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COnvex Optimization

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```
% Q6:

clear; clc; close all;
% Load Data:
run('plannning_data.m');
```

First Case:

```
cvx_begin
variable q(n); % quantity of products
variable r(m); % amount of raw material

   % Constraints:
    S = min(q*ones(1,K),D); % finding minimum of q,D (same as d)

    q >= 0;
    r >= 0;
    r >= A*q;

% vector pi is given as init points:
    maximize(p'*S*pi - c'*r) % Objective function :pT.min(q,d)-CTr

cvx_end % having given probabilities as (pi)
```

```
Calling SDPT3 4.0: 1525 variables, 760 equality constraints
------------------------------------------------------------

 num. of constraints = 760
 dim. of linear var  = 1525
*****************************************************************
   SDPT3: Infeasible path-following algorithms
*****************************************************************
 version  predcorr  gam  expon  scale_data
    NT      1      0.000   1        0
it pstep dstep pinfeas dinfeas  gap      prim-obj      dual-obj    cputime
-------------------------------------------------------------------
 0|0.000|0.000|3.8e+02|2.7e+02|1.9e+07| 3.573278e+04  0.000000e+00| 0:0:00| spchol  1  1
 1|0.984|0.958|6.2e+00|1.2e+01|8.5e+05| 3.565719e+04  3.747622e+01| 0:0:00| spchol  1  1
 2|1.000|0.722|3.3e-06|3.4e+00|2.7e+05| 3.407038e+04  6.463390e+01| 0:0:00| spchol  1  1
 3|1.000|0.506|7.5e-07|1.7e+00|2.1e+05| 4.137193e+04  5.420024e+01| 0:0:00| spchol  1  1
 4|1.000|0.569|4.2e-06|7.9e-01|1.3e+05| 3.767296e+04  4.015091e+01| 0:0:00| spchol  1  1
 5|1.000|0.541|7.4e-07|3.8e-01|7.3e+04| 2.779119e+04  2.815022e+01| 0:0:00| spchol  1  1
 6|1.000|0.904|7.6e-07|5.0e-02|2.4e+04| 1.831940e+04  1.586156e+01| 0:0:00| spchol  1  1
 7|0.992|1.000|1.8e-07|7.8e-03|1.1e+03| 1.018374e+03  1.425959e+01| 0:0:00| spchol  1  1
 8|0.790|1.000|4.1e-08|2.3e-03|4.3e+02| 4.386876e+02  1.669046e+01| 0:0:00| spchol  1  1
 9|0.909|0.335|3.6e-09|1.8e-03|3.3e+02| 3.421887e+02  2.058200e+01| 0:0:00| spchol  1  1
10|1.000|0.065|7.3e-13|1.7e-03|3.6e+02| 3.746461e+02  2.483489e+01| 0:0:00| spchol  1  1
11|1.000|0.604|1.5e-14|7.1e-04|2.3e+02| 2.609557e+02  3.003224e+01| 0:0:00| spchol  1  1
```

```
12|1.000|0.763|3.1e-14|1.8e-04|1.6e+02| 2.000307e+02  3.595834e+01| 0:0:00| spchol  1  1
13|1.000|0.424|3.7e-14|1.1e-04|1.2e+02| 1.608500e+02  3.919877e+01| 0:0:00| spchol  1  1
14|0.977|0.656|1.7e-14|3.7e-05|6.6e+01| 1.107615e+02  4.453621e+01| 0:0:00| spchol  1  1
15|1.000|0.592|2.3e-14|1.5e-05|4.9e+01| 9.807636e+01  4.924676e+01| 0:0:00| spchol  1  1
16|0.945|0.602|3.0e-14|6.1e-06|2.8e+01| 8.046958e+01  5.257839e+01| 0:0:00| spchol  1  1
17|1.000|0.527|4.3e-14|2.9e-06|2.1e+01| 7.575319e+01  5.452713e+01| 0:0:00| spchol  1  1
18|0.507|0.410|2.5e-14|1.7e-06|1.7e+01| 7.300921e+01  5.564605e+01| 0:0:00| spchol  1  1
19|1.000|0.656|5.0e-14|5.8e-07|1.3e+01| 7.027143e+01  5.708722e+01| 0:0:00| spchol  1  1
20|1.000|0.885|2.7e-14|6.7e-08|8.5e+00| 6.738084e+01  5.887237e+01| 0:0:00| spchol  1  1
21|0.817|0.694|4.9e-14|2.0e-08|5.3e+00| 6.519647e+01  5.994613e+01| 0:0:00| spchol  1  1
22|0.648|1.000|3.3e-14|1.0e-12|3.4e+00| 6.429338e+01  6.085707e+01| 0:0:00| spchol  1  1
23|0.929|0.714|6.5e-14|1.3e-12|2.1e+00| 6.325819e+01  6.116480e+01| 0:0:00| spchol  1  1
24|1.000|1.000|6.0e-14|1.0e-12|9.8e-01| 6.265993e+01  6.167756e+01| 0:0:00| spchol  1  1
25|0.532|0.892|3.5e-14|1.1e-12|7.0e-01| 6.252605e+01  6.182766e+01| 0:0:00| spchol  1  1
26|0.719|0.368|1.1e-13|1.7e-12|5.4e-01| 6.240182e+01  6.186342e+01| 0:0:00| spchol  1  1
27|1.000|0.633|1.4e-13|1.6e-12|3.2e-01| 6.226311e+01  6.194078e+01| 0:0:00| spchol  1  1
28|1.000|1.000|9.1e-14|1.0e-12|1.5e-01| 6.219488e+01  6.204928e+01| 0:0:00| spchol  1  1
29|0.959|1.000|1.7e-13|1.0e-12|1.8e-02| 6.212856e+01  6.211029e+01| 0:0:00| spchol  1  1
30|0.982|0.985|1.1e-13|1.0e-12|3.1e-04| 6.211815e+01  6.211784e+01| 0:0:00| spchol  1  1
31|0.990|0.991|9.8e-14|1.0e-12|6.6e-06| 6.211795e+01  6.211795e+01| 0:0:00| spchol  1  1
32|0.991|0.992|1.7e-13|1.0e-12|1.3e-07| 6.211795e+01  6.211795e+01| 0:0:01|
  stop: max(relative gap, infeasibilities) < 1.49e-08
------------------------------------------------------------------
 number of iterations   = 32
 primal objective value =  6.21179509e+01
 dual   objective value =  6.21179508e+01
 gap := trace(XZ)       = 1.28e-07
 relative gap           = 1.02e-09
 actual relative gap    = 1.02e-09
 rel. primal infeas (scaled problem)   = 1.72e-13
 rel. dual     "        "       "      = 1.01e-12
 rel. primal infeas (unscaled problem) = 0.00e+00
 rel. dual     "        "       "      = 0.00e+00
 norm(X), norm(y), norm(Z) = 2.2e+02, 1.4e+00, 4.7e+00
 norm(A), norm(b), norm(C) = 6.4e+01, 7.1e+01, 5.7e+00
 Total CPU time (secs)  = 0.51
 CPU time per iteration = 0.02
 termination code       =  0
 DIMACS: 5.5e-13  0.0e+00  4.7e-12  0.0e+00  1.0e-09  1.0e-09
------------------------------------------------------------------

------------------------------------------------------------
Status: Solved
Optimal value (cvx_optval): +114.331
```

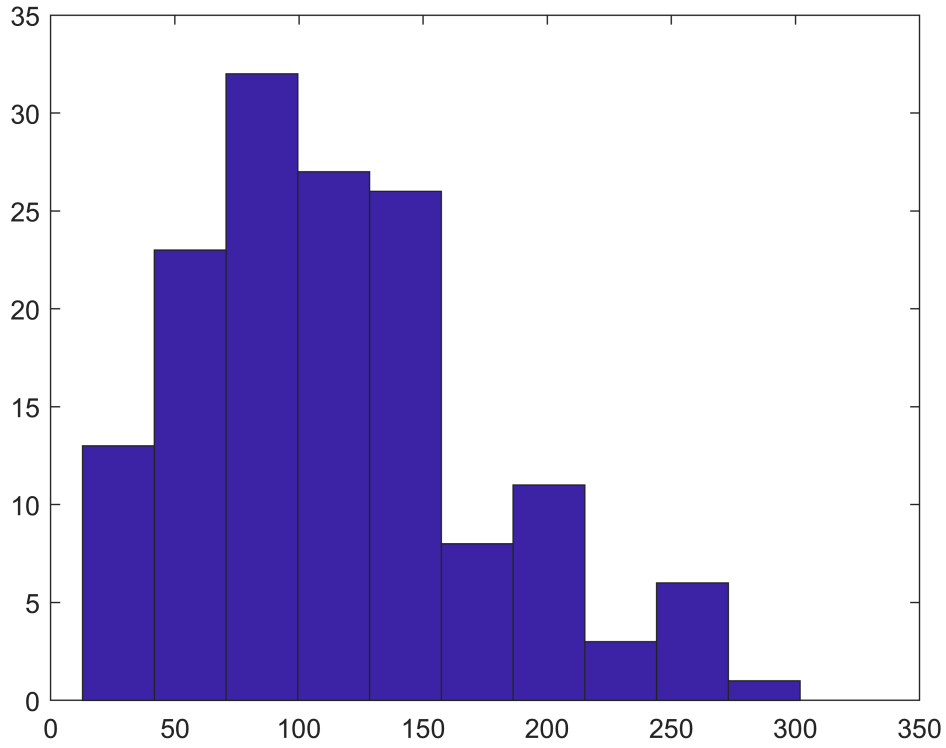
```
rI = r % see the amount of materials
```

```
rI = 10×1
   45.5203
   65.8287
   44.6489
   76.6555
   71.9572
   77.8437
   59.2585
   61.8943
   83.2460
   73.0732
```

```
fprintf('<CVX_optimal Value = Profit =  "%f"\n',cvx_optval)
```

```
<CVX_optimal Value = Profit =  "114.331327"
```

```
% Profit from this kind of viewing at problem:
profit1 = p'*S - c'*r; % keeping
nbins = 10;
hist(profit1, nbins)%%
```



Second Problem:

```
cvx_begin
variable q(n, K); % quantity of products
variable r(m); % amount of raw material

   % Constraints:
    S = min(q, D); % finding minimum of q,D (same as d)

    q >= 0;
    r >= 0;
    %r >= A*q;
    r*ones(1,K) >= A*q;

% vector pi is given as init points:
    maximize(p'*S*pi - c'*r) % Objective function :pT.min(q,d)-CTr

cvx_end % having given probabilities as (pi)
```

```
Calling SDPT3 4.0: 3760 variables, 1510 equality constraints
   For improved efficiency, SDPT3 is solving the dual problem.
------------------------------------------------------------

 num. of constraints = 1510
 dim. of linear var  = 3760
*****************************************************************
   SDPT3: Infeasible path-following algorithms
*****************************************************************
 version  predcorr  gam  expon  scale_data
    NT      1      0.000   1        0
it pstep dstep pinfeas dinfeas  gap      prim-obj      dual-obj    cputime
-------------------------------------------------------------------
 0|0.000|0.000|1.5e+04|6.2e+01|1.6e+07|-7.258741e+04  0.000000e+00| 0:0:00| spchol  1  1
 1|0.146|1.000|1.3e+04|2.6e-01|2.0e+07|-5.998374e+04 -1.185476e+04| 0:0:00| spchol  1  1
 2|0.976|1.000|3.1e+02|7.8e-02|4.9e+05|-1.466577e+03 -1.184934e+04| 0:0:00| spchol  1  1
 3|0.942|1.000|1.8e+01|7.8e-03|3.7e+04|-1.467188e+02 -1.003753e+04| 0:0:00| spchol  1  1
 4|0.291|0.656|1.3e+01|3.2e-03|2.9e+04|-9.697934e+01 -4.886170e+03| 0:0:00| spchol  1  1
 5|0.978|0.980|2.8e-01|1.4e-04|2.1e+03|-1.776180e+01 -1.675755e+03| 0:0:00| spchol  1  1
 6|0.944|0.898|1.5e-02|2.1e-05|2.4e+02|-1.632327e+01 -2.466606e+02| 0:0:00| spchol  1  1
 7|0.537|0.861|7.1e-03|3.1e-03|1.3e+02|-1.788092e+01 -1.445543e+02| 0:0:00| spchol  1  1
 8|0.281|0.733|5.1e-03|2.2e-03|1.1e+02|-2.144092e+01 -1.283367e+02| 0:0:00| spchol  1  1
 9|0.215|0.205|4.0e-03|2.8e-03|1.0e+02|-2.355710e+01 -1.242026e+02| 0:0:00| spchol  1  1
10|0.361|0.384|2.6e-03|2.5e-03|9.8e+01|-2.782736e+01 -1.227482e+02| 0:0:00| spchol  1  1
11|0.155|0.216|2.2e-03|2.5e-03|8.9e+01|-2.766575e+01 -1.146408e+02| 0:0:00| spchol  1  1
12|0.433|0.790|1.2e-03|9.6e-04|6.6e+01|-3.081874e+01 -9.616024e+01| 0:0:00| spchol  1  1
13|0.485|0.190|6.3e-04|1.0e-03|6.3e+01|-3.206499e+01 -9.487047e+01| 0:0:00| spchol  1  1
14|0.290|0.618|4.5e-04|5.2e-04|5.1e+01|-3.314970e+01 -8.398570e+01| 0:0:00| spchol  1  1
15|0.351|0.637|2.9e-04|2.8e-04|4.1e+01|-3.503734e+01 -7.570962e+01| 0:0:00| spchol  1  1
16|0.502|0.291|1.5e-04|2.6e-04|3.8e+01|-3.679118e+01 -7.488895e+01| 0:0:00| spchol  1  1
17|0.190|0.274|1.2e-04|2.1e-04|3.4e+01|-3.731232e+01 -7.169873e+01| 0:0:00| spchol  1  1
18|0.507|1.000|5.8e-05|2.4e-05|2.6e+01|-3.919935e+01 -6.524879e+01| 0:0:00| spchol  1  1
19|0.187|0.166|4.7e-05|3.1e-05|2.5e+01|-3.943076e+01 -6.399537e+01| 0:0:00| spchol  1  1
20|0.553|1.000|2.1e-05|9.5e-06|1.6e+01|-4.145426e+01 -5.759921e+01| 0:0:00| spchol  1  1
21|0.276|0.596|1.5e-05|8.0e-06|1.5e+01|-4.225921e+01 -5.709014e+01| 0:0:00| spchol  1  1
22|0.393|0.887|9.3e-06|4.0e-06|1.2e+01|-4.311258e+01 -5.478006e+01| 0:0:00| spchol  1  1
23|0.557|0.797|4.1e-06|2.7e-06|1.0e+01|-4.437173e+01 -5.443686e+01| 0:0:00| spchol  1  1
24|0.566|0.816|1.8e-06|1.3e-06|7.2e+00|-4.548192e+01 -5.267137e+01| 0:0:00| spchol  1  1
25|0.293|0.827|1.3e-06|5.9e-07|6.0e+00|-4.598746e+01 -5.203592e+01| 0:0:00| spchol  1  1
26|0.545|1.000|5.7e-07|2.5e-07|4.5e+00|-4.686168e+01 -5.137651e+01| 0:0:00| spchol  1  1
27|0.581|0.953|2.4e-07|1.3e-07|3.6e+00|-4.746116e+01 -5.104690e+01| 0:0:00| spchol  1  1
28|0.470|1.000|1.3e-07|4.8e-08|2.4e+00|-4.805894e+01 -5.049056e+01| 0:0:00| spchol  1  1
29|0.963|0.628|4.7e-09|4.3e-08|1.4e+00|-4.897208e+01 -5.036082e+01| 0:0:00| spchol  1  1
30|0.501|0.861|2.3e-09|7.0e-09|1.0e+00|-4.910990e+01 -5.014443e+01| 0:0:00| spchol  1  1
31|0.621|1.000|8.8e-10|4.7e-10|7.9e-01|-4.926662e+01 -5.005805e+01| 0:0:00| spchol  1  1
32|0.530|0.843|4.2e-10|2.5e-10|6.8e-01|-4.934396e+01 -5.002601e+01| 0:0:00| spchol  1  1
33|0.944|1.000|2.3e-11|8.3e-11|4.3e-01|-4.953493e+01 -4.996840e+01| 0:0:00| spchol  1  1
34|0.443|0.749|1.3e-11|2.5e-11|3.1e-01|-4.961197e+01 -4.992488e+01| 0:0:00| spchol  1  1
35|0.276|1.000|9.4e-12|2.6e-12|2.8e-01|-4.963249e+01 -4.991210e+01| 0:0:00| spchol  1  1
36|1.000|1.000|4.7e-15|1.9e-12|1.1e-01|-4.976741e+01 -4.988223e+01| 0:0:00| spchol  1  1
37|1.000|0.855|3.9e-14|1.3e-12|1.5e-02|-4.984399e+01 -4.985862e+01| 0:0:00| spchol  1  1
38|0.961|0.977|1.5e-14|1.0e-12|5.9e-04|-4.985141e+01 -4.985200e+01| 0:0:00| spchol  1  1
39|0.992|0.989|1.1e-12|1.0e-12|2.0e-05|-4.985179e+01 -4.985181e+01| 0:0:00| spchol  1  1
40|0.994|0.991|5.5e-13|1.0e-12|3.7e-07|-4.985181e+01 -4.985181e+01| 0:0:00|
  stop: max(relative gap, infeasibilities) < 1.49e-08
-------------------------------------------------------------------
 number of iterations   = 40
 primal objective value = -4.98518075e+01
 dual   objective value = -4.98518079e+01
 gap := trace(XZ)       = 3.67e-07
 relative gap           = 3.65e-09
 actual relative gap    = 3.65e-09
 rel. primal infeas (scaled problem)   = 5.46e-13
```

```
 rel. dual     "        "       "      = 1.01e-12
 rel. primal infeas (unscaled problem) = 0.00e+00
 rel. dual     "        "       "      = 0.00e+00
 norm(X), norm(y), norm(Z) = 4.6e+00, 2.1e+02, 9.7e+02
 norm(A), norm(b), norm(C) = 5.0e+02, 5.7e+00, 7.1e+01
 Total CPU time (secs)  = 0.34
 CPU time per iteration = 0.01
 termination code       =  0
 DIMACS: 2.5e-12  0.0e+00  3.2e-12  0.0e+00  3.6e-09  3.6e-09
------------------------------------------------------------------

------------------------------------------------------------
Status: Solved
Optimal value (cvx_optval): +133.039
```

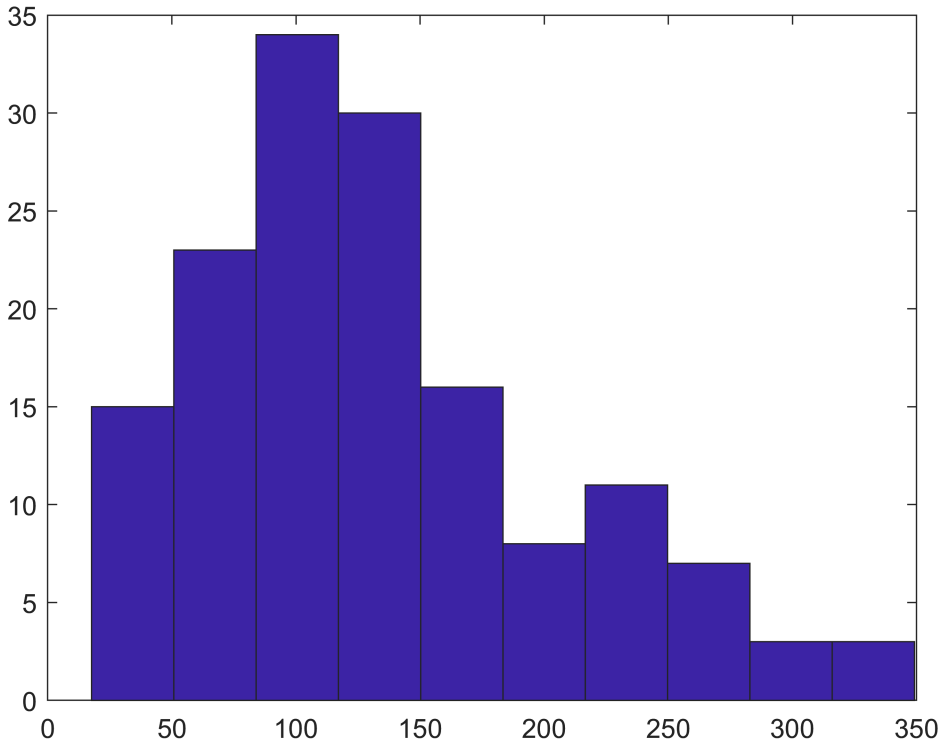
```
rI = r % see the amount of materials
```

```
rI = 10×1
   65.6924
   59.6062
   55.1515
   70.7618
   69.7342
   68.3545
   55.3436
   57.3714
   63.7671
   66.1721
```

```
fprintf('<CVX_optimal Value = Profit =  "%f"\n',cvx_optval)
```

```
<CVX_optimal Value = Profit =  "133.039255"
```

```
% Profit from this kind of viewing at problem:
profit2 = p'*S - c'*r; % keeping
nbins = 10;
hist(profit2, nbins)
```




```
r = rI; % Having rI from previous step
cvx_begin
    variable q(n, K); % quantity of products paired with demands
    r*ones(1,K) >= A*q; q >= 0; S = min(q, D);
    maximize(p'*S*pi - c'*r)% Same Objective as ever!
cvx_end
```

```
Calling SDPT3 4.0: 3750 variables, 1500 equality constraints
   For improved efficiency, SDPT3 is solving the dual problem.
------------------------------------------------------------

 num. of constraints = 1500
 dim. of linear var  = 3750
*****************************************************************
   SDPT3: Infeasible path-following algorithms
*****************************************************************
 version  predcorr  gam  expon  scale_data
    NT      1      0.000   1        0
it pstep dstep pinfeas dinfeas  gap      prim-obj      dual-obj    cputime
-----------------------------------------------------------------
 0|0.000|0.000|1.4e+04|6.1e+01|5.6e+08| 5.732385e+06  0.000000e+00| 0:0:00| spchol  1  1
 1|0.961|0.887|5.6e+02|6.8e+00|3.2e+07| 3.382605e+05 -2.556678e+05| 0:0:00| spchol  1  1
 2|0.942|0.790|3.2e+01|1.4e+00|6.0e+06| 2.174498e+05 -3.145191e+05| 0:0:00| spchol  1  1
 3|1.000|1.000|5.7e-05|6.7e-04|3.2e+05| 1.950165e+05 -1.187988e+05| 0:0:00| spchol  1  1
 4|0.987|0.977|1.1e-06|2.2e-04|5.3e+03| 2.501419e+03 -2.781930e+03| 0:0:00| spchol  1  1
 5|0.956|0.880|5.0e-08|4.5e-05|1.1e+03| 4.726241e+02 -6.211641e+02| 0:0:00| spchol  1  1
 6|0.997|0.570|3.4e-10|2.0e-05|7.2e+02| 3.155087e+02 -4.064351e+02| 0:0:00| spchol  1  1
 7|1.000|0.926|5.7e-11|1.7e-06|3.1e+02| 1.626336e+02 -1.471369e+02| 0:0:00| spchol  1  1
 8|0.942|0.902|7.4e-12|1.9e-07|1.8e+02| 8.421589e+01 -9.631459e+01| 0:0:00| spchol  1  1
 9|1.000|0.761|3.2e-12|4.6e-08|9.6e+01| 3.563096e+01 -6.029864e+01| 0:0:00| spchol  1  1
```

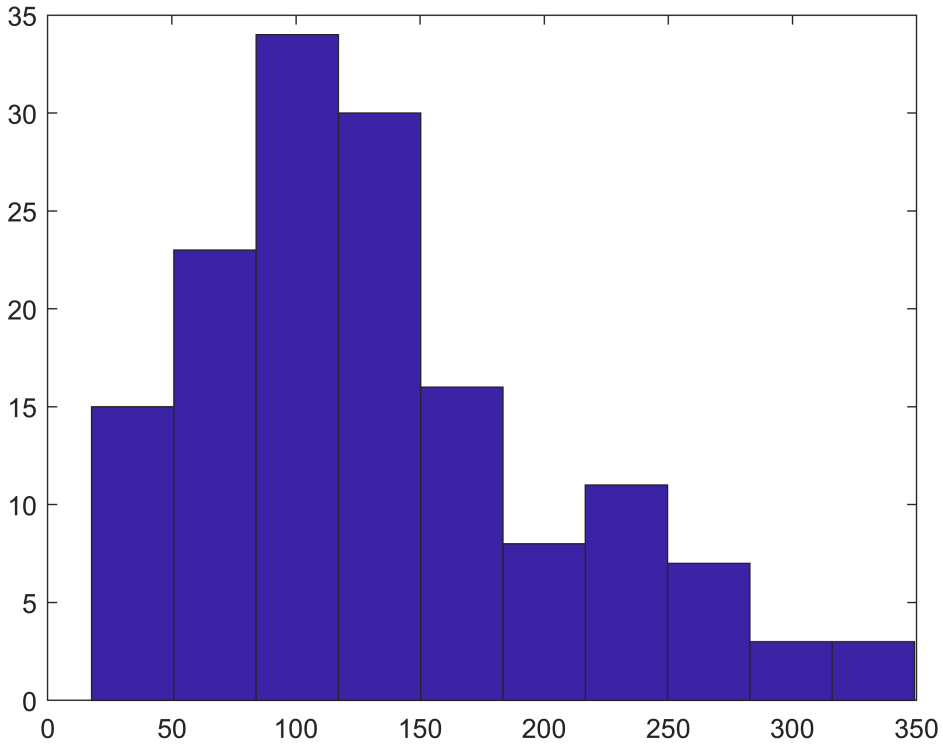
```
10|1.000|0.988|1.7e-16|7.7e-10|4.6e+01| 1.040233e+01 -3.601334e+01| 0:0:00| spchol  1  1
11|1.000|0.899|1.5e-16|9.7e-11|2.4e+01|-3.877482e+00 -2.758338e+01| 0:0:00| spchol  1  1
12|1.000|1.000|1.6e-16|3.0e-12|1.1e+01|-1.164452e+01 -2.254326e+01| 0:0:00| spchol  1  1
13|1.000|1.000|3.0e-16|1.2e-12|4.7e+00|-1.579254e+01 -2.049926e+01| 0:0:00| spchol  1  1
14|1.000|1.000|2.5e-16|1.0e-12|1.0e+00|-1.838432e+01 -1.941346e+01| 0:0:00| spchol  1  1
15|0.833|1.000|2.7e-16|1.0e-12|2.8e-01|-1.890154e+01 -1.917774e+01| 0:0:00| spchol  1  1
16|0.977|0.987|5.1e-16|1.0e-12|1.0e-02|-1.912402e+01 -1.913425e+01| 0:0:00| spchol  1  1
17|0.988|0.988|4.7e-16|1.0e-12|1.2e-04|-1.913245e+01 -1.913257e+01| 0:0:00| spchol  1  1
18|0.994|0.958|5.2e-16|1.0e-12|4.0e-06|-1.913255e+01 -1.913255e+01| 0:0:00| spchol  1  1
19|0.839|0.979|1.9e-15|1.0e-12|1.1e-06|-1.913255e+01 -1.913255e+01| 0:0:00| spchol  1  1
20|0.982|1.000|5.7e-16|1.0e-12|3.1e-07|-1.913255e+01 -1.913255e+01| 0:0:00|
  stop: max(relative gap, infeasibilities) < 1.49e-08
------------------------------------------------------------------
 number of iterations   = 20
 primal objective value = -1.91325530e+01
 dual   objective value = -1.91325533e+01
 gap := trace(XZ)       = 3.09e-07
 relative gap           = 7.87e-09
 actual relative gap    = 7.75e-09
 rel. primal infeas (scaled problem)   = 5.75e-16
 rel. dual     "        "       "      = 1.00e-12
 rel. primal infeas (unscaled problem) = 0.00e+00
 rel. dual     "        "       "      = 0.00e+00
 norm(X), norm(y), norm(Z) = 4.6e+00, 6.7e+01, 9.5e+02
 norm(A), norm(b), norm(C) = 5.0e+02, 5.7e+00, 2.5e+03
 Total CPU time (secs)  = 0.17
 CPU time per iteration = 0.01
 termination code       =  0
 DIMACS: 2.6e-15  0.0e+00  3.4e-11  0.0e+00  7.7e-09  7.9e-09
------------------------------------------------------------------

------------------------------------------------------------
Status: Solved
Optimal value (cvx_optval): +133.039
```

```
fprintf('<CVX_optimal Value = Profit =  "%f"\n',cvx_optval)
```

```
<CVX_optimal Value = Profit =  "133.039255"
```

```
% Profit from this kind of viewing at problem:
profit2_rI = p'*S - c'*r; % keeping
nbins = 10;
hist(profit2_rI, nbins)
```



Final Point of View:

```
cvx_begin
variable r(m, K); % amount of raw material for each demands
variable q(n, K); % quantity of products paired with demands

   S = min(q, D); r >= A*q; r >= 0;  q >= 0;

    maximize((p'*S - c'*r)*pi)
cvx_end
```

```
Calling SDPT3 4.0: 5250 variables, 2250 equality constraints
------------------------------------------------------------

 num. of constraints = 2250
 dim. of linear var  = 5250
*****************************************************************
   SDPT3: Infeasible path-following algorithms
*****************************************************************
 version  predcorr  gam  expon  scale_data
    NT      1      0.000   1        0
it pstep dstep pinfeas dinfeas  gap      prim-obj      dual-obj    cputime
-------------------------------------------------------------------
 0|0.000|0.000|8.1e+03|6.8e+02|2.2e+08| 2.811282e+02  0.000000e+00| 0:0:00| spchol  1  1
 1|0.964|0.946|2.9e+02|3.8e+01|1.2e+07| 6.393142e+04 -2.087654e+02| 0:0:00| spchol  1  1
 2|1.000|0.814|4.5e-05|7.2e+00|2.6e+06| 7.314090e+04 -1.260577e+02| 0:0:00| spchol  1  1
 3|1.000|1.000|1.9e-05|1.2e-01|9.6e+04| 5.559950e+04 -9.626541e+01| 0:0:00| spchol  1  1
 4|0.980|1.000|5.7e-07|6.2e-02|5.8e+03| 1.173726e+03 -9.701235e+01| 0:0:00| spchol  1  1
 5|0.981|0.801|1.8e-07|3.7e-02|1.4e+03| 1.139459e+02 -1.050911e+02| 0:0:00| spchol  1  1
```

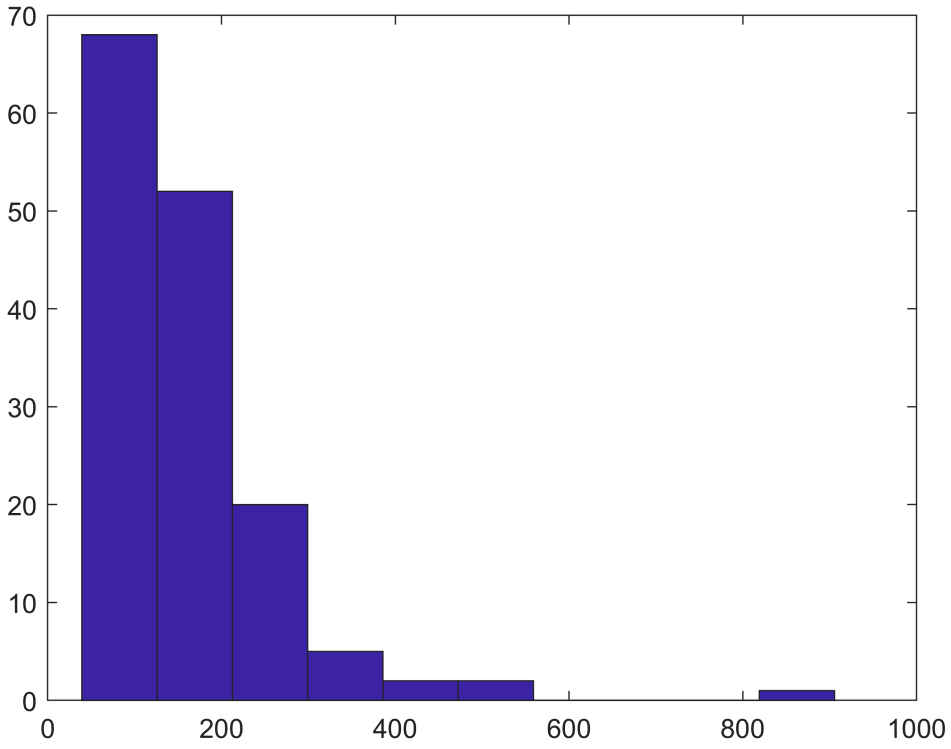
```
 6|0.611|0.802|8.6e-08|2.0e-02|7.5e+02| 5.747582e+01 -1.287660e+02| 0:0:00| spchol  1  1
 7|0.377|0.517|5.5e-08|1.4e-02|5.2e+02| 1.085780e+01 -1.388862e+02| 0:0:00| spchol  1  1
 8|0.891|0.933|8.2e-09|4.6e-03|2.2e+02|-6.500176e+01 -1.601409e+02| 0:0:00| spchol  1  1
 9|0.706|0.728|2.7e-09|2.7e-03|1.0e+02|-1.104409e+02 -1.611778e+02| 0:0:00| spchol  1  1
10|0.744|1.000|7.0e-10|5.9e-04|4.9e+01|-1.279649e+02 -1.659733e+02| 0:0:00| spchol  1  1
11|0.872|0.986|8.9e-11|1.8e-04|7.5e+00|-1.569795e+02 -1.629561e+02| 0:0:00| spchol  1  1
12|1.000|0.856|2.3e-14|7.1e-05|2.5e+00|-1.599952e+02 -1.619483e+02| 0:0:00| spchol  1  1
13|1.000|0.917|1.1e-14|2.0e-05|3.9e-01|-1.612381e+02 -1.614966e+02| 0:0:00| spchol  1  1
14|0.932|0.976|1.9e-14|5.1e-06|3.5e-02|-1.614049e+02 -1.614069e+02| 0:0:00| spchol  1  1
15|0.984|0.984|9.4e-14|1.5e-06|5.6e-04|-1.614270e+02 -1.614181e+02| 0:0:00| spchol  1  1
16|0.996|0.998|2.3e-12|3.2e-09|9.0e-06|-1.614274e+02 -1.614274e+02| 0:0:00| spchol  1  1
17|0.997|1.000|4.0e-13|1.5e-12|1.2e-07|-1.614274e+02 -1.614274e+02| 0:0:00|
  stop: max(relative gap, infeasibilities) < 1.49e-08
-----------------------------------------------------------------
 number of iterations   = 17
 primal objective value = -1.61427376e+02
 dual   objective value = -1.61427376e+02
 gap := trace(XZ)       = 1.16e-07
 relative gap           = 3.57e-10
 actual relative gap    = 3.27e-10
 rel. primal infeas (scaled problem)   = 3.97e-13
 rel. dual     "        "       "      = 1.54e-12
 rel. primal infeas (unscaled problem) = 0.00e+00
 rel. dual     "        "       "      = 0.00e+00
 norm(X), norm(y), norm(Z) = 1.9e+03, 4.3e+00, 4.3e+00
 norm(A), norm(b), norm(C) = 5.0e+02, 7.1e+01, 7.7e+00
 Total CPU time (secs)  = 0.19
 CPU time per iteration = 0.01
 termination code       =  0
 DIMACS: 1.3e-12  0.0e+00  9.5e-12  0.0e+00  3.3e-10  3.6e-10
-----------------------------------------------------------------

------------------------------------------------------------
Status: Solved
Optimal value (cvx_optval): +161.427
```

```
fprintf('<CVX_optimal Value = Profit =  "%f"\n',cvx_optval)
```

```
<CVX_optimal Value = Profit =  "161.427376"
```

```
% Profit from this kind of viewing at problem:
profit3 = p'*S - c'*r; % keeping
nbins = 10;
hist(profit3, nbins)
```


70
60
50
40
30
20
10
0
0
200
400
600
800
1000