

ISE 307 — In-Class Activity 24

Replace the Truck? Defender vs. Challenger under Uncertainty

Term 253 · Lecture 24 · Ch. 11–12 · Teams of 3–4 · One submission per team · Graded 0/1/2 on good-faith completion

Team members (name — ID):

1. _____ 2. _____
3. _____ 4. _____

Context. Ore haulage at *Najd Copper* has doubled since the mine opened a satellite pit, and one **mine-site ore-transfer truck** is showing its age. The company bought it three years ago for **65,000 SAR**. Today:

Defender (current truck)	Challenger (new truck), cost 50,000 SAR				
	keep for n (yrs)	1	2	3	4
Market value <i>now</i> : 20,000 SAR	market value S_n	36,000	27,000	20,000	14,000
	op. cost, year n	5,000	7,000	10,000	15,000
Operating cost: 9,000 SAR/yr					
Usable 3 more years, then worth 5,000 SAR					

MARR = 10%. The 65,000 SAR the company paid is **sunk** — it must not appear anywhere in your analysis. Decide: keep the old truck, or replace it now?

Useful factors at $i = 10\%$:

n	1	2	3	4
$(A/P, 10\%, n)$	1.1000	0.5762	0.4021	0.3155
$(P/F, 10\%, n)$	0.9091	0.8264	0.7513	0.6830

Worked mini-example (read together, 2 minutes)

Annual equivalent cost of owning a machine ($I = 10,000$, kept $n = 2$ years, $S_2 = 4,000$, operating costs 2,000 then 3,000, $i = 10\%$):

$$\begin{aligned}
 CR(2) &= (I - S_2)(A/P, 10\%, 2) + i S_2 = 6,000 (0.5762) + 0.10 (4,000) = 3,857.2 \\
 AOC(2) &= [2,000 (0.9091) + 3,000 (0.8264)] (A/P, 10\%, 2) = 4,297.4 (0.5762) = 2,476.2 \\
 AEC(2) &= CR(2) + AOC(2) = 3,857.2 + 2,476.2 = 6,333.4 \text{ SAR/yr}
 \end{aligned}$$

(a) Defender's annual equivalent cost (outsider viewpoint).

- (i) Draw the defender's cash flow diagram **as an outsider would see it**: keeping the truck means giving up its **20,000 SAR market value today** (that is the investment at year 0), paying the operating costs for 3 years, and recovering 5,000 SAR at year 3.

- (ii) Compute the defender's annual equivalent cost, $AEC_D = (20,000 - 5,000)(A/P, 10\%, 3) + 0.10(5,000) + 9,000$:

(b) Challenger's economic service life. Most of the table is done. Fill the **four shaded cells**, then find the minimum.

keep for n	$CR(n)$	annualized op. cost $AOC(n)$	$AEC(n) = CR + AOC$
1	19,000.0	5,000.0	24,000.0
2	15,952.6	5,952.3	21,904.9
3	14,063.0		
4		8,861.9	

Reminders: $CR(n) = (I - S_n)(A/P, 10\%, n) + 0.10 S_n$; $AOC(n) = [\sum_{j=1}^n OC_j (P/F, 10\%, j)] (A/P, 10\%, n)$.
Show your work for the four cells:

Economic service life $N^* =$ _____ years, $AEC^* =$ _____ SAR/yr.

(c) The decision. Compare AEC_D from (a) with AEC^* from (b) and complete:

"We recommend that Najd Copper _____ (keep the truck / replace it now) because its annual equivalent cost of _____ SAR/yr is _____ (below / above) the challenger's best AEC^* of _____ SAR/yr."

(d) **Break-even twist (Ch. 11).** A dealer hints he might pay **more** than 20,000 SAR for the old truck. A higher offer raises the defender's opportunity cost — and could flip the verdict. Find the **break-even market value** MV^* at which the two options tie:

$$(MV^* - 5,000)(A/P, 10\%, 3) + 0.10(5,000) + 9,000 = AEC^*$$

(e) **Sensitivity sentence.** Today's resale estimate of 20,000 SAR is uncertain ($\pm$ a few thousand). In **one line**: is your decision in (c) robust to that uncertainty? (Compare the size of the plausible error with the gap to MV^* .)