

Question Book for
Investment Criteria and Decision

Self-Test Problem

(ST-1)
Project Analysis

You are a financial analyst for the Hittle Company. The director of capital budgeting has asked you to analyze two proposed capital investments, Projects X and Y. Each project has a cost of \$10,000, and the cost of capital for each is 12%. The projects' expected net cash flows are as follows:

Expected Net Cash Flows		
Year	Project X	Project Y
0	-\$10,000	-\$10,000
1	6,500	3,500
2	3,000	3,500
3	3,000	3,500
4	1,000	3,500

- Calculate each project's payback period, net present value (NPV), internal rate of return (IRR), modified internal rate of return (MIRR), and profitability index (PI).
- Which project or projects should be accepted if they are independent?
- Which project should be accepted if they are mutually exclusive?
- How might a change in the cost of capital produce a conflict between the NPV and IRR rankings of these two projects? Would this conflict exist if r were 5%? (*Hint*: Plot the NPV profiles.)
- Why does the conflict exist?

Problems

EASY PROBLEMS 1–7

(10–1) NPV A project has an initial cost of \$52,125, expected net cash inflows of \$12,000 per year for 8 years, and a cost of capital of 12%. What is the project's NPV? (*Hint:* Begin by constructing a time line.)

(10–2) IRR Refer to Problem 10-1. What is the project's IRR?

(10–3) MIRR Refer to Problem 10-1. What is the project's MIRR?

(10–4) Profitability Index Refer to Problem 10-1. What is the project's PI?

(10–5) Payback Refer to Problem 10-1. What is the project's payback period?

(10–6) Discounted Payback Refer to Problem 10-1. What is the project's discounted payback period?

(10–7) NPV Your division is considering two investment projects, each of which requires an up-front expenditure of \$15 million. You estimate that the investments will produce the following net cash flows:

Year	Project A	Project B
1	\$ 5,000,000	\$20,000,000
2	10,000,000	10,000,000
3	20,000,000	6,000,000

- What are the two projects' net present values, assuming the cost of capital is 5%? 10%? 15%?
- What are the two projects' IRRs at these same costs of capital?

INTERMEDIATE PROBLEMS 8–18

(10–8) NPVs, IRRs, and MIRRs for Independent Projects Edelman Engineering is considering including two pieces of equipment, a truck and an overhead pulley system, in this year's capital budget. The projects are independent. The cash outlay for the truck is \$17,100 and that for the pulley system is \$22,430. The firm's cost of capital is 14%. After-tax cash flows, including depreciation, are as follows:

Year	Truck	Pulley
1	\$5,100	\$7,500
2	5,100	7,500
3	5,100	7,500
4	5,100	7,500
5	5,100	7,500

Calculate the IRR, the NPV, and the MIRR for each project, and indicate the correct accept–reject decision for each.

(10-9)
NPVs and IRRs for
Mutually Exclusive
Projects

Davis Industries must choose between a gas-powered and an electric-powered forklift truck for moving materials in its factory. Since both forklifts perform the same function, the firm will choose only one. (They are mutually exclusive investments.) The electric-powered truck will cost more, but it will be less expensive to operate; it will cost \$22,000, whereas the gas-powered truck will cost \$17,500. The cost of capital that applies to both investments is 12%. The life for both types of truck is estimated to be 6 years, during which time the net cash flows for the electric-powered truck will be \$6,290 per year and those for the gas-powered truck will be \$5,000 per year. Annual net cash flows include depreciation expenses. Calculate the NPV and IRR for each type of truck, and decide which to recommend.

(10-10)
Capital Budgeting
Methods

Project S has a cost of \$10,000 and is expected to produce benefits (cash flows) of \$3,000 per year for 5 years. Project L costs \$25,000 and is expected to produce cash flows of \$7,400 per year for 5 years. Calculate the two projects' NPVs, IRRs, MIRR, and PIs, assuming a cost of capital of 12%. Which project would be selected, assuming they are mutually exclusive, using each ranking method? Which should actually be selected?

(10-11)
MIRR and NPV

Your company is considering two mutually exclusive projects, X and Y, whose costs and cash flows are shown below:

Year	X	Y
0	-\$1,000	-\$1,000
1	100	1,000
2	300	100
3	400	50
4	700	50

The projects are equally risky, and their cost of capital is 12%. You must make a recommendation, and you must base it on the modified IRR (MIRR). Which project has the higher MIRR?

(10-12)
NPV and IRR Analysis

After discovering a new gold vein in the Colorado mountains, CTC Mining Corporation must decide whether to go ahead and develop the deposit. The most cost-effective method of mining gold is sulfuric acid extraction, a process that could result in environmental damage. Before proceeding with the extraction, CTC must spend \$900,000 for new mining equipment and pay \$165,000 for its installation. The gold mined will net the firm an estimated \$350,000 each year for the 5-year life of the vein. CTC's cost of capital is 14%. For the purposes of this problem, assume that the cash inflows occur at the end of the year.

- What are the project's NPV and IRR?
- Should this project be undertaken if environmental impacts were not a consideration?
- How should environmental effects be considered when evaluating this, or any other, project? How might these concepts affect the decision in part b?

(10-13)
NPV and IRR Analysis

Cummings Products is considering two mutually exclusive investments whose expected net cash flows are as follows:

EXPECTED NET CASH FLOWS		
Year	Project A	Project B
0	−\$300	−\$405
1	−387	134
2	−193	134
3	−100	134
4	600	134
5	600	134
6	850	134
7	−180	0

- Construct NPV profiles for Projects A and B.
- What is each project's IRR?
- If you were told that each project's cost of capital was 10%, which project, if either, should be selected? If the cost of capital were 17%, what would be the proper choice?
- What is each project's MIRR at the cost of capital of 10%? At 17%? (*Hint:* Consider Period 7 as the end of Project B's life.)
- What is the crossover rate, and what is its significance?

(10–14)

Timing Differences

The Ewert Exploration Company is considering two mutually exclusive plans for extracting oil on property for which it has mineral rights. Both plans call for the expenditure of \$10 million to drill development wells. Under Plan A, all the oil will be extracted in 1 year, producing a cash flow at $t = 1$ of \$12 million; under Plan B, cash flows will be \$1.75 million per year for 20 years.

- What are the annual incremental cash flows that will be available to Ewert Exploration if it undertakes Plan B rather than Plan A? (*Hint:* Subtract Plan A's flows from B's.)
- If the company accepts Plan A and then invests the extra cash generated at the end of Year 1, what rate of return (reinvestment rate) would cause the cash flows from reinvestment to equal the cash flows from Plan B?
- Suppose a firm's cost of capital is 10%. Is it logical to assume that the firm would take on all available independent projects (of average risk) with returns greater than 10%? Further, if all available projects with returns greater than 10% have been taken, would this mean that cash flows from past investments would have an opportunity cost of only 10%, because all the firm could do with these cash flows would be to replace money that has a cost of 10%? Finally, does this imply that the cost of capital is the correct rate to assume for the reinvestment of a project's cash flows?
- Construct NPV profiles for Plans A and B, identify each project's IRR, and indicate the crossover rate.

(10–15)

Scale Differences

The Pinkerton Publishing Company is considering two mutually exclusive expansion plans. Plan A calls for the expenditure of \$50 million on a large-scale, integrated plant that will provide an expected cash flow stream of \$8 million per year for 20 years. Plan B calls for the expenditure of \$15 million to build a somewhat less efficient, more labor-intensive plant that has an expected cash flow stream of \$3.4 million per year for 20 years. The firm's cost of capital is 10%.

- Calculate each project's NPV and IRR.
- Set up a Project Δ by showing the cash flows that will exist if the firm goes with the large plant rather than the smaller plant. What are the NPV and the IRR for this Project Δ ?
- Graph the NPV profiles for Plan A, Plan B, and Project Δ .
- Give a logical explanation, based on reinvestment rates and opportunity costs, as to why the NPV method is better than the IRR method when the firm's cost of capital is constant at some value such as 10%.

(10-16)
Unequal Lives

Shao Airlines is considering two alternative planes. Plane A has an expected life of 5 years, will cost \$100 million, and will produce net cash flows of \$30 million per year. Plane B has a life of 10 years, will cost \$132 million, and will produce net cash flows of \$25 million per year. Shao plans to serve the route for only 10 years. Inflation in operating costs, airplane costs, and fares is expected to be zero, and the company's cost of capital is 12%. By how much would the value of the company increase if it accepted the better project (plane)? What is the equivalent annual annuity for each plane?

(10-17)
Unequal Lives

The Perez Company has the opportunity to invest in one of two mutually exclusive machines that will produce a product it will need for the foreseeable future. Machine A costs \$10 million but realizes after-tax inflows of \$4 million per year for 4 years. After 4 years, the machine must be replaced. Machine B costs \$15 million and realizes after-tax inflows of \$3.5 million per year for 8 years, after which it must be replaced. Assume that machine prices are not expected to rise because inflation will be offset by cheaper components used in the machines. The cost of capital is 10%. By how much would the value of the company increase if it accepted the better machine? What is the equivalent annual annuity for each machine?

(10-18)
Unequal Lives

Filkins Fabric Company is considering the replacement of its old, fully depreciated knitting machine. Two new models are available: Machine 190-3, which has a cost of \$190,000, a 3-year expected life, and after-tax cash flows (labor savings and depreciation) of \$87,000 per year; and Machine 360-6, which has a cost of \$360,000, a 6-year life, and after-tax cash flows of \$98,300 per year. Knitting machine prices are not expected to rise, because inflation will be offset by cheaper components (microprocessors) used in the machines. Assume that Filkins's cost of capital is 14%. Should the firm replace its old knitting machine? If so, which new machine should it use? By how much would the value of the company increase if it accepted the better machine? What is the equivalent annual annuity for each machine?

CHALLENGING PROBLEMS
19-22

(10-19)
Multiple Rates of Return

The Ulmer Uranium Company is deciding whether or not it should open a strip mine whose net cost is \$4.4 million. Net cash inflows are expected to be \$27.7 million, all coming at the end of Year 1. The land must be returned to its natural state at a cost of \$25 million, payable at the end of Year 2.

- Plot the project's NPV profile.
- Should the project be accepted if $r = 8\%$? If $r = 14\%$? Explain your reasoning.
- Can you think of some other capital budgeting situations in which negative cash flows during or at the end of the project's life might lead to multiple IRRs?
- What is the project's MIRR at $r = 8\%$? At $r = 14\%$? Does the MIRR method lead to the same accept-reject decision as the NPV method?

(10–20)
Present Value
of Costs

The Aubey Coffee Company is evaluating the within-plant distribution system for its new roasting, grinding, and packing plant. The two alternatives are (1) a conveyor system with a high initial cost but low annual operating costs, and (2) several forklift trucks, which cost less but have considerably higher operating costs. The decision to construct the plant has already been made, and the choice here will have no effect on the overall revenues of the project. The cost of capital for the plant is 8%, and the projects' expected net costs are listed in the following table:

Year	Expected Net Cost	
	Conveyor	Forklift
0	–\$500,000	–\$200,000
1	–120,000	–160,000
2	–120,000	–160,000
3	–120,000	–160,000
4	–120,000	–160,000
5	–20,000	–160,000

- What is the IRR of each alternative?
- What is the present value of the costs of each alternative? Which method should be chosen?

(10–21)
Payback, NPV,
and MIRR

Your division is considering two investment projects, each of which requires an up-front expenditure of \$25 million. You estimate that the cost of capital is 10% and that the investments will produce the following after-tax cash flows (in millions of dollars):

Year	Project A	Project B
1	5	20
2	10	10
3	15	8
4	20	6

- What is the regular payback period for each of the projects?
- What is the discounted payback period for each of the projects?
- If the two projects are independent and the cost of capital is 10%, which project or projects should the firm undertake?
- If the two projects are mutually exclusive and the cost of capital is 5%, which project should the firm undertake?
- If the two projects are mutually exclusive and the cost of capital is 15%, which project should the firm undertake?
- What is the crossover rate?
- If the cost of capital is 10%, what is the modified IRR (MIRR) of each project?

(10–22)
Economic Life

The Scampini Supplies Company recently purchased a new delivery truck. The new truck cost \$22,500, and it is expected to generate net after-tax operating cash flows, including depreciation, of \$6,250 per year. The truck has a 5-year expected life. The expected salvage values after tax adjustments for the truck are given below. The company's cost of capital is 10%.

Year	Annual Operating Cash Flow	Salvage Value
0	-\$22,500	\$22,500
1	6,250	17,500
2	6,250	14,000
3	6,250	11,000
4	6,250	5,000
5	6,250	0

- Should the firm operate the truck until the end of its 5-year physical life? If not, then what is its optimal economic life?
- Would the introduction of salvage values, in addition to operating cash flows, ever *reduce* the expected NPV and/or IRR of a project?