Assignment 03

1. Problem 1

Calculate the conventional and the modified benefit-cost ratios for the following project:

Initial capital costs	\$1,200,000
Annual benefits to users	\$500,000
Annual costs to users	\$50,000
Annual cost to government	\$125,000
Project life	35 years
Interest rate	10%

Round each ratio to one decimal place.

$PW\ of\ Benefits: \$500,000(P/A, 10\%, 35) = \$4,822,079.49$

$PW\ of\ Annual\ Costs: (\$50,000 + \$125,000)(P/A, 10\%, 35) = \$1,687,727.82$

Conventional B/C Ratio

$$= \frac{\$4,822,079.49}{\$1,687,727.82 + \$1,200,000}$$

$$= 1.7$$

Modified B/C Ratio

$$= \frac{\$4,822,079.49 - \$1,687,727.82}{\$1,200,000}$$

$$= 2.6$$

2. Problem 2 The Highridge region needs an additional supply of water from Steep Creek. The engineer has selected two plans for comparison:

Gravity plan: Divert water at a point 10 km upstream on Steep Creek and carry it through a pipeline by gravity to the district.

Pumping plan: Divert water at a point on Steep Creek that is nearer to the district, and pump it through 2 km of pipelines to the district. The pumping plant can be built in two stages, with the building, infrastructure, and one pump (half-capacity) installed initially, and the other pump (other half of capacity) installed 10 years later.

	Gravity	**Pumping**
Initial investment	\$2,600,000	\$1,400,000
Investment in 10^{th} year	0	300,000
Operation, maintenance, replacements, per year	10,000	25,000
Average annual power costs		
first 10 years	0	70,000
next 30 years	0	110,000
Average annual benefits		
first 20 years	\$200,000	\$200,000
next 20 years	\$400,000	\$400,000

Use a 40-year analysis period and 7% interest. Assume no salvage values. Which plan is better, applying the conventional benefit-cost ratio method? Calculate B/C ratios to the hundredths place, and recommend which plan is better.

Gravity

$Benefits: \$200,000(P/A,7\%,20) + \$400,000(P/A,7\%,20)(P/F,7\%,20) = \$3,213,880.69$

$Costs: \$2,600,000 + \$10,000(P/A,7\%,40) = \$2,733,317.09$

$B/C\ ratio = 1.18$

Pumping

$Benefits: Same\ as\ Gravity\ plan = \$3,213,880.69$

$Costs: \$1,400,000 + \$300,000(P/F,7\%,10) + \$25,000(P/A,7\%,40) + \$70,000(P/A,7\%,10) + \$11,000(P/A,7\%,30)(P/F,7\%,10)$
$= \$2,446,837.62$

$B/C\ ratio = 1.31$

The pumping plan is better.

3. Problem 3

Evaluate these mutually exclusive alternatives over a time period of 15 years assuming a MARR of 9%:

	A	B	C
Initial investment	\$12,000	\$18,300	\$22,000
Annual savings	\$2,600	\$5,500	\$9,600
Annual costs	\$1,000	\$2,750	\$6,400
Salvage value	\$6,000	\$4,400	\$14,000

Use the following:

(a) Conventional B/C ratio (rounded to 3 decimal places)

(b) Present worth analysis (rounded to nearest dollar)

(c) Internal rate of return analysis (rounded to 1 decimal place)

(d) Payback period (rounded up to the total # of years until payback is complete)

Assume that salvage value is considered like a cost in these evaluations.

(a) (A)

$$Benefits: \$2,600(P/A,9\%,15) + \$6,000(P/F,9\%,15) = \$22605.02$$

$$Costs: \$12,000 + \$1,000(P/A,9\%,15) = \$20,060.69$$

(B)

$$Benefits: \$5,500(P/A,9\%,15) + \$4,400(P/F,9\%,15) = \$45,541.75$$

$$Costs: \$18,300 + \$2,750(P/A,9\%,15) = \$40,466.89$$

(C)

$$Benefits: \$9,600(P/A,9\%,15) + \$14,000(P/F,9\%,15) = \$81,226.14$$

$$Costs: \$22,000 + \$6,400(P/A,9\%,15) = \$73,588.41$$

	A	B	C
B/C Ratio	1.127	1.125	1.104

(b)

	A	B	C
NPW	\$2,544	\$5,075	\$7,638

(c)

General Formula : Initial investment − Annual net savings + Salvage value

	A	B	C
IRR	12.0%	13.2%	13.7%

(d)

	A	B	C
Uniform annual benefit	\$1,600	\$2,750	\$3,200
Payback Period (years)	8	7	7

4. Problem 4

A proposed bridge will cost \$4 million to build and \$230,000 per year to maintain. The bridge should last 40 years. Time-saving benefits to the driving public are estimated to be \$1,000,000 per year. Ongoing damage to adjacent property owners due to noise is estimated to be worth \$300,000 per year. It is uncertain what interest rate should be used to evaluate the project: calculate the break-even annual interest rate that results in a B/C ratio of 1. Round your answer to 1 decimal place (x.x%).

Rewriting the above data:

Initial capital costs	\$4,000,000
Annual benefits to users	\$1,000,000
Annual costs for maintenance	\$230,000
Annual costs to property owners	\$300,000
Project life	40 years

$$B/C\ Ratio: \frac{\$1,000,000(P/A, i\%, 40)}{\$4,000,000 + (\$230,000 + \$300,000)(P/A, i\%, 40)} = 1$$

$i = 11.6\%$