CAPITAL BUDGETING

Key Terms and Concepts to Know

Capital budgeting:

- The process of planning significant investments in projects that have long lives and affect more than one future period, such as the purchase of new equipment.

Cash Flows:

- Cash inflows may take two forms:
  - Actual cash receipts received
  - Cash outflows avoided
- Cash outflows may take two forms:
  - Actual cash payments made
  - Cash inflows avoided or lost
- Net cash flows are cash inflows less cash outflows.
- Net cash flows are not the same as operating income:
  - Cash flow – depreciation expense = operating income
  - Operating income + depreciation expense = cash flow.

Capital Budgeting Methods:

- Methods that ignore the time value of money
  - Payback method
  - Average / simple / accounting rate of return method
- Methods that consider the time value of money
  - Net present value method (NPV)
  - Internal rate of return method (IRR)

Present Value or Profitability Index

- Method for ranking the net present values of projects when capital is scarce
- Computed as $\frac{\text{Net present value of all future cash flows}}{\text{Net amount to be invested today}}$
- Value greater than 1 equates to a net present value of greater than 0.

Key Topics to Know

Discounted Cash Flow Model

- Always considers the time value of money that makes this model superior to other methods of evaluating capital projects.
- Two separate approaches to capital investment analysis: Net Present Value method and Internal Rate of Return method.
- Net Present Value method computes the difference between the present value of an investment project's future net cash flows and net initial cash outflows using a known discount rate.
- Internal Rate of Return solves for the discount rate which makes the net present value of an investment project's future net cash flows equal to net initial cash outflows, i.e., the internal rate of return sets the net present value = 0.
- The discounted cash flow model always uses cash flows, not operating income.
- Choosing an appropriate discount rate is crucial and may significantly impact the final decision. Typically, the discount rate is based on the cost of capital, the average rate of return a company must pay to its long-term creditors and shareholders for the use of their funds.

Net Present Value Method

- Net Present Value method computes the difference between the present value of an investment project's future net cash flows and net initial cash outflows using a known discount rate.
- The net present value method always uses cash flows, not operating income.
- When projects require investments of significantly different amounts, the project present value or profitability index is computed and used to compare various investment alternatives.
- Project present value or profitability index is the ratio of the net present value of a project's future cash flows to the investment required.

Example #1

The management of Ocala Company is considering the purchase of a $25,000 machine that would reduce operating costs by $4,000 per year. At the end of the machine's 10 year useful life, it will have a zero salvage value. The company requires a 14% on all investment projects.

Required: a) Net present value of the investment
b) Difference between the total, undiscounted, cash inflows and cash outflows, over the entire life of the machine.

Solution #1

a)

	Years	Cash Flows	PV Factor	Present Value
Purchase of machine	Now	($25,000)	1.000	($25,000)
Annual cost savings	1 – 10	4,000	5.216	20,864
Net Present Value				($4,136)

b)

Total annual cost savings	$40,000
Present value of annual cost savings	20,864
Excess of cash flow over present value	$19,136

Example #2

Miami Company has $15,000 to invest. Management is trying to decide between two alternative uses for the funds as follows. The company's discount rate is 16%.

	Project A	Project B
Investment required	$15,000	$15,000
Single cash inflow at the end of 10 years	$0	$60,000
Annual cash inflows	$4,000	$0
Life of the project	10 years	10 years

Required: Which alternative would the company choose?

Solution #2

	Years	Amount	PV Factor	Present Value
Project A				
Cost of equipment	Now	($15,000)	1.000	($15,000)
Annual cash inflows	1 – 10	4,000	4.833	19,332
Salvage value	10	0	.227	0
Net present value				$4,332
Project B				
Cost of equipment	Now	($15,000)	1.000	($15,000)
Annual cash inflows	1 – 10	0	4.833	0
Working capital released	10	60,000	.227	13,620
Net present value				($1,380)

Project A should be selected. Project B does not provide the required 16% return, as shown by its negative net present value.

Example #3

Information on four investment proposals at Tampa Corp. is given below:

	A	B	C	D
Investment required	$85,000	$200,000	$90,000	$170,000
Present value of cash flows	119,000	250,000	135,000	221,000
Net present value	34,000	50,000	45,000	51,000
Life of the project	5 years	7 years	6 years	6 years

Required: Compute the project present value or profitability index for each proposal and rank the proposals in terms of preference.

Solution #3

	A	B	C	D
Net present value	$34,000	$50,000	$45,000	$51,000
Investment required	$85,000	$200,000	$90,000	$170,000
Project present value index	.40	.25	.50	.30
Ranking	2	4	1	3

Note that proposal D has the highest net present value, but it ranks third in terms of the project present value index.

Internal Rate of Return Method

- Internal Rate of Return method computes the discount rate at which the difference between the present value of an investment project's future net cash flows and net initial cash outflows is 0, i.e., the IRR is the discount rate that sets the NPV to 0.
- The internal rate of return method always uses cash flows, not operating income.
- The major limitation of the IRR is the assumption that cash inflows are reinvested at the IRR. This assumption becomes more of an issue as the higher the IRR becomes. The higher the IRR, the less likely it is that there will be an alternative investment with the same or similar IRR to invest in.
- As a result of this limitation, the Modified Internal Rate of Return was developed. The modification to the IRR methodology is that the user specifies the reinvestment rate of the cash inflows.

Example #4

Neighbors Company is considering the purchase of new equipment that will cost $130,000. The equipment will save the company $38,000 per year in cash operating costs. The equipment has an estimated useful life of five years and a zero expected salvage value. The company's cost of capital is 10%.

Required: a) Compute the net present value and internal rate of return.
b) Should the equipment be purchased?

Solution #4

a)

Present value		$38,000	3.7901	$144,050
less: Investment				(130,000)
NPV				$14,050
IRR	$130,000 / $38,000	3.42105	Searching the 5 period row in the PV annuity table, the value closest is 3.43308 in the 14% column. Since the computed value is slightly smaller, the actual IRR must be slightly greater than 14%. The actual IRR is 14.15%.	

b)

The equipment should be purchased since the net present value is positive.

Payback Method:

- Ignores the time value of money.
- Calculates the time period to recover the initial net investment through future cash flows.
- The method for determining the payback period differs whether the future cash flows are even (the same each period) or uneven (differ in one or more future periods.)

Example #5

Tallahassee Company is considering two investments: first, a low-quality blueprint printer with at cost of $20,000 and annual savings of $3,000 for 8 years and second, a high-quality blueprint printer with the following cash flows:

Year	Investment	Cash Inflow
1	($38,000)	$2,000
2	(6,000)	4,000
3		8,000
4		9,000
5		12,000
6		10,000
7		8,000
8		6,000
9		5,000

Required: a) Determine the payback period of each investment.
b) Would the payback periods be affected if the cash inflows in year 7 and 8 were $18,000 each?

Solution #5

a) The payback periods are determined as follows:

First Investment $\dfrac{\text{Investment}}{\text{Annual cash Flow}} = \dfrac{\$20,000}{\$3,000} = 6.67$ years

Second Investment

Year	Investment	Cash Inflow	Unrecovered Investment
1	($38,000)	$2,000	$36,000
2	(6,000)	4,000	38,000
3		8,000	30,000
4		9,000	21,000
5		12,000	9,000
6		10,000	0
7		8,000	
8		6,000	
9		5,000	

The first investment is fully recovered in 6.67 years. The second investment is fully recovered in the 6th year; the payback period is approximately 5.9 years.

b) Since the investment is recovered prior to the last year, the amounts of the cash inflow in years 7 through 9 have no effect on the payback method.

Average (Simple or Accounting) Rate of Return:

- Ignores the time value of money.
- Computed using operating income (accounting income) rather than cash flow divided by the net initial investment.

Example #6

The Marcus Corporation purchased a piece of new equipment in January for $120,000. The equipment was depreciated using the straight line method over an 8 year life without a salvage value. At the end of the year, Marcus reported cash inflow from the new equipment of $51,000.

Required: Compute the average rate of return the year.

Solution #6

$$\frac{\text{Operating income}}{\text{Net investment}} = \frac{\$51{,}000 - \frac{\$120{,}000}{8 \text{ years}}}{\$120{,}000} = \frac{\$36{,}000}{\$120{,}000} = 30\%$$

Practice Problems

Practice Problem #1:

L Company is considering two new machines that should produce considerable cost savings in its assembly operations. The cost of each machine is $14,000 and neither is expected to have a salvage value at the end of a 4-year useful life. L Company's required rate of return is 12% and the company prefers that a project return its initial outlay within the first half of the project's life. The annual after-tax cash savings for each machine are provided in the following table:

Year	Machine A	Machine B
1	$5,000	$8,000
2	5,000	6,000
3	5,000	4,000
4	5,000	2,000
Total	$20,000	$20,000

Required:
a) Compute the payback period for each machine using the incremental approach and comment on the results.
b) Compute the average rate of return based on average investment for each machine. The machines will be depreciated on a straight-line basis.
c) Compute the net present value for each machine.
d) Which machine should be purchased?

Practice Problem #2:

R Company is considering investing in one of the following two projects:

Year	Project A	Project B
1	$2,000	$4,000
2	3,000	2,000
3	3,000	2,000
4	1,000	1,000
Total	$9,000	$9,000

Required:
a) Which project is more desirable strictly in terms of cash inflows? Why?
b) Compute the present value of each project's cash inflows assuming the company's required rate of return is 12%.
c) What is the maximum amount R Company should be willing to pay for each project?
d) Suppose each project costs $7,000. Which project(s) should be accepted? Note that only one project can be accepted.

Practice Problem #3:

B Company is considering purchasing equipment that costs $235,000. The equipment has an estimated useful life of 5 years and no salvage value. B Company believes that the annual cash inflows from using the equipment will be $65,000.

Required:
a) Calculate the net present value of the equipment assuming that B Company's cost of capital is 12%. Is the equipment an acceptable investment?
b) Calculate the net present value of the equipment assuming that B Company's cost of capital is 10%. Is the equipment an acceptable investment?

Practice Problem #4

On January 2, 2009, M Company invested in P Company, paying $18,000 for 900 shares of common stock. M Company received an $.80 per share dividend on the stock at the end of each year for 4 years. At the end of 4 years the stock was sold for $22,500. M Company has a goal of earning a minimum return of 12% on all of his investments.

Required: Did M Company earn a 12% return on the stock?

Practice Problem #5

C Company is investigating four different opportunities. Information on the four projects under study is as follows:

	Project 1	Project 2	Project 3	Project 4
Investment required	$480,000	$360,000	$270,000	$450,000
Present value of cash inflows	567,270	433,400	336,140	522,970
Net present value	$87,270	$73,400	$66,140	$72,970
Life of project	6 years	12 years	6 years	3 years

The company's required rate of return is 10%; therefore a 10% discount rate has been used in the present value computations above. Limited funds are available for investment, so the company cannot accept all of the available projects.

Required:
a) Compute the present value index for each investment project.
b) Rank the four projects according to preference, in terms of:
   - Net present value
   - Present value index

Practice Problem #6

S Company is considering the purchase of a new piece of equipment for laying sod. Relevant information concerning the equipment follows:

Cost of the equipment	$180,000
Annual cost savings from new equipment	$37,500
Life of the new equipment	12 years

Required:
a) Compute the payback period for the equipment. If the company requires a payback period of four years or less, would the equipment be purchased?
b) Compute the average rate of return on the equipment. Use straight-line depreciation based on the equipment's useful life. Would the equipment be purchased if the company's required rate of return is 14%?

Practice Problem #7

P Company is considering a 5-year project. It plans to invest $62,000 now and it forecasts cash flows for each year of $16,200. The company requires a minimum rate of 12%.

Required: Calculate the internal rate of return to determine whether it should accept this project.

True / False Questions

1. Capital budgeting decisions usually involve large investments and often have a significant impact on a company's future profitability.
   True False

2. For purposes of capital budgeting, estimated cash inflows and outflows are preferred for inputs into the capital budgeting decision tools.
   True False

3. The payback technique is a quick way to calculate net present value.
   True False

4. The cash payback period is computed by dividing the cost of the capital investment by the annual cash inflow.
   True False

5. The cash payback method is frequently used as a screening tool but it does *not* take into consideration the profitability of a project.
   True False

6. Using the net present value method, a net present value of zero indicates that the project would not be acceptable.
   True False

7. The net present value method can only be used in capital budgeting if the expected cash flows from a project are an equal amount each year.
   True False

8. The present value index is calculated by dividing the total cash flows by the initial net investment.
   True False

9. The present value index allows comparison of the relative desirability of projects that require differing initial investments.
   True False

10. A post-audit is an evaluation of how well a project's actual performance matches the projections made when the project was proposed.
    True False

11. The interest yield of a project is a rate that will cause the present value of the proposed capital expenditure to equal the present value of the expected annual cash inflows.
    True False

12. Since accounting rate of return method and the internal rate of return method both calculate a rate for return for potential projects, they will recommend the same project(s).
    True False

13. The time value of money is irrelevant in capital budgeting decisions.
    True False

14. The net present value method assumes that cash outflows are reinvested at the discount rate.
    True False

15. The acceptance criteria for the net present value method is a net present value greater than or equal to zero.
    True False

Multiple Choice Questions

1. The capital budgeting decision depends in part on the
   a) Availability of funds.
   b) Relationships among proposed projects.
   c) Risk associated with a particular project.
   d) All of these.

2. Which of the following is *not* a typical cash flow related to equipment purchase and replacement decisions?
   a) Increased operating costs
   b) Overhaul of equipment
   c) Salvage value of equipment when project is complete
   d) Depreciation expense

3. The rate that yields a net present value of zero for an investment is the:
   a) Payback method
   b) Present value index
   c) Net present value
   d) Internal rate of return.

4. The investment required for the project profitability index should:
   a) Be reduced by the amount of any salvage recovered from the sale of the new equipment at the end of its useful life.
   b) Be reduced by the amount of any salvage recovered from the sale of both the old and new equipment.
   c) Be reduced by the amount of any salvage recovered from the sale of old equipment.
   d) Not be adjusted for the salvage value of old or new equipment

5. An asset costs $210,000 with a $30,000 salvage value at the end of its ten-year life. If annual cash inflows are $30,000, the cash payback period is
   a) 8 years.
   b) 7 years.
   c) 6 years.
   d) 5 years.

6. B Company is considering the purchase of a piece of equipment that costs $23,000. Projected net annual cash flows over the project's life are:

Year	Net Annual Cash Flow
1	$3,000
2	8,000
3	15,000
4	9,000

The cash payback period is:
a) 2.63 years.
b) 2.80 years.
c) 2.37 years.
d) 2.20 years.

7. A disadvantage of the cash payback technique is that it
a) Ignores obsolescence factors.
b) Ignores the cost of an investment.
c) Is complicated to use.
d) Ignores the time value of money.

8. If a company's required rate of return is 10% and, in using the net present value method, a project's net present value is zero, this indicates that the
a) Project's rate of return exceeds 10%.
b) Project's rate of return is less than the minimum rate required.
c) Project earns a rate of return of 10%.
d) Project earns a rate of return of 0%.

9. The average or accounting rate of return is the only capital budgeting method that
a) uses net income and not cash flows
b) does not consider the time value of money
c) uses cash flows and not net income
d) considers the time value of money

10. When a capital budgeting project generates a positive net present value, this means that the project earns a return higher than the
    a) Internal rate of return.
    b) Annual rate of return.
    c) Required rate of return.
    d) Present value index

11. S Company recently invested in a project with a 3-year life span. The net present value was $3,000 and annual cash inflows were $7,000 for year 1; $8,000 for year 2; and $9,000 for year 3. The initial investment for the project, assuming a 15% required rate of return, was

Year	Present Value	Present Value of an Annuity
1	.870	.870
2	.756	1.626
3	.658	2.283

    a) $15,264.
    b) $15,060.
    c) $9,744.
    d) $12,792.

12. The internal rate of return method is not subject to the limitations of the net present value method when comparing projects with different amounts invested because:
    a) The internal rate of return is expressed as an absolute dollar value rather than the percent of net present value.
    b) The internal rate of return is expressed as an absolute dollar value rather than the time value of money used in net present value.
    c) The internal rate of return is expressed as a percent rather than the absolute dollar value of present value.
    d) The internal rate of return reflects the time value of money rather than the absolute dollar value of present value.

13. The present value index is computed by dividing the
    a) Total cash flows by the initial investment.
    b) Present value of cash flows by the initial investment.
    c) Initial investment by the total cash flows.
    d) Initial investment by the present value of cash flows.

14. The capital budgeting method that takes into account both the size of the

original investment and the discounted cash flows is the
a) Cash payback method.
b) Internal rate of return method.
c) Net present value method.
d) Present value index.

15. J Company has an 8% required rate of return. It's considering a project that would provide annual cost savings of $20,000 for 5 years. The most that Johnson would be willing to spend on this project is

Year	Present Value	Present Value of an Annuity
1	.926	.926
2	.857	1.783
3	.794	2.577
4	.736	3.312
5	.681	3.993

a) $50,364.
b) $66,240.
c) $79,860.
d) $13,620.

Solutions to Practice Problems

Practice Problem #1

a) Machine A: $14,000/$5,000 = 2.8 years Machine A does not meet the objective.
Machine B: $8,000 + $6,000 = $14,000. Machine B achieves payback in 2 years, and meets the objective.

b) Unadjusted rate of return:
Depreciation expense = $14,000/4 = $3,500 per year
Average incremental increase in annual net income:
Machine A = $5,000 - $3,500 = $1,500
Machine B = ($8,000 + $6,000 + $4,000 + $2,000)/4 = $5,000; $5,000 - $3,500 = $1,500
Average investment = $14,000/2 = $7,000
Machine A: $1,500/$7,000 = 21.4%
Machine B: $1,500/$7,000 = 21.4%

c) Net present value:

	Machine A			Machine B		
Year	Cash flow	PV factor	PV	Cash flow	PV factor	PV
0	($14,000)	1.0000	($14,000)	($14,000)	1.0000	($14,000)
1	$5,000	.8929	$4,465	$8,000	.8929	$7,143
2	5,000	.7972	3,986	6,000	.7972	4,783
3	5,000	.7118	3,559	4,000	.7118	2,847
4	5,000	.6355	3,177	2,000	.6355	1,271
			$1,187			$2,044

d) Machine B is preferred. It has a higher net present value and a shorter payback period.

Practice Problem #2

a) Project B is more desirable because the majority of the cash flows occur earlier. The timing of the cash flows is important because of the time value of money, i.e., the present value of a dollar received in the future is worth less than a dollar today.

b) Present values:

	Project A			Project B	
Cash Flow	PV factor	PV	Cash Flow	PV factor	PV
$2,000	.8929	$1,786	$4,000	.8929	$3,571
3,000	.7919	2,392	2,000	.7919	1,594
3,000	.7118	2,134	2,000	.7118	1,424
1,000	.6355	636	1,000	.6355	636
$9,000		$6,948	$9,000		$7,225
$7,000	Investment	$7,000	$7,000	Investment	$7,000
	NPV	($52)		NPV	$225

c) Maximum that should be paid is the present value of each project.

d) Redmond should accept Project B because its NPV is positive, while Project A's is negative.

Practice Problem #3

a)

Present value	$65,000	3.6048	$234,310
less: Investment			(235,000)
NPV			($690)

Because net present value is negative, the equipment is not an acceptable investment at a required rate of return of 12%.

b)

Present value	$65,000	3.7901	$246,401
less: Investment			(235,000)
NPV			$11,401

Because net present value is positive, the equipment is an acceptable investment at a required rate of return of 10%.

Practice Problem #4

	Years	Cash Flows	PV Factor	Present Value
Purchase of stock	Now	($18,000)	1.000	($18,000)
Annual dividends	1 – 4	720	3.037	2,187
Sale of stock	4	22,500	.636	14,310
Net Present Value				($1,503)

*900 shares X $.80 per share per year = $720 per year.

Mr. Orchard did not earn a 12% return on the stock. The negative net present value indicates that the rate of return on the investment is less than the minimum required rate of 12%.

Practice Problem #5

a)

	Net Present Value	Net Investment	Present value index
Project 1	$87,270	$480,000	.18
Project 2	$73,400	$360,000	.20
Project 3	$66,140	$270,000	.24
Project 4	$72,970	$450,000	.16

b)

	Net Present Value	Present value index
1st Preference	Project 1	Project 3
2nd Preference	Project 2	Project 2
3rd Preference	Project 3	Project 1
4th Preference	Project 4	Project 4

Present value index method is preferred because it properly considers the amount of investment. For example, the present value index method ranks project #3 first as it is has the highest cash inflow generated for each dollar of investment fourth yet the NPV method ranks this project last because of it low net present value.

Practice Problem #6

a)

$$\frac{\text{Net investment required}}{\text{Annual cash flow}} = \frac{\$180,000}{\$37,500} = 4.8 \text{ years}$$

The equipment would not be purchased, since the 4.8 year payback period exceeds the company's maximum 4 year payback period.

b)

Annual cash flow	$37,500
Less: depreciation expense ($180,000/12 yrs)	15,000
Annual incremental operating income	$22,500

$$\frac{\text{Annual incremental operating income}}{\text{Net investment required}} = \frac{\$22,500}{\$180,000} = 12.5\%$$

The equipment would not be purchased since its 12.5% rate of return is less than the company's 14% required rate of return.

Practice Problem #7

Investment	$62,000
Annual cash flows	$16,200
IRR Factor	3.827

In the present value of an annuity of $1 table 5 period column, the factor of 3.827 is between the factors for 9% and 10%. Therefore the project should be rejected as the minimum rate of return is not met.

Solutions to True / False Problems

1. True
2. True
3. False - The payback method and the net present value method are two alternative methods for evaluating capital investments
4. True
5. True
6. False - Unacceptable projects have a negative net present value.
7. False - The net present value method can accommodate both even and uneven cash flows.
8. False - The present value index is calculated as net present value divided by net initial investment.
9. True
10. True
11. False – the IRR is the discount rate that equates the investment with the present value of future cash flows.
12. False – since the two methods have different calculations and the average rate of return ignores the time value of money, they may or may not recommend the same projects.
13. False - the sooner the cash flows are received, the more they will be worth in the future.
14. True
15. True

Solutions to Multiple Choice Questions

1. A
2. D
3. D
4. C
5. B
6. B
7. D
8. C
9. A
10. C
11. B
12. C
13. B
14. B
15. D