IEGR 350: Engineering Economy
Spring 2016
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Quiz 4

100 Points (Time: 30:00 Minutes)

Explain and show your work. No use of computer or cell phone allowed. Use of printed formula sheet and table for 8% is allowed. Non-digital textbook for use of 8% table (not the formula) is allowed.

Select one of the problems below and answer.

PROBLEM 1:

A very popular water and entertainment park headquartered in has been asked by four different cities outside of Texas to consider building a park in their area. All the offers include some version of the following incentives:

- Immediate cash incentive (year 0)
- A 10% of first-year incentive as a direct property tax reduction for 8 years
- Sales tax rebate sharing plan for 8 years
- Reduced entrance (usage) fees for area residents for 8 years

Table below summarizes the estimates for each proposal, including the present worth of the initial construction cost and anticipated annual revenue. The annual M&O costs are expected to be the same for all locations. Use incremental B/C analysis at 8% per year and an 8-year study period to advise the board of directors if they should consider any of the offers to be economically attractive.

	City 1	City 2	City 3	City 4
First cost, $ million	38.5	40.1	45.9	60.3
Entrance fee costs, $/year	500,000	450,000	425,000	250,000
Annual revenue, $ million/year	7.0	6.2	10.0	10.4
Initial cash incentive, $	250,000	350,000	500,000	800,000
Property tax reduction, $/year	25,000	35,000	50,000	80,000
Sales tax sharing, $/year	310,000	320,000	320,000	340,000

Solution

First we convert all non-annual cash flow items to their equivalent annuals.

To develop the AW equivalents over 8 years for total costs for all projects we recognize that to company first cost and annual entrance fee discounts to the residents are considered cost.

AW of costs = first cost (A/P,8%,8) + entrance fee reduction to residents

AW costs City 1 = 38.5 (0.1740) + 0.5 = 7.199 or $7,199,000 per year

AW costs City 2 = 40.1 (0.1740) + 0.45 = 7.427 or $7,427,000 per year

AW costs City 3 = 45.9 (0.1740) + 0.425 = 8.411 or $8,411,000 per year

AW costs City 4 = 60.3 (0.1740) + 0.25 = 10.742 or $10,742,000 per year

Based on the above numbers, the four alternatives are correctly ordered by increasing equivalent total cost in the given table. We now calculate the annual equivalent of total benefits.

AW of total benefits = revenue + initial incentive (A/P, 7%, 8)

+ property tax reduction + sales tax sharing

AW of total benefits City 1 = 7.0 + 0.25 (0.1740) + 0.025 + 0.31 = 7.385

AW of total benefits City 2 = 6.2 + 0.35 (0.1740) + 0.035 + 0.32 = 6.616

AW of total benefits City 3 = 10.0 + 0.5 (0.1740) + 0.05 + 0.32 =10.457

AW of total benefits City 4 = 10.4 + 0.8 (0.1740) + 0.08 + 0.34 =10.959

No dis-benefits are given, so overall B/C for each alternative is easily calculated.

B/C of City 1 = 7.385 /7.199 = 1.026

B/C of City 2 = 6.616 /7.427 = 0.891

B/C of City 3 = 10.457 /8.411 = 1.243

B/C of City 4 = 10.959 /10.742 = 1.020

City 2 is eliminated with B/C = 0.891 < 1; the rest are initially acceptable. We need to perform incremental analysis.

City 1 (challenger) vs DN (defender) → ΔB/C = 1.026 > 1, eliminate DN

City 3 (challenger) vs City 1 (defender) →

ΔB/C = (10.959 - 10.457) / (10.742 - 8.411) = 2.53 > 1, eliminate City 1

City 4 (challenger) vs City 3 (defender) →

ΔB/C = (10.457 - 7.385) / (8.411 - 7.199) = 0.215 < 1, eliminate City 4

City 3 is the one to recommend to the board.

PROBLEM 2:

Glyphosate is the active ingredient in the herbicide Roundup® marketed by Monsanto Co. Roundup has been a dependable product used by farmers, municipalities, and suburbanites alike to control weeds in fields, yards, gardens, streets, and parks. Contributions to Monsanto's revenue have been reduced significantly by international dumping of generic glyphosate, as announced in mid-2010.1 Monsanto's sales price was decreased from $16 to $12 per gallon to compete with the highly competitive pricing, and it is expected that the international price will settle at approximately $10 per gallon. Assume when the price was set at $16 per gallon, there was a prediction that in 5 years the price would inflate to $19 per gallon. Perform the following analysis.

(a) Determine the annual rate of inflation over 5 years to increase the price from $16 to $19.

(b) Using the same annual rate determined above as the rate at which the price continues to decline from the new $12 price, calculate the expected price in 5 years. Compare this result with $10 per gallon that Monsanto predicted would be the longer-term price.

(c) Provided Monsanto were somehow able to recover the same market share as it had previously, and the same inflation rate was applied to the reduced $12 per gallon price, determine the price 5 years in the future and compare it with the pre-dumping price of $16 per gallon.

(d) Determine the market interest rate that must be used in economic equivalence computations, if inflation is considered and an 8% per year real return is expected by Monsanto.

Solution

The first three parts involve inflation only—no return on investments.

(a) Use equation Constant-value dollars = future dollars / $(1 + f)^n$ for the annual inflation rate f with known constant-value and future amounts.

$16 = 19\ (P/F, f, 5) = 19/ (1 + f)^5$

$1 + f = (19/ 16)^{1/5} = (1.1875)^{0.2} = 1.035 \rightarrow f = 0.035$ or 3.5% per year

(b) If the price deflation rate is 3.5% per year, find the F value in 5 years with P = $12.

$F = P\ (F/P, -3.5\%, 5) = 12(1 - 0.035)^5 = 12\ (0.8368) = \$10.04$

The price will fall to exactly $10 per gallon after 5 years, as Monsanto predicted.

(c) Five years in the future, at 3.5% per year inflation, the price will be

$F = P\ (F/P, 3.5\%, 5) = 12\ (1.035)^5 = 12\ (1.1877) = \$14.25$

After 5 years of recovery at the same level as historically experienced, the price will still be considerably lower than it was at the pre-dumping point ($14.25 versus $16 per gallon).

(d) With inflation at 3.5% per year and a real return of 8% per year, equation $i_f = i + f + (i)(f)$ results in a market rate of 11.78% per year.

$i_f = 0.08 + 0.035 + (0.08)\ (0.035) = 0.1178$ or 11.78% per year