The graphical approach, where more values are calculated, is a more powerful one. By allowing the decision maker to see the range over which the choices are valid, it provides a form of sensitivity analysis. It also makes it clear that "close" to the changeover point the alternatives are very similar in value.

PROBLEMS

These problems are organized such that the (*a*) parts are best done with graphical analysis and as such are much more easily done with spreadsheets, and the (*b*) parts require numerical incremental analysis. Some problems include only one approach. Usually only (*b*) answers are included in Appendix E.

Two Action Alternatives

8-1 Including a do-nothing alternative, construct a choice table for interest rates from 0% to 100%.

Year	X	Y
0	−$1000	−$2000
1	1500	2800

8-2 (A) Construct a choice table for interest rates from 0% to 100% for two mutually exclusive alternatives and the do-nothing alternative.

Year	Buy Y	Buy X
0	−$50.0	−$100.0
1-4	16.5	31.5

8-3 (E) Consider three alternatives *A*, *B*, and "do-nothing."

(*a*) Construct a choice table for interest rates from 0% to 100%.

Year	A	B
0	−$10,000	−$15,000
1-5	3,200	4,500

(*b*) Step #4 of the decision-making process described in Chapter 1 is *Identify Feasible Alternatives*. Would you view it as ethical to not consider an alternative *C*, if you knew it was competitive but your boss asked you to leave it off the list? What would you do and why?

8-4 (A) (G) A paper mill is considering two types of pollution control equipment.

	Neutralization	Precipitation
Initial cost	$700,000	$500,000
Annual chemical cost	40,000	110,000
Salvage value	175,000	125,000
Useful life, in years	5	5

(*a*) Construct a choice table for interest rates from 0% to 100%.

(*b*) The firm wants a 12% rate of return on any avoidable increments of investment. Which equipment should be purchased?

8-5 (E) A stockbroker has proposed two investments in low-rated corporate bonds paying high interest rates and selling at steep discounts (junk bonds). The bonds are rated as equally risky and both mature in 15 years.

Bond	Stated Value	Annual Interest Payment	Current Market Price with Commission
Gen Dev	$1000	$ 67	$480
RJR	1000	98	630

(*a*) Construct a choice table for interest rates from 0% to 100%.

(*b*) Which, if any, of the bonds should you buy if your MARR is 20%?

(*c*) Are there professional ethics standards for stockbrokers in the U.S.? What are some common ethical pitfalls?

8-6 (A) A firm is considering two alternatives that have no salvage value.

	A	B
Initial cost	$10,700	$5500
Uniform annual benefits	2,100	1800
Useful life, in years	8	4

At the end of 4 years, another *B* may be purchased with the same cost, benefits, and so forth.

(*a*) Graph the EUAC or EUAW for the alternatives. Construct a choice table for interest rates from 0% to 100%.

(*b*) If the MARR is 10%, which alternative should be selected?

8-7 Don Garlits is a landscaper. He is considering the purchase of a new commercial lawn mower, either the Atlas or the Zippy. Graph the EUAC or EUAW for the alternatives. Construct a choice table for interest rates from 0% to 100%.

	Atlas	Zippy
Initial cost	$6700	$16,900
Annual O&M	1500	1,800
Annual benefit	4000	5,500
Salvage value	1000	3,500
Useful life, in years	3	6

8-8 (A) Your cat's summer kitty-cottage needs a new roof. You feel a 15-year analysis period is in line with your cat's remaining lives. (There is no salvage value for old roofs.)

	Thatch	Slate
First cost	$200	$350
Annual upkeep	50	20
Service life, in years	3	5

(*a*) Graph the EUAC or EUAW for the alternatives. Construct a choice table for interest rates from 0% to 100%.

(*b*) Which roof should you choose if your MARR is 12%? What is the actual value of the IRR on the incremental cost?

8-9 The South End bookstore has an annual profit of $370,000. The owner may open a new bookstore by leasing an existing building for 5 years with an option to continue the lease for a second 5-year period. If he opens "The North End," it will take $1,200,000 of store fixtures and inventory. He believes that the two stores will have a combined profit of $560,000 a year after all the expenses of both stores have been paid.

The owner's economic analysis is based on a 5-year period. He will be able to recover $800,000 at the end of 5 years by selling the store fixtures and moving the inventory to The South End.

(*a*) Construct a choice table for interest rates from 0% to 100%.

(*b*) If The North End is opened, what rate of return can he expect?

8-10 (A) (E) George is going to replace his car in 3 years when he graduates, but now he needs a radiator repair. The local shop has a used radiator, which will be guaranteed for 2 years, or they can install a new one, which is "guaranteed for as long as you own the car." The used radiator is $250 and the new one is $425. If George assumes the used radiator will last 3 years, but will need to be replaced so he can sell the car, which should he buy?

(*a*) Graph the EUAC or EUAW for the alternatives. Develop a choice table for interest rates from 0% to 50%.

(*b*) George's interest rate on his credit card is 20%. What should he do?

(*c*) Find the ASA auto repair ethics standards. How are the profession's ethical standards similar and different from those of your engineering discipline?

8-11 (G) Using the current specifications, resurfacing a road will cost $1.5M initially, need $120K in annual maintenance, and need to be resurfaced every 10 years. A proposed new specification is expected to be more resistant to wear. The resurfacing cost will be $2.1M with $90K in annual maintenance and resurfacing every 15 years.

(*a*) Develop a choice table for interest rates from 0% to 25%.

(*b*) If the highway department's interest rate is 6%, which specification is preferred?

(*c*) How significant is the economic difference between the two specifications?

(*d*) Research the relationship between road surfacing and environmental impact. You may be surprised!

Multiple Alternatives

8-12 (A) Each alternative has a 10-year useful life and no salvage value.

	A	*B*	*C*
Initial cost	$3000	$6000	$2000
Uniform annual benefits	410	980	350

(*a*) Construct a choice table for interest rates from 0% to 100%.

(*b*) If the MARR is 8%, which alternative should be selected?

8-13 The following three mutually exclusive alternatives have no salvage value after 5 years. Construct a choice table for interest rates from 0% to 100%.

	A	B	C
First cost	$2000	$3000	$6000
Uniform annual benefit	597	771	1652
Computed rate of return	15%	9%	11.7%

8-14 (A) The following four mutually exclusive alternatives have no salvage value after 10 years.

	A	B	C	D
First cost	$7500	$5000	$5000	$8500
Uniform annual benefit	1600	1200	1000	1700
Computed rate of return	16.8%	20.2%	15.1%	15.1%

(*a*) Construct a choice table for interest rates from 0% to 100%.

(*b*) Using 8% for the MARR, which alternative should be selected?

8-15 Consider four mutually exclusive and a do-nothing alternatives, each having an 10-year useful life:

	A	B	C	D
First cost	$1000	$800	$600	$500
Uniform annual benefit	125	120	100	125
Salvage value	750	500	250	0

(*a*) Construct a choice table for interest rates from 0% to 100%.

(*b*) If the minimum attractive rate of return is 8%, which alternative should be selected?

8-16 (A) Three mutually exclusive alternatives are being considered.

	A	B	C
Initial investment	$50,000	$22,000	$15,000
Annual net income	5,093	2,077	1,643
Rate of return	8%	7%	9%

Each alternative has a 20-year useful life with no salvage value.

(*a*) Construct a choice table for interest rates from 0% to 100%.

(*b*) If the minimum attractive rate of return is 7%, which alternative should be selected?

8-17 Each alternative has a 10-year useful life and no salvage value. Construct a choice table for interest rates from 0% to 100%, if doing nothing is allowed.

	A	B	C
Initial cost	$1500	$1000	$2035
Annual benefit for first 5 years	250	250	650
Annual benefit for subsequent 5 years	450	250	145

8-18 (A) QZY, Inc. is evaluating new widget machines offered by three companies. The chosen machine will be used for 3 years.

	Company A	Company B	Company C
First cost	$15,000	$25,000	$20,000
Maintenance and operating	1,600	400	900
Annual benefit	8,000	13,000	9,000
Salvage value	3,000	6,000	4,500

(*a*) Construct a choice table for interest rates from 0% to 100%.

(*b*) MARR = 15%. From which company, if any, should you buy the widget machine? Use rate of return analysis.

8-19 Andrews Manufacturing offers three models for one of its products to its customers. You have been asked to analyze the choices from the customer's perspective. Which model should a customer choose if each model has a life of 12 years? Doing nothing is an alternative.

	Alternative		
	Deluxe	Regular	Economy
First cost	$220,000	$125,000	$75,000
Annual benefit	79,000	43,000	28,000
Maintenance and operating costs	38,000	13,000	8,000
Salvage value	16,000	6,900	3,000

(*a*) Construct a choice table for interest rates from 0% to 100%.

(*b*) MARR = 15%. Using incremental rate of return analysis, which alternative, if any, should the customer choose?

I have three options. I can receive (*A*) \$30,976 now, (*B*) \$359.60 per month for the rest of my life, or (*C*) \$513.80 per month for the next 10 years. For option C if I die within 10 years, payments continue to my heirs. My interest rate is 9%. What should I do?" Ignore the timing of the monthly cash flows and assume that the payments are received at the end of year.

Contributed by D. P. Loucks, Cornell University

(*a*) Develop a choice table for life spans from age 66 to 100.

(*b*) If remaining life is 20 years and $i = 9\%$, use an incremental rate of return analysis to recommend which option should be chosen.

8-37 A firm must decide which of three alternatives to adopt to expand its capacity. The firm wishes a minimum annual profit of 20% of the initial cost of each separable increment of investment. Any money not invested in capacity expansion can be invested elsewhere for an annual yield of 20% of initial cost.

Alt.	Initial Cost	Annual Profit	Profit Rate
A	\$100,000	\$30,000	30%
B	300,000	66,000	22%
C	500,000	80,000	16%

Which alternative should be selected? Use a challenger–defender rate of return analysis.

8-38 A The New England Soap Company is considering adding some processing equipment to the plant to aid in the removal of impurities from some raw materials. By adding the processing equipment, the firm can purchase lower-grade raw material at reduced cost and upgrade it for use in its products.

Four different pieces of processing equipment with 20-year lives are being considered:

	A	*B*	*C*	*D*
Initial investment	\$10,000	\$18,000	25,000	\$30,000
Annual saving in materials costs	4,000	6,000	7,500	9,000
Annual operating cost	2,000	3,000	3,000	4,000

The company can obtain a 15% annual return on its investment in other projects and is willing to invest money on the processing equipment only as long as it can obtain 15% annual return on each increment of money invested. Which one, if any, of the alternatives should be selected? Use a challenger–defender rate of return analysis.

Cash vs. Loan vs. Lease

8-39 Frequently we read in the newspaper that one should lease a car rather than buying it. For a typical 24-month lease on a car costing \$9400, the monthly lease charge is about \$267. At the end of the 24 months, the car is returned to the lease company (which owns the car). As an alternative, the same car could be bought with no down payment and 24 equal monthly payments, with interest at a 12% nominal annual percentage rate. At the end of 24 months the car is fully paid for. The car would then be worth about half its original cost.

(*a*) Over what range of nominal before-tax interest rates is leasing the preferred alternative?

(*b*) What are some of the reasons that would make leasing more desirable than is indicated in (*a*)?

8-40 A *The Financial Advisor* is a weekly column in the local newspaper. Assume you must answer the following question. "I need a new car that I will keep for 5 years. I have three options. I can (*A*) pay \$19,999 now, (*B*) make monthly payments for a 6% 5-year loan with 0% down, or (*C*) make lease payments of \$299.00 per month for the next 5 years. The lease option also requires an up-front payment of \$1000. What should I do?"

Assume that the number of miles driven matches the assumptions for the lease, and the vehicle's value after 5 years is \$6500. Remember that lease payments are made at the beginning of the month, and the salvage value is received only if you own the vehicle.

(*a*) Develop a choice table for nominal interest rates from 0% to 50%. (You do not know what the reader's interest rate is.)

(*b*) If $i = 9\%$, use an incremental rate of return analysis to recommend which option should be chosen.

8-41 *The Financial Advisor* is a weekly column in the local newspaper. Assume you must answer the following question. "I need a new car that I will keep for 5 years. I have three options. I can (*A*) pay \$25,999 now, (*B*) make monthly payments for a 9% 5-year loan with 0% down, or (*C*) make lease payments of \$470 per month for the next 5 years.