UNIVERSITAT DE BARCELONA

OPTIMIZATION

MASTER IN FUNDAMENTAL PRINCIPLES OF DATA SCIENCE

OPTIMIZATION PROBLEM 2

CONCRETE MIXING PROBLEM

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1 Problem description

Suppose that we are mixing concrete and are using n ***different gravel sizes*** $s_1, \ldots, s_n$***.***

The ideal mixture is given by $\mathbf{c} = (c_1, \ldots, c_n)$***, where*** c_i $(0 \leq c_i \leq 1)$ ***is the fraction of size*** s_i ***in the mix, and*** $\sum_{i=1}^{n} c_i = 1$***.***

Gravel mixtures come from m ***different mines:*** $C_1, \ldots C_m$***. The gravel composition at each mine*** C_j ***is given by*** $C_j = (c_1^j, \ldots, c_n^j)$***, where*** $0 \leq c_i^j \leq 1$ ***for all*** $i = 1, \ldots, n$ ***and*** $\sum_{i=1}^{n} c_i^j = 1$***.***

Let $\mathbf{x} = (x_1, \ldots, x_m)$ ***be the vector which represents the fraction of the gravel of the mine*** $C_j \in C$ ***in the mixture, where*** $0 \leq x_j \leq 1$ ***for all*** $j = 1, \ldots, m$ ***and*** $\sum_{j=1}^{m} x_j = 1$***.***

Find the best possible approximation $\mathbf{x} = (x_1, \ldots, x_m)$ ***of the ideal mixture,*** $\mathbf{c} = (c_1, \ldots, c_n)$***, by using the material from the*** m ***mines.***

2 Solution