Freie Universität Berlin
FB Mathematik und Informatik
Sommersemester 2017

Prof. Dr. Ralf Borndörfer
Torsten Klug

Optimierung I

Excercise Sheet 2

Submission: until 14:15 on Tuesday, Mai 9 2017

Exercise 2.1 **10 Points**

Proof that the following sets are convex.

a) $\emptyset$, $\mathbb{R}^n$

b) hyperplan with normal vector a

$$\mathcal{H} = \left\{x \in \mathbb{R}^n \mid a^T x = \alpha\right\}, a \in \mathbb{R}^n, a \neq 0, \alpha \in \mathbb{R}$$

c) closed halfspace generated by $\mathcal{H}$

$$\mathcal{H}^\alpha = \left\{x \in \mathbb{R}^n \mid a^T x \geq \alpha\right\}, a \in \mathbb{R}^n, \alpha \in \mathbb{R}$$

d) open halfspace generated by $\mathcal{H}$

$$\overset{\circ}{\mathcal{H}}{}^\alpha = \left\{x \in \mathbb{R}^n \mid a^T x > \alpha\right\},$$

e)

$$M = \left\{(x, y) \in \mathbb{R}^2 \mid xy \geq 1, x \geq 0, y \geq 0\right\}$$

Exercise 2.2 **10 Points**

Proof:

a) Let C, $D \subset \mathbb{R}^n$ be convex, $\alpha \in \mathbb{R}, \alpha \geq 0$. Then the following sets are convex:

$$C + D := \{x + y \mid x \in C, y \in D\}$$

$$\alpha C := \{\alpha x \mid x \in C\}$$

b) The convex hull of a set $M \subset \mathbb{R}^n$ coincides with the set of convex combinations of points in M.

Exercise 2.3 **10 + 5* Points**

The Reggio Advertising Company wishes to plan an advertising campaign in three different media: television, radio and magazines. The purpose of the advertising program is to reach as many potential customers as possible. Results of a market study given below:

	Television			
	Day Time	Prime Time	Radio	Magazines
Cost of an advertising unit	$ 40,000	$ 75,000	$ 30,000	$ 15,000
Number of potential customers reached per unit	400,000	900,000	500,000	200,000
Number of women customers reached per unit	300,000	400,000	200,000	100,000

The company does not want to spend more than $800,000 on advertising. It further requires that

- at least 2 million exposures take place among woman;
- advertising on television be limited to $500,000;
- at least 3 advertising units be bought on daytime television, and two units during prime time;
- and the number of advertising units on radio and magazine should each be between 5 and 10.

Formulate into a linear programming problem!

(optional, 5 points) Implement your model with ZIMPL and solve it with SCIP. Please send your zimpl code by email to `klug@zib.de`

`http://scip.zib.de/#scipoptsuite`

Homepage of the Lecture: `http://www.zib.de/ss17_Optimierung_I`
Questions?: `klug@zib.de`