Deterministic OR Models

CO 370

Bertrand Guenin

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Preface

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What is operations research (OR)? There's no standard definitions for it. One particular definition: use of mathematical models to make complex decisions for real life problems. The origin is British military in WW2. OR is actually everywhere today. Key milestone: Simplex algorithm (1947).

Recall optimization problem is of the form:

$$\begin{aligned} \max \quad & f(x) \\ \text{s.t.} \quad & \text{a set of constraints} \end{aligned}$$

There are some applications: mail delivery, machine scheduling, inventory problem, network design, facility location, class scheduling, portfolio optimization, surgery planning, sensor location.

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Sibelius Peng

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Part I:

Formulations

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LP formulations

Production problem

Products $J = \{1, \ldots, n\}$
Resources $I = \{1, \ldots, m\}$

Data:

- $\forall j \in J : c_j =$ value of unit of product j
- $\forall i \in I : b_i =$ number of units of resource i available
- $\forall i \in I, \forall j \in J : a_{ij} =$ number of units of resource i going to product j

Goal: maximize values of product made subject to available resources

Var: $x_j =$ number of units of product j produced

Then problem is

$$\begin{array}{rll} \max & \sum_{j \in J} c_j x_j & \\ \text{s.t.} & \sum_{j \in J} a_{ij} x_j \leq b_i & (i \in I) \\ & x_j \geq 0 & (j \in J) \end{array}$$