

EE5121 - CVX Assignment

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May 9, 2019

1 Details of the Files

- All files are .m files
- Each question has a separate file with name as Q(question no.).m
- Screenshot of the figure is also in the same file with the question no. as the name.

2 Question 1

The problem can be formulated as follows:

$$\begin{aligned} \min_x \quad & \min ||y - x||^2 \\ \text{subject to} \quad & ||Ax|| \leq b \end{aligned} \tag{1}$$

In standard SOCP form:

$$\begin{aligned} \min_t \quad & t \\ \text{subject to} \quad & ||y - x||^2 \leq t^2, \\ & \sum_{i=1}^{n-1} t_i \leq b, \\ & ||a_j^T x||_1 \leq t_i, \forall i \in 1, 2, \dots, n-1 \end{aligned} \tag{2}$$

We take information from the data provided and formulate the problem in MATLAB as given above. Here, A is the matrix as suggested in the question. We choose b such that 20 jumps are observed in the plot. The plot of estimated x and abrupt y is shown below.

The optimal value is +131.077.

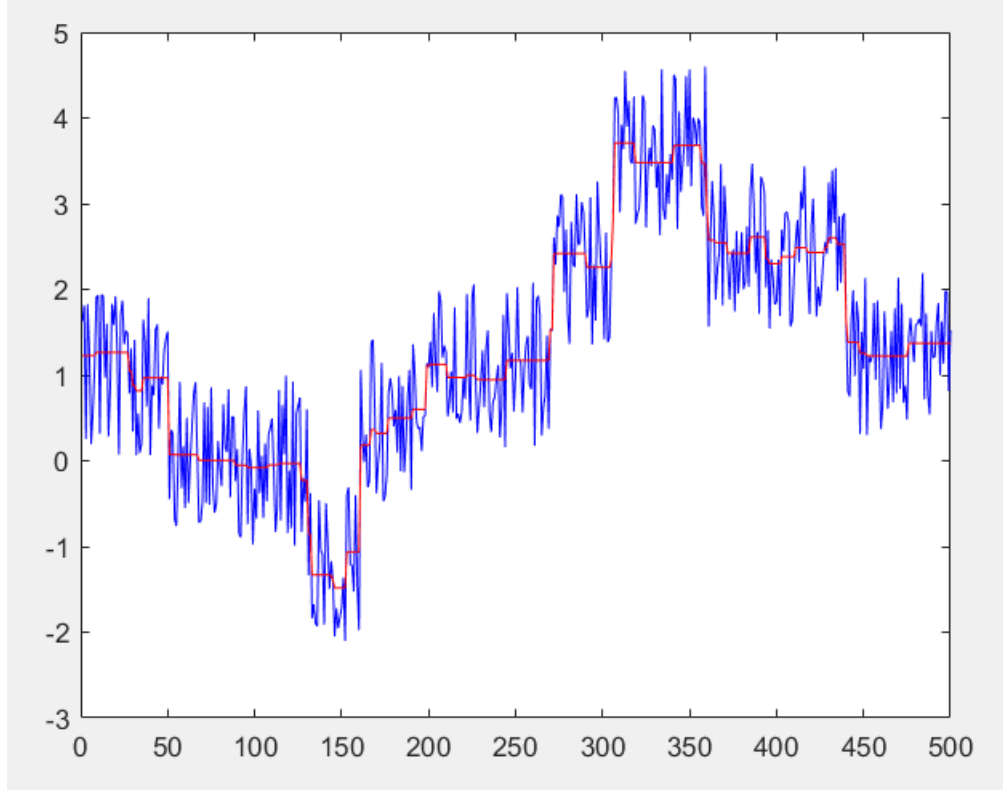


Figure 1: Plot of estimated x and y

3 Question 2

The problem can be formulated as follows:

$$\begin{aligned}
 & \max_{t,x} && 1^T t \\
 & \text{subject to} && t_j \leq p_j * x_j, \\
 & && t_j \leq p_j * q_j + p_{disc} * (x_j - q_j), \\
 & && Ax \leq c_{max}, \\
 & && 0 \leq x
 \end{aligned} \tag{3}$$

We obtain the optimal values for various parameters:

- Revenue: 192.5
- Activity Levels: 4, 22.5, 31, 1.5
- Revenue components: 12, 32.5, 139, 9
- Activity levels cross threshold for $x_{2,3}$.
- Revenue component is max for $x_{2,3}$.

```

Command Window
norm(A), norm(b), norm(C) = 4.0e+01, 1.9e+01, 2.5e+01
Total CPU time (secs) = 0.25
CPU time per iteration = 0.02
termination code = 0
DIMACS: 5.1e-11 0.0e+00 2.3e-12 0.0e+00 5.0e-09 5.0e-09
-----
Status: Solved
Optimal value (cvx_optval): +131.077
fx >> |

```

Figure 2: Optimal value for the problem 1

4 Question 3

The problem can be formulated as follows:

$$\begin{aligned}
 & \min_{A,Y,Z} && tr(Y) + tr(Z) \\
 & \text{subject to} && A_{i,j} = X_{i,j}, \\
 & && \begin{pmatrix} Y & X \\ X^T & Z \end{pmatrix} \geq 0, \\
 & && Y \geq 0, \\
 & && Z \geq 0
 \end{aligned} \tag{4}$$

The optimal value is +186.302.

```

Command Window
-----
Status: Solved
Optimal value (cvx_optval): +192.5

revenue =

    12.0000
    32.5000
   139.0000
     9.0000

x =

     4.0000
    22.5000
    31.0000
     1.5000

ans =

      0      0  0.3871      0
      0      0  1.0484      0
      0      0  4.4839      0
      0      0  0.2903      0

fx >>

```

Figure 3: Optimal value for the problem 2

```

-----
-----
Status: Solved
Optimal value (cvx_optval): +186.302

fx >>

```

Figure 4: Optimal value for the problem 3