# Activity: spend the budget

Chapter 9, Multi-Echelon Inventory Systems

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Work in threes. 25 minutes.

Names: _____

**The spares.** The utility is stocking two repairable items at two storerooms, North and South, starting from no stock at all. The depot's delay is already folded into each pipeline, so each storeroom can be treated on its own. South sees twice North's failures.

| Item | Cost | Mean in resupply, North | Mean in resupply, South |
|---|---|---|---|
| Hydraulic pump | \$2,400 | 1.5 | 3.0 |
| Battery charger | \$6,000 | 0.5 | 1.0 |

The pipelines are Poisson, and these are the expected backorders $\bar{B}(S)$ at each stock level $S$:

| $S$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Pump, North | 1.5000 | 0.7231 | 0.2810 | 0.0898 | 0.0242 | 0.0056 | 0.0011 | 0.0002 |
| Pump, South | 3.0000 | 2.0498 | 1.2489 | 0.6721 | 0.3194 | 0.1346 | 0.0507 | 0.0172 |
| Charger, North | 0.5000 | 0.1065 | 0.0163 | 0.0019 | 0.0002 | 0.0000 | 0.0000 | 0.0000 |
| Charger, South | 1.0000 | 0.3679 | 0.1036 | 0.0233 | 0.0043 | 0.0007 | 0.0001 | 0.0000 |

**The budget is \$31,200.** Choose a whole number of units for each of the four, spending no more than the budget, to make the total expected backorders at the two storerooms as small as possible.

## Part A. Judgment

Without computing any ratios, agree on an allocation in five minutes. Record it and score it: its cost and its total expected backorders.

| | Pump, North | Pump, South | Charger, North | Charger, South | Cost | Total $\bar{B}$ |
|---|---|---|---|---|---|---|
| Your plan | | | | | | |

Before going on: which of the four will the first dollar go to?

### Part B. Greedy, one unit at a time

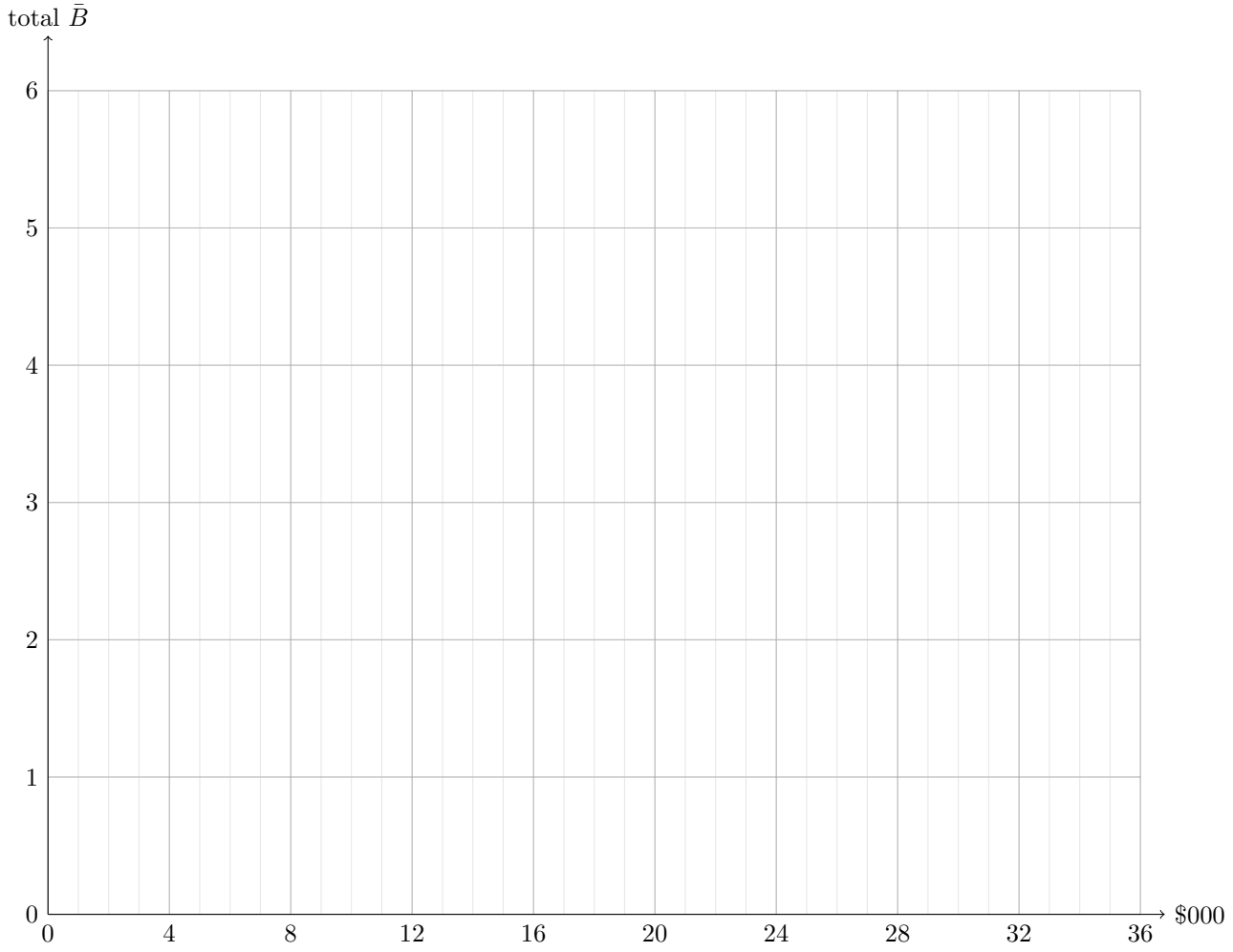
Start from nothing. At each step compute, for each of the four, what its next unit removes per \$1,000, $1000\,[\bar{B}(S) - \bar{B}(S+1)]/c$, buy the largest, and record it. Stop when the next buy would exceed \$31,200.

| Step | Buy | Removed per \$1,000 | Spend | Stock levels (PN, PS, CN, CS) | Total $\bar{B}$ |
|---|---|---|---|---|---|
| 0 | nothing | | \$0 | 0, 0, 0, 0 | 6.0000 |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |

Compare the greedy plan with your plan of Part A. Where did the two differ?

## Part C. The curve

Plot the greedy steps as total expected backorders against spend, and join them. Then plot your Part A plan as a single point, and, as your instructor reads them out, the other groups' plans.




Where do the class's plans lie against the curve? What does the vertical distance from a plan to the curve measure?

## Part D, if you have time. A smaller budget

The budget is cut to $30,000.

1. Run greedy with the rule of Part B. What does it buy, what does it leave unspent, and what is the total expected backorders?
2. Now spend what is left on whatever unit removes the most and still fits. Then compare with stock levels of 3, 4, 1 and 1. What does that say about the curve's points as answers to an arbitrary budget?

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**Exit ticket** (tear off and hand in)

Name: _____

1. The charger costs two and a half times as much as the pump. Why does that not make it the item to stock first?

2. True or false, and why: spreading the budget evenly across the four, in dollars, is a reasonable approximation to the greedy plan.