

capital investment appraisal

relevant to CAT Scheme Papers 4 and 10

cash flow

■ This article, on the subject of capital investment appraisal using discounted cash flow (DCF), is particularly relevant to CAT students preparing for intermediate level Paper 4. It may also provide useful revision for those opting to sit Paper 10.

Question 1 in Section B of the recent December 2005 Paper 4 examination required candidates to calculate the net present value (NPV) of a capital investment project. Apart from awareness of the discounting process, the key aspects of capital investment appraisal that this question tested were:

- understanding the distinction between cash flow and profit
- awareness that it is cash flow (not profit) that is discounted in the evaluation of capital investment viability
- ability to adjust profit figures to establish cash flows.

This article uses Part (b) of the question, and the examiner's comments on candidate performance, to highlight and explain aspects of this topic.

QUESTION

A company is considering an investment in new machinery. The annual incremental profits/(losses) relating to the investment are estimated to be:

	£000
Year 1	(11)
Year 2	3
Year 3	34
Year 4	47
Year 5	8

Investment at the start of the project would be £175,000. The investment sum, assuming nil disposal value after five years, would be written off using the straight-line method. The

depreciation has been included in the profit estimates above, which should be assumed to arise at each year end.

Required:

- i Calculate the net present value (NPV) of the investment at a discount rate of 10% per annum (the company's required rate of return).

Discount factors at 10% are:

Year 1	0.909
Year 2	0.826
Year 3	0.751
Year 4	0.683
Year 5	0.621

- ii State, on the basis of your calculations, whether the investment is worthwhile. Justify your statement.

Examiner's comments

In answers to Part b(i) of Question 1, very few candidates made any attempt to calculate the annual depreciation, and even fewer to adjust profit for the depreciation calculated.

Those candidates who did adjust the annual profit figures given in the question frequently deducted the depreciation rather than adding it back. Also, in the calculation of NPV, candidates were often careless, or seemingly unclear, as to whether values were positive or negative. For example, the year 1 loss was taken as positive not negative, and there were frequent errors of sign with the initial investment and with the total NPV. Several candidates took the profit figures to be in £ rather than £000.

It was also not uncommon for the inflows to be completely ignored, with candidates discounting some variant of the initial investment in each of the years. This tended to be £175,000 in each year, £175,000 less

cumulative depreciation each year, or even the discounted investment from the previous year.

Marks were given for the conclusion and justification, in Part b(ii), if consistent with the NPV in Part b(i). Most candidates, on the basis of their own figures, knew whether and why the investment was worthwhile. Some candidates, however, failed to justify their conclusion or did not understand the criteria for determining investment viability.

Overall, candidates demonstrated an almost universal lack of awareness, or a serious misunderstanding, of the discounted cash flow capital investment appraisal process.

CASH FLOW AND PROFIT

Referring to the question above, addition of the annual incremental profits/(losses) will indicate whether, before taking account of cost of capital, the investment in new machinery is expected to generate income in excess of the initial cost of the investment. Therefore:

	£000
Year 1	(11)
Year 2	3
Year 3	34
Year 4	47
Year 5	8
	<u>81</u>

Total profit before cost of capital is £81,000, ie income exceeds the investment cost by £81,000. The charging of depreciation is a means of spreading the cost of the new machinery over the asset's life to enable the calculation of profit over shorter periods (eg per annum). Over the life of the machinery, incremental profit will equal incremental cash flow. This can be demonstrated by adding back depreciation (a non-cash flow item) to profit in each year to establish the net cash inflows from the machinery investment.

Depreciation is £35,000 per annum (initial investment £175,000 ÷ five years) so cash flows relating to the machinery investment are:

	£000	
Year 0	(175)	
Year 1	24	((11) + 35)
Year 2	38	(3 + 35)
Year 3	69	(34 + 35)
Year 4	82	(47 + 35)
Year 5	<u>43</u>	(8 + 35)
	<u>81</u>	

Thus, total cash flow is also £81,000 but with a different pattern compared with the annual profits/(losses).

DISCOUNTED CASH FLOWS

It is the timing of the cash (not the profit) that is important in capital investment appraisal. Cash outflows are outflows of money which have been provided to a business by investors, and on which a return on investment is required while it remains invested. The sooner the cash is recovered the greater will be its equivalent present value, and the better the return on the investment will be.

DCF involves the application of discounting arithmetic to the estimated future cash flows from a capital investment project, in order to decide whether the project is expected to earn a satisfactory rate of return.

Using the NPV method of DCF, the cost of capital which represents the minimum acceptable rate of return on investment is used as the discount rate, in order to calculate the NPV of the cash inflows and outflows. The NPV method provides an absolute measure of the cash surplus or deficit in present value terms (as opposed to the internal rate of return (IRR) method – not covered in this article – which provides a relative measure of project worth).

The profitability of a capital investment project using NPV is determined by the relationship between the total present value of the net cash inflows and the present value of the cash invested in the project, ie whether the NPV is positive or negative. The decision rule, using the NPV method of appraisal, is to invest if $NPV > 0$ (ie positive).

ANSWER

The annual cash flows identified above need to be discounted, using the factors at 10% provided in the question, in order to determine the NPV:

Year	Cash flow £000	Discount factor 10%	NPV £000	£000
0	(175)	1.000		(175.0)
1	24	0.909	21.8	
2	38	0.826	31.4	
3	69	0.751	51.8	
4	82	0.683	56.0	
5	<u>43</u>	0.621	<u>26.7</u>	<u>187.7</u>
	<u>81</u>			<u>12.7</u>

Discounted at a rate of 10% per annum, the present value of the expected cash inflows from the investment, at £187,700, exceeds the £175,000 original investment. The net cash flow of £12,700 (£187,700 minus £175,000) is significantly less than the undiscounted net cash flow of £81,000 due to the time value of money. The investment in new machinery is nevertheless worthwhile, given that 10% is the company's required rate of annual return, because the NPV is positive when the incremental cash flows are discounted at this rate.

EXAMINATION ERRORS

Most candidates in the December 2005 Paper 4, *Accounting for Costs* examination seemed to know how to use discount factors to arrive at present values. However, as already previously noted in the examiner's comments earlier in this article, the vast majority of candidates discounted the wrong figures (ie profit rather than cash flow). Therefore:

Year	Cash flow £000	Discount factor 10%	NPV £000
1	(11)	0.909	(10.0)
2	3	0.826	2.5
3	34	0.751	25.5
4	47	0.683	32.1
5	<u>8</u>	0.621	<u>5.0</u>
	<u>81</u>		<u>55.1</u>

Those candidates who discounted each of the annual profit figures as above, and then simply added them to get a total NPV of £55,100 failed to correctly take account of the timing of the investment (effectively assumed to be £35,000 in each of years 1 to 5 rather than £175,000 up front).

As a consequence, the value of the investment project was overstated – less than the undiscounted total of £81,000 but much higher than the true present value of £12,700.

Other candidates discounted each of the annual profit figures and added them as above, but then deducted this total of £55,100 from the initial investment of £175,000 to get a negative NPV of £119,900. These candidates effectively double-counted the investment and thus significantly understated the value of the investment project.

Those candidates who did adjust for depreciation, but did this incorrectly by deducting it from (rather than adding it to) the profit figures, effectively charged again for the cost of the investment.

As stated previously, many candidates confused positive and negative values, either in the discounting process with the year 1 loss, or with the final NPV.

For example, many candidates who double-counted the investment showed the NPV of £119,900 to be positive and concluded (correctly on the basis of 'own figures') that the investment in machinery was worthwhile. Some candidates were less clear on the meaning of the resulting present value, especially where there was confusion as to whether values were positive or negative.

CONCLUSION

Candidates need to appreciate the significance of cash flow in capital investment appraisal and the distinction between profit and cash flow. They also need to give more thought to the discounting process and to the meaning and significance of the resulting calculations. ■