the IRR criterion, which investment will you choose? Why?
e. If you apply the profitability index criterion, which investment will you choose? Why?
f. Based on your answers in (a) through (e), which project will you finally choose? Why?

Computing Payback Period for the Project A

3(a)

Year	CF	Cum. CFs
0	-$300,000	-$300,000
1	20,000	-$280,00
2	50,000	-$230
3	50,000	-$180
4	390,000	210,000

Payback = 3+ (180,000/390,000)

Payback = 3.46 years

Computing Payback Period for the Project B

3(a)

Year	CF	Cum. CFs
0	-$40,000	-$40,000
1	19,000	-$21000
2	12,000	-$9,000
3	18,000	$9,000
4	10,500	$19,500

Payback = 2 + (9,000/18,000)

Payback = 2.50 years

The payback criterion implies accepting project B, because it pays back sooner than project A.

Computing Discounted Payback Period for the Project A

3(b)

Year	CF	Discounted CF	Cum. CFs
0	-$300,000	-$300.000	-$300,000
1	20,000	17,391.30	-$282,608.70
2	50,000	37,807.18	-$244,801.52
3	50,000	32,875.81	-$211,925.71
4	390,000	222,983.77	$11,013.06

Payback = 3+ (211,925.71/222,983.77)

Payback = 3.95 years

Computing Discounted Payback Period for the Project B

3(b)

Year	CF	Discounted CF	Cum. CFs
0	-$40,000	-$40,000	-$40,000
1	19,000	16,521.74	-$23,478.26
2	12,000	9,073.72	-$14,404.54
3	18,000	11,835.29	-$2,569.25
4	10,500	6,003.41	$600.41

Payback = 3+ (2,569.25/6,003.41)

Payback = 3.43 years

Computing NPV for the Project A

Project A 3(c)

Cash Flows:

CF0	=	-300,000
CF1	=	20,000
CF2	=	50,000
CF3	=	50,000
CF4	=	390,000

Display	You Enter	
	CF, 2nd,CLR WORK	
CF_0	-300000	Enter, Down
C01	20000	Enter, Down
F01	1	Enter, Down
C02	50000	Enter, Down
F02	1	Enter, Down
C03	50000	Enter, Down
F03	1	Enter, Down
C04	390000	Enter, NPV
I	15	Enter, Down
NPV	CPT	
11,058.07		

Computing NPV for the Project B

Project B 3(c)

Cash Flows:

CF0 = -40,000

CF1 = 19,000

CF2 = 12,000

CF3 = 18,000

CF4 = 10,500

Display	You Enter
	CF, 2nd,CLR WORK
CF_0	-400000 Enter, Down
C01	19000 Enter, Down
F01	1 Enter, Down
C02	12000 Enter, Down
F02	1 Enter, Down
C03	18000 Enter, Down
F03	1 Enter, Down
C04	10500 Enter, NPV
I	15 Enter, Down
NPV	CPT
3,434.16	

NPV criterion implies we accept project A because project A has a higher NPV than project B.

Computing IRR for the Project A

Project A 3(d)

Cash Flows:

CF0	=	**-300,000**
CF1	=	**20,000**
CF2	=	**50,000**
CF3	=	**50,000**
CF4	=	**390,000**

Display	You Enter
	CF, 2nd, CLR WORK
CF_0	-300000 Enter, Down
C01	20000 Enter, Down
F01	1 Enter, Down
C02	50000 Enter, Down
F02	1 Enter, Down
C03	50000 Enter, Down
F03	1 Enter, Down
C04	390000 Enter, IRR
IRR	CPT
16.20	

Computing IRR for the Project B

Project B 3(d)

Cash Flows:

CF0 = -40,000

CF1 = 19,000

CF2 = 12,000

CF3 = 18,000

CF4 = 10,500

Display	You Enter
	CF, 2nd,CLR WORK
C00	-400000 Enter, Down
C01	19000 Enter, Down
F01	1 Enter, Down
C02	12000 Enter, Down
F02	1 Enter, Down
C03	18000 Enter, Down
F03	1 Enter, Down
C04	10500 Enter, IRR
IRR	CPT
19.50	

IRR decision rule implies we accept project B because IRR for B is greater than IRR for A.

3(e). The profitability index for each project is:

A: PI = ($20,000/1.15 + $50,000/$1.15^2$ + $50,000/$1.15^3$ + $390,000/$1.15^4$)/ $300,000 = 1.037

B: PI = ($19,000/1.15 + $12,000/$1.15^2$ + $18,000/$1.15^3$ + $10,500/$1.15^4$)/ $40,000 = 1.086

Profitability index criterion implies accept project B because its PI is greater than project A's.

3(f).

In this instance, the NPV criteria implies that you should accept project A, while profitability index, payback period, discounted payback, and IRR imply that you should accept project B.

The final decision should be based on the NPV since it does not have the ranking problem associated with the other capital budgeting techniques. Therefore, you should accept project A.

#4:
Slow Ride Corp. is evaluating a project with the following cash flows:

Year	Cash Flow
0	-$16,000
1	6,100
2	7,800
3	8,400
4	6,500
5	-5,100

The company uses a 10 percent interest rate on all of its projects. Calculate the MIRR of the project using the combination approach.

Combination approach:

In the combination approach, we find the value of all cash outflows at time 0, and the value of all cash inflows at the end of the project. So, the value of the cash flows is:

Time t=0 cash flow = –\$16,000 – \$5,100 /1.10^5 = –\$19,166.70
Time t=5 cash flow = \$6,100(1.10^4) + \$7,800(1.10^3) + \$8,400(1.10^2) + \$6,500(1.10)
Time t=5 cash flow = \$36,626.81

So, the MIRR using the combination approach is:
0 = –\$19,166.70 + \$36,626.81/$(1+MIRR)^5$
\$36,626.81 / \$19,166.70 = $(1+MIRR)^5$

MIRR = (\$36,626.81 / \$19,166.70)$^{1/5}$ – 1
MIRR = 0.1383 or 13.83%

#5:

The Yurdone Corporation wants to set up a private cemetery business. According to the CFO, Barry M. Deep, business is “looking up.” As a result, the cemetery project will provide a net cash inflow of $85,000 for the firm during the first year, and the cash flows are projected to grow at a rate of 6 percent per year forever.

The project requires an initial investment of $1,400,000.

If Yurdone requires a 13% return on such undertakings, should the cemetery business be started?

The company is somewhat unsure about the assumption of a 6% growth rate in its cash flows. At what constant growth rate would the company just break even if it still required a 13% return on investment?

a. Here the cash inflows of the project go on forever, which is a perpetuity. Unlike ordinary perpetuity cash flows, the cash flows here grow at a constant rate forever, which is a growing perpetuity. If you remember back to the chapter on stock valuation, we presented a formula for valuing a stock with constant growth in dividends. This formula is actually the formula for a growing perpetuity, so we can use it here. The PV of the future cash flows from the project is:

PV of cash inflows = $C_1/(R - g)$

PV of cash inflows = \$85,000/(0.13 – 0.06) = \$1,214,285.71

So, the NPV is:

NPV of the project = –\$1,400,000 + 1,214,285.71 = –\$185,714.29

The NPV is negative, so we would reject the project.

b. Here we want to know the minimum growth rate in cash flows necessary to accept the project. The minimum growth rate is the growth rate at which we would have a zero NPV. The equation for a zero NPV, using the equation for the PV of a growing perpetuity is:

$$0 = -\$1{,}400{,}000 + \$85{,}000/(0.13 - g)$$

Solving for g, we get:

$$g = .0693 \text{ or } 6.93\%$$

#6:
What is the NPV of a publicly listed common stock? Of a bond? Given your answers, would you purchase a common stock and/or a bond?

Net present value of a common stock is simply the intrinsic value of the stock minus the market price of the stock.

Intrinsic value is calculated by discounting the cash payments received from the stock at different time period using an appropriate discount rate. Similar principle applies when we calculate the NPV of bond.

Since the discount rate is a guess, and since future cash flows are speculative for many types of investments, in practice, NPVs are often calculated with only a few years' worth of cash flows, hopefully underestimating the investment's value.

A zero NPV means the initial investment is repaid plus earns a rate of return equal to the discount rate. We should not make an investment when NPV is negative be it stock or bond.

#7:

Joe is considering a project that requires $90,000 for initial investment. The project generates revenues of $X every year for 6 years. The payback for the project is 4.5 years. The NPV for the project is $2,457.59. What is the discounted payback for this project?

Given payback of 4.5 years, X = $90,000/4.5 = $20,000.

NPV=PV(CFs) – Initial investment

Given NPV of $2,457.59,
N = 6; PMT = $20,000; PV = -($90,000+2,457.59); CP I/Y = 8%

	Cash flow	Disc CF@8%	Cum. Disc CF
0	(90,000)	(90,000)	
1	20,000	18,519	(71,481)
2	20,000	17,147	(54,335)
3	20,000	15,877	(38,458)
4	20,000	14,701	(23,757)
5	20,000	13,612	(10,146)
6	20,000	12,603	2,457.59

Discounted payback = 5 + (10,146/12,603) = **5.81** years