

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Nuclear Engineering

22.812 Nuclear Energy Economics and Policy Analysis S '04

PROBLEM SET #5

Due: March 29, 2004

1) MIT is considering building a new car park near Kendall Square. No university funds are available (overhead rates are under pressure) and the new facility would have to pay for itself from parking fees over a 15 year period. A minimum rate of return of 10% (before taxes) is required for the project. The architect has developed four alternative designs for different numbers of parking levels in the structure. Based on the income and cost data in the Table below, how many levels should be built?

(NOTE: Prepare your analysis on a before-tax basis.)

Number of Levels	Cumulative construction costs (\$)	Annual operating costs (\$)	Income per year (\$)
1	600,000	35,000	100,000
2	2,200,000	60,000	350,000
3	3,600,000	80,000	570,000
4	4,800,000	105,000	750,000

2) A municipality is trying to establish a policy on how long to keep economy passenger cars that are used for official business. The purchase cost of a car at fleet discount is \$12,000. Annual costs for insurance, oil, and repairs for 20,000 miles of annual use are \$2,000 for a new car and increase by \$100/year with the age of the car. Fuel consumption is not perceived to change with age and is therefore excluded from the analysis. It is recognized that as a vehicle becomes older it suffers more breakdowns, causing employees to become less productive. The average loss of employee productivity is estimated to be 4 days/year for a new car and to increase by 2 days/year with the age of the car.

The average payroll cost of any employee likely to use the car is \$200/day. After 8 years spare parts become difficult to obtain, and the downtimes of the vehicle become unacceptably long and frequent. Salvage values as a function of age up to 8 years are given below.

Salvage Value Table

N	1	2	3	4	5	6	7	8
S	9000	6750	5060	3800	2850	2140	1600	1200

Using $i = 10\%$, find the economic life of such a car. Ignore income taxes, inflation and technological improvements.

- 3) A new automobile with a list price of \$10,000 is being considered as a replacement for a used automobile presently owned by the company. The new automobile can be acquired by trading in the old one plus \$6000 cash. Alternatively, the company can sell outright the present auto for \$2000 and purchase the new car outright for \$8000 cash. Current remaining book value (unallocated cost) of the present auto is \$3000.
 - a. If AEC of the present auto is based on its remaining book value, the resulting AEC tends to be (a) overstated, (b) understated, or (c) correctly stated
 - b. If AEC of the new automobile is based on the \$10,000 list price and if AEC of the used auto is based on the trade-in allowance of \$4000, the study tends to be biased in favor of (a) the proposed, (b) the present, or (c) neither automobile.
 - c. If AEC of the new automobile is based on the \$6000 cash paid and if AEC of the used auto is based on the fact that because "already owned" it requires zero outlay and therefore has zero present basis, the study tends to be biased in favor of (a) the proposed, (b) the present, or (c) neither auto.

- 4) You have calculated the economic life of a facility. Now you are asked to indicate for each factor below whether an increase in that factor would *shorten* or *lengthen* that economic life.
 - a. The amount of increase in the positive gradient pattern of year-by-year costs
 - b. Rate of return requirement

- c. Estimated future salvage values
- d. First cost of the facility
- e. Rate of technological progress
- f. Applicable income tax rate
- g. Emphasis on prestige and image of the firm

5) (PSB 16.11) A defender has a current salvage value of \$15000, a remaining life of 5 years with zero salvage thereafter, and O&M costs of \$26,000 per year. The challenger costs \$50,000, has a life of 12 years with \$5,000 salvage value thereafter, and O&M costs of \$20,000/year. MARR = 15%

- d. Use AE with the outsider point of view to make a decision.
- e. Use AE with the cash flow approach to make a decision.
- f. Use PV with the outsider point of view to make a decision.
- g. Use PV with the cash flow approach to make a decision.
- h. Reconcile any conflicting answers.

(Hint: What is the study period?)

6) (Sullivan et al, Q 13-6) A small dam is being planned for a river tributary that is subject to frequent flooding. From past experience, the probabilities that water flow will exceed the design capacity of the dam during a year, plus relevant cost information, are as follows:

Design	Probability of greater flow during a year	Capital investment
A	0.100	-180,000
B	0.050	-195,000
C	0.025	-208,000
D	0.015	-214,000
E	0.006	-224,000

Estimated annual damages that occur if water flows exceed design capacity are \$150000, \$160000, \$175000, \$190,000, and \$210000 for design A, B, C, D, and E, respectively. The life of the dam is expected to be 50 years, with negligible salvage value. For an interest rate of 8% per year, determine which design should be implemented. What nonmonetary considerations might be important to the selection?