1. Introduction
   - The value of money – inflation
   - Interest

2. Financing organisations
   - Business plans
   - Sources of capital
   - Financial reporting

3. Financing projects and appraising investments
   - Net present value, internal rate of return

4. Pricing products and contracts
   - Direct and indirect costs
   - Relationship between costs and price
   - Competitive tendering
3. Financing projects and appraising investment

- So far we have looked at issues involving financial accounting (reporting externally)
- We now wish to look at some internal tools which will help us to run the business and make appropriate financial decisions
- This is the field of management accounting
- We will look first at some tools which allow us to appraise a proposed investment to see whether it is worthwhile
Before examining some reasonably well-founded techniques for appraising projects and investments it is appropriate to look at some simple techniques and to see where they go wrong.

We will work with the example given in Solt and Hill (Appendix 3):

- Pilot trials of a new production process will take 1 year and will cost £2 million.
- A full scale plant will cost £18m to build over two years (£12m in the first year and £6m in the second).
- Profits from sales are estimated at £2m in the first year of production, £4m in the second, £6m per year for four years, and then falling to zero over the next four years.
From a simple perspective, the project delivers a cumulative profit of £21m after 12 years and might therefore seem worthwhile.

Another way of looking (simplistically) at the project is to assess when it starts to make a simple cumulative profit.

- Based on the figures (and graph) above, it would seem that our project has a ‘payback time’ of 6.5 years.

However, these simplistic calculations take no account of the need to borrow money to carry out the project.
Example project – effect of interest

- The previous calculations took no account of the need to borrow money to carry out the project.
  - Even if we don’t need to borrow, we will lose interest that we might otherwise gain on the money (e.g. by leaving it in the bank)

- Suppose interest is charged on a loan at 5% p.a.

- We can modify the calculations spreadsheet to take into account the need to borrow money to carry out the project
Note that the effect of the interest charges has been to reduce the overall cumulative profit from £21m to £16.4m.

Also, the payback period has been extended to just over 7 years.

Of course, this assumes that we can get such a flexible loan. It may be necessary to get a loan for a fixed term and/or for a fixed amount.

The problem with these simplistic calculations is that they don’t take account of the fact that the expenses occur first and the profit isn’t generated until later in the project and that the ‘value’ of money isn’t constant with time.
3.2 The value of money

- Would you rather have £100 today or £100 in a year’s time?

- The answer is fairly obvious, not least because if you took £100 today and invested it in a high interest account it might (in normal times at least) be worth £106 (or thereabouts) in a year’s time.

- It should be reasonably clear that money is ‘worth’ more to us now than the promise of the same amount of money at some stage in the future.

- This argument is associated with the opportunities to do things with money if we have it now (e.g. invest it) and has nothing to do with inflation (although this is a potentially complicating factor).
  - For the time being we will assume that the inflation rate is zero, though we will relax this later on.
Suppose the original question was ‘Would you rather have £100 today or £125 in a year’s time?’

The answer is less obvious – it will depend on what sort of a person we are, what we think we can do with the money between now and next year, and so on.

The same sort of question arises in making investment decisions

– Suppose an investment of £100,000 will make savings of £12,000 p.a. for 10 years. Is it worth doing?

– What we need is a way of comparing money in the future with money now
Compound interest

- Suppose we **invest £100 at 5% interest p.a.**
- The money will grow as follows

<table>
<thead>
<tr>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>1</td>
<td>105</td>
</tr>
<tr>
<td>2</td>
<td>110.25</td>
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<tr>
<td>3</td>
<td>115.76</td>
</tr>
<tr>
<td>4</td>
<td>121.55</td>
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<td>5</td>
<td>127.63</td>
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<td>6</td>
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<td>7</td>
<td>140.71</td>
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<tr>
<td>8</td>
<td>147.75</td>
</tr>
<tr>
<td>9</td>
<td>155.13</td>
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<tr>
<td>10</td>
<td>162.89</td>
</tr>
<tr>
<td>11</td>
<td>171.03</td>
</tr>
<tr>
<td>12</td>
<td>179.59</td>
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<tr>
<td>13</td>
<td>188.56</td>
</tr>
<tr>
<td>14</td>
<td>197.99</td>
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<td>15</td>
<td>207.89</td>
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<tr>
<td>16</td>
<td>218.29</td>
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<tr>
<td>17</td>
<td>229.20</td>
</tr>
<tr>
<td>18</td>
<td>240.66</td>
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<tr>
<td>19</td>
<td>252.70</td>
</tr>
<tr>
<td>20</td>
<td>265.33</td>
</tr>
</tbody>
</table>

It can be seen that £100 today is equivalent to £265 in 20 years time. Of course, that is a long time to wait, but plenty of engineering projects have durations this long or longer.
3.3 Present value

- The value $V(t)$ of a sum of money in the future is given by $V(t) = V_0 (1+i)^t$

- where $i$ is the interest rate (expressed as a proportion, i.e. a 5% interest rate means $i = 0.05$), $V(t)$ is the future value and $V_0$ the present value.

- The same calculation can be used in reverse to find the ‘Present Value’ $V_0$ of a sum of money available at some time $t$ in the future:

$$V_0 = \frac{V_t}{(1 + i)^t}$$

- The Present Value is less than the value in the future – money available in the future is worth less than money available now.
The idea of present value is convenient as it refers all monetary flows (in or out) to a fixed point in time (now) so that we can compare different options.

In the previous slide we used the interest rate $i$, but a more general approach is to define a ‘discount rate’ $d$, which is related to interest rates, but which might also take other things into account (e.g. risk, whether we wish to invest for the long term, etc.).

Hence

$$V_0 = \frac{V_t}{(1+d)^t}$$

The factor $\frac{1}{(1+d)^t}$ is known as the discount factor.
To return to the example, the income we have from the project occurs in the **future**, and so needs to be **discounted** to obtain a present value.

If we assume an interest rate of **5%** we can calculate a ‘**discount factor**’ \((= (1+d)^{-t})\) for the income in any year and can calculate a **total present value** of the income.

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income (£'000)</td>
<td></td>
<td></td>
<td></td>
<td>2000</td>
<td>4000</td>
<td>6000</td>
<td>6000</td>
<td>6000</td>
<td>6000</td>
<td>5000</td>
<td>3000</td>
<td>2000</td>
<td>1000</td>
</tr>
<tr>
<td>Discount factor</td>
<td>1</td>
<td>0.95</td>
<td>0.91</td>
<td>0.86</td>
<td>0.82</td>
<td>0.78</td>
<td>0.75</td>
<td>0.71</td>
<td>0.68</td>
<td>0.64</td>
<td>0.61</td>
<td>0.58</td>
<td>0.56</td>
</tr>
<tr>
<td>Present value</td>
<td>1728</td>
<td>3291</td>
<td>4701</td>
<td>4477</td>
<td>4264</td>
<td>4061</td>
<td>3223</td>
<td>1842</td>
<td>1169</td>
<td>557</td>
<td>29313</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The income of £41m **only has a present value of £29m** because much of it occurs in the future.

Investing £20m to obtain a return of £29m no longer looks quite so clear cut. The effective profit is reduced from a nominal £21m to £9m.
A useful means of making decisions about investment is to compare the present value of the projected returns with the cost of the investment in order to obtain a ‘Net Present Value’.

\[ \text{NPV} = \text{PV of future income} - \text{cost of investment} \]

A useful extension if investment costs are also spread over a number of years is to look at the difference between the PVs of income and expenditure.

\[ \text{NPV} = \text{PV of future income} - \text{PV of expenditure} \]

If the NPV is greater than zero the project is ‘worth doing’, although of course the resources available to carry out projects may be limited and there may be other projects under consideration with a greater NPV.
We can now look at the NPV of our example, including both the income and the expenditure:

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income (£'000)</td>
<td>-2000</td>
<td>-12000</td>
<td>-6000</td>
<td>2000</td>
<td>4000</td>
<td>6000</td>
<td>6000</td>
<td>6000</td>
<td>6000</td>
<td>5000</td>
<td>3000</td>
<td>2000</td>
<td>1000</td>
<td>21000</td>
</tr>
<tr>
<td>Discount factor</td>
<td>1</td>
<td>0.95</td>
<td>0.91</td>
<td>0.86</td>
<td>0.82</td>
<td>0.78</td>
<td>0.75</td>
<td>0.71</td>
<td>0.68</td>
<td>0.64</td>
<td>0.61</td>
<td>0.58</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>Present value</td>
<td>-2000</td>
<td>-11429</td>
<td>-5442</td>
<td>1728</td>
<td>3291</td>
<td>4701</td>
<td>4477</td>
<td>4264</td>
<td>4061</td>
<td>3223</td>
<td>1842</td>
<td>1169</td>
<td>557</td>
<td>10442</td>
</tr>
</tbody>
</table>

The NPV of the project is £10.4m, which compares to the simple profit calculation of £21m.

The process of calculating an NPV (or a PV) is sometimes known as ‘discounted cash flow’ because a ‘discount factor’ is applied to earnings.
The NPV of a project will be sensitive to the discount rate assumed

- Particularly for projects with large initial costs and delayed income
- The Parliamentary Office for Science and Technology argues that, since nuclear power plants are so capital intensive, the discount rate is arguably the most important factor affecting the sensitivity of the cost projections:
  - “The Sizewell B project appeared to be economically viable at a 5% public sector discount rate and was approved on that basis in 1987. By 1989, the official rate had risen to 8% and the next PWR, Hinkley Point C, was close to being viable, though with lower expected construction costs than Sizewell B. Following privatization, the nuclear industry was advised that the lowest possible commercial discount rate for a nuclear project would be 11%. At this rate, the proposed Sizewell C power station would have made a large loss, though the construction costs were even lower than those expected at Hinkley Point C”.

It is not always easy to decide how to set the discount rate.
Sensitivity to discount rate

- Sensitivity of projects to discount rate is the main reason why we have only one third generation (PWR) nuclear power station in the UK.

- Similar issues arise with non-nuclear projects (e.g. the Severn Barrage).

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3.4 Internal rate of return

- One way of getting around the difficulty of setting the discount rate for a project is to use the concept of ‘internal rate of return’.

- Suppose that we plot the NPV of our project against the discount rate.

- At some point, the project becomes uneconomic as the NPV falls to zero.

- The corresponding discount rate is called the *internal rate of return*, IRR.
The **internal rate of return** for a project is therefore defined as: **the discount rate for which the NPV is zero**

It effectively represents **the return which is achieved on the money**

- Money invested externally (e.g. in a bank account) generates a NPV of zero when the interest rate is equal to the discount rate

The **internal rate of return** can be calculated for any project and we do not have to choose the discount rate in advance

- We can then compare the IRR of the project with other opportunities for investing the money
Internal rate of return

- Calculating the internal rate of return does not tell us whether the project should go ahead or not
  - What we have to do is to compare the IRR for the project with other things we could do with the money (e.g. invest it externally), or with the cost of borrowing the money to carry out the project
  - When doing this we need to take account of the risks involved. If there is a significant amount of risk, we would expect the IRR to be significantly greater than the cost of borrowing for the project to go ahead

- In practice, there is often a limited budget for investment. What one can do is compare alternative proposals to see which gives the best IRR.
IRR calculations

- Calculation of the IRR has, in general, to be done iteratively.
  - Calculate the NPV of a project as a function of discount rate and see when it falls to zero
  - Fortunately it is fairly easy to implement this sort of calculation in a spreadsheet
  - Excel has a ‘Present Value’ function
  - Excel also has an NPV function and an IRR function
Observations on the discounted cash flow approach

- The discounted cash flow approach is logical – money in the future is worth less than it is today.

- This has the beneficial feature of giving more weight in the calculation to cash flows in the near future (which are probably more certain), than those far in the future, which are probably less certain.

- However, there can be problems with this feature. E.g. Large items of expenditure a long way in the future have relatively little effect on the NPV because of the large discount factor applied.
  - These items of expenditure will still have to be met.
  - Provision must be made in the project plan to take account of this.
Nuclear decommissioning

- The design life of nuclear power stations is long
- There are significant decommissioning costs at the end of their lives
- For example, after 40 years, the discount factor for a discount rate of 8% is $(1.08)^{-40} = 0.046$
- Hence, every £1 of decommissioning cost only affects the NPV of the project by 4.6p
- DCF says that costs in the future don’t matter much – we can save up to meet them (But will we?)
3.5 Inflation in NPV calculations

- In undertaking NPV and IRR calculations we have assumed that the inflation rate was zero.
- This is, of course, a simplification, although fortunately we have had a couple of decades of relatively low inflation in the UK (and the developed world generally).
- We need to consider how inflation affects the calculations.
Inflation in NPV calculations

- The basis of our present value calculations is that we can invest money so that it is worth more in the future.
  - Hence the future value of money is greater than its current value, and correspondingly the current (present) value of money less than its future value.
- Inflation has the opposite effect – the future value of money is less than its present value.
- One approach, therefore, is to account for inflation by adjusting the discount rate rather than explicitly adjusting all the income flows for inflation.
If we have an interest rate $i$, and an inflation rate $r$, then the real interest rate $i'$ is given by

$$i' = i - r$$

Similarly, we can adjust our discount rate, so that an effective discount rate $d'$ is given by

$$d' = d - r$$

Where $d$ is the discount rate that we would have chosen without inflation.

It may seem that we are introducing one more uncertainty into the calculation (future inflation levels as well as future interest rates), but in practice real interest rates tend to be more stable than nominal ones.
UK interest rates and consumer prices index 1998 – 2006

The real interest rate is the difference between the two curves
So, the simplest approach to accounting for inflation in NPV calculations is to adjust the discount rate and leave all cash flows unadjusted for inflation.

However, if it is thought that some items might increase at a different rate from others (e.g. energy or raw materials at a different rate to staff costs) a single adjustment is not possible.

In these circumstances it is probably best to inflate the cash flows individually according to the appropriate assumptions, but then to use an unadjusted discount rate.
3.6 Setting the discount rate or deciding an acceptable IRR

- Setting the discount rate in a DCF calculation (or determining an acceptable IRR for an investment to proceed) is far from straightforward.

- As a guide, interest rates for cash in the UK have in the past been around 5.5%, and inflation (by the CPI measure at least) has been around 2.5%. This suggests a real interest rate of around 3%.

- However, investing cash in a bank is effectively a zero risk investment (despite Northern Rock and other fairly recent events!)

- Investment in areas with greater risk (e.g. stock markets) should give a greater average return to compensate for the risk (technically, the volatility or variance of return rates)

- It is difficult to be precise, but share prices might be expected to give a real rate of return of around 5% at least in the long term

- These considerations suggest that we should expect a real rate of return of 3% from putting cash in the bank and 5% from investing in other companies.

- However, as we shall see on the next slide, the current situation is very different (though we might consider it extraordinary)
The current situation

- Of course, things are rather different at the moment, with base rates at 0.25%, CPI at 1%, and RPI at 2%. This suggests that the real interest rate might be in the region of –0.75% to –1.75% (!)

- In practice though, base rates seem to have been decoupled from what the banks are charging/offerings. One can still get 1-2% on savings, and a secured loan might cost a business at least 4 to 5%
Setting the discount rate

- The considerations on the previous pages suggest that a **discount rate of 5%** might be the **minimum acceptable**
- The stock exchange experience is that **companies seem to generate around 5% real**. We might therefore take this to be a guide for our company.
- If so, we might hope that new projects would give **better than the average return** (as there will be some areas of the company which don’t perform so well, but which we do not wish to stop)
- This rather suggests that a **real discount rate should be quite a bit higher than 5%** (7 to 8%?)
- Compare and contrast these figures for the Sizewell B example (5, 8, and 11%)

This, of course is equivalent to a nominal rate of around **6%**

Wikipedia (!) suggests that the following are commonly used in the private sector:

- Startups seeking money: 50 – 100 %
- Early Startups: 40 – 60 %
- Late Startups: 30 – 50%
- Mature Companies: 10 – 25%

- The reasons for high discount rates for start up companies are:
  - Reduced marketability of ownerships because stocks are not traded publicly
  - Limited number of investors willing to invest
  - Startups face high risks
  - Over optimistic forecasts by enthusiastic founders.
Money available now is worth more than money available in the future.

Future income must therefore be discounted by an appropriate factor to obtain a present value.

Using this discounted cash flow approach a Net Present Value can be calculated, which is useful for appraising investments.

These calculations are usually very sensitive to the discount rate, and setting an appropriate rate is not usually straightforward.

An alternative, but related, approach is the concept of the internal rate of return.