L5 APSC221 - Comparison Methods 1

Present Worth, Future Worth, Annual Worth, and Payback Period

Determining the feasibility of a project based on the costs and benefits, aka Resources vs Investments.

Key Assumptions in Comparison Methods

1. Costs and benefits are measurable
2. Future cash flows are known in certainty
3. Cash flows are not affected by inflation (for now)
4. Taxes are not applicable (for now)
5. There are sufficient funds available unless specified
6. All investments have a first cost / cash outflow to start (not zero)

Project Relationships

An independent project's expected cost/benefits do not depend on if another project is chosen.

Mutually exclusive (ME) projects are more realistic. Choosing one project from a pool of projects excludes the others.

Related, but not ME project's expected cost/benefits depend on if another project is chosen.

Minimum Acceptable Rate of Return (MARR)

A minimum threshold to determine if a project is worth our time.

How to determine this rate?

- Weighted Average Cost of Capital (debt and equity) aka WACC
- Internal and External Rate of Return
- Risk Free Rates

Comparison Methods

Take cash flows for project, shift to a common point, and determine, based on common-point value, if we want to take on this project or which project.

Because we are equating cash flows, all projects compared must have the same lifespan.

Present Worth Method (PW) and Future Worth Method (FW)

Shift cash flows to present or end time.
PW < 0, costs are higher than benefits
PW = 0, this is the break-even point
PW > 0, benefits are outweighing costs

Projects are ME, and the goal is to maximize PW/FW.

Annual Worth/Annual Cost Method (AW/AC)

For profits, maximize AW
For costs, minimize AC

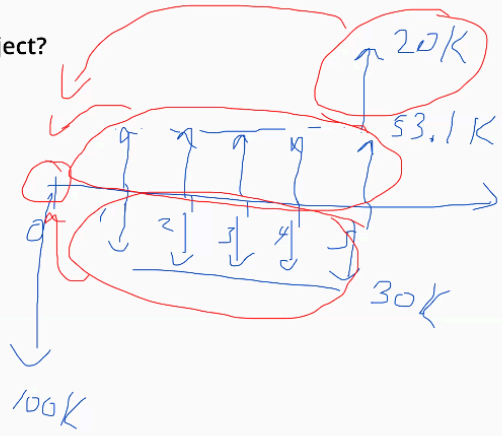
Independent PW Example

Example – Independent PW

Aurora Air wants to open a temporary base in Sweden. The initial startup costs are expected to be $100,000 and will yield $53,100 annual revenues for 5 years. Maintaining the base will cost $30,000 per year and they expect to recover $20,000 when they close the base.

If Aurora Air requires a 10% per year return, is this a desirable project?

$$PW = -100K + 20K(P/F, 10\%, 5) + 53.1K(P/A, 10\%, 5) - 30K(P/A, 10\%, 5)$$



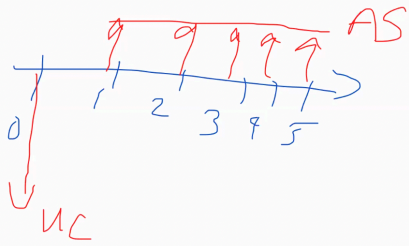
Mutually Exclusive PW Example

Aurora Air wants to replace its fleet of aircraft at the temporary base. The following 3 options were provided to them:

Aircraft	Unit Cost	Annual Savings
737 MAX 7	$90 M	$24.0M
A320neo	$108M	$28.5M
CS300	$87M	$23.0M

Assuming the same required return and time period as the temporary base, which aircraft should they choose?

$$PW = -UC + AS(P/A, 10\%, 5)$$



Uneven Lifespan

When comparing alternatives with unequal lifespans, we need a common basis for economic comparison:

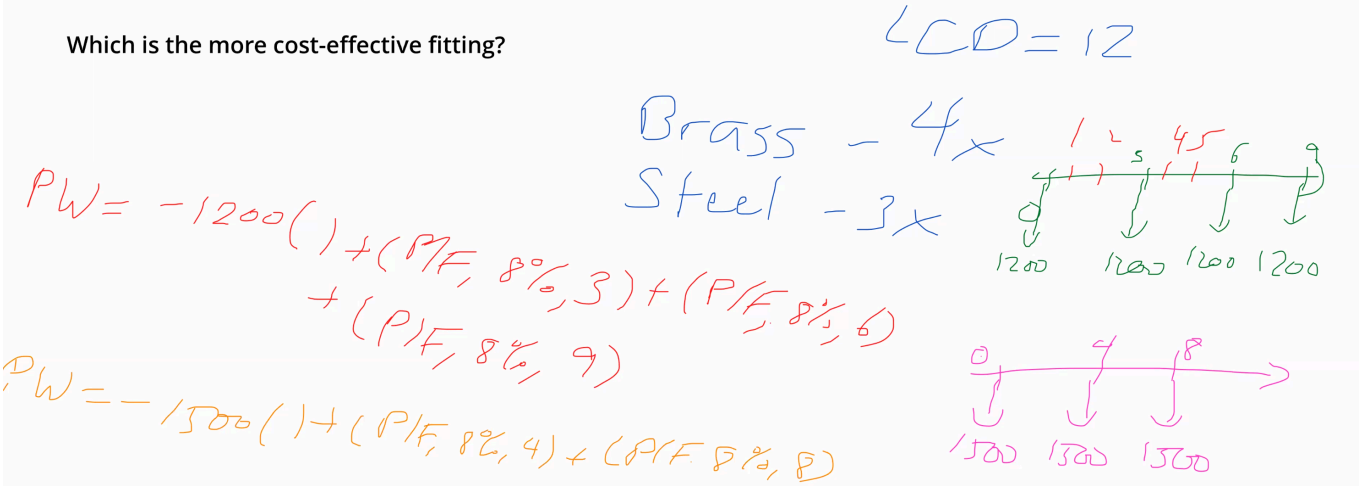
1. **Repeated Lives Approach**
   Repeat each alternative's cash flow until they both span the **Least Common Multiple** of their lifespans.
2. **Study Period Approach**
   Determine a specific study period and realize a salvage value at the end of the study. Requires that the costs/benefits are reasonably well distributed.
3. **Do an AW/AC Method**
   Convert the PW of each alternative to an equivalent uniform annual cost over its own lifespan.
   Use: AW = Pw(A/P, i, n)
   This simplifies the comparison to an annualized basis, regardless of lifespan.

Uneven Lifespan Example

Example – Uneven Lifespan

A plant has brass fittings which last 3 years and cost $1200 and stainless-steel fittings which last 4 years and cost $1500. Neither has a salvage value, and the required interest rate is 8%

Which is the more cost-effective fitting?



Payback Period

Simplest method in judging a project's viability.
Number of years for the first cost to be recovered.

Period = First Cost / Annual Benefit.

If annual benefits are non constant, we can simplify the period:
First Cost = sum of Annual Benefits.

This method is very crude and ignores the time value of money.

We commonly use a hurdle period of 2-4 years. If payback period exceeds, the project is not viable.

Payback Period Example

Of the 2 opportunities below, what is the payback period for each and what would be the recommendation?

	Machine A	Machine B
First cost	$15 000	$20 000
Annual revenues	9000	11000
Annual costs	6000	8000
Scrap value	1000	2000
Service life	5 years	10 years

$$PB = \frac{FC}{AB} = \frac{15K}{(9K-6K)} = 5$$

$$\frac{20K}{(11K-8K)} = 6.67$$