**Lecture 7 notes**

* This lecture note focuses on ‘Investment Decisions’.
* **Please read/revise the power point presentation on this topic. Use this to revise this topic before the next lecture**.
* The answers to G plc [question from the power point presentation on ‘Investment Appraisal’ are included in these notes below.
* Please attempt H plc

Question:

G plc

The management of G plc is considering investing in three projects. The finance director has prepared the following estimates for the three projects A, B and C are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Project | A | B | C |
| Cash flows in: |  |  |  |
| Year 0 | (60,000) | (120,000) | (180,000) |
| Year 1 | 25,000 | 50,000 | 95,000 |
| Year 2 | 30,000 | 70,000 | 80,000 |
| Year 3 | 32,000 | 80,000 | 58,000 |

The company’s cost of capital is 10 %. and company’s required payback is 2 years

Present value factors @ 10 % is:

|  |  |  |  |
| --- | --- | --- | --- |
| Year | 1 | 2 | 3 |
| Present value factors | 0.909 | 0.826 | 0.751 |

**Required:**

**a) Calculate the following for the 3 projects:**

* **payback**
* **net present value**

**b) Rank the three projects in order of investment potential using the above 2 methods:**

**c) Which projects may be recommended if the projects are mutually exclusive. Explain your selection**

**d) Critically evaluate the above methods.**

**e) State five other factors that require consideration before a final decision is made.**

**f) Calculate the payback and NPV for project D (details are below) and advice on its feasibility.**

**Initial investment is £100,000 with an annuity of £35,000 p.a. for 5 years. The residual value of assets is expected to be £14,000.**

**Payback required is 3 years and the cost of capital for similar projects are 10%.**

**-------------------------------------------------------------------------------------------**

**INDICATIVE CONTENT /SUGGESTED ANSWER**

**a)**

Calculation of payback period:

Project A

|  |  |  |
| --- | --- | --- |
|  | CF £000 | Cumulative CF £000 |
| Year - 1 | 25 | 25 |
| 2 | 30 | 55 |
| 3 | 32 | 87 |

Payback for A = 2 + [5 / 32] = 2 + 0.156 = 2.156 years.

Payback for B = 2 years (by observation of the cumulative cash flows)

Payback for C = 2 + 5 / 58 = 2. 09 years.

|  |
| --- |
| **THE FOLLOWING EXPLANATION IS NOT NEEDED IN THE EXAM – JUST SHOW THE CALCULATIONS AS ABOVE.**  **The payback calculation for A can be explained as follows –**  The initial investment of £60,000 for A is recovered between the cumulative cash flows of years 2 and 3. Hence the payback is between years 2 and 3. |
| Year 2’s cumulative cash flow of £55,000 requires an additional £5,000 (to make up the initial investment of £60,000). This additional £5,000 is from year 3’s cash flow of £32,000] |
| Payback for Project A = 2 years + £5,000 / £32,000 = 2 years + 0.156 year = 2.156 or 2.16 years |
| Payback for Projects B is exactly 2 years (by observation of its cumulative cash flows). |
| Payback for Project C |
|  |
| |  |  |  | | --- | --- | --- | |  | CF £000 | Cumulative CF £000 | | Year - 1 | 95 | 95 | | 2 | 80 | 175 | | 3 | 58 | 233 | |
| The payback for C = 2 + £5000 / £58,000 = 2.09 years (Using a similar reasoning as that of project A) |

Calculation of NPV

NPVs @ 10 % for all 3 projects in £000s:

Project A: 25 x 0.909 + 30 x 0.826 + 32 x 0.751 – 60

= 22.725 + 24.78 + 25.032 – 60 = 11.537

Project A’s NPV @ 10 % = £11,537

Similarly, NPVs for Projects B and C are: £43,350 and £15,993 respectively (please note: in an exam scenario, students are expected to show similar workings as that of Project A)

**b)**

Ranking of projects:

* Payback – shortest payback ranked first; reject those outside the maximum payback specified by management.
* NPV – highest positive ranked first

|  |  |  |  |
| --- | --- | --- | --- |
| Project | A | B | C |
| Payback ranking | - | 1 | - |
| NPV ranking | 3 | 1 | 2 |

**c)** All investment decisions should be made using any DCF method – in this case, NPV.

All 3 projects show a positive NPV, i.e. an **economic profit** @ 10 % cost of capital. Hence all 3 projects are viable.

However, in a **mutually exclusive** scenario, **project B is recommended** for selection since it has the **highest NPV.** This selection will lead to an increase in the present value of the company and consequently will result in an increase in shareholders’ wealth and the company’s share price.

Payback may be used as an additional criterion **and not as the** **primary/main method** for investment decisions since it does not take account of the required risk / return (ignores time value of money).

**d)** The advantage of both methods, payback and NPV, is that both use cash flows (objectively determined) rather than subjective accounting profits.

**Payback** method has the following strengths / advantages:

-- is quick & easy to calculate.

-- readily understood by users / managers.

-- since the cashflows beyond the payback criteria set by management are ignored, this can relieve management of the difficulties of forecasting over a long time period horizon. The ranking approach deals with this problem of forecasting by favouring projects with shorter payback period. The assumption here is that forecasting risks of project cash flow increase over time – the further away into future the more difficult it is to determine the cash flows. (you may be more certain of in you want to do today compared to what you want to do tomorrow or in one month or ten years’ time)

Payback has the following problems / weaknesses / disadvantages in its use for investment decisions:

– does not account for time value of money (an adequate return to providers of long – term funds) and so is not directly related to the presumed objective of shareholder wealth maximisation.

-- has no objective accept/reject decision rule (since this rule / criterion is set by management).

-- it ignores cash flows beyond the payback period.

**NPV** has the following advantages:

-- this method accounts for time value of money – return required by providers of long-term funds used in long term investments / projects and so is directly related to the objective of shareholder wealth maximisation.

-- it considers all the cashflows of the investment

-- provides clear decision rules for both accept /reject and ranking decisions.

NPV have these challenges / criticisms /disadvantages:

-- though there are software packages available to deal with the calculations speedily & accurately it may pose a challenge in understanding its significance. So, often the alternative DCF method, IRR, expressed in percentage terms may be preferable to NPV.

-- it can be difficult to identify the correct discount rate / cost of capital / rate of return to account for time value of money.

**e)**

Other factors (financial & non - financial) that may need consideration before a final decision include the following:

* Accuracy and completeness of the analysis
* Inflation may require consideration
* Taxation implications
* Impact on sales of existing products/services
* Reaction of competitors
* Environmental considerations
* Industrial relations – management and employee issues relating to the introduction of new techniques / machinery & tools / rules
* Impact of existing / new legislation

**f)**

Payback = Initial investment / Annual cashflow

= £100,000 / £35,000 = 2.86 years

NPV @10% = 3.791 x £35,000 + 0.621 x £14,000 – £100,000

= £132,685 + £8,694 – £100,000 = £41,379

The project’s NPV is positive and makes an economic profit

of £41,379. It is feasible/viable on quantitative terms.

the payback criteria set by the company - an additional [and not

the main reason] reason to accept the project.

Question:

H plc

Two mutually exclusive investments in machines A or B are being considered by H plc to expand its capacity.

Their expected cash flows, in £000s, are as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Year | 1 | 2 | 3 | 4 | 5 |
| Machine A | 100 | 300 | 300 | 100 | 100 |
| Machine B | 250 | 300 | 100 | 90 | 80 |

Both machines require similar initial investment of £600,000 and similar scrap value at the end of year 5 of £40,000.

H plc’s cost of capital is 10% and require a payback period of 3 years.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Year | 1 | 2 | 3 | 4 | 5 |
| Discount factors @ 10 % | 0.909 | 0.826 | 0.751 | 0.683 | 0.621 |

**Required:**

(a) Payback for both machines. Which machine is preferred? [6 marks]

(b) Net present value (NPV) for both machines. Which machine is

preferred? [8 marks]

(c) Advise Y plc on the investment decision. Explain why? [4 marks]

(d) Comment on the Internal Rate of Return (IRR) of the machine recommended in (c). Calculation of the IRR is **not** required.

(e) Explain the technique Internal Rate of Return (IRR). State one advantage and one disadvantage of this technique. [4 marks]

**H plc. [INDICATIVE CONTENT / SUGGESTED ANSWER]**

**(a) Payback for both machines. Which machine is preferred? [6 marks]**

Payback period for machine A

|  |  |  |
| --- | --- | --- |
| Year | NCF (£000) | Cumulative NCF (£000) |
| 1 | 100 | 100 |
| 2 | 300 | 400 |
| 3 | 300 | 700 |

Payback is between years 2 and 3

Payback = 2 + £[600,000 – 400,000] / £300,000 = 2 + £200,000/ £300,000 = 2.67 years

***Another* way to present the above answer**

Payback period for machine A

Cumulative cash flow for year 2 is £400,000

Cumulative cash flow for year 3 is £700,000

Payback is between years 2 and 3

Payback for A = 2 + [£200,000 / £300,000] = 2.67 years

Machine B

Payback period for machine B

Cumulative cash flow for year 2 is £550,000

Cumulative cash flow for year 3 is £650,000

Payback for B = 2 + [£50,000 / £100,000] = 2.5 years

***Machine B is preferred since it has the shortest/quickest payback.***

**(b) Net present value (NPV) for both machines. Which machine is**

**preferred? [8 marks]**

NPV @10% [£000s] for machine A

= 100 x 0.909 + 300 (0.826 + 0.751) + 100 x 0.683 + (100 + 40) x 0.621 - 600

= 90.9 + 473.1 + 68.3 + 86.94 – 600 = 119.24

**NPV @10% = £119,240**

NPV @10% [£000s] for machine B

= 250 x 0.909 + 300 x 0.826 + 100 x 0.751 + 90 x 0.683 + [80 + 40] x 0.621 – 600

= 227.25 + 247.8 + 75.1 + 61.47 + 74.52 – 600

= 86.14

**NPV @ 10% for machine B is £86,140**

***Machine A is preferred since it has the higher/larger NPV****.*

**(c) Advise H plc on the investment decision. Explain why? [5 marks]**

***Please note: This is a longer answer for the above marks***

All investment decisions should be made using any DCF method. This may be either NPV or IRR. In this case, NPVs for both investments are available.

Both investments show a positive NPV, i.e. an **economic profit** @ 10 % cost of capital. Hence both are viable.

However, in a **mutually exclusive** scenario, **machine A is recommended** for selection since it has the **highest NPV.** This selection will lead to an increase in the present value of the company and consequently will result in an increase in the company’s share price and shareholders’ wealth.

Payback may be used as an additional criteria but **not** as the primary/main method for investment decisions since it ignores time value of money and the post payback cashflows.

**(d) Comment on the Internal Rate of Return (IRR) of the machine recommended in (c). Calculation of the IRR is not required. [5 marks]**

IRR is the discount rate/cost of capital at which the NPV = 0

The relationship between NPV and cost of capital: As cost of capital increases, NPV decreases and tends towards zero and then becomes negative.

This relationship is an inverse relationship.

Hence based on this and the fact that machine A has a positive NPV, the IRR must be more than 10%

An increase in the discount rate/cost of capital will lead to a decrease in discount factors. So as the discount rate increases will result in the positive NPV of an investment to decrease and tend towards zero before the NPV becomes negative.

Since the NPV of the recommended machine A is positive at the 10% discount rate, this discount rate has to increase above 10% for the NPV to be equal to zero.

Hence it can be concluded that the IRR for machine A must be higher than 10%.

**(e) Explain the technique Internal Rate of Return (IRR). State one advantage and one disadvantage of this technique. [5 marks]**

IRR is the discount rate or cost of capital at which the NPV will be zero. It is the investment’s rate of return in DCF terms.

Advantages of IRR are: (any ***one*** of these advantages will be good enough)

* It accounts for time value of money
* It is cash flowbased.
* It evaluates on the basis of a “user-friendly” percentage rate of return.

Disadvantage of IRR are:

* IRR provides **unreliable advice** when evaluating alternative projects involving different costs/sizes. [see explanation below]

***The following explain the above – this is not required to answer the above question.***

The IRR of a larger investment may be lower but may have a higher positive NPV. An investment with a higher NPV may be preferable even though its IRR is lower. The investment with the higher NPV will increase the value of the company and the shareholders’ wealth by a larger amount.

This is referred to as the **“big factory / little factory” problem** of the IRR method.

So, in mutually exclusive situations, where a conflict arises in the ranking between the two DCF methods, NPV and IRR, the NPV ranking should be relied on.

**Big Factory or Little Factory**

**Cost: £20m £8m**

**IRR: 25% 30%**

**Minimum acceptable IRR: 20%...**

**IRR says the *Little Factory* is best – but is this correct?**

**An IRR of 25% on £20m [big factory] will have a higher NPV compared to the IRR of 30% from a smaller investment of £8m [little factory] which may have a lower NPV.**

**An investment with a higher NPV will increase shareholders’ wealth/equity as well as the value of the company/business if the big factory is chosen instead of the little factory investment.**

**Example to illustrate the financial effect of investing in a project with a positive NPV.**

A plc has 10 million shares and its current market price of its shares is £5 per share.

Market value of A plc’s equity is: 10 million shares x £5 per share = £50m

The Board of Directors of A plc has decided to invest in a new project which has a positive NPV of £10m.

What is the financial consequence of this investment decision on the value of the company?

Total market value of A plc will rise from £50m to £60m [market value of £50m + NPV of new project of £10m].

This announcement to undertake this investment is expected to affect the share price as follows:

The share price will rise to £6 per share. [i.e. £60m/10m shares = £6]

**Calculation of IRR** **using the method of interpolation**

**Example:**

An investment has an NPV @ 15% cost of capital of £3,000 and at 20% cost of capital the NPV is negative at £ (7000).

This shows the investment’s IRR will lie between 15% and 20% and it will be more than 15% and less than 20%. In addition, the IRR will be closer to 15% than 20% since the NPV @15% of £3000 will be closer to zero than the NPV@20% of £ (7000).

Using the method of interpolation:

The IRR = 15% + [£3,000 / (3,000 + 7000)] x (20% - 15%)

= 15% + [£3000 / £10,000] x 5%

= 15% + 0.3 x 5%

= 15% + 1.5%

= **16.5%**

--------------------------------------------------------------------------------------------

* **Next topic -** ‘Cost-Volume-Profit analysis’.

**End of lecture 7 notes**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |