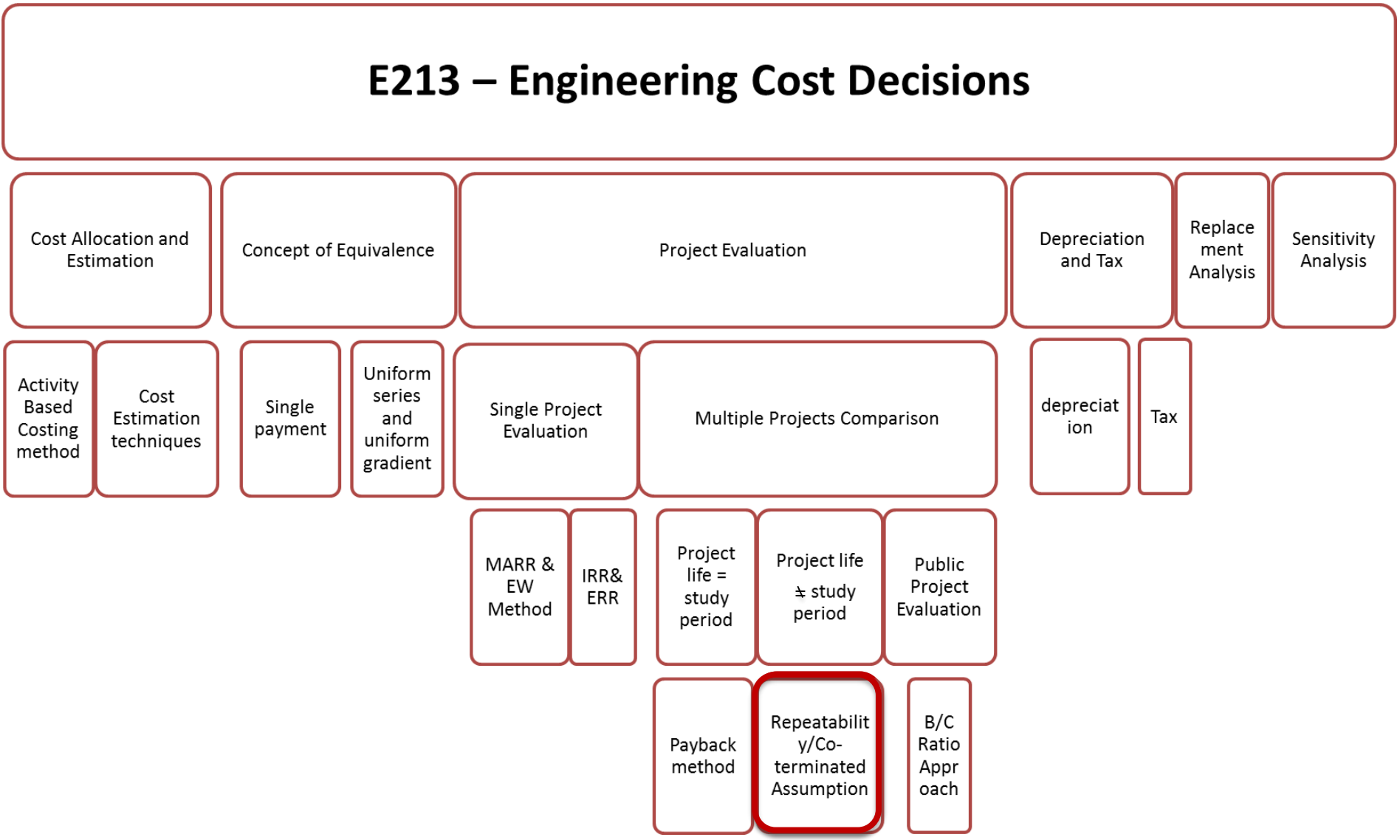
Problem 08

To own or to rent?

E213 – Engineering Cost Decisions

SCHOOL OF ENGINEERING

Module Coverage: Topic Tree



Service Life vs. Study Period

- Service life – useful operating life of a machine or system
- Study period – time period for which an alternative is being evaluated
- Study period may be longer than service life when the intended use of a system exceeds its serviceable life.
- On the other hand, study period may be shorter than service life due to plans of upgrading a capability or when possible technology advancements may shorten a system’s serviceable life.

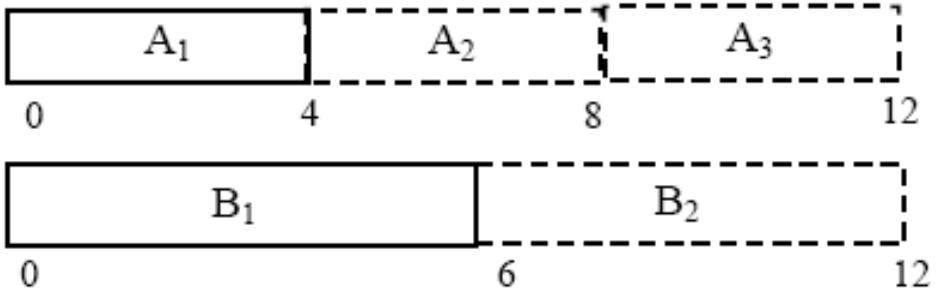
Comparison of Alternatives with Unequal Lives

When the lives of mutually exclusive alternatives are different, or at least one of the alternative lives is not equal to study period, we *make adjustments* to the analysis.

1. Repeatability Assumption
2. Co-terminated Assumption

The Repeatability Assumption

- We may use the repeatability assumption if
  - The study period can be assumed to be infinite in length, or
  - The study period is a common multiple of all the alternatives' lives.
- **For example**: Consider two alternatives A and B with service lives of 4 and 6 years respectively. The study period is 12 years, a common multiple of 4 and 6.



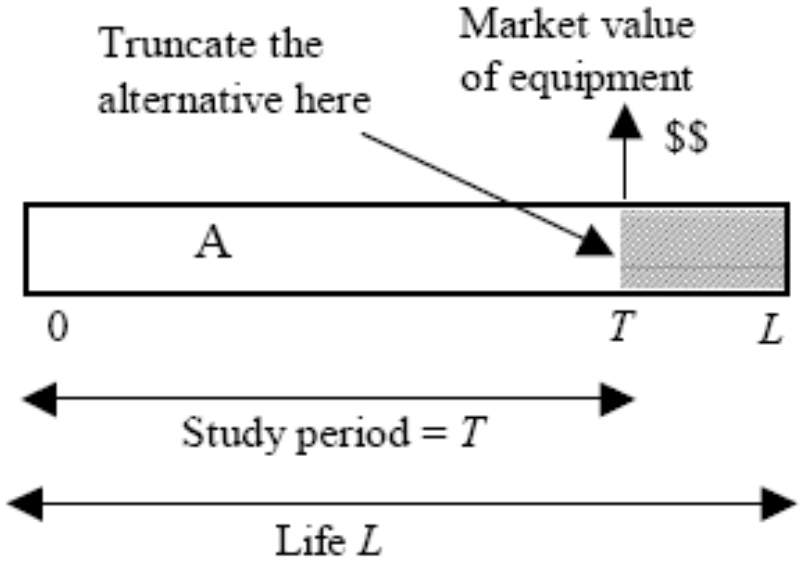
- Under the repeatability assumption, the alternatives' service life cycle will be repeated over the study period. The criterion is then to select the alternative with the Maximum Equivalent Worth over the whole study period.
- Take note that the Annual Worth of each alternative will have the same value for each cycle and for the whole study period.

The Co-terminated Assumption

- Most frequently used in engineering practice.
- Cash flows of alternatives are either shorter or longer than the proposed study period.
- Cash flows are adjusted so that all the alternatives are compared over the same study period.

The Co-terminated Assumption

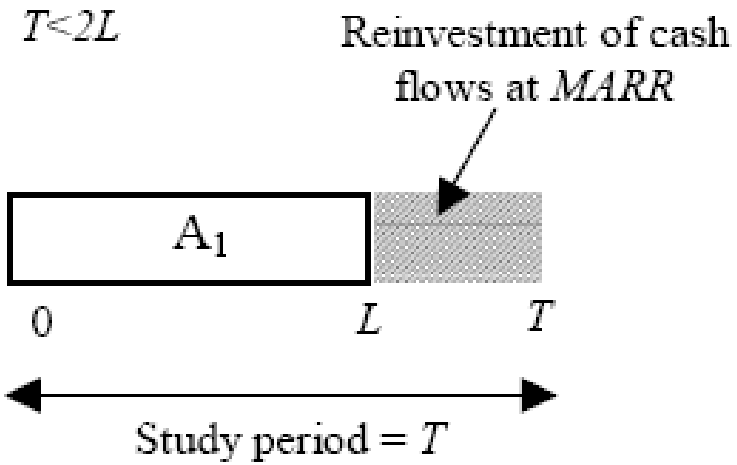
- **When service life > study period**
  - Truncate the alternative at the end of the study period and use an estimated market value
  - Assume that the disposable assets will be sold at the end of the study period at the market value



The Co-terminated Assumption

- **When service life < study period**

  - For ***investment alternatives***, we assume that all cash flows will be reinvested in other opportunities available at MARR to the end of the study period.

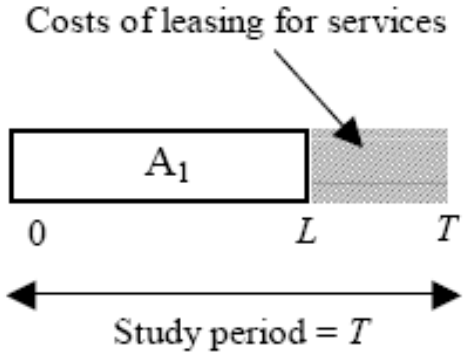


Compute the *FW* of each project at the end of the study period.

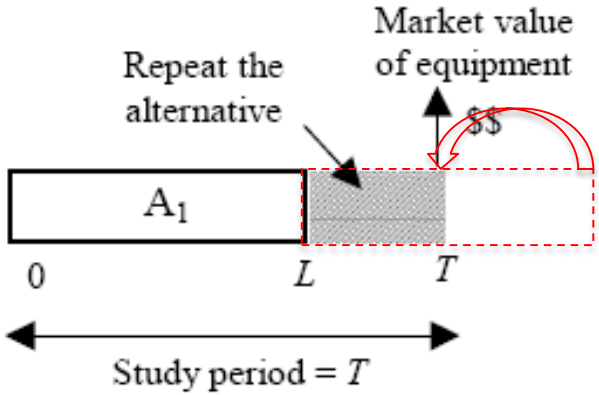
The Co-terminated Assumption

- **When service life < study period**

  - For ***cost alternatives***, one solution is to consider contracting for service or leasing the needed equipment for the remaining years of service to the end of the study period.



  - For ***cost alternatives***, another solution is to repeat part of the useful life of the alternative, and then use an estimated market value to truncate it at the end of the study period.



P08 Suggested Solution

Problem Analysis

- Service lives ≠ Study Period
- Study Period = 3 Years

Which assumption to use?

Repeatability Assumption

Options cannot be mixed and study period must be infinite or a common multiple of all the alternatives' lives.

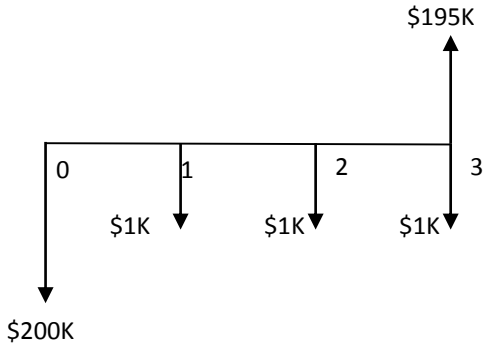
Co-terminated Assumption

Options can be mixed and study period can be more or less than alternatives' lives.

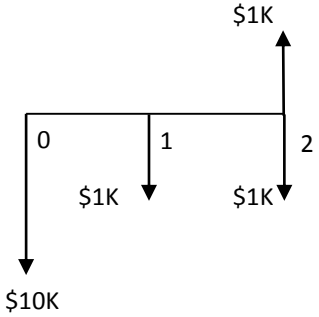
Cash Flows of Each Option

Option 1 Rent Room

Option 2 Buy Resale



Option 3 Buy End of Lease



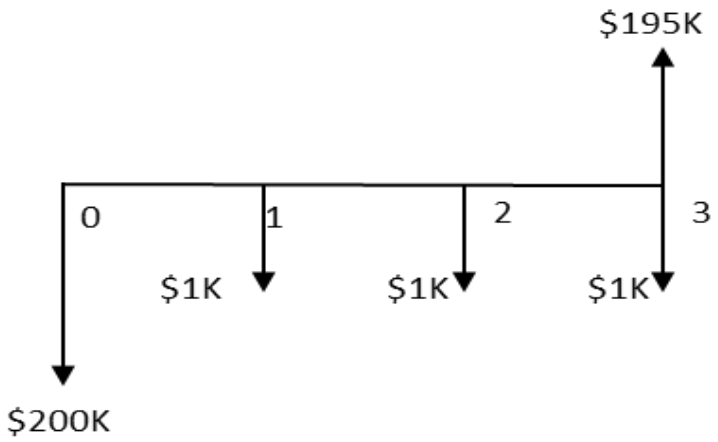
Possible alternatives with Co-terminated Assumption:

1. Buy Resale apartment, use for 3 years and sell off
2. Buy End of Lease apartment, use for 2 years and sell off, thereafter Rent Room for 1 more year
3. Rent Room for 3 years

Using Co-terminated Assumption

Alternative 1: (Study Period = 3 years)

- Buy Resale apartment, use for 3 years and sell off



FW(5%) = -200K(F/P,5%,3) – 1K(F/A,5%,3) + 195K

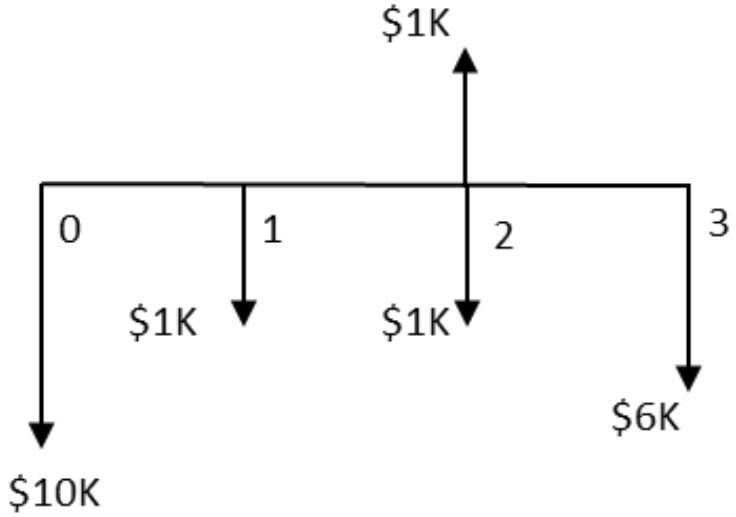
= -200K(1.1576) – 1K(3.1525) + 195K

= **-$39.67K**

Using Co-terminated Assumption

Alternative 2: (Study Period = 3 years)

Buy End of Lease apartment, use for 2 years and sell off, thereafter Rent Room for 1 more year

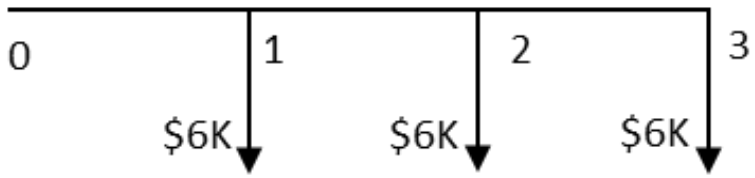


FW(5%) = -10K(F/P,5%,3) – 1K(F/A,5%,3) + 1K(F/P,5%,1) – 5K
= -10K(1.1576) – 1K(3.1525) +1K(1.05) – 5K
= **-$18.68K**

Using Co-terminated Assumption

Alternative 3: (Study Period = 3 years)

Rent Room for 3 years



FW(5%)= -6K(F/A,5%,3)

= -6K(3.1525)

= **-$18.92K**

Using Co-terminated Assumption

Future Worth (Cost) equivalent summary of the 3 alternatives:

Alternatives	Future Worth
Alternative 1: **Buy Resale apartment, use for 3 years and sell off**	-$39.67K
Alternative 2: **Buy End of Lease apartment, use for 2 years and sell off, thereafter Rent Room for 1 more year**	-$18.68K
Alternative 3: **Rent Room for 3 years**	-$18.92K

Hence, **choose Alternative 2 (Buy End of Lease apartment, use for 2 years and sell off, thereafter Rent Room for 1 more year)** will minimize cost under co-terminated assumption.

Assumptions:

The apartment loses the same amount of its value each year throughout its service life.

Using Repeatability Assumption

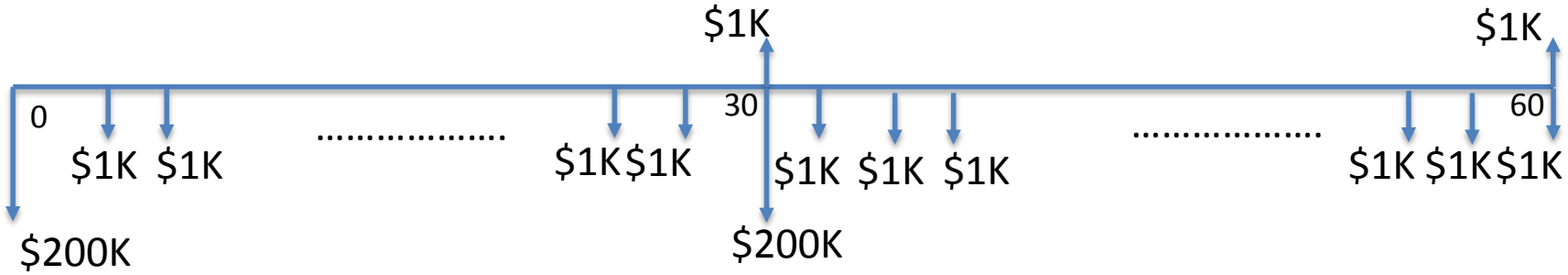
If the study period is a common multiple of all the alternatives' lives (e.g. study period = 60 years), you can select alternatives under repeatability assumption by comparing Annual Worth (Cost) of the 3 Options:

Annual Worth (Resale apartment)

AW(5%) = -$200K(A/P,5%,30) - $1K + $1K(A/F,5%,30)

= -$200K(0.0651) - $1K + $1K(0.0151)

= **-$14K**



Note: For repeatability assumption, there are only 3 alternatives as options cannot be mixed.

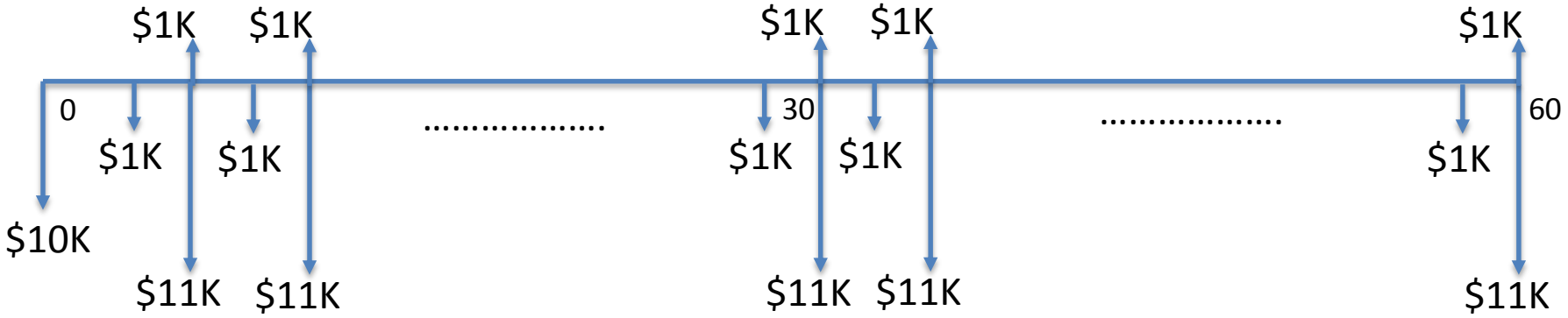
Using Repeatability Assumption

Annual Worth (End of Lease Apartment)

AW(5%) = -$10K(A/P,5%,2) - $1K + $1K(A/F,5%,2)

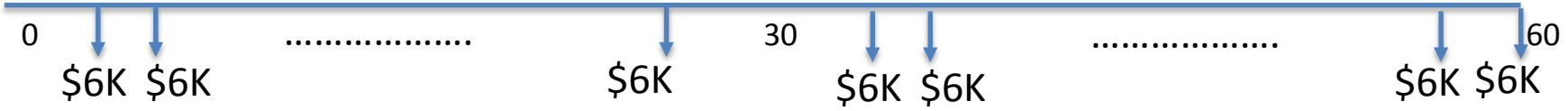
= -$10K(0.5378) - $1K + $1K(0.4878)

= **-$5.89K**



Annual Worth (Rent)

AW(5%) = **-$6K**



Hence, ***choose to purchase End of Lease Apartment*** to minimize cost under repeatability assumption.

Conclusion

- With the study period of 3 years, the study period is not a common multiple of all the alternatives' lives. Thus, repeatability assumption is not suitable for the comparison.
- Xavier should use co-terminated assumption for comparing alternatives.
- By using co-terminated assumption, Xavier should choose Alternative 2: Buy End of Lease apartment, use for 2 years and sell off, thereafter Rent Room for 1 more year

Learning Objectives

- Apply the concepts of
  - Repeatability Assumption
  - Co-terminated Assumption

- Compare mutually exclusive alternatives of unequal lives using Equivalent Worth Method with the Repeatability Assumption or the Co-terminated Assumption

E213 Engineering Cost Decisions (Topic Flow)

Today's learning

Application of ABC costing method in cost management

Application of different cost estimating techniques

Comparison of alternatives using the concept of equivalence

Alternatives evaluation using single, uniform series and uniform gradient cash flows

Project evaluation using MARR and Equivalent Worth method

Project evaluation based on Internal Rate of Return and External Rate of Return

Evaluate alternatives of equal life spans using payback method

Evaluate alternatives with different life spans

Evaluate public projects through incremental B/C analysis

Depreciation estimation and consideration in economic analysis

Tax consideration in economic analysis

Replacement analysis application

Risk and uncertainties handling in economic analysis