Chapter 14 Solutions

Solution 14.1

a) Compare and contrast the various methods of investment appraisal. To what extent would it be true to say there is a place for each of them

As capital investment decisions usually involve significant amounts of finance, it is important to fully evaluate each decision using sound appraisal techniques. The main methods used to evaluate investment in capital projects are:

- Accounting rate of return.
- Payback method.
- Net present value.
- Internal rate of return

These methods use different approaches to evaluating the value of an investment for an organisation. While three of the methods focus on cash flow, the accounting rate of return uses accounting profit in its appraisal calculation, providing a view of the overall profitability of the investment.

The accounting rate of return method calculates the estimated overall profit or loss on an investment project and relates that profit to the amount of capital invested and to the period for which it is required. It is the profit that is directly related to the investment project that is used in the appraisal process and thus costs or revenues generated elsewhere in the business are excluded. A business will have a required minimum rate of return for any investment. This is related to the cost of capital of the business. If an investment yields a return greater than the cost of capital, then the investment would be considered suitable and profitable. The accounting rate of return is an average rate of return calculated by expressing average annual profit as a percentage of the average value of the investment.

Its main advantages are

- It takes account of the overall profitability of the project.
- It is simple to understand and easy to use.
- Its end result is expressed as a percentage, allowing projects of differing sizes to be compared.
- Its main disadvantages are
- It is based on accounting profits rather than cash flows. The calculation of profit and capital employed depend on which items of expenditure are treated as capital (on the balance sheet) and as revenue (charged to the profit and loss account). Despite guidelines in this area, it can be quite subjective. Also different accounting policies (depreciation) can produce different profit and capital employed figures, thus allowing the profit and balance sheet figures to be somewhat manipulated. It is for this reason that capital projects are also evaluated in terms of cash flows.
- The ARR does not take into account the timing of cash flows. For example, project A may give an ARR of 20 per cent compared to project B's 18 per cent. However project A may be an eight year project whereas project B may be a five year project. Investors may choose a project that is slightly less profitable but which generates cash earlier.
- The ARR does not take into account the time value of money. It does not take into account the cost of waiting to recoup the investment.
- The ARR takes no account of the size of the initial investment. A five per cent return on an investment of €25,000 might be acceptable, however it may not be an acceptable return on an initial investment of €10 million.

The payback method of investment appraisal simply asks the question 'how long before I get my money back?' In other words how quickly will the cash flows arising from the project exactly equal the amount of the investment. It is a simple method, widely used in industry and is based on management's concern to be reimbursed on the initial outlay as soon as possible. It is not concerned with overall profitability or the level of profitability.

Based on this method a business will simply reject a project with a payback period longer than that required. The advantages of payback are

- It is simple to understand and apply.
- It promotes a policy of caution in investment.
- Its main disadvantages are
- It takes no account of the timing of cash flows (€100 received today is worth more than €100

received in 12 months time). This is known as the time value of money and will be considered in more detail below.

- It is only concerned with how quickly the initial investment is recovered and thus it ignores the overall profitability and return on capital for the whole project. The accounting rate of return incorporates the overall profitability of the investment.
- The net present value approach involves discounting all cash outflows and inflows of a capital investment project at a chosen target rate of return or cost of capital. The present value of the cash inflows minus the present value of the cash outflows is the net present value. If the NPV is positive, the project is likely to be profitable, whereas if the NPV is negative, the project is likely to be unprofitable. Its main advantages are
- It takes into account the time value of money.
- Profit and the difficulties of profit measurement are excluded.
- Using cash flows emphasises the importance of liquidity.
- It is easy to compare the NPV of different projects.

The main disadvantage associated with this method is that it is not as easily understood as the payback and accounting rate of return. Also, the net present value approach requires knowledge of the company's cost of capital, which is difficult to calculate.

The IRR method calculates the exact rate of return which the project is expected to achieve based on the projected cash flows. The IRR is the discount factor which will have the effect of producing a NPV of 0. It is the return from the project, taking into account the time value of money. Its decision rule is to accept the project if it's IRR is greater than the cost of capital. It main advantage is that the information it provides is more easily understood by managers, especially non-financial managers. Its main disadvantages are

- It is possible to calculate more than two different IRR's for a project. This occurs where the cash flows over the life of the project are a combination of positive and negative values. Under these circumstances it is not easy to identify the real IRR and the method should be avoided.
- In certain circumstances the IRR and the NPV can give conflicting results. This occurs because the IRR ignores the relative size of investments as it is based on a percentage return rather than the cash value of the return. As a result, when considering 2 projects, one may give an IRR of 10 per cent and the other an IRR of 13 per cent. However the project with the lower IRR may yield a higher NPV in cash terms and thus would be preferable.

Overall all four methods provide different approaches to investment appraisal and can provided a difference outlook on a proposed investment. Thus it would seem prudent that management should use all four methods in assessing investment projects. However the NPV approach is the one approach with the least amount of weaknesses or disadvantages and hence this approach should be used as the main guide in evaluating investment projects.

b) With regard to capital investment appraisal methods, explain why cash flows are preferred to accounting profits

The four methods of investment appraisal use different approaches to evaluating the value of an investment for an organisation. While three of the methods focus on cash flow, the accounting rate of return uses accounting profit in its appraisal calculation, providing a view of the overall profitability of the investment.

The accounting rate of return is based on the use of operating profit. The operating profit of a project is the difference between revenues earned by the project, less all the operating costs associated with the project, including depreciation. Note, the revenues and expenses must be directly related to the project and would exclude any element of fixed costs apportioned from elsewhere in the business.

All other appraisal methods use net cash flows as the basis for appraising capital projects. Ultimately cash flows are preferred to accounting profits due to the nature of capital investment projects. This is due to the fact that the timescale on capital projects between investing and receiving payback are quite long.

Financial theory tells us that waiting for money has a cost. For example the cost of waiting for a customer to pay their account is the interest charge on a bank overdraft used while waiting. To take account of this cost of waiting, it is important to be mindful of the timing of the cash inflows and outflows of a business. The calculation of accounting profit is not concerned with the timing of cash flows and thus cannot take into account this cost of waiting.

Solution 14.2

a) List the distinctive features of capital investments which make it worthwhile developing and applying a special set of techniques to evaluate them

Capital investments have very distinct features which make it worthwhile developing and applying a special set of techniques to appraise these decisions. These features are:

- The sums involved are relatively large. Bad decisions can have very serious long-term consequences.

- The timescale over which the benefits will be received is relatively long, with greater risks and uncertainty in forecasting future revenues and costs.

- The nature of a business, its direction and rate of growth is ultimately governed by its overall investment programme.

- The irreversibility of some projects due to the specialised nature of certain assets for example, some plant and machinery bought with a specific project in mind could have little or no scrap value.

- In order to complete projects on time and within budget, adequate continuous control information is required.

- Capital investment is long-term and the recoupment of investment may involve a significant period of time. This waiting period has a cost because the money tied up could be used elsewhere to generate a return or earn interest. This is an important principle of financial management which recognises that monies receivable in the future, have less value than if they were received immediately. This is because:

    - By waiting for cash, one is foregoing the opportunity to invest and earn interest or a return on the investment.

    - The buying power of €1 received today is greater than €1 received in 12 months time due to inflation.

b) Briefly describe the term 'cost of capital', explaining its significance in relation to appraising capital projects

All investment projects require funding. Generally, funding can be classified into:

- Equity funding, where investors buy an equity or ownership share in a project. This is done through the issue of shares or by retaining profits in the business.

- Debt, where the company can borrow or issue its own debentures.

Each source of finance has a cost. The cost of debt is the interest rate that applies to the debt. The costs of equity finance are the dividends and increases in share price expected by shareholders. It is not enough for a business to generate a profit. A business must generate a profit level sufficient to cover the cost of capital. Hence cost of capital becomes the benchmark or minimum required return for a business. Thus a business is only truly profitable when its actual return on assets is greater than its cost of capital. For example a company invests €150,000 in two second-hand limousines. The investment has been financed through a bank loan of nine per cent. In its first year, the cars generate an operating profit of €20,000. *Is this business generating a return greater than the cost of capital.*

Ignoring corporation tax, the business achieved an operating profit of €20,000 and hence the return on assets (ROCE) is 13.33 per cent (€20,000 ÷ €150,000). This is greater than the cost of capital of nine per cent and thus the project is truly profitable. Another way to look at this is that the business must make at least €13,500 (€150,000 x 9%) profit to meet the cost of capital.

The business cost of capital is the discount factor to use when discounting future cash flows to present values, as it represents the minimum required return for investors to compensate them for the interest lost, inflation, and risk inherent in any investment. Should a business be financed through a mixture of equity and debt, then a weighted average cost of capital should be calculated and this should be the factor used in discounting future cash flows to present value.

Solution 14.3

a) Describe what is meant by the term 'the time value of money' and briefly describe the factors that ensure that monies received in different time periods will have different values

In appraising capital projects it must be kept in mind that €1 earned or spent sooner, is worth more than €1 earned or spent later. The earlier positive cash flows are generated, the sooner they can be used to make a further contribution to profit. Thus money ahs a time value and this plays an important role in appraising capital projects because the time lag between the initial investment and payback can be quite long. However the difficulty lies in comparing €1 cash flow received today with €1 received in the future, as the two cannot be equal to each other given they are received in different time periods. Thus to evaluate any project taking into account the time value of money, the cash flows received in the future must be reduced or discounted to a present value, so that all relevant cash flows are denominated in todays value (present value). This discount factor represents the cost of waiting, or the time value of money.

The reasons why cash flows received in different time periods have different values are:

- *Uncertainty*: Monies invested in projects run the risk of not being refundable. Ultimately, investors take this risk and profit is a payment for risk-taking. The greater the risk an investor takes, the greater will be the required return from the project to compensate for this risk-taking. The business world is full of uncertainty and risk, thus investors will require the promise of significant returns to entice them to take on extra risk. Although there might be a promise of future cash flows, it can never be certain that the money will be received. For example the massive investment in the 'dot.com' sector in the late 1990's ensured massive valuations for these companies before they even made a profit. However as many investors will now testify, most did not make and never will make, a profit.

- *Interest or returns lost*: Monies received earlier can be invested to earn extra income for a business. Monies received earlier can be used to reduce bank overdrafts and thus reduce the associated interest cost. Having to wait for cash results in this opportunity cost. DCF therefore takes into account the notional interest lost because of the time delay in receiving cash flows.

- *Inflation:* General price inflation ensures that €1 now, purchases more and is worth more, than €1 received in the future. It is important to know that even if there was a period of zero inflation, the time value of money would still be a relevant concept and DCF would still be used for investment appraisal.

Uncertainty and risk, inflation, and the interest or return lost by not receiving cash earlier, all ensure that waiting for future cash flows has a cost and hence money has a time value. The difficulty for every business is to evaluate their cost of waiting or their time value of

money, as it will be different for every business due to the following:

- The differing levels of uncertainty and risk that applies to different business sectors, as well as to different businesses within a sector.

- The inflation rate that applies to the specific business sector that the company operates in.

- The opportunity cost of waiting is related to the interest foregone by not having the money earlier. This is certainly easier to evaluate than inflation or risk.

In reality, these three elements make up the cost of capital of a business and hence the discount factor to use in evaluating capital projects should be the cost of capital that applies to that business.

b) Compare the payback and net present value methods of investment appraisal

The payback method of investment appraisal focuses on how quickly will the cash flows arising from the project exactly equal the amount of the investment. It is a simple method, widely used in industry and is based on management's concern to be reimbursed on the initial outlay as soon as possible. Its main disadvantages are it is not concerned with overall profitability or the level of profitability and it takes no account of the time value of money. Management can set a required payback period when appraising projects so that if the payback on any project looks to be longer than this set criteria then the project is rejected.

The net present value method of investment appraisal focuses on all the cash flows generated by an investment project. It focuses on discounting all the cash outflows and inflows of a capital investment project, at a chosen target rate of return or cost of capital. Thus cash flow are all based on a present or current value The present value of the cash inflows, minus the present value of the cash outflows, is the net present value (NPV).

- *If the NPV is positive*, it means that the cash inflows from the investment will yield a return in excess of the cost of capital and thus the project should be undertaken, as long as there are no other projects offering a higher NPV.

- *If the NPV is negative*, it means that the cash inflows from the investment yield a return below the cost of capital and so the project should not be undertaken.

- *If the NPV is exactly zero,* the cash inflows from the investment will yield a return which is exactly the same as the cost of capital and thus the project may or may not be worth undertaking depending on other investment opportunities available.

Its advantages include

- It takes into account the time value of money.
- Profit and the difficulties of profit measurement are excluded.
- Using cash flows emphasises the importance of liquidity.
- It is easy to compare the NPV of different projects.

The main disadvantages associated with the net present value approach are that it is not as easily understood as the payback and accounting rate of return. Also, the net present value approach requires knowledge of the company's cost of capital, which is difficult to calculate.

Solution 14.4

a) Briefly state what you understand by discounted cash flows and explain why, in appraising capital investments, it is necessary to discount cash flows?

Discounted cash flows are cash flows that are to be received in the future and are discounted to give them a present or current value. Discounted cash flow methods (DCF) are capital appraisal techniques that account for the fact that €1 earned or spent sooner, is worth more than €1 earned or spent later. The earlier positive cash flows are generated, the sooner they can be used to make a further contribution to profit. Thus the time value of money concept plays an important role in appraising capital projects because the time lag between the initial investment and payback can be quite long. However the difficulty lies in comparing €1 cash flow received today with €1 received in the future, as the two cannot be equal to each other given they are received in different time periods. Thus to evaluate any project taking into account the time value of money, the cash flows received in the future must be reduced or discounted to a present value, so that all relevant cash flows are denominated in todays value (present value). This discount factor represents the cost of waiting, or the time value of money.

b) Distinguish between the net present value and the internal rate of return methods of capital investment appraisal. You should explain why the net present value method is preferred to the internal rate of return method

The net present value approach involves discounting all cash outflows and inflows of a capital investment project at a chosen target rate of return or cost of capital. The present value of the cash inflows minus the present value of the cash outflows is the net present value. If the NPV is positive, the project is likely to be profitable, whereas if the NPV is negative, the project is likely to be unprofitable. Its main advantages are

- ❑ It takes into account the time value of money.
- ❑ Profit and the difficulties of profit measurement are excluded.
- ❑ Using cash flows emphasis's the importance of liquidity.
- ❑ It is easy to compare the NPV of different projects.

The main disadvantage associated with this method is that it is not as easily understood as the payback and accounting rate of return. Also, the net present value approach requires knowledge of the company's cost of capital, which is difficult to calculate.

The IRR method calculates the exact rate of return which the project is expected to achieve based on the projected cash flows. The IRR is the discount factor which will have the effect of producing a NPV of 0. It is the return from the project, taking into

account the time value of money. Its decision rule is to accept the project if it's IRR is greater than the cost of capital. It main advantage is that the information it provides is more easily understood by managers, especially non-financial managers. Its main disadvantages are

- It is possible to calculate more than two different IRR's for a project. This occurs where the cash flows over the life of the project are a combination of positive and negative values. Under these circumstances it is not easy to identify the real IRR and the method should be avoided.

- In certain circumstances the IRR and the NPV can give conflicting results. This occurs because the IRR ignores the relative size of investments as it is based on a percentage return rather than the cash value of the return. As a result, when considering 2 projects, one may give an IRR of 10 per cent and the other an IRR of 13 per cent. However the project with the lower IRR may yield a higher NPV in cash terms and thus would be preferable.

It is for these reasons that the NPV method is preferred to the IRR approach especially when comparing mutually exclusive investments.

Solution 14.5

a) Determine which project to recommend according to:
The payback method.
The net present value method.

(Your recommendation should be clearly explained for both methods)

1) Payback method

Year	Project A Cash Flows	Project A Cumulative Cash Flows	Project B Cash Flows	Project B Cumulative cash flows
0	-70,000	-70,000	-70,000	-70,000
1	10,500	-59,500	8,900	-61,100
2	15,600	-43,900	8,560	-52,540
3	20,567	-23,333	24,066	-28,474
4	25,671		30,200	
5	22,700		38,131	
Payback	3 years + {12 x 23333/25671}		3 years + [12 x 28474/30200]	
	3 years + 10.9 months		3 years + 11.31 months	

2) Net present value

Year	Project A Cash Flows	Disc 10%	Present Value	Project B Cash Flows	Disc 10%	Present Value
0	-70,000	1	-70000	-70,000	1	-70000
1	10500	0.909	9544.5	8900	0.909	8090.1
2	15600	0.826	12885.6	8560	0.826	7070.56
3	20567	0.751	15445.82	24066	0.751	18073.57
4	25671	0.683	17533.29	30200	0.683	20626.6
5	22,700	0.621	14096.7	38,131	0.621	23679.35
NPV			**-494.09**			**7540.18**

Based on the net present value approach it is clear that project B should be recommended at the expense of project A. Project B is projected to provide a positive net present value. This means that the present value of the cash inflows are greater than the present value of the cash outflows with all cash flow discounted at the cost of capital. Thus the project should provide a return in excess of the minimum required return. Project A is projected to provide a negative net present value and thus this project is expected to provide a return less than the minimum required return.

The payback approach simply asks the question, which project will be first to payback the initial capital outlay. In this case there is very little difference between the projects with the payback for project A at 3 years and 10.9 months whereas project B is at 3 years and 11.3 months. Overall the recommendation should be based on the net present value approach as it focuses on the total cash flows of each projects as well as taking the time value of money into account. Thus the recommendation should be project B.

b) Briefly list any other factors that should be taken into account before a decision is made

- Management should assess the uncertainty in its forecast figures through the use of sensitivity analysis. Sensitivity analysis should he applied to all the variables that are inputs to for example the net present value decision model. Thus applying sensitivity analysis to the cost of capital as

well as the forecast cash flows

- Management should try and ascertain the non quantifiable factors which may effect the business based on their decision.

- Management should try and assess are their any other investment opportunities available

Solution 14.6

a) Calculate the payback period, the net present value and the internal rate of return for the project

Approach: In this question one must firstly calculate the relevant cash flows for the project. In this case sales and variable costs are relevant to the decision however of the fixed costs depreciation should be excluded as it is only a restatement of the initial cost of the asset and is a non-cash item. Thus only €30,000 of the fixed costs are relevant to the decision.

Payback period

Year	Cash flow	Cumulative cash flow
0	-(500,000)	(500,000)
1	94,000	(406,000)
2	106,400	(299,600)
3	162,200	(137,400)
4	137,400	
5	150,200	

The payback period is exactly 4 years. Thus the payback is projected to occur 80% through the life of the project. Relatively speaking this is a long payback period.

Net present Value

Year	Cash flow	Disc 10%	P.V.
0	-500,000	1	-500000
1	94,000	0.909	85446
2	106,400	0.826	87886.4
3	162,200	0.751	121812.2
4	137,400	0.683	93844.2
5	150,200	0.621	93274.2
		NPV	**-17737**

The net present value is a negative value of €17,737. Thus the sum of the present value of the cash outflows exceeds the sum of the present value of the cash inflows. That implies that the project is offering returns below the cost of capital for the business. The Internal rate of return can calculate the actual return on the project taking into account the time value of money

Internal rate of return

This involves through trial and error finding and discount factor that will give a positive NPV. At 10% the NPV is negative. Thus reducing the cost of capital should help ensure a positive NPV. Let us try discounting the cash flows at 5%.

Year	Cash flow	Disc 10%	P.V.	Disc 5%	P.V.
0	-500,000	1	-500000	1	-500000
1	94,000	0.909	85446	0.952	89488
2	106,400	0.826	87886.4	0.907	96504.8
3	162,200	0.751	121812.2	0.864	140140.8
4	137,400	0.683	93844.2	0.823	113080.2
5	150,200	0.621	93274.2	0.784	117756.8
		NPV	**-17737**		**56970.6**

Through the use of the interpolation formula one can calculate the IRR as follows

$$\text{IRR} = 5 + \frac{56971}{17737 + 56971} \times 10 - 5$$

$$5 + 3.81$$

$$8.81$$

The IRR of this project is 8.81% and is below the cost of capital of 10%.

b) State, with reasons, whether you feel the project is financially viable

The project is not financially viable according to the projected figure given and thus the project should be rejected on the basis that

- The payback period is projected to happen very late in the life of the project.
- The net present value of the project is decisively negative at the company's cost of capital.
- The IRR is less that the company's cost of capital.

Solution 14.7

Evaluate the proposals and make recommendations to management on the best course of action

The Approach to this question focuses on the relevant cash flows for the decision to either hold and use the assets or sell now. You will notice that the question does not ask you to assess the decision based on any one investment appraisal technique. This situation is a mutually exclusive one and thus the appropriate technique to use in assessing this decision is the net present value approach.

Sell now option

In this option the relevant cash flow is the cash received if the assets are sold. The original cost of the asset and net book value are sunk costs and thus irrelevant to the decision. The profit on the sale is irrelevant as it takes into account the sunk cost of the net book value of the assets. The cash received for selling the assets are received immediately and they represent the present value of that transaction. Thus the present value of the cash flows received in selling the assets is €250,000.

		Cash flow	Disc 15%	Present Value
Proposal 1 Sell now				
	Relevant cash flows	250000	1	**250000**

Hold the assets option

In this option the relevant cash flows are the sales revenues and the variable costs. Depreciation is excluded as it is simply a restatement of the cost of the asset. Fixed costs are also excluded as they would occur irrespective of the decision and thus are non incremental. The relevant cash flows discounted at 15% are as follows

Proposal 2 Hold the assets

calculation of relevant cash flows

Year	Revenues	Variable costs	Contribution	Disc 15%	Present Value
1	187500	63750	123750	0.87	107662.5
2	216250	76250	140000	0.756	105840
3	146250	49550	96700	0.658	63628.6
NPV					**277131.1**

Based on the net present value approach management should hold and use the assets.

Solution 14.8

a) Calculate the following, explaining your answer in each case:

i. The payback period.

Year	Cash Flows	Cumulative Cash Flow
0	-210,000	-210,000
1	53,000	-157,000
2	49,500	-107,500
3	46,000	-61,500
4	42,500	-19,000
5	39,000	
6	32,000	
7	25,000	

The payback period is calculated as follows

Payback	4 years + (19,000/39,000 x 1)	4.49 years

The company expects to be repaid their initial investment in 4.5 years.

ii. The accounting rate of return.

This requires the calculation of the total profit for the project which can be calculated as total relevant cash flows less depreciation. The calculations are as follows

ARR	Total project profit (287,000 - 210,000)		77,000
	Average annual profit	77,000/7	11,000
	Average investment	210,000 +0/2	105,000
	ARR	**11,000/105,000**	**10.47%**

The overall average annual return on investment offered by the project, not taking into account the time value of money is 10.47%.

iii. *The net present value of the project.*

Year	Cash Flows	Disc 12%	Present Value
0	-210,000	1	-210000
1	53,000	0.893	47329
2	49,500	0.797	39451.5
3	46,000	0.712	32752
4	42,500	0.636	27030
5	39,000	0.567	22113
6	32,000	0.507	16224
7	25,000	0.452	11300
	NPV		**-13800.5**

The NPV of the project is €13,800 negative. The present value of the cash outflows exceed the present value of the cash inflows by €13,800. Thus the project is not acceptable as it will not offer a return on capital greater than the cost of capital.

iv. The internal rate of return for the project.

As the NPV of the project is negative one must calculate a positive NPV. This is achieved by discounting the cash flows at a lower cost of capital.

Year	Cash Flows	Disc 12%	Present Value	Disc 8%	Present Value
0	-210,000	1	-210000	1	-210000
1	53,000	0.893	47329	0.926	49078
2	49,500	0.797	39451.5	0.857	42421.5
3	46,000	0.712	32752	0.794	36524
4	42,500	0.636	27030	0.735	31237.5
5	39,000	0.567	22113	0.681	26559
6	32,000	0.507	16224	0.63	20160
7	25,000	0.452	11300	0.583	14575
			-13800.5		10555

The IRR is calculated as follows

$$8 + \left(\frac{10555}{10555 + 13800} \times 12 - 8 \right) = 9.73\%$$

b) State, with reasons, whether you feel the project is viable

This project is not viable as it offers a return less than the cost of capital

- The accounting rate of return is 10.5% less than the cost of capital of 12%
- The IRR is less than the ARR (as it takes into account the extra cost of waiting) at 9.73%. This is well below the cost of capital or minimum required return for the business and thus the project should be rejected.
- The NPV of the project is €13,800 negative. The present value of the cash outflows, exceed the present value of the cash inflows by €13,800. Thus the project is not acceptable as it will not offer a return on capital greater than the cost of capital.

Solution 14.9

Recommend to management which investment should be made and why

Approach: *In this question you are not given the initial investment required for each of the asset types. This is calculated by adding the total depreciation charged over the life and as the assets are expected to have a residual value of zero this adds to the original cost of the assets.*

i. *The payback method.*

New Age

Year	Cash flow	Cum C/F
0	-47,500	-47,500
1	10,000	-37,500
2	11,000	-26,500
3	18,000	-8,500
4	16,200	7,700
5	10,000	17,700

Payback 3 years + (8500/16200 x 12) 3 years 6.3 months

Standard Equipment

Calculation of relevant cash flows

Year	Cash flow	Cum C/F
0	-30,000	-30,000
1	4,000	-26,000
2	7,500	-18,500
3	13,200	-5,300
4	8,400	3,100
5	4,000	7,100

Payback 3 years + (5300/8400 x 12) 3 years + 7.57 months

ii. The net present value method.

New Age

Year	Cash flow	Disc 10%	P.V.
0	-47,500	1	-47500
1	10,000	0.909	9090
2	11,000	0.826	9086
3	18,000	0.751	13518
4	16,200	0.683	11064.6
5	10,000	0.621	6210
			1468.6

Standard Equipment

Year	Cash flow	Disc 10%	P.V.
0	-30,000	1	-30000
1	4,000	0.909	3636
2	7,500	0.826	6195
3	13,200	0.751	9913.2
4	8,400	0.683	5737.2
5	4,000	0.621	2484
			-2034.6

iii. The internal rate of return method.

New Age

Year	Cash flow	Disc 10%	P.V.	Disc 15%	P.V.
0	-47,500	1	-47500	1	-47500
1	10,000	0.909	9090	0.87	8700
2	11,000	0.826	9086	0.756	8316
3	18,000	0.751	13518	0.658	11844
4	16,200	0.683	11064.6	0.572	9266.4
5	10,000	0.621	6210	0.497	4970
			1468.6		**-4403.6**

IRR 10 + (1468.6/1468.6+4403.6) x 10-15 11.25%

Standard Equipment

Year	Cash flow	Disc 10%	P.V.	Disc 3%	P.V.
0	-30,000	1	-30000	1	-30000
1	4,000	0.909	3636	0.971	3884
2	7,500	0.826	6195	0.943	7072.5
3	13,200	0.751	9913.2	0.915	12078
4	8,400	0.683	5737.2	0.888	7459.2
5	4,000	0.621	2484	0.863	3452
			-2034.6		**3945.7**

IRR 3 + (3945.7/3945.7+2034.6) x 10-3 7.62%

Based on the various appraisal techniques the company should invest in the new age equipment. The reasons are as follows

- The payback period is slightly less for the new age investment
- More importantly the NPV of the new age investment is positive whereas the NPV for the standard equipment is negative. Thus the present value of the cash inflows exceed the present value of the cash outflows for the new age investment whereas the opposite is expected to occur for the standard equipment.
- The IRR for the new age investment is above the cost of capital for the business whereas the IRR for the standard equipment is below the cost of capital or minimum required return for the business

Solution 14.10

Advise the company on the course of action it should take

Approach: This company must choose one of 3 options and as such this is a mutually exclusive decision scenario. Thus the NPV method is the most suitable technique to use in this situation.

Option 1 - Rent the land.

This will ensure an annual rental income of €10,000 for the 6 years. This must be discounted to get the present value of this annuity as follows using the annuity tables (12% year 6).

NPV	10,000 * 4.111	**41,111**

Option 2 - Work the land

The following are the relevant cash flows for this option discounted at 12%

Year	C/F	DISC 12%	P.V
0			
1	-10,000	0.893	-8930
2	20,000	0.797	15940
3	18,000	0.712	12816
4	15,000	0.636	9540
5	12,000	0.567	6804
6	9,000	0.507	4563
NPV			**40733**

Option 3 – Sell the remainder of the lease

In this scenario the lease can be sold immediately for €39,000. Thus the NPV of thie option is €39,000

Overall the option with the highest NPV is to rent the land. This option would also be less risky then option 2 as it would be based on a rental agreement whereas option 2 is based on forecast costs and revenue which may not be accurate. The least risky option is option 3 to sell the remainder of the lease although this has the lowest NPV. Overall the company should choose option 1

Solution 14.11

a) Evaluate the above project using the following methods:

- **Net present value**
- **Internal rate of return**

To calculate the NPV and IRR of this project one must first calculate the relevant cash flows. This will require excluding or adding back depreciation and any apportioned overheads. Also any increases in working capital will be treated as a cash outflow in the year it occur with working capital liquidated in year 5. The cash flow and working capital calculations are as follows.

Cash flows / year	1	2	3	4	5
	€000s	€000s	€000s	€000s	€000s
Sales revenue	980	1,132	1,200	1,309	1,440
Less: Variable costs	-630	-729	-768	-833	-900
Cash contribution	350	403	432	476	540
Less: Hotel fixed overheads	-350	-360	-370	-375	-380
Operating accounting profit	0	43	62	101	160
Add: Depreciation	200	200	200	200	200
Apportioned head office overheads	70	70	75	75	75
Relevant operating cash flows	**270**	**313**	**337**	**376**	**435**
Opening working capital	98	113	120	131	144
(Incr)/decr in working capital	-98	-15	-7	-11	-13
Recovery of working capital in yr 5					144

Once the cash flows are ascertained then one can calculate the net present value and the internal rate of return of the project

Net Present Value

Discounted Cash Flow Valuation as of 01 Jan year 1

Year	Investment	(Incr)/Decr working capital	Relevant Operating Cash Flows	Net Cash Flow	11% Disc	PV of Cash Flows
	€	€	€	€		4
2001	-1,200	-98		-1,298	1.000	-1,298
2001		-15	270	255	0.901	230
2002		-7	313	306	0.812	248
2003		-11	337	326	0.731	238
2004		-13	376	363	0.659	239
2005	200	144	435	779	0.593	462
	-1,000	0	1,731	731	**NPV**	**120**

Internal rate of return

The NPV of the project based on the cost of capital of 11% is positive thus to calculate a negative NPV one must use a higher cost of capital.

Internal Rate of Return Method

Yr	Net Cash Flow €	11% Disc	PV of Cash Flow €	15% Disc	PV of Cash Flow €
0	-1,298	1.000	-1,298	1.000	-1,298
1	255	0.901	230	0.870	222
2	306	0.812	248	0.756	231
3	326	0.731	238	0.658	214
4	363	0.659	239	0.572	207
5	779	0.593	462	0.497	387
	731		120		(37)

Low rate	11%
High rate less low rate	4%
NPV of low rate	120
NPV of high rate	(37)

IRR% = 11% + (4%)(120/ 120+37) 14.05%

b) Compare and contrast the above two approaches to project evaluation

The net present value approach involves discounting all cash outflows and inflows of a capital investment project at a chosen target rate of return or cost of capital. The present value of the cash inflows minus the present value of the cash outflows is the net present value. If the NPV is positive, the project is likely to be profitable, whereas if the NPV is negative, the project is likely to be unprofitable. Its main advantages are

- It takes into account the time value of money.
- Profit and the difficulties of profit measurement are excluded.
- Using cash flows emphasises the importance of liquidity.
- It is easy to compare the NPV of different projects.

The main disadvantage associated with this method is that it is not as easily understood as the payback and accounting rate of return. Also, the net present value approach requires knowledge of the company's cost of capital, which is difficult to calculate.

The IRR method calculates the exact rate of return which the project is expected to achieve based on

the projected cash flows. The IRR is the discount factor which will have the effect of producing a NPV of 0. It is the return from the project, taking into account the time value of money. Its decision rule is to accept the project if it's IRR is greater than the cost of capital. It main advantage is that the information it provides is more easily understood by managers, especially non-financial managers. Its main disadvantages are

- It is possible to calculate more than two different IRR's for a project. This occurs where the cash flows over the life of the project are a combination of positive and negative values. Under these circumstances it is not easy to identify the real IRR and the method should be avoided.

- In certain circumstances the IRR and the NPV can give conflicting results. This occurs because the IRR ignores the relative size of investments as it is based on a percentage return rather than the cash value of the return. As a result, when considering 2 projects, one may give an IRR of 10 per cent and the other an IRR of 13 per cent. However the project with the lower IRR may yield a higher NPV in cash terms and thus would be preferable.

c) Comment on the proposed project

The project gives a positive NPV of €120,000. Also the IRR for the project is 14.05% which is in excess of the cost of capital for the company of 11%. Thus the project is acceptable. However further investigation into the assumptions and projections by applying sensitivity analysis to the key variable should provide further information to support the decision.

Solution Question 14.12

a) Calculate the net present value of the investment.

The approach to this question is firstly to calculate the relevant operating cash flows. This means excluding or adding back depreciation as follows

Accounting profits and Cash flows

Cash flows / year	Year 1	Year 2	Year 3	Year 4	Year 5
	€	€	€	€	€
Sales revenue	600,000	640,000	680,000	810,000	810,000
Variable costs	-360,000	-384,000	-408,000	-486,000	-486,000
Cash contribution	240,000	256,000	272,000	324,000	324,000
Fixed costs	-210,000	-210,000	-210,000	-210,000	-210,000
Operating accounting profit	30,000	46,000	62,000	114,000	114,000
Add: Depreciation	120,000	120,000	120,000	120,000	120,000
Operating cash flows	**150,000**	**166,000**	**182,000**	**234,000**	**234,000**

Once the operating and capital and working capital cash flows are known then one can calculate the net cash flows and the NPV of the project

(a) Net Present Value

Year	Investment.	(Incr)/decr working capital	Operating Cash flow	Net Cash Flow	13% Disc	Present Value Cash Flow
	€	€	€	€		€
0	-750,000	-50,000		-800,000	1.000	-800,000
1			150,000	150,000	0.885	132,750
2			166,000	166,000	0.783	129,978
3			182,000	182,000	0.693	126,126
4			234,000	234,000	0.613	143,442
5	150,000	50,000	234,000	434,000	0.543	235,662
	-600,000	0	966,000	366,000	**NPV**	**-32,042**

b) Calculate the internal rate of return.

The NPV at 13% is a negative figure of €32,040. Now we must calculate a positive NPV by choosing a lower discount rate.

(b) IRR

Year	Net CF	10% Fac	Present Value Cash Flows
	€		€
0	-800,000	1.000	-800,000
1	150,000	0.909	136,350
2	166,000	0.826	137,116
3	182,000	0.751	136,682
4	234,000	0.683	159,822
5	434,000	0.621	269,514
	366,000	**NPV**	**39,484**

$$\text{IRR} \quad 10\% + \frac{(39484 \times 3)}{39484+32040}$$

IRR 10% + 1.66% = 11.66%

c) *Calculate the payback period.*

Year	Net Cash Flow	**(c) Payback** Cum cash flow
	€	€
0	-800,000	(800,000)
1	150,000	(650,000)
2	166,000	(484,000)
3	182,000	(302,000)
4	234,000	(68,000)
5	434,000	
	366,000	

Payback, 4 years + (68,000/234,000 x 12) = 4.29 years

Note: In calculating the number of months in the final year for the payback the amount outstanding of €68,000 is divided by the projected operating cash flows for the final year as the capital cash flows for that year are very significant (€200,000)and will not be received until the year end.

d) Comment on the proposed investment.

The project should be rejected on the basis of the following

- It offers a negative NPV of €32,040 or 4% of the initial outlay.
- It has a IRR of 11.66% compared to the company's cost of capital of 13%
- The project is not estimated to repay the capital investment until the final year.

However further investigations on the projections and the projected assumptions particularly tourist numbers, the price per tour, the variable cost per tour and also the cost of capital before a final decision is made.

Solution Question 14.13

a) Evaluate and comment on the above project using the following methods:

i. Net present value.

ii. Internal rate of return.

Approach

The initial step in this question is to calculate the capital and operating cash flows. Regarding the capital cash flows the consultancy costs are irrelevant to the decision they have already being paid. All increases in working capital will be liquidated in the final year.

Regarding the operating cash flows depreciation is excluded or added back and the profit lost in other areas due to the decision to upgrade is a relevant cost and must be deducted in calculating the operating cash flows. The calculation of the operating cash flows are as follows.

(A) Cash flows / year	**1**	**2**	**3**	**4**	**5**
Sales revenue	1,800	1,900	2,100	2,250	2,350
Less: Variable costs	720	830	900	930	980
Cash contribution	1,080	1,070	1,200	1,320	1,370
Less: Hotel fixed overheads	790	810	825	835	850
Operating accounting profit	290	260	375	485	520
Add: Depreciation	650	650	650	650	650
Operating cash flows from hotel	940	910	1,025	1,135	1,170
Less: Other profits lost	-35	-40	-45	-45	-45
Relevant oper. cash flows	**905**	**870**	**980**	**1,090**	**1,125**
Opening working capital	90	95	105	113	118
(Incr)/decr in working capital	-90	-5	-10	-8	-5
Recovery of work cap end yr 5					118

Calculation of NPV

NPV Method

Yr	Investment	(Incr)/Decr working capital	Operating Cash Flow	Net Cash Flow	11% Disc	Present Value Net Csh Flows
	€	€	€	€		€
0	-3,750	-90		-3,840	1.000	-3,840
1		-5	905	900	0.901	811
2		-10	870	860	0.812	698
3		-8	980	973	0.731	711
4		-5	1,090	1,085	0.659	715
5	500	118	1,125	1,743	0.593	1,034
	-3,250	0	4,970	1,720	**NPV**	**129**

Calculation of IRR

The NPV of the project is a positive value based on a discount factor of 11%. To calculate the IRR one must calculate a negative NPV using a higher discount factor.

Calculation IRR

Year	Net Cash Flow	13% Disc	Present Value Net Cash Flows
0	-3840	1.000	-3,840
1	900	0.885	796
2	860	0.783	674
3	973	0.693	674

4	1,085	0.613	665
5	1,743	0.543	946
		NPV	**-85**

The IRR is calculated as $(11) + \left(\frac{129}{129 + 85} \times 2\right) = 12.2\%$

b) How sensitive is the project to the assumptions regarding selling prices and customer numbers?

This part of the question asks how sensitive the NPV of the project is to changes in selling price and sales volume. With regard to selling price if we calculate the present value of sales then we can assess how much sales must fall for the NPV to be zero.
In a similar way changes to sales volume will affect sales and variable costs. Thus we should calculate the prevent value of contribution and assess how much contribution must fall for the NPV to be zero.

(B)		**Selling Prices**		**Sales Volume**	
Year	11% Disc	Revenue	Present Value Revenue	Contribution	Present Value Contribution
		€	€	€	€
1	0.901	1,800	1,622	1,080	973
2	0.812	1,900	1,542	1,070	868
3	0.731	2,100	1,536	1,200	877
4	0.659	2,250	1,482	1,320	870
5	0.593	2,350	1,395	1,370	813
		10,400	**7,576**	6,040	**4,401**
NPV of project			**129**		**129**
% decrease for before NPV zero		(**129/7576)**	**1.7%**	**(129/4401)**	**2.9%**

One can see that the NPV of the project is more sensitive to sales price than sales volume and that only a decrease in price of 1.7% will ensure the project does not give a positive NPV. Sales volume only needs to fall by 2.9% from its forecast level for the project not to have a positive NPV. Thus the project is very sensitive to changes in both selling price and sales volume and would be considered to have a high level of operating risk or gearing.

c) *Advise whether or not the company should upgrade its fixed assets.*

Overall the project give a positive NPV of €129,000 representing 3% of the initial outlay of €3,840,000. The project also offers an IRR of 12.2% compared to the cost of capital of 11%. These factors indicate acceptance of the project. However the viability of the project is very sensitive to the assumptions about selling prices and sales volume. A reduction in selling price of 1.7% would bring the NPV of the project down to zero. Customer numbers would only need to fall by 2.9% to bring the NPV of the project down to zero. In view of growing competition and overcapacity in the market at present this gives too little leeway and thus on balance the project should be rejected. However further investigation of forecast customer numbers prices and costs is desirable.