## PROBLEM 1

For all allowed values of the parameters, find all global maxima of the following maximization problem, or show that none exist.

Objective function $8A_1 + \log A_2$

Constraints

$$2B_1 - A_2 \geq \theta$$
$$A_1 + B_1 \leq \delta$$
$$A_2 \leq \delta$$
$$A_1 \geq 0, B_1 \geq 0, A_2 \geq 0$$

variables $A_1, B_1, A_2$

parameters $\delta, \theta$

conditions on parameters $\delta > 0$

## PROBLEM 2

For all allowed values of the parameters, find all global maxima of the following maximization problem, or show that none exist.

Objective function $\mu(8A_1 + \log A_2) + \nu(2B_1 - A_2)$

Constraints

$$A_1 + B_1 \leq \delta$$
$$A_2 \leq \delta$$
$$A_1 \geq 0, B_1 \geq 0, A_2 \geq 0$$

variables $A_1, B_1, A_2$

parameters $\delta, \mu, \nu$

conditions on parameters $\delta > 0, \mu \geq 0, \nu \geq 0, \mu + \nu > 0$

## PROBLEM 3

For all allowed values of the parameters, find all global maxima of the following maximization problem, or show that none exist.

Objective function $p_1 y_1 + p_2 y_2$

Constraints

$$y_1 + 3y_2 \le 4$$
$$2y_1 + 3y_2 \le 1$$
$$y_1 + y_2 \le 0$$

variables $y_1, y_2$

parameters $p_1, p_2$

conditions on parameters $p_1 > 0, p_2 > 0$

## PROBLEM 4

For all allowed values of the parameters, find all global maxima of the following maximization problem, or show that none exist.

Objective function $2k\theta A - \frac{1}{2}A^2 - \frac{\theta^2}{2}L^2$

Constraints

$$0 \le A \le wL$$
$$0 \le L \le \gamma$$

variables $A, L$

parameters $k, \theta, \gamma, w$

conditions on parameters $k > 0, \theta > 0, \gamma > 0, w > 0$

## PROBLEM 5

For all allowed values of the parameters, find all global maxima of the following maximization problem, or show that none exist.

Objective function $x - \frac{1}{2y^2}$

Constraints

$$px + qy \le m$$
$$x \ge 1, y \ge 0$$

variables $x, y$

parameters $p, q, m$

conditions on parameters $p > 0, q > 0, m > 0$

## PROBLEM 6

For all allowed values of the parameters, find all global minima of the following minimization problem, or show that none exist.

Objective function $w_1 x_1 + w_2 x_2$

Constraints

$$\max\{x_1, x_2\} \geq q$$
$$x_1 \geq 0, x_2 \geq 0$$

variables $x_1, x_2$

parameters $q, w_1, w_2$

conditions on parameters $q > 0, w_1 > 0, w_2 > 0$

## PROBLEM 7

For all allowed values of the parameters, find all global maxima of the following maximization problem, or show that none exist.

Objective function $pF(x) - wx$

constraints $x \in \mathbb{R}^n, x \geq 0$

variables $x = \begin{bmatrix} x_1 & x_2 & \dots & x_n \end{bmatrix} \in \mathbb{R}^n$

parameters

$$p \in \mathbb{R}$$
$$w = \begin{bmatrix} w_1 & w_2 & \dots & w_n \end{bmatrix} \in \mathbb{R}^n$$
$$\mathbb{R}^n_+ \xrightarrow{F} \mathbb{R}_+$$

conditions on parameters

$$p > 0, w_1 > 0, w_2 > 0, \dots, w_n > 0, \text{and}$$
there exists a vector $b \in \mathbb{R}^n_+$ such that $pF(b) - wb > 0$

## PROBLEM 8

For all allowed values of the parameters, find all global maxima of the following maximization problem, or show that none exist.

Objective function

$$U(x,y)=\begin{cases} x+A & \text{if} \quad y \le x+A \\ \\ y & \text{otherwise} \end{cases}$$

constraints

$$x+py \le m$$
$$x \ge 0, y \ge 0$$

variables $x, y$

parameters $A, p, m$

conditions on parameters $A>0, p>0, m>0$

## PROBLEM 9

Find all global maxima and all global minima of the following problem or show that none exist.

Objective function $x_1^{\,3}-x_2 2^{x_1}$

Constraints

$$(x_1+1)(x_2-1)(x_1-7)(x_2-5)=0$$
$$\left((x_2)^2-1\right)\left((x_3)^2-1\right)=0$$
$$\left((x_1)^3+1\right)(x_3-1)(x_3-4)=0$$

variables $x_1, x_2, x_3$

## PROBLEM 10

For all allowed values of the parameters, find all global maxima of the following maximization problem, or show that none exist.

Objective function $49-\frac{1}{2}(x_1-1)^2-\frac{1}{2}(x_2-2)^2$

Constraints

$$2x_1+3x_2\le 10$$
$$x_1\ge 0, x_2\ge 0$$

variables $x_1, x_2$