```
>> %compute problem in Example 5.2
>> [prob,para] = P_5_2; %n=10

prob =

  struct with fields:

    Xnum: 10
    Ynum: 10
       X: [10×1 sdpvar]
       Y: [10×1 sdpvar]
       f: [1×1 sdpvar]
       g: [1×1 sdpvar]
       r: [10×1 double]

>> prob.r % the random vector a in the problem

ans =

   -0.4468
   -0.4764
   -0.2244
   -0.8328
    0.5325
    0.9602
   -0.5359
    0.1211
    0.8170
   -0.3967

>> tic; fsippsolve(prob,para,1); toc; % compute r^primal_1
The optimal value r^primal_k of the 1-th primal SDP relaxation (P_k) is
0.44137
Elapsed time is 3.740201 seconds.
>> tic; fsippdis(prob.r, 1); toc % compute r^dis_1

Local minimum found that satisfies the constraints.

Optimization completed because the objective function is non-decreasing in
feasible directions, to within the default value of the optimality tolerance,
and constraints are satisfied to within the default value of the constraint tolerance.

<stopping criteria details>

The optimal value by discretization method with N=1 is
0.47522
Elapsed time is 0.853884 seconds.
>> [prob,para] = P_5_2; %n=11

prob =

  struct with fields:

    Xnum: 11
    Ynum: 11
       X: [11×1 sdpvar]
       Y: [11×1 sdpvar]
       f: [1×1 sdpvar]
       g: [1×1 sdpvar]
       r: [11×1 double]

>> prob.r % the random vector a in the problem
```

```
ans =

   -0.4894
    0.8354
   -0.3381
    0.8664
    0.0580
   -0.1433
    0.9982
   -0.3192
    0.3481
    0.2142
    0.1940

>> tic; fsippsolve(prob,para,1); toc; % compute r^primal_1
The optimal value r^primal_k of the 1-th primal SDP relaxation (P_k) is
0.52085
Elapsed time is 4.417683 seconds.
>> tic; fsippdis(prob.r, 1); toc % compute r^dis_1

Local minimum found that satisfies the constraints.

Optimization completed because the objective function is non-decreasing in
feasible directions, to within the default value of the optimality tolerance,
and constraints are satisfied to within the default value of the constraint tolerance.

<stopping criteria details>

The optimal value by discretization method with N=1 is
0.52543
Elapsed time is 2.575175 seconds.
>> [prob,para] = P_5_2; %n=12

prob =

  struct with fields:

    Xnum: 12
    Ynum: 12
       X: [12×1 sdpvar]
       Y: [12×1 sdpvar]
       f: [1×1 sdpvar]
       g: [1×1 sdpvar]
       r: [12×1 double]

>> prob.r % the random vector a in the problem

ans =

    0.7174
   -0.2753
   -0.2868
   -0.9682
    0.6561
   -0.3294
   -0.4672
    0.0231
   -0.2435
   -0.3332
    0.7911
   -0.1677
```

```
>> tic; fsippsolve(prob,para,1); toc; % compute r^primal_1
The optimal value r^primal_k of the 1-th primal SDP relaxation (P_k) is
0.59585
Elapsed time is 5.407540 seconds.
>> tic; fsippdis(prob.r, 1); toc % compute r^dis_1

Local minimum found that satisfies the constraints.

Optimization completed because the objective function is non-decreasing in
feasible directions, to within the default value of the optimality tolerance,
and constraints are satisfied to within the default value of the constraint tolerance.

<stopping criteria details>

The optimal value by discretization method with N=1 is
0.60415
Elapsed time is 8.134008 seconds.
>> [prob,para] = P_5_2; %n=13

prob =

  struct with fields:

    Xnum: 13
    Ynum: 13
       X: [13×1 sdpvar]
       Y: [13×1 sdpvar]
       f: [1×1 sdpvar]
       g: [1×1 sdpvar]
       r: [13×1 double]

>> prob.r % the random vector a in the problem

ans =

    0.5896
   -0.6948
   -0.0630
   -0.6985
   -0.9496
    0.6401
   -0.6475
    0.9469
    0.7706
    0.8777
    0.7244
   -0.1730
    0.1853

>> tic; fsippsolve(prob,para,1); toc; % compute r^primal_1
The optimal value r^primal_k of the 1-th primal SDP relaxation (P_k) is
0.63601
Elapsed time is 6.837556 seconds.
>> tic; fsippdis(prob.r, 1); toc % compute r^dis_1

Local minimum found that satisfies the constraints.

Optimization completed because the objective function is non-decreasing in
feasible directions, to within the default value of the optimality tolerance,
and constraints are satisfied to within the default value of the constraint tolerance.
```

```
<stopping criteria details>

The optimal value by discretization method with N=1 is
0.71519
Elapsed time is 22.785914 seconds.
>> [prob,para] = P_5_2; %n=14

prob =

  struct with fields:

    Xnum: 14
    Ynum: 14
       X: [14×1 sdpvar]
       Y: [14×1 sdpvar]
       f: [1×1 sdpvar]
       g: [1×1 sdpvar]
       r: [14×1 double]

>> prob.r % the random vector a in the problem

ans =

    0.6149
    0.7638
   -0.4344
   -0.5687
    0.0424
    0.5583
    0.0370
   -0.6675
    0.4938
   -0.3346
    0.0942
   -0.8077
   -0.3099
    0.4090

>> tic; fsippsolve(prob,para,1); toc; % compute r^primal_1
The optimal value r^primal_k of the 1-th primal SDP relaxation (P_k) is
0.7438
Elapsed time is 9.465843 seconds.
>> tic; fsippdis(prob.r, 1); toc % compute r^dis_1

Local minimum found that satisfies the constraints.

Optimization completed because the objective function is non-decreasing in
feasible directions, to within the default value of the optimality tolerance,
and constraints are satisfied to within the default value of the constraint tolerance.

<stopping criteria details>

The optimal value by discretization method with N=1 is
0.75653
Elapsed time is 73.167354 seconds.
>> [prob,para] = P_5_2; %n=15

prob =

  struct with fields:

    Xnum: 15
```

```
    Ynum: 15
       X: [15×1 sdpvar]
       Y: [15×1 sdpvar]
       f: [1×1 sdpvar]
       g: [1×1 sdpvar]
       r: [15×1 double]

>> prob.r % the random vector a in the problem

ans =

   -0.6665
    0.0568
   -0.2722
   -0.8224
   -0.2585
   -0.2351
    0.0446
   -0.0339
    0.7911
   -0.1801
   -0.4139
    0.9309
    0.6056
    0.7000
   -0.5436

>> tic; fsippsolve(prob,para,1); toc; % compute r^primal_1
The optimal value r^primal_k of the 1-th primal SDP relaxation (P_k) is
0.81085
Elapsed time is 18.295255 seconds.
>> tic; fsippdis(prob.r, 1); toc % compute r^dis_1

Local minimum found that satisfies the constraints.

Optimization completed because the objective function is non-decreasing in
feasible directions, to within the default value of the optimality tolerance,
and constraints are satisfied to within the default value of the constraint tolerance.

<stopping criteria details>

The optimal value by discretization method with N=1 is
0.82242
Elapsed time is 230.062334 seconds.
>> [prob,para] = P_5_2; %n=16

prob =

  struct with fields:

    Xnum: 16
    Ynum: 16
       X: [16×1 sdpvar]
       Y: [16×1 sdpvar]
       f: [1×1 sdpvar]
       g: [1×1 sdpvar]
       r: [16×1 double]

>> prob.r % the random vector a in the problem

ans =
```

```
    0.8863
   -0.2886
   -0.0754
    0.1465
   -0.6242
    0.5049
    0.3647
    0.2151
   -0.2519
   -0.4949
   -0.4341
    0.3306
   -0.1439
   -0.1178
    0.2455
    0.4864

>> tic; fsippsolve(prob,para,1); toc; % compute r^primal_1
The optimal value r^primal_k of the 1-th primal SDP relaxation (P_k) is
0.90504
Elapsed time is 23.517609 seconds.
>> tic; fsippdis(prob.r, 1); toc % compute r^dis_1

Local minimum found that satisfies the constraints.

Optimization completed because the objective function is non-decreasing in
feasible directions, to within the default value of the optimality tolerance,
and constraints are satisfied to within the default value of the constraint tolerance.

<stopping criteria details>

The optimal value by discretization method with N=1 is
0.88154
Elapsed time is 759.956550 seconds.
>> [prob,para] = P_5_2; %n=17

prob =

  struct with fields:

    Xnum: 17
    Ynum: 17
       X: [17×1 sdpvar]
       Y: [17×1 sdpvar]
       f: [1×1 sdpvar]
       g: [1×1 sdpvar]
       r: [17×1 double]

>> prob.r % the random vector a in the problem

ans =

   -0.9902
    0.7200
    0.0711
    0.0949
    0.9801
    0.6061
    0.0002
    0.8642
   -0.7693
    0.0892
```

```
   -0.3368
   -0.1059
    0.5299
    0.5229
   -0.1268
    0.7357
    0.8502

>> tic; fsippsolve(prob,para,1); toc; % compute r^primal_1
The optimal value r^primal_k of the 1-th primal SDP relaxation (P_k) is
0.93425
Elapsed time is 28.861860 seconds.
>> tic; fsippdis(prob.r, 1); toc % compute r^dis_1

Solver stopped prematurely.

fmincon stopped because it exceeded the function evaluation limit,
options.MaxFunctionEvaluations = 5000 (the selected value).

The optimal value by discretization method with N=1 is
0.9824
Elapsed time is 2254.685768 seconds.
>> [prob,para] = P_5_2; %n=18

prob =

  struct with fields:

    Xnum: 18
    Ynum: 18
       X: [18×1 sdpvar]
       Y: [18×1 sdpvar]
       f: [1×1 sdpvar]
       g: [1×1 sdpvar]
       r: [18×1 double]

>> prob.r % the random vector a in the problem

ans =

   -0.0733
   -0.9029
   -0.1118
   -0.5244
    0.3845
    0.8531
    0.1896
    0.3349
    0.7464
    0.7449
    0.8550
    0.2283
    0.7610
    0.0719
    0.5354
    0.5255
    0.7676
    0.7533

>> tic; fsippsolve(prob,para,1); toc; % compute r^primal_1
The optimal value r^primal_k of the 1-th primal SDP relaxation (P_k) is
1.007
```

```
Elapsed time is 44.811531 seconds.
>> tic; fsippdis(prob.r, 1); toc % compute r^dis_1

Solver stopped prematurely.

fmincon stopped because it exceeded the function evaluation limit,
options.MaxFunctionEvaluations = 5000 (the selected value).

The optimal value by discretization method with N=1 is
1.0835
Elapsed time is 7995.089263 seconds.
>>
```