SOLUTIONS TO END-OF-CHAPTER QUESTIONS CHAPTER 16

RECALL AND REVIEW

Question 16.1

- Payback: This method measures the number of years it will take to recover the initial amount of money invested in a project. Under this method, the project that pays back the initial investment most quickly will be selected.
- Accounting rate of return (ARR): This method measures the average accounting return (the average annual profit divided by the average capital employed) over the life of the project. Under this method, the project with the highest ARR will be selected.
- Net present value (NPV): This method calculates NPV as the difference between the discounted cash flows from the project over the life of the project and the costs of making the investment. Under this method, the project with the highest positive NPV will be selected.
- Internal rate of return (IRR): This method determines the discount rate at which the present value of project cash inflows is equal to the initial investment in the project, the discount rate at which the present value of the project is £Nil. Under this method the project with the highest IRR or the project whose IRR is higher than the entity's required rate of return will be selected.

Question 16.2

To determine which project should receive investment funding, the projects are ranked based on each capital investment appraisal technique.

	Project A	Project B	Project C	Project D
Discounted payback	4	2	1	3
ARR	3	1	4	2
NPV	2	1	4	3
IRR	1	2	3	4

From the ranking table, it is clear that Project B should be selected for investment funding as it ranks first based on two appraisal techniques, ranks second based on the other two and so outperforms the other three projects.

DEVELOP YOUR UNDERSTANDING

Question 16.3

Podcaster University Press

Payback

	Accounting book		Economics book	
	Annual cash flows	Cumulative	Annual cash flows	Cumulative
	£000	£000	£000	£000
Investment at time 0	(450)	(450)	(600)	(600)
Net cash inflows year 1	160	(290)	240	(360)
Net cash inflows year 2	160	(130)	200	(160)
Net cash inflows year 3	160	30	160	0
Net cash inflows year 4	100	130	105	105
Net cash inflows year 5	100	230	105	210
Year 5 sale of assets	50	280	100	310

Accounting book payback period: 2 years + (130 ÷ 160) × 12 months = 2 years and 10 months
Economics book payback period: 3 years exactly
Payback: considerations

- The Accounting book is clearly preferable on the payback method of investment appraisal, although the Economics book pays back only two months later.
- The Economics book does have net cash inflows of £30,000 more than the Accounting book, although these net cash inflows do rely heavily on the sale of the assets for £100,000 at the end of year 5.
- Without this final inflow of cash from the sale of the assets, the net cash inflows of the Accounting book would be £230,000 (£280,000 – £50,000 cash from sale of the assets) compared with £210,000 (£310,000 – £100,000 cash from sale of the assets) for the Economics book.

Accounting rate of return

Accounting book

- The cost of the assets is £450,000
- The residual value of the assets is £50,000

Therefore, total depreciation is: £450,000 (cost) – £50,000 (residual value) = £400,000
Total accounting profits are £680,000 (cash inflows) – £400,000 (depreciation) = £280,000
Average accounting profit for the Accounting book: £280,000 ÷ 5 years = £56,000

Average investment in the Accounting book over its life: $\frac{(£450{,}000 + £50{,}000)}{2} = £250{,}000$

Accounting rate of return for the Accounting book: £56,000 ÷ £250,000 × 100% = 22.40%

Economics book

- The cost of the assets is £600,000
- The residual value of the assets is £100,000

Therefore, total depreciation is: £600,000 (cost) – £100,000 (residual value) = £500,000
Total accounting profits are £810,000 (cash inflows) – £500,000 (depreciation) = £310,000
Average accounting profit for the Economics book: £310,000 ÷ 5 years = £62,000

Average investment in the Economics book over its life $\frac{(£600,000 + £100,000)}{2} = £350,000$

Accounting rate of return for the Economics book: £62,000 ÷ £350,000 = 17.71%

Accounting rate of return: considerations

- The Accounting book has the higher accounting rate of return so would be the preferred project on the basis of this capital investment appraisal technique.
- Average annual profits between the two book projects differ only by £6,000.
- The Economics book requires an additional average capital investment of £100,000.
- Therefore, the additional return of £6,000 per annum for this additional investment might not be considered worthwhile.

Net present value

NPV for the Accounting book

	Cash flow £000	10% Discount factor	NPV £000
Investment at time 0	(450)	1.0000	(450.00)
Net cash inflows year 1	160	0.9091	145.46
Net cash inflows year 2	160	0.8264	132.22
Net cash inflows year 3	160	0.7513	120.21
Net cash inflows year 4	100	0.6830	68.30
Net cash inflows year 5	100	0.6209	62.09
End of year 5 sale of assets	50	0.6209	31.05
		Project NPV	**109.33**

NPV for the Economics book

	Cash flow £000	10% Discount factor	NPV £000
Investment at time 0	(600)	1.0000	(600.00)
Net cash inflows year 1	240	0.9091	218.18
Net cash inflows year 2	200	0.8264	165.28
Net cash inflows year 3	160	0.7513	120.21
Net cash inflows year 4	105	0.6830	71.72
Net cash inflows year 5	105	0.6209	65.19
End of year 5 sale of assets	100	0.6209	62.09
		Project NPV	**102.67**

Net present value: considerations

- The Accounting book has the higher net present value, so this book should be accepted instead of the Economics book.
- The Accounting book breaks even on a net present value basis towards the end of year 4.
- The Economics book breaks even on a net present value basis only at the end of year 5.

Internal rate of return

NPV for the Accounting book discounted at 20%

	Cash flow £000	20% Discount factor	NPV £000
Investment at time 0	(450)	1.0000	(450.00)
Net cash inflows year 1	160	0.8333	133.33
Net cash inflows year 2	160	0.6944	111.10
Net cash inflows year 3	160	0.5787	92.59
Net cash inflows year 4	100	0.4823	48.23
Net cash inflows year 5	100	0.4019	40.19
End of year 5 sale of assets	50	0.4019	20.10
		Project NPV	**(4.46)**

Internal rate of return: Accounting book

$$10\% + \frac{109.33}{109.33 + 4.46} \times (20\% - 10\%) = 19.61\%$$

NPV for the Economics book discounted at 20%

	Cash flow £000	20% Discount factor	NPV £000
Investment at time 0	(600)	1.0000	(600.00)
Net cash inflows year 1	240	0.8333	199.99
Net cash inflows year 2	200	0.6944	138.88
Net cash inflows year 3	160	0.5787	92.59
Net cash inflows year 4	105	0.4823	50.64
Net cash inflows year 5	105	0.4019	42.20
End of year 5 sale of assets	100	0.4019	40.19
		Project NPV	**(35.51)**

Internal rate of return: Economics book

$$10\% + \frac{102.67}{102.67 + 35.51} \times (20\% - 10\%) = 17.43\%$$

Internal rate of return: considerations

- The Accounting book has the higher internal rate of return.
- This internal rate of return is higher than Podcaster University Press's cost of capital (10%), so the project should be accepted.
- The decision under IRR is consistent with the decision under the net present value appraisal method, which is to choose the Accounting book as this project has the higher net present value of the two books.

Additional considerations:

- The Accounting book is the preferred project under all the investment appraisal methods.
- The Accounting book has a lower capital outlay than the Economics book, which makes the Accounting book less risky as less capital is required to fund the project.
- The Accounting book is the chosen project as this will maximise investors' returns and increase the value of the press when compared with the Economics book.
- If the company has £600,000 to invest in a new project, choosing the Accounting book will leave £150,000, which could be invested to generate additional interest income for the company and its shareholders.

» Question 16.4

Payback

	Option 1		Option 2	
	Annual cash flows £000	Cumulative £000	Annual cash flows £000	Cumulative £000
Investment at time 0	(200)	(200)	(245)	(245)
Cash savings year 1	50	(150)	—	(245)
Cash savings year 2	70	(80)	80	(165)
Cash savings year 3	80	—	85	(80)
Cash savings year 4	70	70	86	6
Cash savings year 5	60	130	101	107
Cash savings year 6	—	—	81	188
Cash savings year 7	—	—	71	259

Option 1 has a payback period of exactly three years whereas option 2 has a payback period of just under four years. Under the payback method of capital investment appraisal, option 1 would be the chosen project.

Accounting rate of return

Total depreciation for option 1: £200,000 (cost) – £Nil (residual value) = £200,000
Total depreciation for option 2: £245,000 (cost) – £Nil (residual value) = £245,000
Average accounting profit for option 1: (£330,000 – £200,000) ÷ 5 years = £26,000
Average accounting profit for option 2: (£504,000 – £245,000) ÷ 7 years = £37,000

Average investment in each project over each project's life

Option 1: $\frac{(£200,000 + £Nil)}{2} = £100,000$

Option 2: $\frac{(£245,000 + £Nil)}{2} = £122,500$

Accounting rate of return: option 1: £26,000 ÷ £100,000 = 26.00%
Accounting rate of return: option 2: £37,000 ÷ £122,500 = 30.20%
Under the accounting rate of return approach to capital investment appraisal, option 2 offers the higher rate of return and so would be the chosen project on this criterion.

Net present value

NPV of option 1

	Cash flow £	15% Discount factor	NPV £
Investment at time 0	(200,000)	1.0000	(200,000)
Cash savings year 1	50,000	0.8696	43,480
Cash savings year 2	70,000	0.7561	52,927
Cash savings year 3	80,000	0.6575	52,600
Cash savings year 4	70,000	0.5718	40,026
Cash savings year 5	60,000	0.4972	29,832
		Project NPV	**18,865**

NPV of option 2

	Cash flow £	15% Discount factor	NPV £
Investment at time 0	(245,000)	1.0000	(245,000)
Cash savings year 1	—	0.8696	—
Cash savings year 2	80,000	0.7561	60,488
Cash savings year 3	85,000	0.6575	55,888
Cash savings year 4	86,000	0.5718	49,175
Cash savings year 5	101,000	0.4972	50,217
Cash savings year 6	81,000	0.4323	35,016
Cash savings year 7	71,000	0.3759	26,689
		Project NPV	**32,473**

Based on our calculations of net present value, option 2 will be the preferred project as this has a higher net present value when compared with option 1.

Internal rate of return

IRR of option 1

Discounting cash flows at 19%	Cash flow £	19% Discount factor	NPV £
Investment at time 0	(200,000)	1.0000	(200,000)
Cash savings year 1	50,000	0.8403	42,015
Cash savings year 2	70,000	0.7062	49,434
Cash savings year 3	80,000	0.5934	47,472
Cash savings year 4	70,000	0.4987	34,909
Cash savings year 5	60,000	0.4190	25,140
		Project NPV	**(1,030)**

Internal rate of return: option 1

$$15\% + \frac{18,865}{18,865 + 1,030} \times (19\% - 15\%) = 18.79\%$$

IRR of option 2

Discounting cash flows at 19%	Cash flow £	19% Discount factor	NPV £
Investment at time 0	(245,000)	1.0000	(245,000)
Cash savings year 1	—	0.8403	—
Cash savings year 2	80,000	0.7062	56,496
Cash savings year 3	85,000	0.5934	50,439
Cash savings year 4	86,000	0.4987	42,888
Cash savings year 5	101,000	0.4190	42,319
Cash savings year 6	81,000	0.3521	28,520
Cash savings year 7	71,000	0.2959	21,009
		Project NPV	**(3,329)**

Internal rate of return: option 2

$$15\% + \frac{32,473}{32,473 + 3,329} \times (19\% - 15\%) = 18.63\%$$

Based on the internal rate of return criteria, the directors should choose option 1 as this has the higher internal rate of return. However, as the internal rate of return gives a different result compared with the net present value calculation, the directors should stick with option 2 as advised by the NPV decision.

Other factors in the decision

- The capital investment appraisal techniques applied favour option 2, with both the accounting rate of return and the net present value suggesting this project should be adopted, whereas only the payback method favoured option 1.
- However, seven years is a long time in technology terms and it is quite possible that better computerised supply chain systems will be developed well before option 2 has completed its useful life, resulting in losses from scrapping the system and unrealised cash savings.

- Given the length of the project and the likelihood that new technology will be developed before option 2 reaches the end of its life, the directors of Zippo Drinks Limited should consider the possible obsolescence of option 2's system and any consequences arising from this.
- Cash flows from option 2 do not start until the end of year 2 and are therefore more uncertain than the cash flows from option 1: the directors of Zippo Drinks should factor in the possibility that the cash flows from option 2 do not meet expectations.

» Question 16.5

Payback

	Run the restaurant		Rent restaurant	
	Annual cash flows	Cumulative	Annual cash flows	Cumulative
	£000	£000	£000	£000
Investment at time 0	(110)	(110)	(80)	(80)
Net cash inflows/Rent year 1	35	(75)	40	(40)
Net cash inflows/Rent year 2	45	(30)	40	0
Net cash inflows/Rent year 3	60	30	40	40
Net cash inflows/Rent year 4	65	95	40	80
Net cash inflows/Rent year 5	55	150	40	120
Year 5 sale of assets	2	152	—	120

Running the restaurant yourself results in a payback period of 2½ years, whereas the payback period for renting out the restaurant is just 2 years.

Accounting rate of return

Total depreciation if you are running the restaurant yourself:

£110,000 (cost) – £2,000 (residual value) = £108,000

Total depreciation if you rent the restaurant out:

£80,000 (cost) – £Nil (residual value) = £80,000

Average accounting profit:

Running the restaurant yourself: (£260,000 – £108,000) ÷ 5 years = £30,400

Renting the restaurant out:

(£200,000 – £80,000) ÷ 5 years = £24,000

Average investment:

Running the restaurant yourself: $\frac{(£110,000 + £2,000)}{2} = £56,000$

Renting the restaurant out: $\frac{(£80,000 + £nil)}{2} = £40,000$

Accounting rate of return:

Running the restaurant yourself: £30,400 ÷ £56,000 = 54.29%

Renting the restaurant out: £24,000 ÷ £40,000 = 60.00%

Net present value

NPV: running the restaurant yourself

	Cash flow £000	12% Discount factor	NPV £000
Investment at time 0	(110,000)	1.0000	(110,000)
Net cash inflows year 1	35,000	0.8929	31,252
Net cash inflows year 2	45,000	0.7972	35,874
Net cash inflows year 3	60,000	0.7118	42,708
Net cash inflows year 4	65,000	0.6355	41,308
Net cash inflows year 5	55,000	0.5674	31,207
End of year 5 sale of assets	2,000	0.5674	1,135
		Project NPV	**73,484**

NPV: renting the restaurant out

	Cash flow £000	12% Discount factor	NPV £000
Investment at time 0	(80,000)	1.0000	(80,000)
Rent year 1	40,000	0.8929	35,716
Rent year 2	40,000	0.7972	31,888
Rent year 3	40,000	0.7118	28,472
Rent year 4	40,000	0.6355	25,420
Rent year 5	40,000	0.5674	22,696
		Project NPV	**64,192**

Evaluation based on purely financial considerations

- Renting the restaurant out produces a payback period of 2 years compared with a payback period of 2½ years if you run the restaurant yourself.
- Similarly, the accounting rate of return for the renting option is 60% compared with an accounting rate of return of only 54.29% if you were to run the restaurant yourself.
- The internal rate of return from renting is 41.10% compared with an IRR of 33.84% from running the restaurant yourself.
- The net present value of renting is £9,292 lower (£73,484 – £64,192) than the option of running the restaurant yourself.
- Therefore, given the superiority of the net present value investment appraisal technique, running the restaurant would seem to be the preferred option despite the preference of the other two methods for taking on the renting option.

Other factors in the decision

- Running the restaurant will be very hard work, so you might prefer to take the lower annual income from renting the restaurant out.
- If you were to rent the restaurant out, all the time you would have spent running the restaurant can now be used to undertake other activities to generate cash inflows to replace those lost from running the restaurant yourself.

- Renting the restaurant out is much lower risk as the other entrepreneur is taking on the risk of the restaurant failing to match expectations and generate the anticipated cash inflows.
- Running the restaurant yourself might have been much more profitable than you had expected, so renting it out might result in lost income.
- However, your fellow entrepreneur might not do as well as she expected and this might affect your profit share if this is not guaranteed.
- The problem you face is a common one in investment decisions: a steady, guaranteed income compared with the potentially much higher rewards that might be gained from taking a much bigger risk.

» Question 16.6

(a) Using the payback method of capital investment appraisal it will take 3 years to recover the initial investment in the equipment.

	Cash flows £	Cumulative cash flows £
Year 0 (Initial investment)	(150,000)	(150,000)
Year 1	60,000	(90,000)
Year 2	50,000	(40,000)
Year 3	40,000	0
Year 4	30,000	30,000
Year 5 (including resale value)	45,000	75,000

(b) Discounted payback period = 4 + (3,592/27,940) = 4 years and 2 months
Payback of the initial investment takes a further 1 year and 2 months when the time value of money is considered and cash flows are discounted to their net present values.

	Cash flows £	Cash flows discounted at 10% £	Cumulative discounted cash flows £
Year 0 (Initial investment)	(150,000)	(150,000)	(150,000)
Year 1	60,000	54,546	(95,454)
Year 2	50,000	41,320	(54,134)
Year 3	40,000	30,052	(24,082)
Year 4	30,000	20,490	(3,592)
Year 5 (including resale value)	45,000	27,940	24,348

(c) The time value of money should be taken into consideration in capital investment decisions because inflation will reduce the value of projected future cash flows. In addition, cash receivable tomorrow is less certain than cash in hand today, so projected cash flows are discounted to allow for this extra risk.

» Question 16.7

All projects generate a positive NPV as indicated in the calculations below. However, the NPV of Gas field B is considerably higher than that of the other two projects. Gas field B also has the highest IRR. In addition, Gas field B has the lowest initial capital investment outlay at £24m. Therefore, the company should select Gas field B.

Net present values

Gas field A	Cash flow £m	12% Discount factor	NPV £m
Year 0 Initial investment	(28.0)	1.0000	(28.0000)
2023	4.0	0.8929	3.5716
2024	6.5	0.7972	5.1818
2025	9.0	0.7118	6.4062
2026	13.0	0.6355	8.2615
2027	15.0	0.5674	8.5110
2028	8.6	0.5066	4.3568
2028 Decommissioning expenditure	(10.0)	0.5066	(5.0660)
		Net present value	**3.2229**

Gas field B	Cash flow £m	12% Discount factor	NPV £m
Year 0 Initial investment	(24.0)	1.0000	(24.0000)
2023	5.9	0.8929	5.2681
2024	8.0	0.7972	6.3776
2025	12.0	0.7118	8.5416
2026	15.2	0.6355	9.6596
2027	13.0	0.5674	7.3762
2028	9.0	0.5066	4.5594
2028 Decommissioning expenditure	(8.3)	0.5066	(4.2048)
		Net present value	**13.5777**

Gas field C	Cash flow £m	12% Discount factor	NPV £m
Year 0 Initial investment	(31.0)	1.0000	(31.0000)
2023	7.0	0.8929	6.2503
2024	12.0	0.7972	9.5664
2025	14.3	0.7118	10.1787
2026	17.0	0.6355	10.8035
2027	12.5	0.5674	7.0925
2028	7.0	0.5066	3.5462
2028 Decommissioning expenditure	(15.0)	0.5066	(7.5990)
		Net present value	**8.8386**

Internal rates of return

Gas field A	Cash flow £m	16% Discount factor	NPV £m
Year 0 Initial investment	(28.0)	1.0000	(28.0000)
2023	4.0	0.8621	3.4484
2024	6.5	0.7432	4.8308
2025	9.0	0.6407	5.7663
2026	13.0	0.5523	7.1799
2027	15.0	0.4761	7.1415
2028	8.6	0.4104	3.5294
2028 Decommissioning expenditure	(10.0)	0.4104	(4.1040)
		Net present value	**(0.2077)**

Internal rate of return of Gas field A:

$$12\% + \frac{3.2229}{(3.2229 + 0.2077)} \times (16\% - 12\%) = 15.76\%$$

Gas field B	Cash flow £m	30% Discount factor	NPV £m
Year 0 Initial investment	(24.0)	1.0000	(24.0000)
2023	5.9	0.7692	4.5383
2024	8.0	0.5917	4.7336
2025	12.0	0.4552	5.4624
2026	15.2	0.3501	5.3215
2027	13.0	0.2693	3.5009
2028	9.0	0.2072	1.8648
2028 Decommissioning expenditure	(8.3)	0.2072	(1.7198)
		Net present value	**(0.2983)**

Internal rate of return of Gas field B:

$$12\% + \frac{13.5777}{(13.5777 + 0.2983)} \times (30\% - 12\%) = 29.61\%$$

Gas field C	Cash flow £m	24% Discount factor	NPV £m
Year 0 Initial investment	(31.0)	1.0000	(31.0000)
2023	7.0	0.8065	5.6455
2024	12.0	0.6504	7.8048
2025	14.3	0.5245	7.5004
2026	17.0	0.4230	7.1910
2027	12.5	0.3411	4.2638
2028	7.0	0.2751	1.9257
2028 Decommissioning expenditure	(15.0)	0.2751	(4.1265)
		Net present value	**(0.7953)**

Internal rate of return of Gas field C:

$$12\% + \frac{8.8386}{(8.8386 + 0.7953)} \times (24\% - 12\%) = 23.01\%$$

TAKE IT FURTHER

Question 16.8

Payback

	Cumulative cash flows			
	Project 1	Project 2	Project 3	Project 4
	£	£	£	£
Year 0	(100,000)	(120,000)	(90,000)	(115,000)
Year 1	(85,000)	(108,000)	(80,000)	(101,000)
Year 2	(67,500)	(94,000)	(68,000)	(85,500)
Year 3	(48,500)	(77,000)	(54,500)	(67,500)
Year 4	(27,500)	(59,000)	(39,000)	(45,500)
Year 5	(7,500)	(39,500)	(22,000)	(20,500)
Year 6	11,000	(19,000)	(2,000)	500
Year 7	27,000	4,000	17,500	10,500
Year 8	40,000	26,000	35,500	18,500
Resale	80,000	76,000	65,500	33,500

Project 1: 5 years + (7,500/18,500) × 12 months = 5 years and 5 months
Project 2: 6 years + (19,000/23,000) × 12 months = 6 years and 10 months
Project 3: 6 years + (2,000/19,500) × 12 months = 6 years and 1 month
Project 4: 5 years + (20,500/21,000) × 12 months = 6 years and 0 months

Accounting rate of return:

	Project 1	Project 2	Project 3	Project 4
	£	£	£	£
(1) Initial investment	100,000	120,000	90,000	115,000
(2) Total cash inflows	140,000	146,000	125,500	133,500
(3) Resale value	40,000	50,000	30,000	15,000
(4) Total depreciation: (1) – (3)	60,000	70,000	60,000	100,000
(5) Total accounting profit: (2) – (4)	80,000	76,000	65,500	33,500
(6) Average annual profit: (5) ÷ 8	10,000	9,500	8,188	4,188
(7) Average capital employed: [(1) + (3)] ÷ 2	70,000	85,000	60,000	65,000
	%	%	%	%
(8) ARR: (6) ÷ (7) × 100%	14.29	11.18	13.65	6.44

Net present value and Internal rate of return

Project 1

		Discounting at 10% 10% Discount			Discounting at 13% 13% Discount	
Year	**Cash flow £**	**factor**	**NPV**	**Cash flow £**	**factor**	**NPV**
0	(100,000)	1.0000	(100,000)	(100,000)	1.0000	(100,000)
1	15,000	0.9091	13,637	15,000	0.8850	13,275
2	17,500	0.8264	14,462	17,500	0.7831	13,704
3	19,000	0.7513	14,275	19,000	0.6931	13,169
4	21,000	0.6830	14,343	21,000	0.6133	12,879
5	20,000	0.6209	12,418	20,000	0.5428	10,856
6	18,500	0.5645	10,443	18,500	0.4803	8,886
7	16,000	0.5132	8,211	16,000	0.4251	6,802
8	13,000	0.4665	6,065	13,000	0.3762	4,891
8 Resale	40,000	0.4665	18,660	40,000	0.3762	15,048
		Project NPV	**12,514**		Project NPV	**(490)**

Internal rate of return Project 1:

$$10\% + \frac{12,514}{(12,514 + 490)} \times (13\% - 10\%) = 12.89\%$$

Project 2

		Discounting at 10% 10% Discount			Discounting at 9% 9% Discount	
Year	**Cash flow £**	**factor**	**NPV**	**Cash flow £**	**factor**	**NPV**
0	(120,000)	1.0000	(120,000)	(120,000)	1.0000	(120,000)
1	12,000	0.9091	10,909	12,000	0.9174	11,009
2	14,000	0.8264	11,570	14,000	0.8417	11,784
3	17,000	0.7513	12,772	17,000	0.7722	13,127
4	18,000	0.6830	12,294	18,000	0.7084	12,751
5	19,500	0.6209	12,108	19,500	0.6499	12,673
6	20,500	0.5645	11,572	20,500	0.5963	12,224
7	23,000	0.5132	11,804	23,000	0.5470	12,581
8	22,000	0.4665	10,263	22,000	0.5019	11,042
8 Resale	50,000	0.4665	23,325	50,000	0.5019	25,095
		Project NPV	**(3,383)**		Project NPV	**2,286**

Internal rate of return Project 2:

$$9\% + \frac{2,286}{(2,286 + 3,383)} \times (10\% - 9\%) = 9.40\%$$

Project 3

		Discounting at 10% 10% Discount			Discounting at 11% 11% Discount	
Year	**Cash flow £**	**factor**	**NPV**	**Cash flow £**	**factor**	**NPV**
0	(90,000)	1.0000	(90,000)	(90,000)	1.0000	(90,000)
1	10,000	0.9091	9,091	10,000	0.9009	9,009
2	12,000	0.8264	9,917	12,000	0.8116	9,739
3	13,500	0.7513	10,143	13,500	0.7312	9,871
4	15,500	0.6830	10,587	15,500	0.6587	10,210
5	17,000	0.6209	10,555	17,000	0.5935	10,090
6	20,000	0.5645	11,290	20,000	0.5346	10,692
7	19,500	0.5132	10,007	19,500	0.4817	9,393
8	18,000	0.4665	8,397	18,000	0.4339	7,810
8 Resale	30,000	0.4665	13,995	30,000	0.4339	13,017
		Project NPV	**3,982**		Project NPV	**(169)**

Internal rate of return Project 3:

$$10\% + \frac{3,982}{(3,982 + 169)} \times (11\% - 10\%) = 10.96\%$$

Project 4

		Discounting at 10% 10% Discount			Discounting at 5% 5% Discount	
Year	**Cash flow £**	**factor**	**NPV**	**Cash flow £**	**factor**	**NPV**
0	(115,000)	1.0000	(115,000)	(115,000)	1.0000	(115,000)
1	14,000	0.9091	12,727	14,000	0.9524	13,334
2	15,500	0.8264	12,809	15,500	0.9070	14,059
3	18,000	0.7513	13,523	18,000	0.8638	15,548
4	22,000	0.6830	15,026	22,000	0.8227	18,099
5	25,000	0.6209	15,523	25,000	0.7835	19,588
6	21,000	0.5645	11,855	21,000	0.7462	15,670
7	10,000	0.5132	5,132	10,000	0.7107	7,107
8	8,000	0.4665	3,732	8,000	0.6768	5,414
8 Resale	15,000	0.4665	6,998	15,000	0.6768	10,152
		Project NPV	**(17,675)**		Project NPV	**3,971**

Internal rate of return Project 4:

$$5\% + \frac{3,971}{(3,971 + 17,675)} \times (10\% - 5\%) = 5.92\%$$

Advice to the directors

Project 1 with a payback of 5 years and 5 months, an accounting rate of return of 14.89%, a net present value of £12,514 and an internal rate of return of 12.89% is the standout project which should be undertaken. Both Projects 2 and 4 have a negative net present value when discounted at the company's expected rate of return and so should be rejected outright. Should further capital for investment become available, Project 3 can be considered as it has a positive net present value when discounted at the rate of 10%.

»» Question 16.9

Ambulators Limited

Before we can undertake any calculations to determine payback, the accounting rate of return, the net present value and the internal rate of return of the two proposed projects, we will have to calculate the expected sales and production together with the estimated net cash inflows (sales – costs) of each project.

Option 1: the new pram: sales, production and net cash inflows

The first step will be to calculate the sales from the new pram for the five years of the project's life. Sales units rise by 20% per annum, so sales units for the five years will be as follows:

Year	Calculation	Sales units
1	—	5,000
2	5,000 × 120%	6,000
3	6,000 × 120%	7,200
4	7,200 × 120%	8,640
5	8,640 × 120%	10,368

Now that the sales and production units are known, the net cash flows (receipts from sales – costs of production) from the production and sales of prams can be calculated.

- Selling price per pram: £450.
- Variable production price per pram: £150.00 + £75.00 + £25.00 = £250.
- Annual fixed overheads for prams: £50 × 5,000 = £250,000.

Remember that fixed costs are fixed and so will not change over the five-year life of the pram project. Net cash flows per annum:

	Sales units	Gross sales value @ £450 per pram £000	Variable production costs @ £250 per pram £000	Fixed costs £000	Net cash flows £000
Year 1	5,000	2,250.00	1,250.00	250.00	750.00
Year 2	6,000	2,700.00	1,500.00	250.00	950.00
Year 3	7,200	3,240.00	1,800.00	250.00	1,190.00
Year 4	8,640	3,888.00	2,160.00	250.00	1,478.00
Year 5	10,368	4,665.60	2,592.00	250.00	1,823.60
Totals	**37,208**	**16,743.60**	**9,302.00**	**1,250.00**	**6,191.60**

Option 2: the new push chair: sales, production and net cash inflows

Projected demand for the new push chair together with expected selling prices for each year is as follows:

Year	Calculation	Sales units	Selling Price
1	—	6,000	£220
2	6,000 × 110%	6,600	£230
3	6,600 × 110%	7,260	£240
4	7,260 × 110%	7,986	£250
5	7,986 × 110%	*8,785	£260

*Rounded from 8,784.6 to the nearest whole number.

- Selling price per push chair: as given in the table above with selling prices rising by £10 per annum from a starting price in the first year of £220.
- Variable production price per push chair: £80.00 + £40.00 + £10.00 = £130.
- Annual fixed overheads for prams: £20 × 6,000 = £120,000.

Remember that fixed costs are fixed and so will not change over the five-year life of the push chair project.

	Sales units	Selling price per push chair £	Gross sales value £000	Variable production costs @ £130 per push chair £000	Fixed costs £000	Net cash flows £000
Year 1	6,000	220	1,320.00	780.00	120.00	420.00
Year 2	6,600	230	1,518.00	858.00	120.00	540.00
Year 3	7,260	240	1,742.40	943.80	120.00	678.60
Year 4	7,986	250	1,996.50	1,038.18	120.00	838.32
Year 5	8,785	260	2.284.10	1,142.05	120.00	1,022.05
Totals	**36,631**		**8,861.00**	**4,762.03**	**600.00**	**3,498.97**

Payback

	Pram			Push chair	
	Cash Flow £000	Cumulative Cash Flow £000		Cash Flow £000	Cumulative Cash Flow £000
Investment	(3,300.00)	(3,300.00)	Investment	(2,200.00)	(2,200.00)
Year 1	750.00	(2,550.00)	Year 1	420.00	(1,780.00)
Year 2	950.00	(1,600.00)	Year 2	540.00	(1,240.00)
Year 3	1,190.00	(410.00)	Year 3	678.60	(561.40)
Year 4	1,478.00	1,068.00	Year 4	838.32	276.92
Year 5	1,823.60	2,891.60	Year 5	1,022.05	1,298.97
			Transfer	500.00	1,798.97

Payback period: pram: 3.28 years (3 + 410.00/1,478.00)
Payback period: push chair: 3.67 years (3 + 561.40/838.82)

Accounting rate of return

Pram
Cost of investment: £3,300,000
Residual value: £Nil
Total depreciation: £3,300,000
Total accounting profits: £6,191,600 – £3,300,000 = £2,891,600
Average accounting profit for the pram: £2,891,600 ÷ 5 years = £578,320
Average investment in the pram: (£3,300,000 + £Nil) ÷ 2 = £1,650,000
Accounting rate of return: £578,320 ÷ £1,650,000 = 35.05%

Push chair
Cost of investment: £2,200,000
Residual value: £500,000
Total depreciation: £1,700,000
Total accounting profits: £3,498,970 – £1,700,000 = £1,798,970
Average accounting profit for the pram: £1,798,970 ÷ 5 years = £359,794
Average investment in the pram: (£2,200,000 + £500,000) ÷ 2 = £1,350,000
Accounting rate of return: £359,794 ÷ £1,350,000 = 26.65%

Net present value

	Pram			Push chair		
	Cash flow £000	11% Discount factor	NPV £000	Cash flow £000	11% Discount factor	NPV £000
Year 0	(3,300.00)	1.0000	(3,300.000)	(2,200.00)	1.0000	(2,200.000)
Year 1	750.00	0.9009	675.675	420.00	0.9009	378.378
Year 2	950.00	0.8116	771.020	540.00	0.8116	438.264
Year 3	1,190.00	0.7312	870.128	678.60	0.7312	496.192
Year 4	1,478.00	0.6587	973.559	838.32	0.6587	552.201
Year 5	1,823.60	0.5935	1,082.307	1,022.05	0.5935	606.587
Transfer	—	—	—	500.00	0.5935	296.750
	Pram: NPV		**1,072.689**		Push chair: NPV	**568.372**

Internal rate of return

	Pram			Push chair		
	Cash flow £000	22%* Discount factor	NPV £000	Cash flow £000	19% Discount factor	NPV £000
Year 0	(3,300.00)	1.0000	(3,300.000)	(2,200.00)	1.0000	(2,200.000)
Year 1	750.00	0.8197	614.775	420.00	0.8403	352.926
Year 2	950.00	0.6719	638.305	540.00	0.7062	381.348
Year 3	1,190.00	0.5508	655.452	678.60	0.5934	402.681
Year 4	1,478.00	0.4514	667.169	838.32	0.4987	418.070
Year 5	1,823.60	0.3700	674.732	1,022.05	0.4190	428.239
Transfer	—	—	—	500.00	0.4190	209.500
	Pram: NPV		**(49.567)**		Push chair: NPV	**(7.236)**

*Use the formula $1/(1 + r)^n$ to calculate the 22% discount factors.

Internal rate of return: pram

$$11\% + \frac{1,072,689}{(1,072,689 + 49,567)} \times (22\% - 11\%) = 21.51\%$$

Internal rate of return: push chair:

$$11\% + \frac{568,372}{(568,372 + 7,236)} \times (19\% - 11\%) = 18.90\%$$

Recommendation:

- On financial grounds, the pram project has the shortest payback period, the highest accounting rate of return, the highest net present value and the highest internal rate of return.
- However, the directors should consider whether sales growth of 20% each year is realistic and achievable.
- Similarly, is a 10% annual rise in the sales of the push chairs realistic and achievable?
- How realistic is the projection that the price of pushchairs will rise by £10 a year?
- The pram project requires 50% more investment than the push chair project (£3,300,000 v. £2,200,000) and returns 88.73% more (£1,072,689 v. £568,372) for this additional 50% investment.

Additional factors to consider:

- Projected birth rates over the next five years.
- If these are rising, then the projected growth rates in sales might be achievable.
- If birth rates are expected to fall, then the expected growth rate will probably not be achievable at all.
- Prams and push chairs produced by other companies and the likely demand for competitor companies' products.
- How competitor company products compare with Ambulators' prams and pushchairs.
- How effectively Ambulators' products will compete with other products on the market.

- Prices charged by competitors and how these compare to the prices charged by Ambulators Limited.
- The possibility that Ambulators will have to reduce their prices in order to compete more effectively against competitors' products.
- An assumption has been made that the cost prices of each product will not change over the five years: this might not be a realistic assumption, so sensitivity analysis should be carried out on the projected results to see what effect any price rises in materials, director labour, variable overheads and fixed costs would have on the results of the calculations above.

»» Question 16.10

Chillers plc

Our first task will be to calculate the annual net cash flows arising from the production of the new deluxe fridge-freezer. Information that we will need to complete this task is as follows:

- Selling price of the new deluxe fridge freezer: £600.
- Variable costs per deluxe fridge-freezer: £600 × 40% = £240.
- Annual fixed costs: £1,200,000.
- Annual value of lost sales of standard fridge freezers: 2,000 × £350 = £700,000.
- Annual cost savings arising from the lost sales of standard fridge freezers: (£700,000 × 35%) + £395,000 of annual fixed costs = £640,000.

We can now calculate the annual net cash flows arising from the introduction of the new deluxe fridge-freezer:

Year	Sales units	Sales value £000	Variable costs £000	Fixed costs £000	Lost sales £000	Costs saved £000	Net cash flows £000
2023	3,500	2,100	840	1,200	700	640	0
2024	4,000	2,400	960	1,200	700	640	180
2025	4,500	2,700	1,080	1,200	700	640	360
2026	5,250	3,150	1,260	1,200	700	640	630
2027	5,750	3,450	1,380	1,200	700	640	810
2028	5,500	3,300	1,320	1,200	700	640	720
2029	5,250	3,150	1,260	1,200	700	640	630
Totals	**33,750**	**20,250**	**8,100**	**8,400**	**4,900**	**4,480**	**3,330**

Net cash flows are calculated as follows: + sales value – variable costs – fixed costs – lost sales + costs saved. Thus, for 2023, the calculation is + £2,100 – £840 – £1,200 – £700 + £640 = £0.

Payback

	Cash Flow £000	Cumulative Cash Flow £000
Investment	(2,000)	(2,000)
2023	0	(2,000)
2024	180	(1,820)
2025	360	(1,460)
2026	630	(830)
2027	810	(20)
2028	720	700
2029	630	1,330
Scrap value 2029	100	1,430

Payback period: 5.03 years

Accounting rate of return

Cost of investment: £2,000,000
Residual value: £100,000
Total depreciation: £1,900,000
Total accounting profits: £3,330,000 – £1,900,000 = £1,430,000
Average accounting profit: £1,430,000 ÷ 7 years = £204,286
Average investment: (£2,000,000 + £100,000) ÷ 2 = £1,050,000
Accounting rate of return: £204,286 ÷ £1,050,000 = 19.46%

Net present value

	Cash flow £000	13% Discount factor	NPV £000
Year 0	(2,000)	1.0000	(2,000.000)
2023	0	0.8850	0.000
2024	180	0.7831	140.958
2025	360	0.6931	249.516
2026	630	0.6133	386.379
2027	810	0.5428	439.668
2028	720	0.4803	345.816
2029	630	0.4251	267.813
2029 Scrap value	100	0.4251	42.510
		Net present value	**(127.340)**

Internal rate of return

As the net present value at a 13% discount rate is negative, the internal rate of return must be lower than 13%.

	Cash flow £000	11% Discount factor	NPV £000
Year 0	(2,000)	1.0000	(2,000.000)
2023	0	0.9009	0.000
2024	180	0.8116	146.088
2025	360	0.7312	263.232
2026	630	0.6587	414.981
2027	810	0.5935	480.735
2028	720	0.5346	384.912
2029	630	0.4817	303.471
2029 Scrap value	100	0.4817	48.170
		Net present value	**41.589**

Internal rate of return:

$$11\% + \frac{41{,}589}{(41{,}589 + 127{,}340)} \times (13\% - 11\%) = 11.49\%$$

Should the directors undertake the project?

- Net present value at a discount rate of 13% is negative, so this project does not give a positive return to the company.
- The internal rate of return shows that the rate of return on this project is 1.51% below the required rate of return.
- The project only pays back after five years. This is a long time to wait for the return of the capital invested.
- The project is thus risky because of the length of time it takes to return the capital originally invested.

Therefore, based on the capital investment appraisal figures, this project should not go ahead.