

CAPITAL BUDGETING: PROBLEMS (copyright © 2021 Joseph W. Trefzger)

This problem set covers all of our capital budgeting situations. The problems progress in a building-block fashion, with concepts presented in an order designed to provide a coherent coverage of the applications. Thus some of the later problems may actually be easier, computationally, than some earlier problems. But you are encouraged to work the earlier problems before moving ahead, to facilitate understanding. Problems 17 – 20 allow for extra practice with the concepts covered in key earlier problems 1 – 6 and 12.

1. The managers of Charles Mound Company, a publishing firm, just paid author Christina Redbird \$200,000 in royalties for the rights, for one year, to distribute her tell-all book about her controlling father, *Reggie Dearest*. They expect to sell thousands of copies, after which they expect to have a year-end net cash flow (money left for Charles Mound's lenders and owners after all production and distribution costs, along with income taxes, have been paid) of \$230,000. What is this investment project's expected internal rate of return (IRR) in annual terms? What if that single cash flow at the end of year 1 instead were expected to be only \$184,000, or \$200,000? What if Charles Mound instead had the rights to distribute the book for two years, and it expected net cash flows of \$120,000 in year 1 and \$113,220 in year 2; vs. \$120,000 in year 1 and \$80,000 in year 2? What if instead it had the rights to produce and distribute the book for three years, with expected net cash flows of \$80,000 at the ends of each of years 1 – 3?

2. Ms. McKinley, owner of Denali Art Gallery, just bought a painting done by a critically-acclaimed, but not yet famous, artist, for \$250,000. Experience as an art dealer tells her that if she waits 20 years the artist will be famous, and she will be able to sell the painting for \$8,000,000. She expects no other costs; Denali is already insured, for example. Because Ms. McKinley would require a 15% annual rate of return on an equally-risky investment, we view her cost of capital for the painting purchase as 15%/year. What are the net present value (NPV), profitability index (PI), internal rate of return (IRR), and modified internal rate of return (MIRR) for this investment?

3. Everest Steel Fabricating Company plans to pay \$4,000,000 for equipment to expand its productive capacity. The project is expected to generate \$800,000 in net cash flows each year of its expected 10-year life. What is the expected payback period? If the annual weighted average cost of capital for a project such as this one is 12.5%, what is the expected discounted payback period?

4. Rainier Agricultural Industries plans to pay \$3,500,000 for equipment to expand its productive capacity. Expected net cash flows for each year of the project's expected 8-year life are as follows:

Year 1	\$ 780,500	Year 3	\$ 970,337	Year 5	\$ 1,206,347	Year 7	\$ 1,499,761
Year 2	\$ 870,258	Year 4	\$ 1,081,926	Year 6	\$ 1,345,077	Year 8	\$ 1,672,234

What is the expected payback period? If the annual weighted average cost of capital for such a project is 11.5%, what is the expected discounted payback period?

5. Whitney Specialty Foods, which produces frozen pizzas sold under private brand labels, wants to increase its manufacturing capacity. Its sales representatives consistently hear from grocery industry executives that a Whitney-produced frozen lasagna, sold under stores' own brand names, would create strong consumer interest. As a result, Whitney's managers plan to invest \$3,200,000 in lasagna processing machinery, which has a 6-year expected life. The project is expected to create added net cash flows (*i.e.*, beyond what the current money providers get from the current Whitney business lines) of \$650,000 in year 1; \$750,000 in year 2; \$850,000 in year 3; \$950,000 in year 4; \$1,100,000 in year 5; and back to a lower \$750,000 in year 6 (as aging equipment and new competition cause problems). If the annual weighted average cost of capital for a project of this type would be 10.75%, should Whitney's managers purchase the new processing machinery? (Include the NPV, PI, IRR, and MIRR criteria.)

6. Managers of Eaux Arcs Ice Cream are considering the purchase of new mixing and freezing equipment so they can produce new flavors and expand their output. The total cost of acquiring the equipment and related items is expected to be \$5,750,000. This type of equipment is expected to have a six-year productive life. Net cash flows (the money remaining for Eaux Arcs' lenders and owners, after all operating costs and income taxes have been paid) are expected to be \$1,500,000 in each of years 1 – 6. a. If Eaux Arcs estimates its annual weighted average cost of capital for an expansion project of this type to be 9.5% per year, should the new ice cream equipment be purchased? b. What if the annual cost of capital instead were 17%? c. What if the WACC were 14% and a net salvage value of \$1,000,000 could be expected at the end of year 6? (Include the NPV, PI, IRR, and MIRR criteria in your analysis.)

7. Kilimanjaro Manufacturing needs to update its technological equipment. Improved technology is not expected to bring about higher sales (customers do not care how modern the factory is if the output is of acceptable price and quality), but would create financial benefits by reducing operating costs. Specifically, if \$22,000,000 were invested in a new company-wide computer network, the firm would expect to realize increased cash flows (through better hardware compatibility, fewer repair outlays, and reduced general information management costs) of \$6 million per year for 5 years. If Kilimanjaro feels that the cost of capital for a low-risk replacement project of this type is 8.25% per year, should the new high-tech equipment be purchased? What if the annual cost of capital instead were 16.5%?

8. Vesuvius Airways is seeking a long-term supplier for air-sickness “barf” bags. It wants to buy 12 million bags per year in cases of 600, with each case containing 200 high quality bags (heavy plastic liner, for use in first class), 300 medium quality (thin plastic liner, for use in coach), and 100 low quality (no plastic liner, for college student fares). The airline is seeking bids from potential suppliers; and will sign a 9-year contract to buy from whichever supplier submits the lowest bid (*i.e.*, offers to sell for the lowest price). Pike’s Peak Paper Products, which has not made air-sickness bags in the past, wants to win the Vesuvius account. If Pike’s Peak bought specialized bag-making machinery with a 9-year expected life, it would cost \$4,500,000. Expected material, labor, and other cash-based variable production costs would be \$.05 per bag for the bare-bones model that Pike’s Peak will call the Hurl Holder, \$.10 per bag for its mid-quality Vomit Vault, and \$.14 per bag for the top-of-the-line Cookie Catcher. If Pike’s Peak attributes a 13.75% annual weighted average cost of capital to a project of this type, and if we ignore income tax effects, for what price should Pike’s Peak bid to sell its 600-bag “Puke-Pak”?

9. Fuji Pet Foods is considering two different capital investment projects. One possibility is to make a new product that would be called Tapir Twinkies; another is to make a new product to be called Muskrat Munchies. Because the new activity will be handled in a small empty section of Fuji’s current production facility, only one of the projects can be undertaken. Equipment for either would have a 5-year expected life and a cost of \$675,000. Expected net cash flows (money left for Fuji’s lenders and owners after operating costs and income taxes have been paid) are:

<u>Year</u>	<u>Tapir Twinkies</u>	<u>Muskrat Munchies</u>
0	(\$675,000)	(\$675,000)
1	\$230,000	\$180,000
2	\$220,000	\$190,000
3	\$210,000	\$200,000
4	\$200,000	\$210,000
5	\$190,000	\$220,000

(Fuji analysts expect tapirs to become less popular as pets, while they expect muskrats to grow in popularity, over the next few years.) Fuji uses a 14% annual cost of capital assumption in evaluating all potential pet food projects. Compute the net present value (NPV) and modified internal rate of return (MIRR) for each project, and determine which of the two should be accepted. Should the superior project’s identity actually be readily apparent?

10. Grand Teton Building Products wants to manufacture pre-cut shelves to sell in large home improvement stores. One possibility is to make traditional plywood shelves, for which net cash flows would be expected to start strong but then decline over time as younger people, who often prefer new synthetic materials, become home owners in greater numbers. The other approach would be to make shelves out of a laminated plastic material, for which net cash flows would be expected to start out lower but then rise over time. The equipment for producing either type of shelving would have a 7-year expected life, and a cost today of \$258,000. Net cash flows (money left for Grand Teton’s lenders and owners, after all operating costs and income taxes have been paid) are expected to be as follows:

<u>Year</u>	<u>Plywood</u>	<u>Plastic</u>
0	(\$258,000)	(\$258,000)
1	\$85,000	\$45,000
2	\$75,000	\$50,000
3	\$65,000	\$55,000
4	\$55,000	\$65,000
5	\$50,000	\$75,000
6	\$45,000	\$85,000
7	\$40,000	\$95,000

If the two possibilities are mutually exclusive, such that only one type of shelving would be produced, and if Grand Teton uses an 8% annual cost of capital assumption in evaluating all potential building materials projects, which

type of shelving should it produce? What if the annual cost of capital instead were 15%? In making your decision, compute the modified internal rate of return (MIRR) for each project, and compile a brief net present value (NPV) profile for each project. Why is the identity of the superior project not readily apparent in this example?

11. St. Helens Corporation wants to begin making pens. One possibility is to make low-priced disposables; another is to make high-end models selling for several hundred dollars each. Because high-end buyers would not purchase expensive pens from a company also known for cheap throw-aways, it would be impractical to produce both types. Equipment for producing the low-priced model would cost \$450,000 and result in expected net cash flows (money left for St. Helens's investors after all operating costs and income taxes had been paid) of \$94,500 in each of the 8 years the equipment would be expected to last. Equipment for the high-priced model would cost \$685,500, with expected net cash flows of \$142,750 in each of the 8 years of the equipment's expected life. St. Helens uses an 11.75% annual cost of capital assumption in evaluating investment projects. Compute the net present value (NPV) and modified internal rate of return (MIRR) for each project, and determine which one St. Helens should accept.

12. Rushmore Consultants wants to make use of unoccupied space in its headquarters by taking on a new consulting project. It will choose the highest net present value project from among four possibilities. Each of the four potential clients would like to enter an arrangement for Rushmore to provide its consulting services for a six-year period.

- Washington Company has approached Rushmore for ongoing advice on managing its payroll system. Specialized computer software for this project would cost Rushmore \$960,000, but because payroll technology does not tend to change rapidly the software would have a long (6-year) expected life. The expected subsequent net cash flows for Rushmore's investors would be \$243,000 per year for six years.
- Jefferson, Inc. has asked Rushmore to upgrade and maintain its inventory control system. The needed software costs a lower \$658,000, but would have only a 3-year expected life, with associated annual net cash flows of \$290,000 per year for 3 years. If Rushmore agreed to do this project, it would have to buy new inventory software at the end of year 3, although because software costs generally have not risen over time the improved software would be expected to have the same \$658,000 cost, while expected annual net cash flows would be the same \$290,000 in each of years 4 – 6 as in each of years 1 – 3.
- Lincoln Bank wants Rushmore to help it develop and maintain a personal identity protection system. Software would cost only \$422,000, with associated net cash flows expected to total \$265,000 each year, but the software likely would be obsolete and have to be replaced after just two years. Thus if Rushmore agreed to do this project, it would have to buy new personal identity software at the end of year 2 and then again at the end of year 4, with each later purchase expected also to cost \$422,000. Expected annual net cash flows would be \$265,000 in years 3 – 4 and 5 – 6, just as in years 1 – 2.
- Finally, Roosevelt Packaging seeks Rushmore's help in protecting against computer viruses. Needed software would cost only \$191,000, but new software surely would have to be purchased every year, although the cost would not be expected to change over time. Doing this project would be expected to generate a net cash flow of \$227,500 in each of the six years for Roosevelt's lenders and owners.

If Rushmore treats any consulting project as having a 10.85% annual weighted average cost of capital, which of the four jobs should be accepted? Make your determination using the replacement chain approach.

13. Aconcagua Fabricating is building a new production facility on its current factory site. During the two years it will take to construct the new facility, Aconcagua will conduct many of its activities from temporary quarters 35 miles away. The company needs access to 5 passenger vans to move workers, as needed, between the two locations during the three-year construction period. One option is to buy the vans, with expected net cash flows (all costs paid in advance) of -\$110,000 in year 0 (the purchase), -\$12,500 in year 1 (for maintenance), and -\$2,500 in year 2 (maintenance costs, net of the present value of a small resale price). The other possibility is to lease the vans, with each year's expected net cash flow totaling -\$46,000 (an amount paid at the start of each year that includes all maintenance). Based on net present value (NPV) analysis, with an 8.75% assumed annual weighted average cost of capital, which choice should Aconcagua's managers make? What is each option's internal rate of return (IRR)?

14. Matterhorn Appliances is deciding whether to build a new, state-of-the-art production facility. The project would involve making an initial investment today (at the end of year 0) and then require two more full years to build, and thus would not be up and running (and generating sales revenues and resulting positive cash flows) until year 3. Expected net cash flows would be as follows: -\$17,750,000 in year 0; -\$9,500,000 in year 1; -\$8,000,000 in year 2; and then \$7,350,000 in each of years 3 through 17. If Matterhorn managers assume that the cost of capital for this type investment is 13.25% per year, should they go ahead with the project? Compute the net present value

(NPV), profitability index (PI), internal rate of return (IRR), and modified internal rate of return (MIRR) in determining your answer.

15. K2 Assurity sells multi-year insurance policies to owners of small commercial buildings. It typically charges \$18,000 in return for coverage over the subsequent four years. Experience with these kinds of policies indicates that K2's average financial-plus-administrative cost of paying claims on a building (when fires or other perils occur) will be \$5,150 per year. If the annual cost of capital is 7% (here we can think of it as the average annual rate of return earned on the investment of premium dollars received), what NPV and IRR does K2 realize, on average, on these policies (an insurance company must deal with large numbers of policies to have predictable outcomes)?

16. Mauna Loa Medical Services contracts with companies to provide workers with medical screenings to detect serious illnesses at early stages. Mauna Loa's analysts expect this type of service to be in high demand for the next ten years, during which Mauna Loa might realize attractive net cash flows (money left for its lenders and owners after all operating costs and income taxes have been paid). However, because of ongoing advances in technology they also expect that any screening equipment purchased today would have to be replaced, and at a higher cost, at the end of year 5, leaving year 5's net cash flow negative. Specifically, the yearly net cash flows are expected to be -\$6,850,000 in year 0 (the initial investment in equipment today); \$1,850,000 in each of years 1 – 4; \$1,850,000 from screenings minus \$7,600,000 for new equipment = -\$5,750,000 in year 5; and then \$2,300,000 in each of years 6 – 10 (as Mauna Loa also expects to charge higher prices for better screenings with the more advanced equipment). Compute this medical screening project's net present value (NPV), profitability index (PI), modified internal rate of return (MIRR), and internal rate of return (IRR), if its annual cost of capital is 9.25%.

17. Return to the story of Ms. McKinley in earlier problem 2. The Denali Art Gallery owner just paid \$250,000 for a painting that she expects to hold for 20 years and then sell for \$8,000,000, and she attributes a 15% annual weighted average cost of capital to this type of investment. We computed the net present value, profitability index, internal rate of return, and modified internal rate of return based on an assumption that no other cash flows would be relevant to the analysis – for example, she had not considered a differential annual security cost for holding this painting because her gallery already is insured. But now Ms. McKinley learns that unusual features of this particular art work would lead to an extra annual cost for insurance, maintenance, and secure storage, expected to be \$25,000 paid at the start of each of years 1 through 20. Taking this new information into account, what would we compute her NPV, PI, IRR, and MIRR for this investment to be? What would these values be if the security costs related to holding the painting were expected to be \$35,000 per year?

A Few Extra Examples

18. [Similar to earlier problems 3, 4, and 5.] After an extensive marketing research project, the directors of Pyrenees Properties have decided to open on-site health clubs in the company's upscale apartment complexes. The initial cost of exercise equipment, along with some minor reconfiguration of existing space in Pyrenees buildings, would be \$13,000,000. The equipment's expected useful life is 7 years. The clubs would be expected to generate net cash flows of \$2,500,000 in year 1; \$3,500,000 in year 2; \$4,500,000 in year 3; \$5,750,000 in year 4; \$4,750,000 in year 5; \$3,750,000 in year 6; and \$2,750,000 in year 7; in line with the researchers' finding that clubs of this type need time to get established, and then peak and ultimately decline as the equipment ages and new competitors emerge. If Pyrenees estimates its annual weighted average cost of capital for a project of this type to be 16%, and if it prefers to have a payback period less than 4 years and discounted payback period less than 5 years, should the project be undertaken? Be sure to compute the net present value (NPV), profitability index (PI), internal rate of return (IRR), and modified internal rate of return (MIRR) in deciding.

19. [Combines aspects of earlier problems 3, 4, and 6.] The managers of Olympus Greenhouses foresee increased demand for hydroponically-grown tomatoes and other vegetables, and therefore wants to develop a hydroponics operation. The total cost of building specialized new facilities and obtaining all needed equipment and related items is expected to be \$18,500,000. The buildings and equipment are expected to be productive for 12 years. Net cash flows (money remaining for the company's lenders and owners, after all other parties including the applicable government taxing bodies have been paid) is expected to be \$3,395,000 in each year of the project's expected 12-year life. If Olympus managers prefer projects with a payback period of less than 5 years and a discounted payback less than 7.5 years, and if they feel that the annual weighted average cost of capital for an expansion project of this type is 11.25%, should the new equipment be purchased? What if instead the annual cost of capital were 18.25%?

20. [Similar to problem earlier 6.] The directors of Porcupine Industries are debating a major corporate move: acquiring Sawtooth Corporation, by purchasing all shares of Sawtooth common stock. The Sawtooth board and stockholders want to sell, recognizing that their company faces a difficult future as a stand-alone operation. The

per-share price Porcupine would pay is \$60, and with 7 million shares outstanding the total outlay would be \$420,000,000. The purchase would be paid for with Porcupine's usual mix of debt and equity financing, with 12.45% as the estimated annual weighted average cost of capital for an undertaking of this type. Because of Sawtooth's modern factories and longstanding reputation as a quality producer, Porcupine expects the acquisition to generate positive net cash flows for a long period, specifically \$62,300,000 per year for 20 years. Should Porcupine go through with the acquisition?

21. [Similar to earlier problem 12.] After years of turning down snow removal jobs because of inadequate plowing equipment, the managers of Mesabi Lawn & Lot have decided to buy ten top-quality Alpine Tyrannosaurus snow plows. They are choosing from among three options:

<u>Type Equipment</u>	<u>Cost for Ten</u>	<u>Expected Life</u>	<u>Expected Annual Net Cash Flow</u>
New	\$640,000	8 Years	\$175,000
Factory Reconditioned	\$384,000	4 Years	\$170,000
Used	\$205,000	2 Years	\$160,000

Expected annual cash flows are slightly lower for the reconditioned or used equipment due to higher expected maintenance/repair costs. Because it plans to be in business indefinitely into the future, Mesabi will evaluate the three possibilities based on a common 8-year investment period. Costs of reconditioned or used equipment, and the net yearly cash flows from snow removal activities, are expected to remain largely unchanged over the next eight years. Based on their experience, Mesabi managers feel that the resale value of any equipment at the end of its expected life will be negligible. The company assigns a 14.25% annual cost of capital to all its equipment purchases. Using the replacement chain method, determine which purchase option provides the highest net present value (NPV). How does the equivalent annual annuity (EAA) method rank the three possibilities?

22. [Somewhat similar to earlier problem 8.] Andes Apparel is negotiating with Carpathian Cartoons for the rights to produce children's clothing featuring Carpathian character logos. Andes would pay \$562,700 for licensing rights to the cartoon figures for an 11-year period. If the internal rate of return (IRR) for the project is measured to be 13.25%, what additional net cash flow does Andes expect to generate each year by putting the Carpathian characters on its products? If the cost of capital is 10.45% per year, what are the project's modified internal rate of return (MIRR) and net present value (NPV)? For how many years would that annual net cash flow have to persist to provide Andes with an NPV of \$150,000?

23. [FIL 404 only] Adirondack Music Stores is considering buying all the buildings and inventory (while taking responsibility for the liabilities) of High Sierra Music Marts, a small but profitable family-owned chain whose owners want to retire. The price that High Sierra's owners are asking Adirondack to pay is \$3,900,000. Adirondack's managers would expect the High Sierra locations to generate attractive net cash flows over an 18-year period. The year 1 figure is expected to be \$465,000, with subsequent years' net cash flows expected to grow by an average rate of 4% per year. Adirondack uses a 13.5% annual cost of capital assumption when evaluating store acquisitions. Determine whether this project should be accepted, based on the net present value (NPV), profitability index (PI), internal rate of return (IRR), and modified internal rate of return (MIRR) decision criteria.