**FIN 303**
**Professor Dow**

**Capital Budgeting Problem Set**

1) For each option, calculate the NPV, IRR and payback period assuming the cost of capital is 6%.

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| A | -10,000 | +5,000 | +5,000 | +5,000 | |
| B | -10,000 | +3,900 | +3,900 | +3,900 | +3,900 |
| C | -10,000 | +2,600 | +2,600 | +2,600 | +2,600 |

If these were independent projects, which would you recommend the firm do?

If these were mutually exclusive projects, which would you prefer?

How would your answer change if the cost of capital increased to 15%? Explain what is happening.

2) You have a choice between two machines. Both machines do the same job, both last the same period of time, both have zero scrap value. Future costs are discounted at 9% (compounded annually).

> Machine A – Costs $10,000 initially, plus expected maintenance costs of $200/year for the next 10 years (starting next year).
>
> Machine B – Costs $11,000 initially, plus expected maintenance costs of $100/year for the next 10 years (starting next year).

At these prices, which machine would you prefer?
At what price for machine B would you be indifferent between machines A and B?

3) A pharmaceutical company will spend $2,000,000 each year for 3 years to develop a new drug (years 0, 1, 2). After that (starting year 3), they will earn $800,000 in profits per year for the next 10 years before the patent runs out. Once the patent is gone they do not expect to earn any additional profits off this drug. If future payments are discounted using an 11% interest rate (compounded annually), is this new drug a profitable venture?

4. The initial cost of developing a project in year 0 is $100,000. You expect to sell 3,000 units per year over the next 5 years (years 1 to 5) at a profit of $10 per unit. Given an interest rate of 7%, what is the NPV of this project? How many units would you have to sell to break even in terms of NPV? If we assumed that you sold 3,000 units per year, what profit per unit would break even in terms of NPV?

5. You are evaluating the NPV of a project to expand sales into a new region. The cost of the expansion is paid in year 0. The benefits of the expansion start in year 1 and last for 10 years, after which they end. Profits are determined by multiplying net-profit-per-unit by the amount of sales. There is some uncertainty about the cost and other parameters. We have high, low and base (most likely) estimates for each of the parameters.

| | High | Base | Low |
|---|---|---|---|
| Cost ($) | 500,000 | 400,000 | 300,000 |
| Sales (units) | 85,000 | 60,000 | 35,000 |
| Net profit per unit ($) | 1.15 | 1.00 | 0.85 |

a) The annual interest rate is 5%. What is the NPV at the base values of the parameters?

b) Show how sensitive the results are to the assumptions about sales, net-profits-per-unit, and cost (use the high and low values of the parameters where appropriate).

c) Do a scenario analysis and determine the NPV for the best and worst cases. (Be careful here, what combination of results is best? What combination is worst?)

1)
A: n: 3, I: 6, **pv: 13,365.06**, pmt: 5000, fv: 0, NPV = 13,365.06-10,000=3,365.06
n: 3, **I(IRR): 23.38**, pv: -10,000, pmt: 5000, fv: 0,
Payback = 2

B: n: 4, I: 6, **pv: 13,513.91**, pmt: 3900, fv: 0, NPV = 13,513.91-10,000=3,513.91
n: 4, **I(IRR): 20.51**, pv: -10,000, pmt: 3900, fv: 0,
Payback = 2+2200/3900 = 2.56

C: n: 4, I: 6, **pv: 9009.27**, pmt: 2600, fv: 0, NPV = 9009.27-10,000=990.73
n: 4, **I(IRR): 1.59**, pv: -10,000, pmt: 2600, fv: 0,
Payback = 3+2200/2600 = 3.85

Independent: Do A and B but not C. Mutually Exclusive: B

A: n: 3, I: 15, **pv: 11,416.13**, pmt: 5000, fv: 0, NPV = 11,416.13-10,000=1,416.13
n: 3, **I(IRR): 23.38**, pv: -10,000, pmt: 5000, fv: 0,

B: n: 4, I: 15, **pv: 11,134.42**, pmt: 3900, fv: 0, NPV = 11,134.42-10,000=1,134.42
n: 4, **I(IRR): 20.51**, pv: -10,000, pmt: 3900, fv: 0,

C: n: 4, I: 15, **pv: 7422.94**, pmt: 2600, fv: 0, NPV = 7422.94-10,000=-2,577.06
n: 4, **I(IRR): 1.59**, pv: -10,000, pmt: 2600, fv: 0,

A is better than B since the payments for B (on average) are coming farther in the future and so are more heavily discounted by the higher interest rate.

2)
A: n: 10, i: 9, **pv: 1283.53**, pmt: 200, fv: 0, Cost=10,000+1,283.53 = 11,283.53

B: n: 10, i: 9, **pv: 641.77**, pmt: 100, fv: 0, Cost=11,000+641.77 = 11,641.77

A is cheaper. If B sold for 10,641.76 they would have the same cost

3)
Cost: $2{,}000{,}000 + 2{,}000{,}000/(1.11) + 2{,}000{,}000/(1.11)^2$

=2,000,000+1,801,801.80+1,623,244.87 = 5,425,046.67

Benefits: n: 10, i: 11, **pv: 4,711,385.61**, pmt: 800,000, fv: 0,

To convert the year 2 pv to year 0 pv: $4{,}711{,}385.61/(1.11)^2 = 3{,}823{,}866.25$

NPV = 3,823,866.25 - 5,425,046.67 = -1,601,180.42 Do not develop the drug.

4.
n: 5, i: 7, **pv: 123,005.92**, pmt: 3000*10, fv: 0,

NPV = 123,005.92- 100,000 = 23,005.92

Break-even pmt is n: 5, i: 7, pv: 100,000, pmt:24,389.07, fv: 0,

At $10 per unit, 2,439 units. At 3,000 units, $8.13

5.

| | |
|---|---|
| Base | n: 10, i: 5, **pv: 463,304**, pmt: 60,000, fv: 0; Cost: 400,000; NPV: 63,304 |
| High Cost | n: 10, i: 5, **pv: 463,304**, pmt: 60,000, fv: 0; Cost: 500,000; NPV: -36,696 |
| Low Cost | n: 10, i: 5, **pv: 463,304**, pmt: 60,000, fv: 0; Cost: 300,000; NPV: 163,304 |
| High Sales | n: 10 ,i: 5, **pv: 656,347**, pmt: 85,000, fv: 0; Cost: 400,000; NPV: 256,347 |
| Low Sales | n: 10, i: 5, **pv: 270,261**, pmt: 35,000, fv: 0; Cost: 400,000; NPV: -129,739 |
| High Profit | n: 10, i: 5, **pv: 532,800**, pmt: 69,000, fv: 0; Cost: 400,000; NPV: 132,800 |
| Low Profit | n: 10, i: 5, **pv: 393,808**, pmt: 51,000, fv: 0; Cost: 400,000; NPV: -6,192 |
| Best | n: 10, i: 5, **pv: 754,800**, pmt: 97,750, fv: 0; Cost: 300,000; NPV: 454,800 |
| Worst | n: 10, i: 5, **pv: 229,722**, pmt: 29,750, fv: 0; Cost: 500,000; NPV: -270,278 |