1.224J: Recitation #1

Linear programming

Modeling and solution in Excel

LP basics

Minimize	(A linear function)
Subject to	(A collection of linear constraints, which are linear equalities and linear inequalities)

*Important note: linear in **decision variables**, not necessarily other data

Typical modeling steps

- Write down problem data
  [known information you have values for]

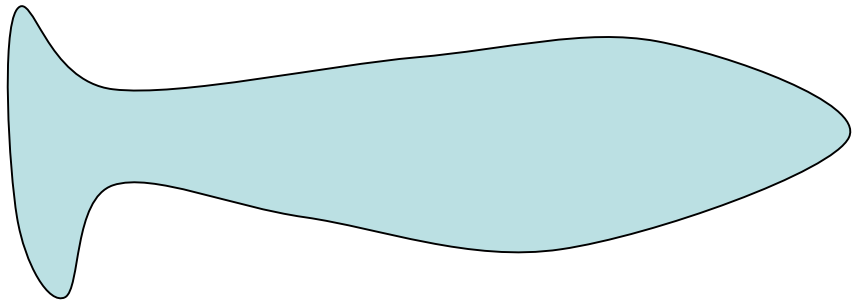
- Write down decision variables

- Choose what your objective is

- Write down problem mathematically, implement in Excel

New England Fisheries Crisis

Optimal allocation of fishing quotas to fishing fleets.



New England Fisheries background

- Historically, fishing (cod in particular) has been an in important livelihood along the northeast coast.
- Since the 1980's cod levels have dropped dramatically.
- Today, the challenge is to find a balance between fishermen's livelihoods and ecosystem sustainability.

Quota system

- A successful approach in Iceland, might be tried here.
- Each fishing company is assigned, or auctioned, a quota for amount of fish they can catch in a certain time frame and a certain region.

- QUESTION: How to allocate quotas?

Optimal quota allocation model

Variable	Description
S	Set of fish species
J	Set of fishing companies
TAC_s	Total allowable catch for species s
c_{js}	Cost per ton of landed fish of species s incurred by company j
p_s	Wholesale price per ton of species s
a_{js}	1 or 0 indicator for whether or not company j has the ability to fish for species s
$\mathrm{NR}_j = \sum_s (p_s - c_{js}) x_{js}$	Net revenue to company j
r_j	Number of fishermen employed by company j
x_{js}	Quota imposed on company j regarding species s

$$
\begin{aligned}
\max \quad & L \\
\text{s. t.} \quad & \textstyle\sum_{j \in J} x_{js} \leq \mathrm{TAC}_s && \forall s \\
& x_{js} \leq a_{js} \mathrm{TAC}_s && \forall j,\ s \\
& (\textstyle\sum_s (p_s - c_{js}) x_{js}) / r_j = L && \forall j, \\
& x_{js} \geq 0 && \forall j,\ s
\end{aligned}
$$