

Linear programming notes

Marco Marini

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Abstract

This document contains notes about Linear programming.

1 Supply chain model

We define a simplified supply chain model as a system that produces products with a chain of product transformations performed by producers.

Let be

$A = a_1 \dots a_n$ the set of producer types

$B = b_1 \dots b_n$ the set of product types.

$N_i, i \in A$ the number of producers of type i .

The system is constrained by some rules:

1. the producer can perform only transformations matching the producer type.
2. the producer can perform only a single transformation for the its duration.

For each product i let define the production rule

$$R_i = (P_i, V_i, Q_i, T_i, C_{i,i})$$

with

$P_i \in A$ the producer

V_i the value of product

Q_i the quantity of outcome in duration interval

T_i the duration interval

$C_{i,j}$ the quantity of product j consumed to produce the product i in duration interval.

1.1 Production indicators

By now we do not consider the constraint on the availability of consuming products. It will be considered later.

When a producer of type i is ready to produce we assign a production slot for the product j such that

Y_{ij} is the weighted distribution

Obviously the distribution of product not produceable by the producer is zero:

$$Y_{ij} = 0, \forall j \mid P_j \neq i \quad (1)$$

The total time of usage of the producer is

$$Z_i = \sum_{j \in B} Y_{ij} T_j \quad (2)$$

During this interval the producer i produces the product j for the period

$$Y_{ij} T_j$$

The produced quantity is

$$Q_j Y_{ij}$$

The production frequency of product j for all producers of type P_i is

$$F_i = N_j Q_i \frac{Y_{ji}}{Z_j}, j = P_i \quad (3)$$

The production value flow of product j is

$$I_i = V_i F_i \quad (4)$$

1.2 Constraints

Il grafo di produzione è un grafo orientato dove ogni nodo rappresenta un prodotto e ogni arco la dipendenza tra prodotti consumati e prodotto generato.

Come calcoliamo la produzione totale dei beni considerando le diverse velocità di produzione dei beni?

Dalla (3) sappiamo con che frequenza viene generato un prodotto.

Possiamo quindi calcolare con che frequenza un prodotto viene consumato

$$E_i = \sum_{j \in B} F_j \frac{C_{ji}}{Q_j} \quad (5)$$

Questa frequenza deve essere ovviamente inferiore alla frequenza di produzione quindi

$$E_i \leq F_i \quad (6)$$