HW 3 Supply Chain

- Stocking People magazine
  - p = \$3.95, w = \$1.50, c = \$0.50, g = \$2.00
  - Uniform demand [1000, 2000]
    - F(x) = (x-a)/(b-a); f(x) = 1/(b-a)
- What is q, profit for M and S with no coordination? Expected overstock?
  - c_u = 3.95+2.00-1.50
  - c_o = 1.50
  - We know optimal q satisfies:
    - $F(q^*) = c_u/(c_u+c_o)$ = 4.45/(4.45+1.5) = 0.7479
    - F(q) = (q-1000)/(2000-1000) → q^* = 1748

Decentralized Supply Chain

- Seller's Profit:
  - Π = p*(sales) – wq – g*(lost sales)
  - Sales = $q(1-F(q)) + s^q_{1000} xf(x)dx$
    $= qF(q) - s^q_{1000} F(x)dx$
  - Lost sales = $s_q^{2000}(x-q)f(x)dx$
  - Π = 3.95(1468.25) – 1.50(1748) – 2.00(31.75) = \$3114.08
- Manufacturer: $\Pi = q(w-c)$ = 1748
- Leftover Inventory = $s^q_{1000} (q-x)f(x)dx$ = 279.75
- Total SC profit = 3115.08 + 1748 = \$4862.08

Centralized Supply Chain

- Order quantity?
  - c_u = 3.95 + 2.00 – 0.50; c_o = 0.50
  - $F(q^*) = c_u/(c_u+c_o) = 5.45/(5.45+0.50) = 0.9159 \rightarrow q^{\wedge *} = 1916$
- Profit?
  - Same as seller's profit function but with different cost values
  - Π = p*(sales) – cq – g*(lost sales) = $4946.01

Buyback

- If there is a buyback price b = $0.75, does this coordinate?
  - In coordinating contract, $b = p(1-\alpha)$ and $w_b = p(1-\alpha) + \alpha c$
  - $b = 0.75 \rightarrow \alpha = 0.81013$
  - To coordinate we need $w_b = 3.95(1-0.81) + 0.81(0.50) = \$1.155$
- Here buyback without a changed w will not coordinate

Buyback

- Seller's q:
  - c_u = 3.95 + 2.00 – 1.50; c_o = 1.50 – 0.75
  - $F(q^*) = 0.8558 \rightarrow q^* = 1856$
- Seller's profit is same as before but now + b*(leftover inventory)
  - $\Pi = p^*[q(1-F(q)) + s^q_{1000} xf(x)dx] – wq – g^*s_q^{2000}(x-q)f(x)dx + b\, s^q_{1000} (q-x)f(x)dx = \$3354$
- Manufacturer: $\Pi = q(w-c) - b\, s^q_{1000} (q-x)f(x)dx = \$1581$
- SC Profit = $4935
- Supplier is better off and Manufacturer is worse off, but total SC is better off

Buyback with Capacity

- What if limited to capacity of 1748?
  - Since $q^*>1748$, the seller will stock as much as possible until that point, so q = 1748
  - Seller: $\Pi(q=1748,b=0.75) = \$3323$
  - Manufacturer: Π (q=1748,b=0.75) = $1538
- Buyback is still a good idea for the supplier (although the M still loses some compared to the 1st case)