

Cleveland Clinic - Medical Resource Optimization Mathematical Formulation

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Dimensions

$r \in Resources$: set of resources

$f \in Facilities$: set of facilities

$sl \in Servicelines$: set of service lines

$ss \in Sub - services$: set of sub-services

$d \in Days$: set of days

Data Parameters: Model Coefficients

$capacity_{f,sl,ss,r}$ is the capacity of resource r at facility f , service line sl , sub-service ss

$revenue_{f,sl,ss}$ is the revenue per patient at facility f , service line sl , sub-service ss

$margin_{f,sl,ss}$ is the margin per patient at facility f , service line sl , sub-service ss

$demand_{f,sl,ss,d}$ is the maximum demand of facility f , service line sl , sub-service ss , and day d

$losMean_{f,sl,ss}$ is the of facility f , service line sl , sub-service ss

Decision Variables

$NumPatientsAccept_{f,sl,ss,d} \geq 0$ is the number of patients accepted in facility f , service line sl , sub-service ss , on day d

Variables

$TotalPatientsDay_{f,sl,ss,d}$ is the total number of patients accepted in facility f , service line sl , subservice ss , cumulative for day d where,

$$TotalPatientsDay_{f,sl,ss,d} = \sum_{\substack{d1 \in d \text{ and} \\ \max\{\min_{d' \in D} [d' - losMean_{f,sl,ss} + 1], d1\} \leq d}} NumPatientsAccept_{f,sl,ss,d1}$$

$\forall f, sl, ss, d$

Objective Functions

$$\max \quad TotalRevenue = \sum_{f,sl,ss,d} NumPatientsAccept_{f,sl,ss,d} revenue_{f,sl,ss}$$

$$\max \quad TotalMargin = \sum_{f,sl,ss,d} NumPatientsAccept_{f,sl,ss,d} margin_{f,sl,ss}$$

Constraints

Maximum demand constraint: Number of patients accepted for f, sl, ss should be less than the maximum demand for day d .

$$NumPatientsAccept_{f,sl,ss,d} \leq demand_{f,sl,ss,d} \quad \forall f, sl, ss, d \quad (1)$$

Capacity constraint: Total number of patients for f, sl, ss on day d should be less than equal to available capacity of resource r for f, sl, ss . Capacity of resource r is normalized per patient.

$$TotalPatientsDay_{f,sl,ss,d} \leq capacity_{f,sl,ss,r} \quad \forall f, sl, ss, d, r \quad (2)$$