Dynamic Pricing

• If a supplier serves multiple customer segments with a fixed asset, the supplier can improve revenues by setting different prices for each segment.

• Prices must be set with barriers such that the segment willing to pay more is not able to pay the lower price.

• Our hotels has established two fare classes: higher price ($p_H$) and lower price ($p_L$).

• For the higher price segment, random demand $D$ with mean $D_H$ and standard deviation $\sigma_H$

• How many rooms (protection level $Q$) shall we protect (i.e. reserve) for the full price payers?

• If $D < Q$, then $C_{\text{over}} = p_L$. If $D > Q$, then $C_{\text{under}} = p_H - p_L$.

• Then $\Phi(Q^0) = \frac{p_H - p_L}{p_H - p_L + p_L} = 1 - \frac{p_L}{p_H}$. 

Example of Dynamic Pricing: ToFrom Trucking

• Revenue from segment A = \( p_A = $3.50 \) per cubic foot but with 24 hours notice

• Revenue from segment B = \( p_B = $2.00 \) per cubic foot and with up to one week notice

• With 2 weeks to go, demand for segment A is forecast to be normally distributed with a mean 3,000 cubic feet and a standard deviation of 1,000. Then the capacity reserved for segment A is

\[
c_A = \text{NORMINV}(1 - p_B/p_A, 3000, 1000) = 2,820 \text{ cubic feet}
\]

• If \( p_A \) increases to $5.00 per cubic foot, then

\[
c_A = \text{NORMINV}(1 - (2.00/5.00), 3000, 1000) = 3,253 \text{ cubic feet}
\]
Overbooking

- Overbooking or overselling of a supply chain asset is valuable if order cancellations occur and the asset is perishable.
- \( p \) = price at which each unit of the asset is sold
- \( c \) = cost of using or producing each unit of the asset
- \( b \) = cost per unit at which a backup can be used in the case of asset shortage
- \( C_w = p - c \) = marginal cost of wasted capacity
- \( C_s = b - c \) = marginal cost of a capacity shortage
- \( O^* \) = optimal overbooking level
- \( s^* = \text{Probability}(\text{cancellations} \leq O^*) = \frac{C_w}{C_w + C_s} \)
Example of Overbooking: Apparel Supplier

• An apparel supplier takes orders for dresses with a Christmas motif.

• Production capacity is 5,000 dresses.

• Profits $10 for each sold, so cost of wasted capacity ($C_w$) = $10 per dress.

• If orders exceed capacity, the backup capacity costs him $5. In this case, cost of capacity shortage ($C_s$) = $5 per dress.

• Then $s^* = \frac{C_w}{C_w + C_s} = \frac{10}{10 + 5} = 0.667$

• If cancellations normally distributed with a mean of 800 and a standard deviation of 400, then the optimal overbooking level is

\[ O^* = \text{NORMINV}(s^*, 800, 400) = 973 \text{ dresses}. \]

• If the mean is 15 percent of the booking level and a coefficient of variation is 0.5, then $O = \text{NORMINV}(0.667, 0.15(5000 + O), 0.075(5000 + O))$. Using Excel Solver, $O^* = 1,115$. 