SMA 6304 / MIT 2.853 / MIT 2.854
Manufacturing Systems
Lecture 2: National Cranberry Cooperative

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Most slides by Larry Wein

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Key Definitions and Notation

λ = arrival rate (units/time)

μ = service rate (units/time)

M = number of servers

$\rho = \dfrac{\lambda}{M\mu}$

bottleneck = workstation with the highest utilization rate

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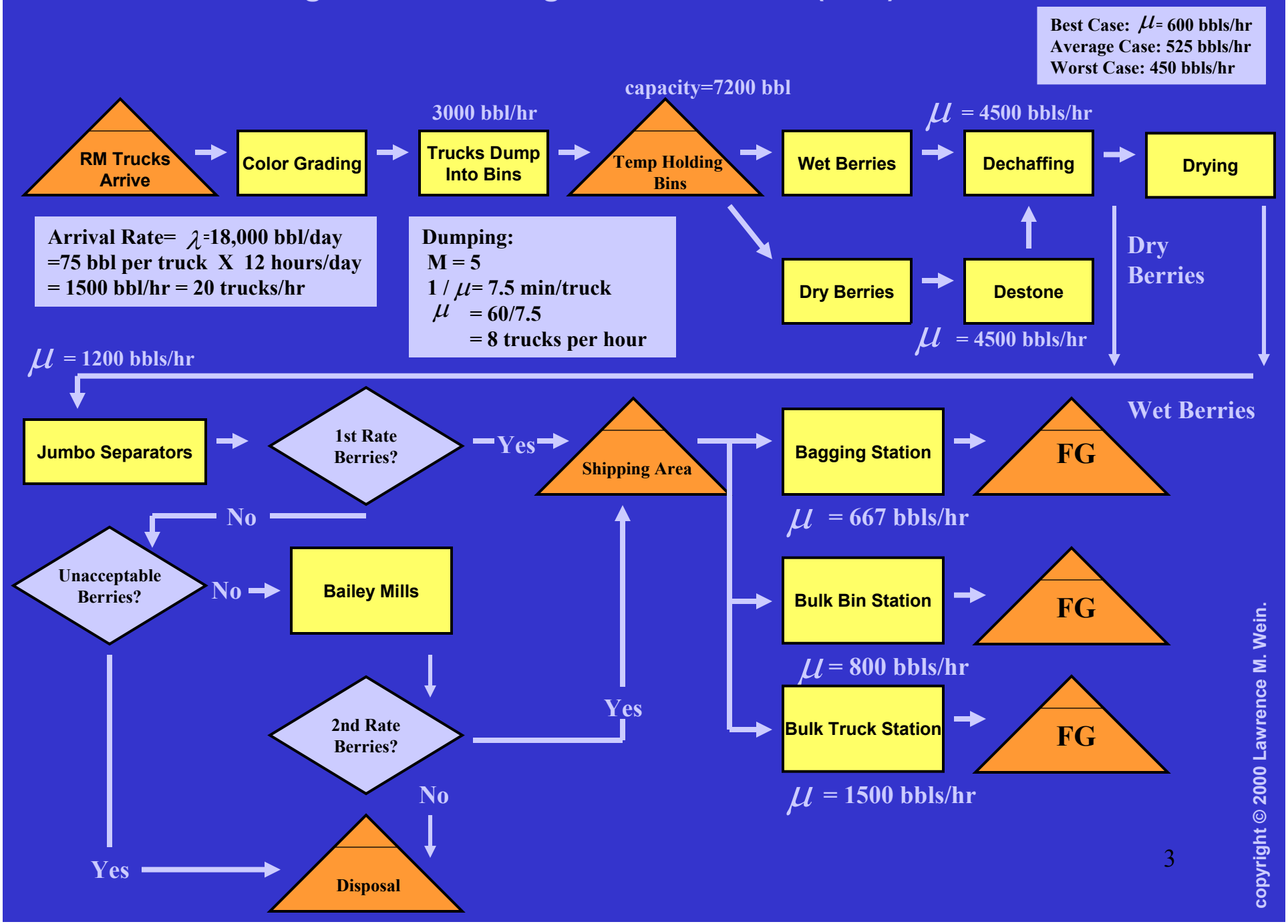
Process Flow Diagram: Receiving Plant Number 1 (RP1)

Exhibit 1



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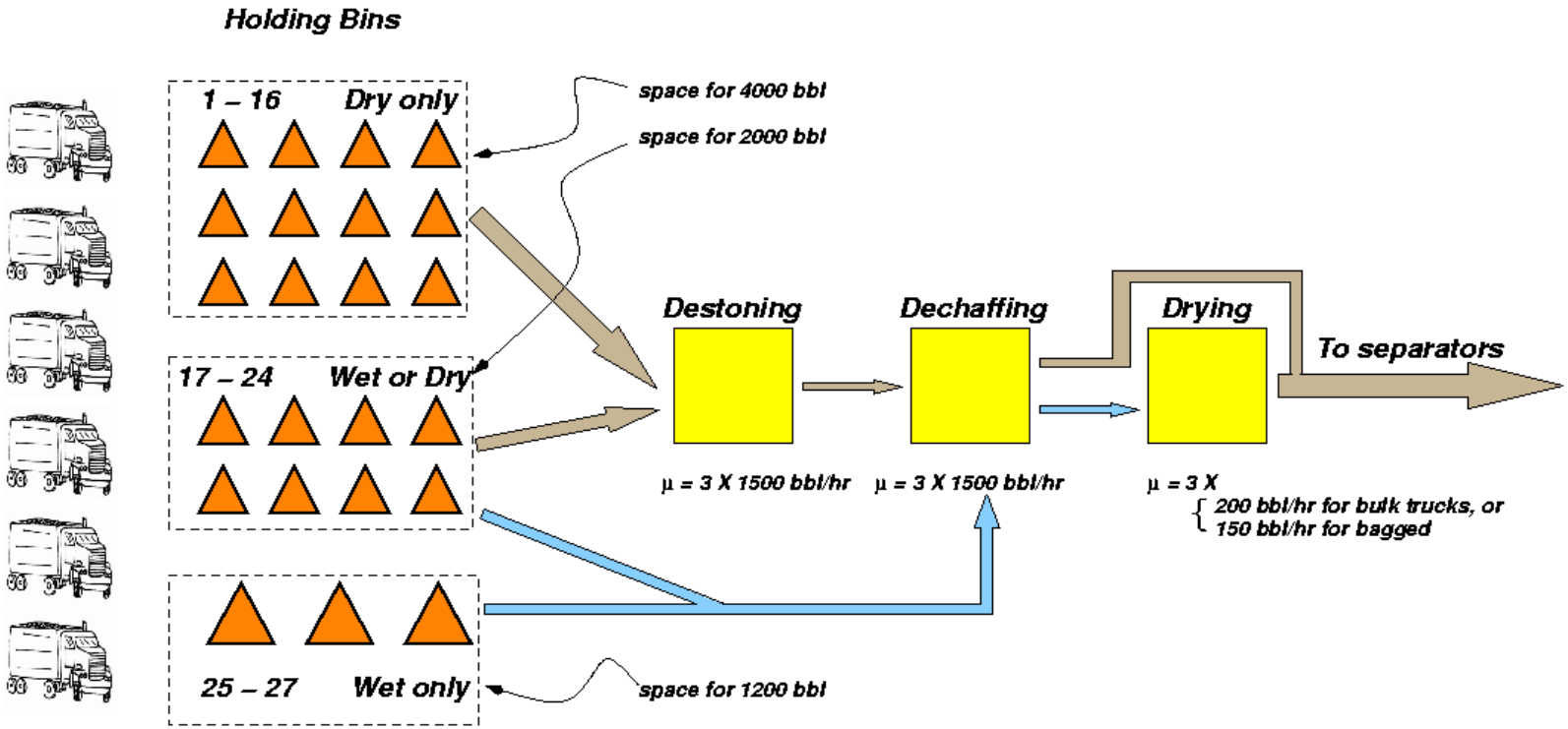
Berry Processing



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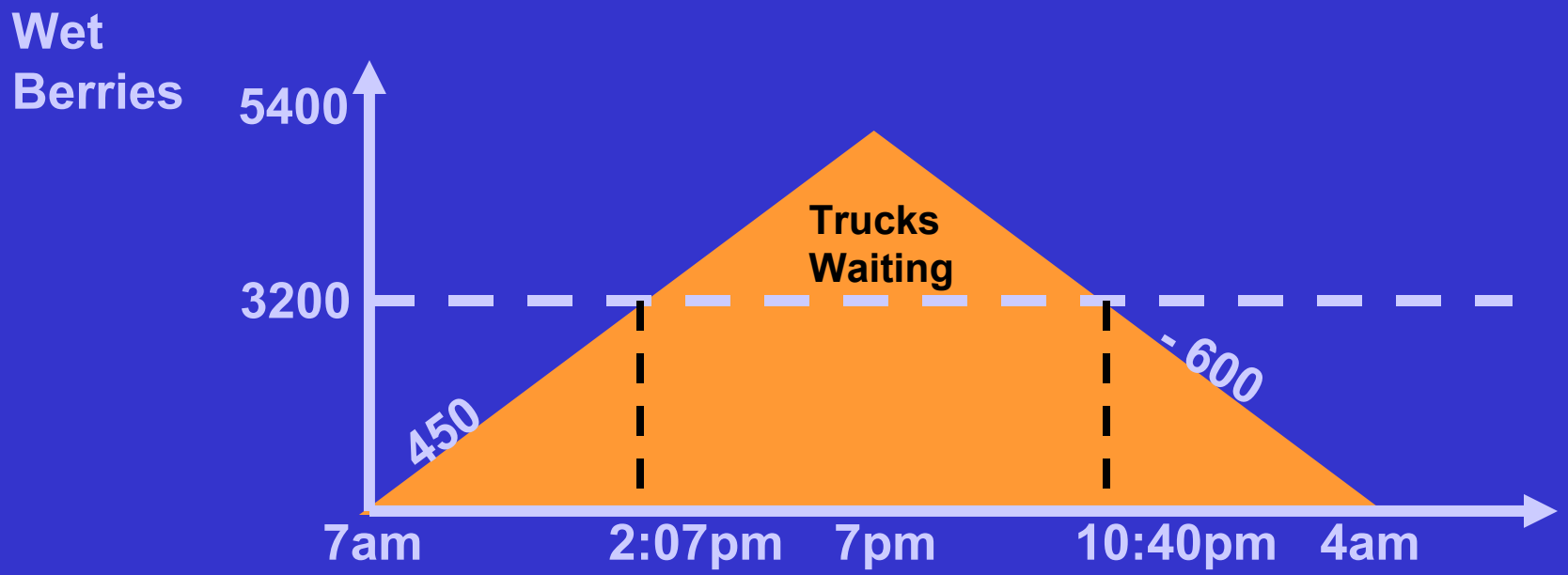
Inventory Buildup Diagram Peak Day



Simplifying Assumptions

1. Dryers start at 7am
2. Wet berries are bulked
3. 18,000 barrels arrive/day, 70% of them are wet
4. Trucks continue to arrive during lunch hour
5. Ignore unpredictable variability
6. Holding bins 17-24 used for wet berries

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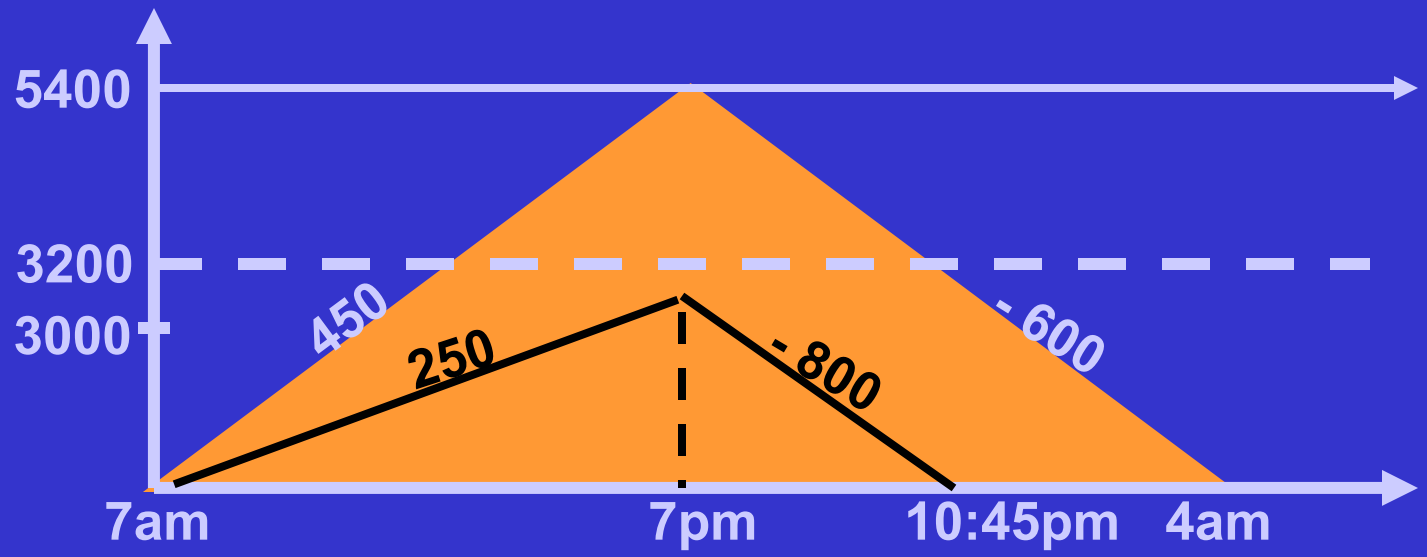
Value of an Extra Dryer



Cost Savings

1. Truck Waiting = $\frac{1/2(2200b)(8\ 5/9hr)}{75b/tr}$ X $10/tr-hr= $1255/day
2. Overtime Labor = (5 1/4 hr)($4/hr) 9 workers = $189/day
3. Receiving Labor = (3 2/3 hr)($4/hr) 3 workers= $44/day

Total = $1488/day

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Cost-Benefit Analysis of One Dryer

Exhibit 2 ⇒ 20 peak days/yr.

($1488/day)(20 days/yr) = $29,760/yr

Cost of Dryer = $25,000

Payback in less than one year!

Buy it!

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Convert Bins?

- Shift horizontal-line from 3200 to 5200
- Waiting costs reduced
- Overtime costs unaffected
- They help to cope with variable demand mix

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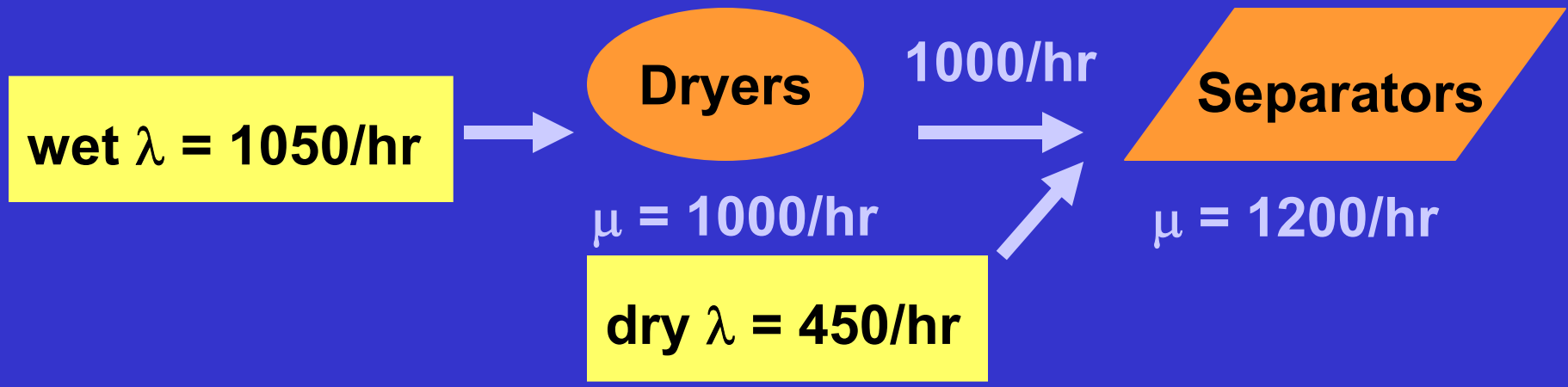
Buy a Second Dryer?



After 12 hours (at 7pm)

- inventory in front of dryers = 600b ⇒ dryers finish at 7:40pm
- inventory in front of separators = 3000b ⇒ separators finish at 10:00pm

Only save 40 minutes

Shifting Bottleneck

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Procedure for Analyzing Multistage Systems

- **Process Flow Diagram**
- **Identify Bottlenecks**
- **Generate Alternatives**
- **Evaluate Alternatives**

system design parameters → system performance measures → cash flows

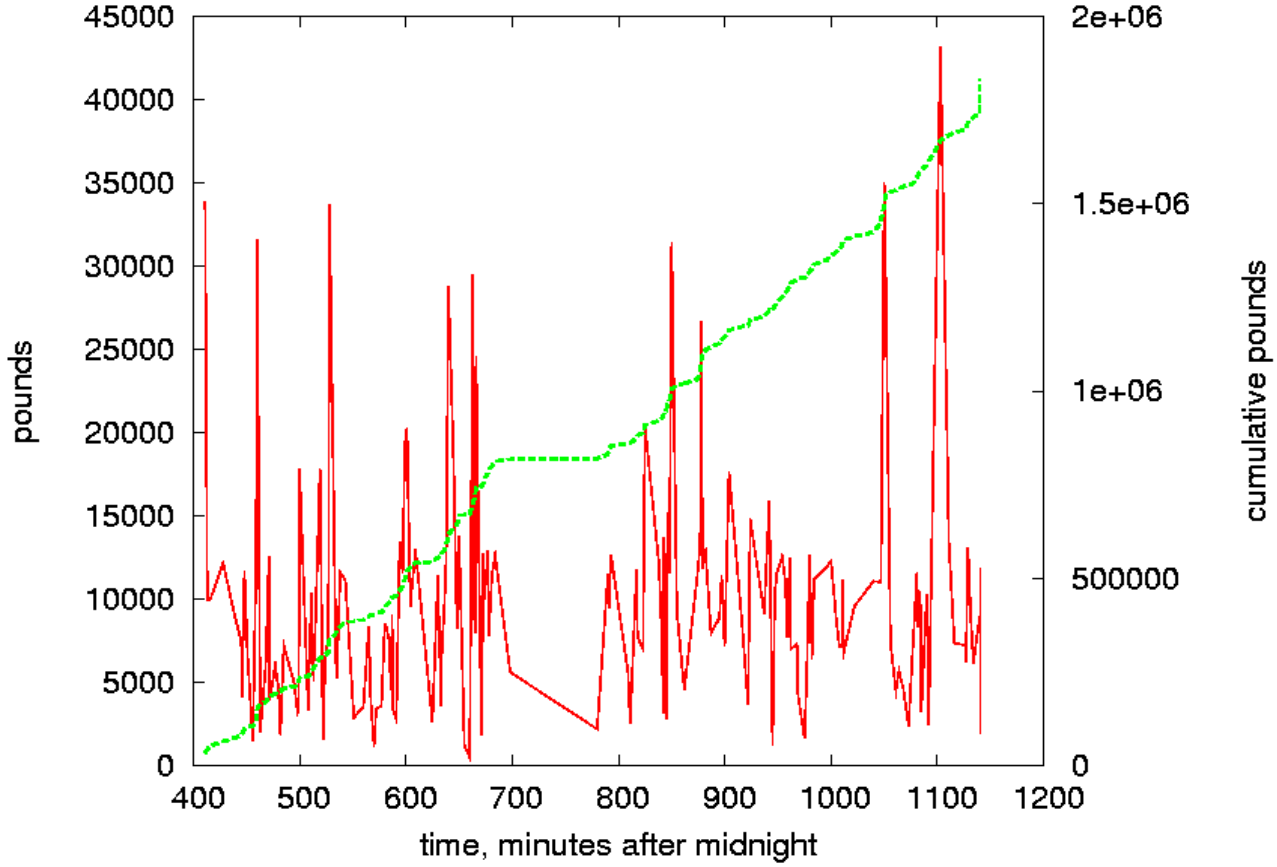
Net present value
Payback period

2 procedures

- **if variability is predictable, then use inventory buildup diagrams**
- **if variability is unpredictable, then use queueing theory**

Actual Deliveries

Very random!



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