CASE STUDY:
NEWSVENDOR PROBLEM

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SETUP

- Rupert sells daily newspapers on street
  - Rupert buys for c = \$0.55 each, sells for r = \$1.00 each
- Each morning, Rupert buys q copies
  - q is a fixed number, same every day
- Demand during a day: $D = \max(\lfloor X \rceil, 0)$
  - $X \sim$ normal ($\mu = 135.7$, $\sigma = 27.1$), from historical data
  - $\lfloor X \rceil$ rounds X to nearest integer
- If $D \leq q$, satisfy all demand, and $q - D \geq 0$ left over, sell for scrap at s = \$0.03 each
- If $D > q$, sells out (sells all q copies), no scrap
  - But missed out on $D - q > 0$ sales
- What should q be?

FORMULATION

- Choose q to maximize expected profit per day
  - q too small – sell out, miss \$0.45 profit per paper
  - q too big – have left over, scrap at a loss of \$0.52 per paper
- Classic operations-research problem
  - Many versions, variants, extensions, applications
  - Much research on exact solution in certain cases
  - But easy to simulate, even in a spreadsheet
- Profit in a day, as a function of q:

$$W(q) = r \min(D, q) + s \max(q - D, 0) - cq$$

  - $W(q)$ is a random variable – profit varies from day to day
- Maximize $E(W(q))$ over nonnegative integers q

SOLVE IT USING SIMULATION

- Build the model
  - Challenges
  - Tips:
    - Conversion of double data to int.
      - E.g. (int)normal (sigma, mu)

SOLVE IT USING SIMULATION

- Questions:
  - What's the profit if Rupert bought 100 news papers?
    - 1. Using random seed 1, one run only
    - 2. What's his long-term expected profit? Using multiple runs (1000). Add a plot showing the profit of each run. Add a "statistics" to calculate the overall mean profit.
  - What's the profit if Rupert bought 200 news papers?
    - 1. Using random seed 2, one run only
    - 2. Long-term expected profit. Using multiple runs (1000). Add a plot showing the profit of each run. Add a "statistics" to calculate the overall mean profit.

SOLVE IT USING SIMULATION (CONT.)

- What's Rupert's long-term strategy (how many news papers to buy) and his expected profit? (Use OptQuest)

DISCUSSIONS

- How can I “manually” obtain the near optimal solutions using “Parameters Variation”?
  - Regression analysis?

SOLUTIONS

- To be revealed ...

SCREENSHOTS

Run Experiment

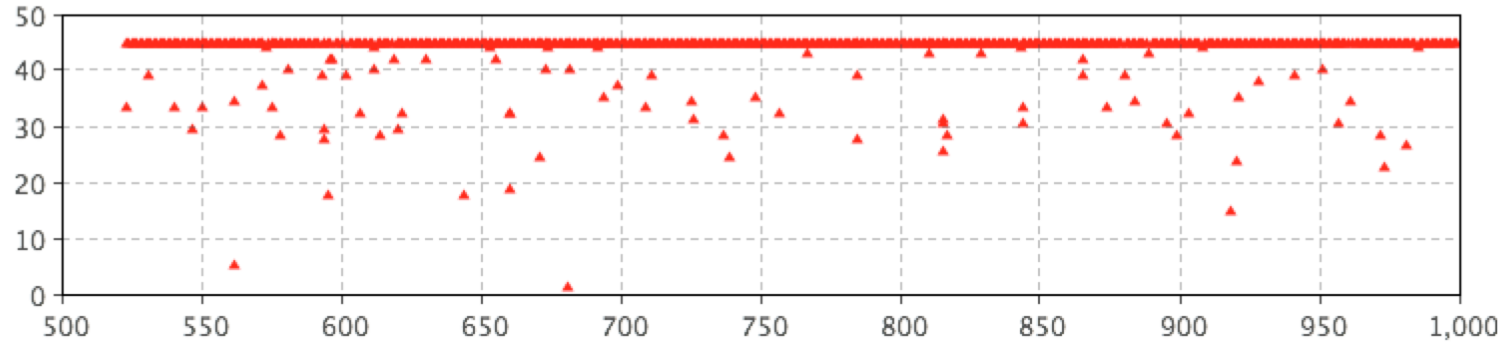
Iteration:	1,000
Replication:	1

Parameters

pNumberToBuy	100
pSellingPrice	1
pScrapPrice	0.03
pBuyingPrice	0.55
pMu	135.7
pSigma	27.1
pMulitpleRuns	1,000

dataset
1,000 samples ...[999, 45]

statistics
2,140 samples [-10.29...45]. Mean=43.863



Run Experiment

Iteration:	201
Replication:	1

Parameters

pNumberToBuy	248
pSellingPrice	1
pScrapPrice	0.03
pBuyingPrice	0.55
pMu	135.7
pSigma	27.1
pMulitpleRuns	1

dataset
1,000 samples ...[200, -55.24]

statistics
2,779 samples [-67.11...94.95]. Mean=31.063