

contemporary engineering economics 5th edition by chan s park solution

Published: September 27, 2026 | Index ID: #-

Understanding Contemporary Engineering Economics: A Guide to the 5th Edition by Chan S. Park

Engineering economics is the discipline that equips engineers with the tools to make sound financial decisions in design, production, and project management. The 5th edition of **Contemporary Engineering Economics** by Chan S. Park has become a cornerstone text for students and professionals alike, offering a blend of theory, practical examples, and real world applications. In this article, we'll dive deep into the book's structure, highlight key concepts, and provide a detailed solution guide that will help you master the material without falling into the trap of rote memorization.

Why Focus on the 5th Edition?

The 5th edition of the textbook incorporates the latest industry trends, updated formulas, and enhanced problem sets that reflect contemporary engineering challenges. It also introduces new sections on environmental economics, risk analysis, and emerging technologies—areas that are increasingly important in today's engineering projects.

Whether you're a sophomore tackling your first engineering economics course or a seasoned professional preparing for a certification exam, the solutions provided here are crafted to reinforce understanding and promote critical thinking.

Table of Contents Overview

The book is organized into six main sections, each building on the last. Below is a concise outline that will serve as your roadmap for the solutions.

- Part I – Foundations: Basic principles, time value of money, and simple interest.
- Part II – Present Worth: Present value, present worth factor, and present worth of annuities.
- Part III – Future Worth: Future value, future worth factor, and compound interest.
- Part IV – Annuities: Ordinary annuity, annuity due, and equivalent annuity.
- Part V – Investment Analysis: Net present value (NPV), internal rate of return (IRR), and payback period.
- Part VI – Advanced Topics: Cost-benefit analysis, risk analysis, and environmental economics.

Key Concepts and Their Solutions

Below we'll walk through the most frequently encountered problems, providing step by step solutions that illustrate the application of formulas and the reasoning behind each step.

1. Calculating Present Worth (PW)

Present Worth is the foundation of engineering economics, allowing you to compare cash flows occurring at different times. The basic formula is:

$$PW = FV \times (P/A, i, n)$$

Where **FV** is the future value, **i** is the interest rate, and **n** is the number of periods. The factor $(P/A, i, n)$ converts a future amount to its present value.

Example Problem: A project requires an investment of \$5,000 today and will generate \$3,000 annually for 5 years. What is the present worth at an interest rate of 8%?

Solution:

1. Identify the cash flows: Initial outlay = \$5,000 (negative), annual inflows = \$3,000 for 5 years.
2. Compute the present worth of the annuity using $(P/A, 8\%, 5) = 4.355$.
3. Present worth of annuity = $\$3,000 \times 4.355 = \$13,065$.
4. Subtract the initial investment: $\$13,065 - \$5,000 = \$8,065$.
5. Result: The project has a positive present worth of \$8,065.

This simple calculation demonstrates how present worth can quickly reveal whether a project is financially viable.

2. Determining Future Worth (FW)

Future Worth evaluates the value of cash flows at a future date. The formula is:

$$FW = PV \times (F/P, i, n)$$

Where **PV** is the present value and $(F/P, i, n)$ is the future worth factor.

Example Problem: You invest \$2,000 today and earn an annual return of 6% for 3 years. What will the investment be worth at the end of year 3?

Solution:

1. Compute the future worth factor $(F/P, 6\%, 3) = 1.191$.
2. Future worth = $\$2,000 \times 1.191 = \$2,382$.
3. Result: The investment grows to \$2,382 in 3 years.

3. Annuity Due vs. Ordinary Annuity

Annuity Due payments occur at the beginning of each period, while Ordinary Annuity payments occur at the end. The relationship between the two is:

$$(P/A, i, n)_{\text{Due}} = (P/A, i, n)_{\text{Ordinary}} \times (1 + i)$$

Understanding this difference is crucial when evaluating lease agreements, loan schedules, or subscription models.

4. Net Present Value (NPV)

NPV is the cornerstone of investment analysis. It sums the present values of all cash inflows and outflows, providing a single metric for decision making.

$$NPV = -C_0 + \sum_{t=1}^n \frac{C_t}{(1+i)^t}$$

Example Problem: A company is considering a new machine that costs \$20,000 upfront and will produce savings of \$5,000 annually for 8 years. The discount rate is 10%. What is the NPV?

Solution:

1. Compute the present worth of the annuity: $(P/A, 10\%, 8) = 5.334$.
2. Present worth of savings = $\$5,000 \times 5.334 = \$26,670$.

3. Subtract the initial cost: $\$26,670 - \$20,000 = \$6,670$.
4. Result: The NPV is \$6,670, indicating a profitable investment.

5. Internal Rate of Return (IRR)

IRR is the discount rate that sets the NPV to zero. It is found by solving:

$$0 = -20,000 + \sum_{t=1}^8 \frac{\$5,000}{(1 + \text{IRR})^t}$$

Because IRR is not always solvable algebraically, iterative methods such as trial and error, Newton Raphson, or spreadsheet tools (Excel's IRR function) are commonly used.

Example Problem: Using the same machine from the NPV example, determine the IRR.

Solution:

1. Set up the cash flow sequence: Year 0 = $-\$20,000$; Years 1–8 = $+\$5,000$.
2. Trial with 10% yields NPV = \$6,670 (positive).
3. Try 15%: NPV = \$4,000 (still positive).
4. Try 20%: NPV = \$2,000 (positive).
5. Try 25%: NPV = \$1,000 (positive).
6. Try 30%: NPV = \$200 (positive).
7. Try 35%: NPV = $-\$300$ (negative).
8. Interpolate between 30% and 35% to estimate IRR ≈ 32%.

The IRR (~32%) exceeds the discount rate (10%), confirming the project's attractiveness.

6. Payback Period

The Payback Period measures how long it takes to recover the initial investment. It is calculated by summing cash inflows until they equal the initial outlay.

Example Problem: The same machine generates \$5,000 annually. How many years to recover the \$20,000 investment?

Solution:

1. Year 1: \$5,000 (cumulative \$5,000).
2. Year 2: \$5,000 (cumulative \$10,000).
3. Year 3: \$5,000 (cumulative \$15,000).
4. Year 4: \$5,000 (cumulative \$20,000).
5. Result: Payback Period = 4 years.

While the payback period ignores the time value of money, it provides a quick snapshot of liquidity.

7. Cost Benefit Analysis (CBA)

CBA evaluates the net benefit of a project by comparing total costs to total benefits, both expressed in present value terms.

Example Problem: A municipal project costs \$1,500,000 and is expected to generate \$300,000 annually for 10 years. The discount rate is 5%. Determine if the project is justified.

Solution:

1. Present worth of benefits: $(P/A, 5\%, 10) = 7.721$.
2. Present worth of benefits = $\$300,000 \times 7.721 = \$2,316,300$.

3. Subtract costs: $\$2,316,300 - \$1,500,000 = \$816,300$.
4. Result: The project yields a positive net benefit of \$816,300, indicating it is worthwhile.

8. Risk Analysis – Sensitivity and Scenario Analysis

Engineering economics rarely deals with certainty. Sensitivity analysis explores how changes in key variables affect outcomes, while scenario analysis examines best case, worst case, and most likely scenarios.

Example Problem: Reevaluate the machine investment if the annual savings could vary between \$4,000 and \$6,000.

Solution:

1. Compute NPV for \$4,000 savings: $\text{NPV} = \$4,000 \times 5.334 - \$20,000 = \$1,336$.
2. Compute NPV for \$6,000 savings: $\text{NPV} = \$6,000 \times 5.334 - \$20,000 = \$10,004$.
3. Interpretation: Even at the low end (\$4,000), the project remains profitable, but the magnitude of benefit varies significantly.

9. Environmental Economics – Life Cycle Costing

Life Cycle Costing (LCC) aggregates all costs associated with a product or system over its entire lifespan, including acquisition, operation, maintenance, and disposal.

Example Problem: A bridge costs \$50,000 to build, incurs \$5,000 annual maintenance for 30 years, and has a disposal cost of \$2,000. The discount rate is 4%. What is the total LCC?

Solution:

1. Present worth of maintenance: $(P/A, 4\%, 30) = 18.793$.
2. Present worth of maintenance = $\$5,000 \times 18.793 = \$93,965$.
3. Present worth of disposal: $\$2,000 / (1 + 0.04)^{30} = \$1,000$.
4. Sum all components: $\$50,000 + \$93,965 + \$1,000 = \$144,965$.
5. Result: Total LCC = \$144,965.

Study Tips for Mastering the 5th Edition

- Practice Regularly: Work through at least two problems from each chapter before moving on.

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