Additional Problems: Chapter Ten: Public Sector Decision-Making

10S.1

A 400-m tunnel must be constructed as part of a sewer system. One alternative is to build a full-capacity tunnel now, costing $500 000; another is to build a half-capacity tunnel now for $300 000, then another half-capacity tunnel in 20 years for $400 000. It is estimated that repair work will have to be done on the tunnels at the end of every 10 years; this will cost $50/m for the full-capacity tunnel, and $40/m for each of the half-capacity tunnels. Assuming a 50-year planning horizon, and no tunnel repairs at the 50-year mark, and assuming that funds are available at 5%, which alternative should be constructed? (Use the benefit/cost ratio, and treat the reduction in tunnel-lining repair costs as a benefit.)

*10S.2

Seven mutually exclusive plans for waste-disposal in Birmingham, England have been put forward. Their costs and benefits, in pounds Stirling, are as follows:

Option	Benefit	Costs
P	4 000 000	500 000
Q	4 000 000	2 000 000
R	7 000 000	2 000 000
S	6 000 000	5 000 000
T	9 000 000	6 000 000
U	2 000 000	4 000 000
V	7 000 000	8 000 000

All the figures in the table are equivalent present worths, using a 25-year planning horizon and an 8% interest rate. Which alternative has the largest B/C ratio? Which is the most expensive alternative with B/C > 1? Which is the cheapest alternative with B/C > 1? Which alternative should be chosen?

10S.3

You are the Director of Urban Planning for Vancouver, and your office is charged with developing a new crossing between the city and the North Shore. Four alternatives are open: a bridge, initial cost $10 000 000, which will require $500 000 of maintenance a year; a tunnel, initial cost $20 000 000, requiring $50 000 maintenance a year; an expanding ferry service, which will involve adding one ferry boat to a fleet every two years for the next 10 years; the initial cost of each boat is $2 500 000, and each boat requires $200 000 / year to maintain and operate; and, lastly, an expanding fleet of hovercraft. You would have to buy one hovercraft now at $1 500 000, and another in five years, when it will cost $2 000 000. The operating and maintenance costs on the hovercraft are $500 000/year/hovercraft.

If your cost of capital is 5%, which option should you choose?

*10S.4

An old wooden bridge over a bay close to Cape Town is in danger of collapse. The highway department is considering two alternatives to alleviate the situation and provide for expected increases in future traffic. One plan is a conventional steel bridge, and the other is a tunnel. The department is familiar with bridge construction and maintenance, but has no experience with maintenance costs for tunnels. The following data have been developed for the bridge:

Item	Cost (R 000)
First cost	17 000
Painting every 6 years	1 000
Deck resurfacing every 10 years	3 000
Structural overhaul after 15 years	4 000
Annual maintenance	300

The tunnel is expected to cost R 24 000 000 and will require repaving every 10 years at a cost of R 2 000 000. If both designs are expected to last 30 years with minimal salvage value, determine the maximum equivalent annual amount for maintenance that could be permitted for the tunnel while holding the total equivalent annual cost equal to that of the bridge. The interest rate is 8%.

10S.5

The Japanese government is considering the introduction of a carbon tax to discourage consumption of fossil fuels. The tax is intended to be revenue-neutral; that is, all income from the tax will be used to subsidize other schemes for pollution reduction. The Ministry of Health, Labour and Welfare, the Ministry of the Environment, the Ministry of Economy, Trade and Industry, and the Ministry of Land, Infrastructure and Transport are asked to prepare reports on the expected effects of such a tax, and their findings are presented to the Cabinet Office in the following summary form:

Effect	Cost/Benefit (¥ 000 000)
Reduction in health costs	20 /year, immediate, increasing by 2/year for 10 years, then continuing at 40/year indefinitely
Reduction in storm damage	50 /year, starting in 20 years
Increased food prices	20 /year, immediate
Reduced competitiveness of exports	20 /year, immediate, reducing by 1/year for 15 years, then continuing at 5/year indefinitely
Administrative costs	10 this year, 5 /year thereafter
Reduced highway wear	5/year, immediate
Reduction in pollution damage to buildings	10/year, immediate

The government uses an MARR of 4%. What is the cost/benefit ratio of the proposed tax? Should it

be implemented?

*10S.6

Morimoto Industries, a company in Kyoto, Japan, operates a fleet of diesel trucks. Each truck is rather inefficient, requiring 50 litres of diesel fuel for every 100 km travelled. Each truck in the fleet travels about 50 000 km a year. A new, more efficient model of truck is available, with approximately double the fuel efficiency. If fuel costs ¥150 per litre, a new truck costs ¥10 000 000, and the salvage value of an old truck is ¥1 000 000, what is the payback time for upgrading to one of the more efficient trucks? What is the internal rate of return on the investment in a new truck, taking a study period of five years?

The Japanese government now places a carbon tax on diesel fuel, increasing the cost to ¥200 per litre. Using the revenue from this tax, the government offers a 10% subsidy to all investments that meet a certain set of regulations for reducing pollution. Assuming that investment in a new truck can be shown to conform to these regulations, what is the new payback time and the new IRR for buying a new truck? For what ranges of the company MARR will the introduction of the new tax and subsidy make a difference to the company's decision on replacement of the trucks?