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Stochastic Optimization Cases

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Transportation model with stochastic demand

There are i can factories and j consumption markets.
Each factory has a maximum capacity of a_i cases, and each market demands a stochastic quantity of q_j^{ω} cases.
The probability of each scenario is π^{ω}. The transportation cost between each factory i and each market j for each case is t_{ij}.
There is a production cost in each factory c_i, a selling price per case in each market p_j, and a penalty cost for the product sent from the factory and not sold at the market b_j
We want to maximize the profits (revenues – costs)

Transportation model with stochastic demand (GAMS)

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sets
   I factories / VIGO, ALGECIRAS /
   J markets   / MADRID, BARCELONA, VALENCIA /
   W scenarios / sc1*sc3 /

parameters
   A(i) capacity of factory i [cases]
       / VIGO      350
         ALGECIRAS 700 /

   C(i) production cost in factory i [cases]
       / VIGO      3.5
         ALGECIRAS 7.0 /

   P(j) price at market j [€ per case]
       / MADRID    9.5
         BARCELONA 9.9
         VALENCIA  9.0 /

   B(j) penalty at market j [€ per case]
       / MADRID    1.5
         BARCELONA 1.9
         VALENCIA  1.0 /

   PI(w) probability of each scenario [p.u.]
       / sc1  0.2
         sc2  0.5
         sc3  0.3 /

table Q(j,w) demand in market j [cases]
            sc1  sc2  sc3
MADRID      400  450  500
BARCELONA   450  500  550
VALENCIA    150  200  350

table T(i,j) transportation cost between i and j [€ per case]
            MADRID BARCELONA VALENCIA
VIGO         0.06     0.12     0.09
ALGECIRAS    0.05     0.15     0.11
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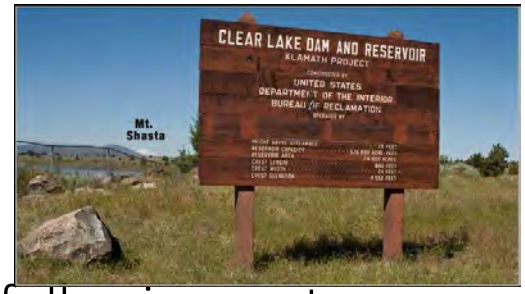
http://tule-lake.com/wildlife/clear-lake-nwr/clear-lake-dam/



Clear Lake Dam (i)

- A reservoir operator faces the following costs
  - Shortfall costs C_s for each mm below a minimum reservoir volume V_{min}
  - Flooding costs C_f for each mm above a maximum reservoir volume V_{max}
- Based on the inflow expectations for the next three months (January, February and March), the operator sets up a stochastic multistage model to determine the optimal recourse decisions that minimize the expected costs of all decisions made. The operator makes a release decision just before the realization of the stochastic inflow has been observed for a given month.

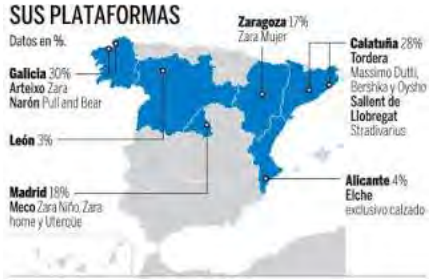
Clear Lake Dam (ii)

- It is assumed that there are three possible inflow realizations for each month, low, normal and high, each of which has its own probability. The operator's expectations are given below

	Low	Normal	High
Probability [p.u.]	0.25	0.5	0.25
Inflow [mm]	50	150	350

- Initial and final water level $V_i = Vf$: 100 mm
- Minimum reservoir level V_{min}: 50 mm
- Maximum reservoir level V_{max}: 250 mm
- Maximum hydro output O_{max}: 200 mm
- Flooding penalty: 10 €/mm
- Shortfall penalty: 5 €/mm

Location of distribution centers



A firm serves essentially two markets, East and West, and is contemplating the location of one or more distribution centers (DC) to serve these markets. A complicating issue is the uncertainty in demand in each market. The firm has enumerated three representative scenarios to characterize the uncertainty. The table below gives (i) the fixed cost per year of having a DC at each of three candidate locations, and (ii) the profit per year in each market as a function of the scenario and which DC is supplying the market. Each market will be assigned to that one open DC that results in the most profit. This assignment can be done after we realize the scenario that holds. The DC location decision must be made before the scenario is known.

Profit by Scenario/Region and Supplier DC

		Scenario One		Scenario Two		Scenario Three	
DC Location	Fixed Cost	East	West	East	West	East	West
A	51	120	21	21	40	110	11
B	49	110	28	32	92	70	70
C	52	60	39	20	109	20	88

For example, if Scenario Three holds and we locate DC's at *A* and *C*, East would get served from *A*, West from *C*, and total profits would be 110 + 88 – 51 – 52 = 95.

a) If Scenario One holds, what is the best combination of DC's to have open?

b) If Scenario Two holds, what is the best combination of DC's to have open?

c) If Scenario Three holds, what is the best combination of DC's to have open?

d) If all three scenarios are equally likely, what is the best combination of DC's to have open?

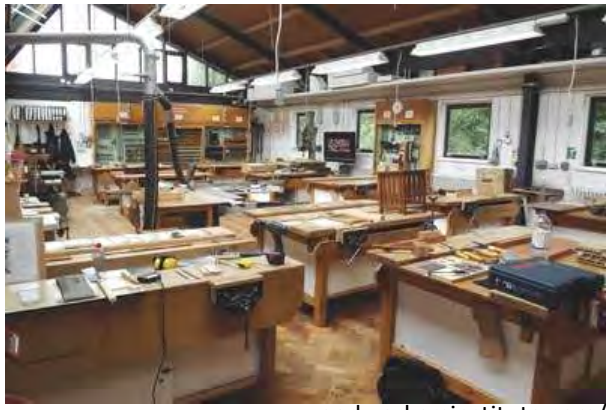
Source: Lindo Systems *Optimization Modeling with LINGO 2006*

Refinery

https://en.wikipedia.org/wiki/Oil_refinery

- A refinery can blend N raw materials into M different products. At present, the management is trying to decide how much of each of the raw materials to purchase and stock, so that they can be blended to satisfy the demand for the products in future T time periods. The demand must be completely satisfied, and in case of raw material shortage the products can be outsourced at a higher cost. There is an inventory constraint on how much raw material can be stocked in total.

Furniture Shop



www.woodworkersinstitute.com/

- The problem consists of determining the product mix for a furniture shop with two workstations: carpentry and finishing. The availability of labor in man-hours at the two stations is limited. There are four product classes, each consuming a certain number of man-hours at the two stations. Each product earns a certain profit and the shop has the option to purchase labor from outside. The objective is to maximize the profit.

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