Fall 2020
EE 236A
Prof. Christina Fragouli
TAs Mine Dogan and Kaan Ozkara

EE236A Linear Programming
Quiz 1
Tuesday October 13, 2020

NAME: _____ **UID**: _____

This quiz has 3 questions, for a total of 20 points.

Open book. The exam is for a total of 1:00 hour. **Please, write your name and UID on the top of each sheet you upload.**

Good luck!

Problem	Mark	Total
P1		6
P2		7
P3		7
Total		20

Problem 1 (`6 points`) Let x be a real-valued random variable which takes values in $\{a_1, a_2, \ldots, a_n\}$ where $0 < a_1 < a_2 < \cdots < a_n$, and $\Pr(x = a_i) = p_i$. Obviously p satisfies $\sum_{i=1}^{n} p_i = 1$.

Consider the problem of determining the probability distribution that maximizes the expected value $\mathbf{E}x$ subject to the constraint that $\Pr(x \geq \alpha) = b$, i.e.,

$$\begin{array}{ll} \text{maximize} & \mathbf{E}x \\ \text{subject to} & \Pr(x \geq \alpha) = b \end{array} \tag{1}$$

where α and b are given ($a_1 < \alpha < a_n$, and $0 \leq b \leq 1$).Write (2) as an LP.

Problem 2 (`7 points`): Can you solve the following problem by solving an (equivalent) LP? If yes, explain how you would do that, if no, explain why it is not possible.

Consider the n dimensional real vectors $x = [x_1, x_2, \ldots x_n]$ and $z = [z_1, z_2, \ldots z_n]$, we want to

$$\begin{array}{lll} \text{minimize} & ||\alpha x||_2^2 - ||z||_1 & \\ \text{subject to} & \max_i x_i^2 \leq \beta, & i = 1 \ldots n \\ & -1 \leq z_i \leq 1, & i = 1 \ldots n \end{array} \tag{2}$$

where α and β are given real nonnegative constants.

Problem 3 (`7 points`) Formulate the following problem as an LP and find its solution.

Four wireless basestations n_1, n_2, n_3 and n_4 are placed on the circumference of a circle, as depicted in Fig. 1. When node i transmits, the two nodes closest to it cannot transmit, because they would cause interference. For example, when basestation 1 transmits, basestations 2 and 4 cannot transmit. Each basestation i transmits at a rate of r_i (the rates r_i are given constants) packets per time unit; moreover, each basestation needs to transmit for at least 1/8 of each time unit. Write an LP that maximizes the total amount of rate, transmitted from all four basestations, during a time unit. Find its solution.

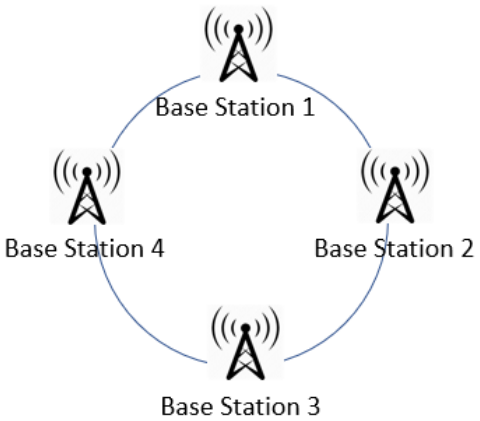

Figure 1: Wireless basestations positioned on a circle