EE5121 Convex Optimization

CVX Assignment

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EP16B005

1 Recovering a piecewise constant signal from a noisy measurement

1.1 Formulation

The SoCP formulation of the problem is as follows

$$\begin{aligned} & \min \quad t \\ \text{s.t.} \quad & w_1\|x-y\|_2 + w_2\|Ax\|_1 \le t \end{aligned}$$

w_1 and w_2 are positive weights adjusted such that $w_1 + w_2 = 1$. And A is the matrix as defined in the question.

1.2 Result

```
------------------------------------------------------------------
 number of iterations   = 18
 primal objective value =  1.18238261e+01
 dual   objective value =  1.18238260e+01
 gap := trace(XZ)       = 1.02e-07
 relative gap           = 4.12e-09
 actual relative gap    = 4.11e-09
 rel. primal infeas (scaled problem)   = 2.49e-11
 rel. dual     "        "       "      = 1.00e-12
 rel. primal infeas (unscaled problem) = 0.00e+00
 rel. dual     "        "       "      = 0.00e+00
 norm(X), norm(y), norm(Z) = 1.6e+01, 9.9e-01, 2.3e+00
 norm(A), norm(b), norm(C) = 4.0e+01, 1.9e+01, 2.8e+00
 Total CPU time (secs)  = 0.51
 CPU time per iteration = 0.03
 termination code       =  0
 DIMACS: 1.2e-10  0.0e+00  1.5e-12  0.0e+00  4.1e-09  4.1e-09
------------------------------------------------------------------

---------------------------------------------------------------
Status: Solved
Optimal value (cvx_optval): +11.8238


optimal_error =

   11.2061
```

Figure 1: Optimal norm of e

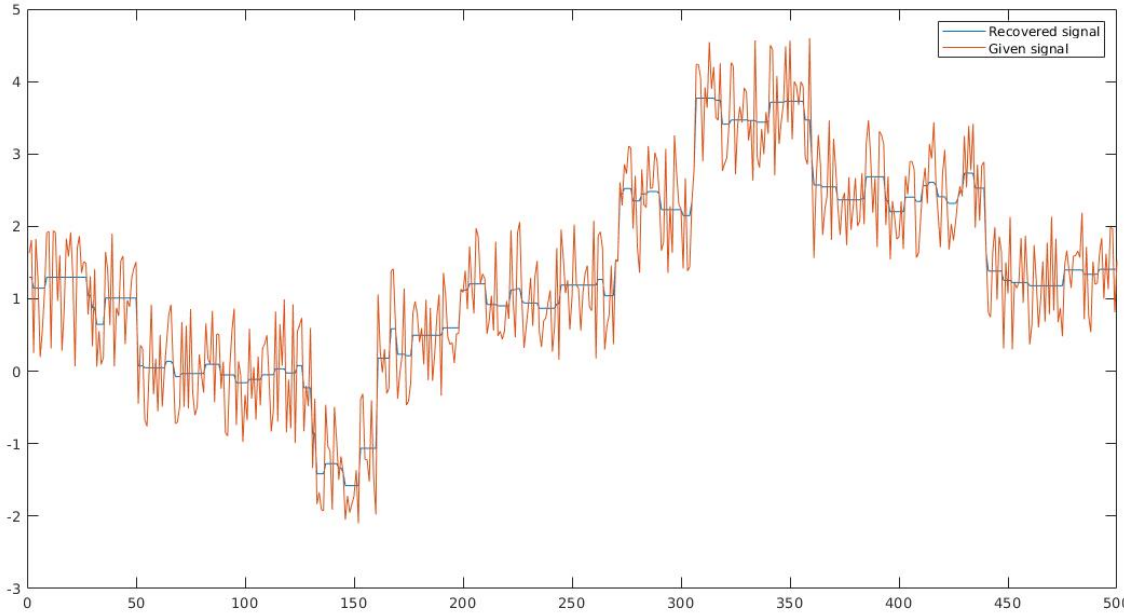


Figure 2: Given noisy signal and the recovered signal with effectively 20 jumps

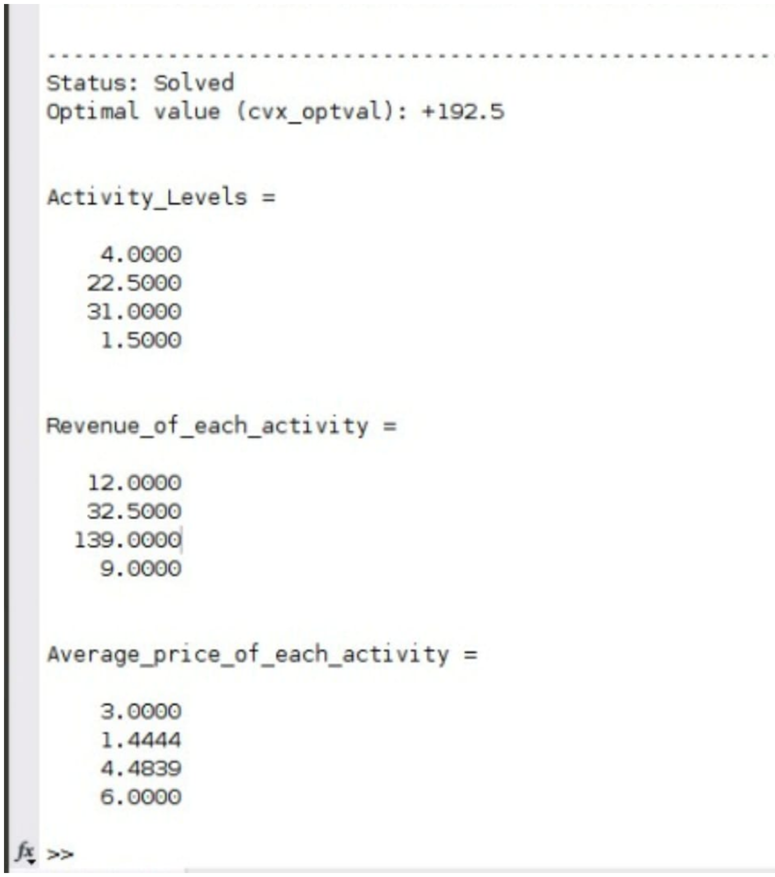
2 Revenue Maximization

2.1 Formulation

Variables as used with the same name as in the question. Two additional variables, as matrices, are introduced to make the formulation compact: $P = \text{diag}(p)$, $P_{disc} = \text{diag}(p^{disc})$.

$$\begin{aligned} max \quad & 1^T u \\ s.t. \quad & Ax \leq c_{max} \\ & x \geq 0 \\ & Px \geq u \\ & P_{disc}x + (P - P_{disc})q \geq u \end{aligned}$$

2.2 Result



```
--------------------------------------------------
Status: Solved
Optimal value (cvx_optval): +192.5


Activity_Levels =

    4.0000
   22.5000
   31.0000
    1.5000


Revenue_of_each_activity =

   12.0000
   32.5000
  139.0000
    9.0000


Average_price_of_each_activity =

    3.0000
    1.4444
    4.4839
    6.0000

fx >>
```

Figure 3: Command Window

3 Matrix Completion

3.1 Formulation

The SDP formulation is as follows

$$
\begin{aligned}
min \quad & r \\
s.t \quad & \text{Trace}(Y) + \text{Trace}(Z) \leq 2r \\
& \hat{x}_{ij} = X_{ij} \text{ wherever } X_{ij} \neq 0 \\
& \begin{bmatrix} Y & X \\ X^T & Z \end{bmatrix} \geq 0
\end{aligned}
$$

3.2 Result

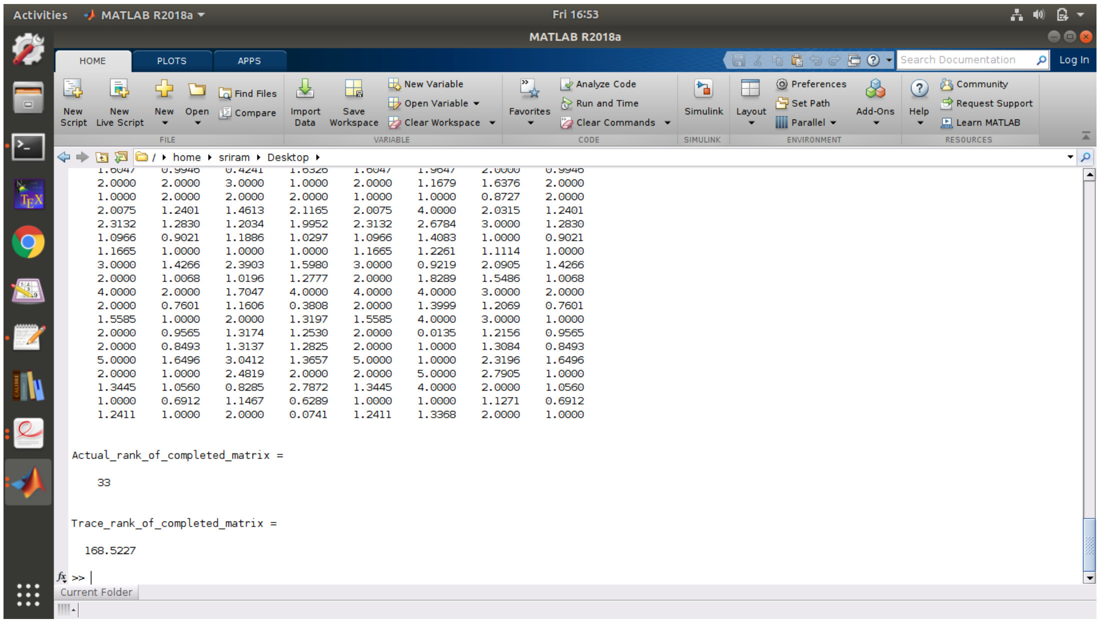


Figure 4: The trace rank of the completed matrix is 168.523