Problem 17–2

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- x_i Decision variable for building a factory in location i
- x'_j Decision variable for building a distribution center in location j
- $y^s_{i,j,l}$ Amount of product l that is sent to distribution center j from factory i in scenario s
- $z^s_{j,h,l}$ Amount of product l that is sent from distribution center j to customer h in scenario s
- $u^s_{h,l}$ Amount of unsatisfied demand of product l for customer h in scenario s

$$
\begin{aligned}
\min \quad & \sum_{i \in I} c_i x_i + \sum_{j \in J} c'_j x'_j \\
& \sum_{s \in S} p^s [\\
& \sum_{i \in I} \sum_{j \in J} f_{i,j} \sum_{l \in L} x^s_{i,j,l} + \\
& \sum_{j \in J} \sum_{h \in H} f'_{j,h} \sum_{l \in L} z^s_{i,j,l} + \\
& \sum_{l \in L} g_l \sum_{h \in H} u^s_{h,l} \\
&]
\end{aligned}
$$

Factory Capacity Constraint

$$\sum_{j \in J} x^s_{i,j,l} \leq r_{i,l} \quad \forall i \in I, \forall l \in L, \forall s \in S$$

Factory to Distribution Center Constraint

$$\sum_{l \in L} x^s_{i,j,l} \leq r'_{i,j} \quad \forall i \in I, \forall j \in J, \forall s \in S$$

Distribution Center to Customer Constraint

$$\sum_{l \in L} z^s_{j,h,l} \leq r''_{j,h} \quad \forall h \in H, \forall j \in J, \forall s \in S$$

Unsatisfied Demand

$$\sum_{j \in J} z^s_{j,h,l} = d^s_{h,l} - u^s_{h,l} \quad \forall h \in H, \forall l \in L, \forall s \in S$$