Activity: from the pipeline to the base stock

Chapter 10, Multi-Echelon Inventory Systems

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Work in pairs. 20 minutes.

Names: _____

The item. The utility's North storeroom stocks the hydraulic pump for its bucket trucks, $2,400 a pump, managed one for one. A failed pump is pulled, a serviceable one is installed, and the carcass goes for repair.

- Pumps fail at the storeroom as a Poisson process, **52 a year**.
- A quarter of the carcasses are rebuilt in the storeroom's own shop, in an average of **3 weeks**.
- The rest go to the depot, which ships a serviceable pump in an average of **1 week**. For now the depot never makes anyone wait: $\bar{W} = 0$.

The storeroom's target is **at most 0.10 expected backorders** of pumps.

Part A. Predict

The depot later runs thin, and a request waits an average of $\bar{W} = 2$ weeks before it ships. How many more pumps will North need to stay on its target: one, two, or more?

Part B. The pipeline

1. Compute the mean number of pumps in resupply, μ_j, as the sum of its two terms. Give the unit conversion as a worked chain.
2. Check it with one rate times one average duration.
3. With one pump on the shelf, what fraction of failures find it there?

Part C. The base stock

Fill the table for μ_j of Part B. Build $P\{X = S\}$ by the recursion $P\{X = S\} = P\{X = S-1\}\,\mu_j/S$, and $\bar{B}_j$ by $\bar{B}_j(S+1) = \bar{B}_j(S) - \Delta_j(S)$, starting from $\bar{B}_j(0) = \mu_j$.

S_j	$P\{X = S_j\}$	$G(S_j)$	$\bar{B}_j(S_j)$	$\bar{I}_j(S_j)$	$\overline{RR}_j(S_j)$	$\Delta_j(S_j)$
0						
1						
2						
3						
4						
5						

1. What is the smallest stock level that meets the target?
2. Check one row with $\bar{I}_j - \bar{B}_j = S_j - \mu_j$.

Part D. The depot runs thin

Now $\bar{W} = 2$ weeks. Recompute μ_j, and find the smallest stock level that meets the target. How many pumps, and how many dollars, does the depot's slowness cost North? If North keeps the stock level of Part C, what are its expected backorders?

Part E, if you have time. Rebuild more at home?

North's shop proposes rebuilding **half** of the carcasses instead of a quarter, still in 3 weeks. Compute μ_j with $\bar{W} = 0$ and with $\bar{W} = 2$ weeks. When does rebuilding more at home help North?

Exit ticket (tear off and hand in)

Name: _____

1. North changed nothing, yet in Part D it needed more pumps. In one sentence, why?

2. True or false, and why: a target of 0.10 expected backorders means that about one failure in ten waits for a pump.