

IND 511 Advanced Engineering Economy Homework #1

(20p) 1. Maintenance expenses of \$ M are expected to flow continuously and uniformly during every fourth year, beginning with year four and continuing indefinitely. Assuming a nominal interest rate (r) of 12% per annum, find the equivalent present value of this infinite series.

(15p) 2. Consider a cash flow series $\{A_1, \dots, A_N\}$ consisting of N discrete cash flows. Suppose $A_k = A_1 e^{(k-1)C}$ where $0 < C < 1$. Develop a closed-form expression for the future sum equivalent based on an interest rate of $r\%$ compounded continuously.

(20p) 3. Assuming $r = 10\%$, find the equivalent PW of the following continuous cash flows:

$$f(t) = \begin{cases} -20t & , 0 < t < 2 \\ -40 & , 2 < t < 5 \\ -672 + 1000(1 - e^{-0.2t}) & , 5 < t < 10 \\ 193 & , 10 < t < 15 \\ 100e^{-0.1t} + 170.7 & , 15 < t < 20 \\ 140 & , t = 20 \end{cases}$$

(25p) 4. Assuming continuous compounding and time dependent rate of return, where the nominal interest rate for period j is denoted by r_j ,

(10p) a. Formulate a cash flow model for finding the present worth of a single payment.

(15p) b. Formulate a cash flow model for finding the present worth of an annuity.

(20p) 5. Suppose that v_1, v_2, \dots, v_n are positive numbers. The arithmetic mean and the geometric mean of these numbers are, respectively.

$$v_A = \frac{1}{n} \sum_{i=1}^n v_i \quad \text{and} \quad v_G = \left(\prod_{i=1}^n v_i \right)^{1/n}$$

a. It is always true that $v_A \geq v_G$. Prove this inequality for $n = 2$.

b. If r_1, r_2, \dots, r_n are rates of return of a stock in each of n periods, the arithmetic and geometric mean rates of return are likewise

$$r_A = \frac{1}{n} \sum_{i=1}^n r_i \quad \text{and} \quad r_G = \left(\prod_{i=1}^n (1 + r_i) \right)^{1/n} - 1$$

Suppose \$ 40 is invested. During the first year it increases to \$ 60 and during the second year it decreases to \$ 48. What are the arithmetic and geometric mean rates of return over the 2 years?

c. When is it appropriate to use these means to describe investment performance?