Test for Gaussian elimination and solvers

```
%Define a random matrix and check that is non-singular with the
 condition
%number of A
A=zeros(20,20);
tol=100;
i=1;
%The following loop will redefine the matrix A until one of them has a
%condition number below tol.
while cond(A)>tol
A=rand(20); %Redefine A
i=i+1;      %Count how many tries
end
A
i
b=rand(20,1)
%We proceed with the Gaussian Elimination with Partial Pivoting.
[L,U,piv]=GEpiv(A)
%Then we obtain PA=A(piv,:), L and U, where PA=LU
A(piv,:)
L*U
%Observe that they are equal
%We are going to solve the following system: PAx=LUx=Pb, where
 Pb=b(piv).
%We start with the following: Lz=Pb, z=Ux.
z=Ltrisol(L,b(piv))
%Obtained z, we now calculate the solution x
x=Utrisol(U,z)
%Calculate the residue vector
r=b(piv)-A(piv,:)*x
%Calculate two norms of the residue vector
N1=norm(r,1)
N2=norm(r,2)

% About the row interchanges, the information is given by the vector
 piv.
```

```
A =

  Columns 1 through 7

    0.4856    0.5930    0.7996    0.5377    0.1989    0.9171    0.5428
    0.1369    0.0630    0.8763    0.0220    0.0706    0.4501    0.6363
    0.4253    0.4980    0.9023    0.7511    0.1336    0.8972    0.5981
    0.4973    0.3576    0.5877    0.0179    0.5903    0.2045    0.7137
    0.6214    0.1675    0.0347    0.9682    0.2744    0.6875    0.4507
    0.3481    0.7312    0.2358    0.3306    0.3383    0.3138    0.5605
    0.7156    0.7461    0.3716    0.6222    0.1502    0.0216    0.1570
    0.6233    0.6982    0.8947    0.5302    0.8222    0.7563    0.7952
    0.1476    0.5780    0.3697    0.9093    0.2266    0.7269    0.4854
```

```
    0.8012    0.1191    0.9690    0.5925    0.9914    0.5841    0.1917
    0.5061    0.7052    0.2950    0.2004    0.7593    0.1778    0.9070
    0.7847    0.6854    0.0844    0.7111    0.0269    0.0010    0.2699
    0.1460    0.3169    0.2330    0.1510    0.1763    0.5231    0.6661
    0.7363    0.2482    0.3520    0.5940    0.1637    0.8676    0.1785
    0.2731    0.2016    0.7430    0.9063    0.7438    0.3105    0.9825
    0.1750    0.3715    0.2289    0.9255    0.8399    0.5665    0.3676
    0.8521    0.0624    0.1749    0.2325    0.3982    0.4761    0.9482
    0.2315    0.6752    0.3337    0.3308    0.2556    0.0083    0.9673
    0.5352    0.9796    0.2979    0.9989    0.2560    0.7028    0.7657
    0.4918    0.3819    0.5880    0.6305    0.4300    0.9965    0.2946

Columns 8 through 14

    0.4460    0.6352    0.5297    0.9561    0.4568    0.6967    0.0361
    0.4355    0.2932    0.2852    0.3259    0.0675    0.8752    0.4630
    0.6875    0.4362    0.7475    0.1227    0.7364    0.6152    0.7124
    0.1723    0.6401    0.0642    0.0431    0.8830    0.6174    0.4077
    0.3623    0.8717    0.2787    0.9308    0.7932    0.4112    0.2351
    0.0931    0.2089    0.6208    0.7733    0.7277    0.5558    0.9380
    0.5259    0.8650    0.6880    0.0549    0.4027    0.5594    0.6787
    0.1812    0.1057    0.4667    0.6543    0.1586    0.7865    0.9045
    0.4971    0.0588    0.5352    0.5747    0.9890    0.5304    0.1457
    0.3884    0.2048    0.6159    0.5145    0.1526    0.0835    0.1272
    0.7470    0.4339    0.8171    0.8070    0.5044    0.6483    0.1021
    0.4351    0.4062    0.3208    0.6298    0.4927    0.4978    0.1589
    0.1685    0.2509    0.5841    0.7389    0.4226    0.9527    0.2415
    0.6594    0.6301    0.8484    0.6274    0.1110    0.3096    0.6884
    0.8694    0.4667    0.4255    0.0385    0.3502    0.2659    0.9604
    0.0747    0.6739    0.9843    0.3610    0.0739    0.8393    0.5402
    0.0134    0.0884    0.6982    0.3830    0.7622    0.5109    0.6270
    0.1320    0.3264    0.4350    0.3230    0.6110    0.3906    0.2186
    0.2306    0.9124    0.4660    0.7910    0.3098    0.2579    0.7671
    0.2344    0.3852    0.3627    0.3255    0.8622    0.7974    0.0548

Columns 15 through 20

    0.9856    0.6295    0.8647    0.7821    0.5778    0.2396
    0.5556    0.9101    0.1914    0.1319    0.8361    0.8349
    0.8498    0.8143    0.5428    0.6566    0.9357    0.1928
    0.7259    0.5469    0.1078    0.1251    0.9826    0.5054
    0.2396    0.9919    0.2524    0.8018    0.0040    0.0892
    0.9008    0.2584    0.1599    0.3147    0.3297    0.3094
    0.0563    0.5813    0.8019    0.0441    0.1307    0.1333
    0.6435    0.0189    0.8733    0.8035    0.7649    0.8888
    0.7074    0.7227    0.5698    0.6096    0.3658    0.6471
    0.6971    0.9499    0.4368    0.3018    0.6000    0.5042
    0.7487    0.3751    0.2562    0.4374    0.4871    0.4721
    0.1780    0.4144    0.0512    0.1220    0.0757    0.2236
    0.6589    0.5324    0.7670    0.9873    0.6988    0.9798
    0.9344    0.0384    0.4390    0.6170    0.2893    0.2812
    0.9637    0.9081    0.7825    0.1377    0.4151    0.0479
    0.9631    0.5358    0.3094    0.4219    0.6600    0.8389
    0.4241    0.9327    0.6005    0.8552    0.6381    0.7561
```

```
    0.0932    0.1343    0.3473    0.0921    0.7709    0.6813
    0.5710    0.6395    0.6782    0.0177    0.6238    0.7081
    0.5934    0.4827    0.6257    0.2370    0.7501    0.4262

i =

     7

b =

    0.0971
    0.4609
    0.8576
    0.1415
    0.0506
    0.5465
    0.2032
    0.3215
    0.8966
    0.4041
    0.8704
    0.5933
    0.0307
    0.1092
    0.7644
    0.2606
    0.4538
    0.1843
    0.7155
    0.9665

L =

  Columns 1 through 7

    1.0000         0         0         0         0         0         0
    0.6281    1.0000         0         0         0         0         0
    0.1607    0.0564    1.0000         0         0         0         0
    0.3205    0.1931    0.7767    1.0000         0         0         0
    0.5939    0.7104    0.0687   -0.7528    1.0000         0         0
    0.9208    0.6676   -0.2415   -0.1224   -0.2737    1.0000         0
    0.9403    0.0642    0.9462    0.5293    0.2944   -0.0570    1.0000
    0.8641    0.2066    0.1934    0.3200   -0.3868   -0.1873    0.5435
    0.1733    0.6031    0.2698    0.5189   -0.1681   -0.3902    0.1141
    0.2054    0.3814    0.1447    0.7840    0.2830   -0.7177    0.4279
    0.7293    0.1297   -0.1400    0.9482   -0.6081   -0.2234    0.2202
    0.5836    0.3415    0.5031   -0.5264    0.6895    0.1281    0.1427
    0.7315    0.6938    0.7597   -0.2561    0.6940   -0.2518    0.4817
    0.4085    0.7504    0.0277   -0.5621    0.5258    0.0084    0.0122
    0.8398    0.7376    0.1026   -0.2731   -0.0231    0.9729    0.1944
    0.2717    0.6999    0.1845   -0.4434    0.4222    0.3966   -0.4411
```

```
    0.5699    0.5927    0.7025   -0.0779    0.0118   -0.1897    0.3462
    0.5771    0.3678    0.4989    0.2991    0.0127   -0.5793    0.6247
    0.1714    0.3256    0.1693   -0.2176    0.2433   -0.4320   -0.0916
    0.4991    0.4964    0.8616    0.3717   -0.3073   -0.0702    0.2628

  Columns 8 through 14

         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
    1.0000         0         0         0         0         0         0
    0.4179    1.0000         0         0         0         0         0
   -0.0010   -0.2222    1.0000         0         0         0         0
    0.6562   -0.4183   -0.3571    1.0000         0         0         0
   -0.4505   -0.6586   -0.4118   -0.3462    1.0000         0         0
   -0.3407    0.5837   -0.3454   -0.2754   -0.2052    1.0000         0
   -0.2619    0.3191    0.3135   -0.0679    0.0733   -0.3763    1.0000
   -0.0911   -0.5434    0.6568   -0.8417    0.8007   -0.6477    0.1907
   -0.6888    0.0168    0.4347   -0.2823    0.1662   -0.6427    0.1098
    0.3107    0.1870   -0.1393    0.1302    0.0859   -0.0919   -0.1688
    0.4455    0.3458   -0.4429   -0.2560    0.5795    0.6183   -0.5431
    0.1358    0.2138    0.1800    0.2773   -0.1795    0.0504    0.1043
    0.4360    0.5191    0.1802   -0.7208    0.5265   -0.3020   -0.1374

  Columns 15 through 20

         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
         0         0         0         0         0         0
    1.0000         0         0         0         0         0
    0.3149    1.0000         0         0         0         0
   -0.3427    0.3365    1.0000         0         0         0
    0.0800   -0.1196    0.0048    1.0000         0         0
   -0.2078    0.0335    0.8730    0.1127    1.0000         0
    0.4371    0.1569   -0.5519   -0.8043   -0.5630    1.0000


U =
```

Columns 1 through 7

0.8521	0.0624	0.1749	0.2325	0.3982	0.4761	0.9482
0	0.9404	0.1880	0.8529	0.0060	0.4037	0.1701
0	0	0.8376	-0.0634	0.0063	0.3508	0.4744
0	0	0	0.7163	0.6102	-0.1925	0.2773
0	0	0	0	0.9774	-0.5608	0.3991
0	0	0	0	0	-0.7992	-0.4591
0	0	0	0	0	0	-1.4500
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Columns 8 through 14

0.0134	0.0884	0.6982	0.3830	0.7622	0.5109	0.6270
0.2222	0.8569	0.0274	0.5505	-0.1689	-0.0630	0.3733
0.4209	0.2307	0.1715	0.2334	-0.0454	0.7967	0.3412
0.4953	0.0937	0.0633	-0.3718	0.1738	-0.5045	0.4223
0.9252	-0.1726	0.4187	-0.1075	0.3056	-0.0448	-0.2410
0.6899	-0.2273	-0.1767	-0.1089	-0.0024	0.1878	-0.5995
-0.5318	-0.1633	-0.3715	0.1204	-0.6924	-0.8557	-0.9959
1.1381	0.2815	0.5168	0.1292	-0.0656	0.3715	0.2041
0	-0.8010	0.1465	0.1780	1.0377	0.5348	-0.7453
0	0	0.7028	0.2705	0.2907	1.6714	-0.2127
0	0	0	0.9354	1.0067	1.4166	-1.2060
0	0	0	0	1.6206	1.5017	-0.5541
0	0	0	0	0	1.3026	0.5171
0	0	0	0	0	0	1.2849
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Columns 15 through 20

0.4241	0.9327	0.6005	0.8552	0.6381	0.7561
0.3047	0.0537	0.3011	-0.5195	0.2230	0.2332
0.4703	0.7573	0.0780	0.0237	0.7210	0.7003
0.4037	0.0106	0.4713	-0.0545	-0.3925	-0.7835
0.5520	-0.2611	0.0351	0.2558	-0.3953	-0.7806
-0.1019	-0.3675	-0.6166	-0.2496	-0.6429	-0.7688

```
   -0.5482   -0.5966   -0.5158   -0.5521   -0.4090   -0.2837
    0.7772   -0.7739   -0.1296    0.3504   -0.3730   -0.5968
   -0.0954    0.5232   -0.1031    0.6588    0.0152    0.4436
    0.3601    0.3868   -0.5643    0.6151    0.4758    0.9960
   -0.4138    1.1561   -0.8231    0.7870    0.1099    0.6973
    0.3533    0.4765   -0.6519    0.8146    0.4539    0.5718
    0.1268   -0.9166   -0.1839    0.8631   -0.0437    0.1170
    0.5449   -0.8224    0.0431    0.2055   -0.4147   -0.7746
   -1.1147    0.2657    0.9020    0.5637   -0.6133   -0.2893
         0   -1.3442   -0.2029    0.3466    0.0779   -0.1531
         0         0    0.8989    0.5941   -0.6153   -0.9874
         0         0         0   -0.6746   -0.0544   -0.5518
         0         0         0         0    0.5618    0.9773
         0         0         0         0         0   -1.1389

piv =

    17
    19
     2
    15
    11
    12
    10
    14
     9
    16
     5
     4
     8
     6
     7
    18
     1
    20
    13
     3


ans =

  Columns 1 through 7

    0.8521    0.0624    0.1749    0.2325    0.3982    0.4761    0.9482
    0.5352    0.9796    0.2979    0.9989    0.2560    0.7028    0.7657
    0.1369    0.0630    0.8763    0.0220    0.0706    0.4501    0.6363
    0.2731    0.2016    0.7430    0.9063    0.7438    0.3105    0.9825
    0.5061    0.7052    0.2950    0.2004    0.7593    0.1778    0.9070
    0.7847    0.6854    0.0844    0.7111    0.0269    0.0010    0.2699
    0.8012    0.1191    0.9690    0.5925    0.9914    0.5841    0.1917
    0.7363    0.2482    0.3520    0.5940    0.1637    0.8676    0.1785
    0.1476    0.5780    0.3697    0.9093    0.2266    0.7269    0.4854
    0.1750    0.3715    0.2289    0.9255    0.8399    0.5665    0.3676
```

```
    0.6214    0.1675    0.0347    0.9682    0.2744    0.6875    0.4507
    0.4973    0.3576    0.5877    0.0179    0.5903    0.2045    0.7137
    0.6233    0.6982    0.8947    0.5302    0.8222    0.7563    0.7952
    0.3481    0.7312    0.2358    0.3306    0.3383    0.3138    0.5605
    0.7156    0.7461    0.3716    0.6222    0.1502    0.0216    0.1570
    0.2315    0.6752    0.3337    0.3308    0.2556    0.0083    0.9673
    0.4856    0.5930    0.7996    0.5377    0.1989    0.9171    0.5428
    0.4918    0.3819    0.5880    0.6305    0.4300    0.9965    0.2946
    0.1460    0.3169    0.2330    0.1510    0.1763    0.5231    0.6661
    0.4253    0.4980    0.9023    0.7511    0.1336    0.8972    0.5981

Columns 8 through 14

    0.0134    0.0884    0.6982    0.3830    0.7622    0.5109    0.6270
    0.2306    0.9124    0.4660    0.7910    0.3098    0.2579    0.7671
    0.4355    0.2932    0.2852    0.3259    0.0675    0.8752    0.4630
    0.8694    0.4667    0.4255    0.0385    0.3502    0.2659    0.9604
    0.7470    0.4339    0.8171    0.8070    0.5044    0.6483    0.1021
    0.4351    0.4062    0.3208    0.6298    0.4927    0.4978    0.1589
    0.3884    0.2048    0.6159    0.5145    0.1526    0.0835    0.1272
    0.6594    0.6301    0.8484    0.6274    0.1110    0.3096    0.6884
    0.4971    0.0588    0.5352    0.5747    0.9890    0.5304    0.1457
    0.0747    0.6739    0.9843    0.3610    0.0739    0.8393    0.5402
    0.3623    0.8717    0.2787    0.9308    0.7932    0.4112    0.2351
    0.1723    0.6401    0.0642    0.0431    0.8830    0.6174    0.4077
    0.1812    0.1057    0.4667    0.6543    0.1586    0.7865    0.9045
    0.0931    0.2089    0.6208    0.7733    0.7277    0.5558    0.9380
    0.5259    0.8650    0.6880    0.0549    0.4027    0.5594    0.6787
    0.1320    0.3264    0.4350    0.3230    0.6110    0.3906    0.2186
    0.4460    0.6352    0.5297    0.9561    0.4568    0.6967    0.0361
    0.2344    0.3852    0.3627    0.3255    0.8622    0.7974    0.0548
    0.1685    0.2509    0.5841    0.7389    0.4226    0.9527    0.2415
    0.6875    0.4362    0.7475    0.1227    0.7364    0.6152    0.7124

Columns 15 through 20

    0.4241    0.9327    0.6005    0.8552    0.6381    0.7561
    0.5710    0.6395    0.6782    0.0177    0.6238    0.7081
    0.5556    0.9101    0.1914    0.1319    0.8361    0.8349
    0.9637    0.9081    0.7825    0.1377    0.4151    0.0479
    0.7487    0.3751    0.2562    0.4374    0.4871    0.4721
    0.1780    0.4144    0.0512    0.1220    0.0757    0.2236
    0.6971    0.9499    0.4368    0.3018    0.6000    0.5042
    0.9344    0.0384    0.4390    0.6170    0.2893    0.2812
    0.7074    0.7227    0.5698    0.6096    0.3658    0.6471
    0.9631    0.5358    0.3094    0.4219    0.6600    0.8389
    0.2396    0.9919    0.2524    0.8018    0.0040    0.0892
    0.7259    0.5469    0.1078    0.1251    0.9826    0.5054
    0.6435    0.0189    0.8733    0.8035    0.7649    0.8888
    0.9008    0.2584    0.1599    0.3147    0.3297    0.3094
    0.0563    0.5813    0.8019    0.0441    0.1307    0.1333
    0.0932    0.1343    0.3473    0.0921    0.7709    0.6813
    0.9856    0.6295    0.8647    0.7821    0.5778    0.2396
    0.5934    0.4827    0.6257    0.2370    0.7501    0.4262
```

```
    0.6589    0.5324    0.7670    0.9873    0.6988    0.9798
    0.8498    0.8143    0.5428    0.6566    0.9357    0.1928


ans =

  Columns 1 through 7

    0.8521    0.0624    0.1749    0.2325    0.3982    0.4761    0.9482
    0.5352    0.9796    0.2979    0.9989    0.2560    0.7028    0.7657
    0.1369    0.0630    0.8763    0.0220    0.0706    0.4501    0.6363
    0.2731    0.2016    0.7430    0.9063    0.7438    0.3105    0.9825
    0.5061    0.7052    0.2950    0.2004    0.7593    0.1778    0.9070
    0.7847    0.6854    0.0844    0.7111    0.0269    0.0010    0.2699
    0.8012    0.1191    0.9690    0.5925    0.9914    0.5841    0.1917
    0.7363    0.2482    0.3520    0.5940    0.1637    0.8676    0.1785
    0.1476    0.5780    0.3697    0.9093    0.2266    0.7269    0.4854
    0.1750    0.3715    0.2289    0.9255    0.8399    0.5665    0.3676
    0.6214    0.1675    0.0347    0.9682    0.2744    0.6875    0.4507
    0.4973    0.3576    0.5877    0.0179    0.5903    0.2045    0.7137
    0.6233    0.6982    0.8947    0.5302    0.8222    0.7563    0.7952
    0.3481    0.7312    0.2358    0.3306    0.3383    0.3138    0.5605
    0.7156    0.7461    0.3716    0.6222    0.1502    0.0216    0.1570
    0.2315    0.6752    0.3337    0.3308    0.2556    0.0083    0.9673
    0.4856    0.5930    0.7996    0.5377    0.1989    0.9171    0.5428
    0.4918    0.3819    0.5880    0.6305    0.4300    0.9965    0.2946
    0.1460    0.3169    0.2330    0.1510    0.1763    0.5231    0.6661
    0.4253    0.4980    0.9023    0.7511    0.1336    0.8972    0.5981

  Columns 8 through 14

    0.0134    0.0884    0.6982    0.3830    0.7622    0.5109    0.6270
    0.2306    0.9124    0.4660    0.7910    0.3098    0.2579    0.7671
    0.4355    0.2932    0.2852    0.3259    0.0675    0.8752    0.4630
    0.8694    0.4667    0.4255    0.0385    0.3502    0.2659    0.9604
    0.7470    0.4339    0.8171    0.8070    0.5044    0.6483    0.1021
    0.4351    0.4062    0.3208    0.6298    0.4927    0.4978    0.1589
    0.3884    0.2048    0.6159    0.5145    0.1526    0.0835    0.1272
    0.6594    0.6301    0.8484    0.6274    0.1110    0.3096    0.6884
    0.4971    0.0588    0.5352    0.5747    0.9890    0.5304    0.1457
    0.0747    0.6739    0.9843    0.3610    0.0739    0.8393    0.5402
    0.3623    0.8717    0.2787    0.9308    0.7932    0.4112    0.2351
    0.1723    0.6401    0.0642    0.0431    0.8830    0.6174    0.4077
    0.1812    0.1057    0.4667    0.6543    0.1586    0.7865    0.9045
    0.0931    0.2089    0.6208    0.7733    0.7277    0.5558    0.9380
    0.5259    0.8650    0.6880    0.0549    0.4027    0.5594    0.6787
    0.1320    0.3264    0.4350    0.3230    0.6110    0.3906    0.2186
    0.4460    0.6352    0.5297    0.9561    0.4568    0.6967    0.0361
    0.2344    0.3852    0.3627    0.3255    0.8622    0.7974    0.0548
    0.1685    0.2509    0.5841    0.7389    0.4226    0.9527    0.2415
    0.6875    0.4362    0.7475    0.1227    0.7364    0.6152    0.7124

  Columns 15 through 20
```

```
    0.4241    0.9327    0.6005    0.8552    0.6381    0.7561
    0.5710    0.6395    0.6782    0.0177    0.6238    0.7081
    0.5556    0.9101    0.1914    0.1319    0.8361    0.8349
    0.9637    0.9081    0.7825    0.1377    0.4151    0.0479
    0.7487    0.3751    0.2562    0.4374    0.4871    0.4721
    0.1780    0.4144    0.0512    0.1220    0.0757    0.2236
    0.6971    0.9499    0.4368    0.3018    0.6000    0.5042
    0.9344    0.0384    0.4390    0.6170    0.2893    0.2812
    0.7074    0.7227    0.5698    0.6096    0.3658    0.6471
    0.9631    0.5358    0.3094    0.4219    0.6600    0.8389
    0.2396    0.9919    0.2524    0.8018    0.0040    0.0892
    0.7259    0.5469    0.1078    0.1251    0.9826    0.5054
    0.6435    0.0189    0.8733    0.8035    0.7649    0.8888
    0.9008    0.2584    0.1599    0.3147    0.3297    0.3094
    0.0563    0.5813    0.8019    0.0441    0.1307    0.1333
    0.0932    0.1343    0.3473    0.0921    0.7709    0.6813
    0.9856    0.6295    0.8647    0.7821    0.5778    0.2396
    0.5934    0.4827    0.6257    0.2370    0.7501    0.4262
    0.6589    0.5324    0.7670    0.9873    0.6988    0.9798
    0.8498    0.8143    0.5428    0.6566    0.9357    0.1928

z =

    0.4538
    0.4305
    0.3637
    0.2534
    0.4608
    0.1330
   -0.6566
    0.0367
    0.5177
    0.1130
    0.1618
   -0.1009
   -0.7173
   -0.5074
   -0.3951
   -0.9829
   -0.4666
    0.8093
   -0.1515
    0.5466

x =

    0.1998
    0.7871
   -1.1736
   -0.0876
    0.4121
    1.0754
```

```
    0.1133
    0.9349
   -1.2463
   -0.0708
   -0.1010
   -0.1946
    0.4686
    0.1128
   -0.1946
    0.6132
   -0.0957
   -0.8527
    0.5653
   -0.4800


r =

   1.0e-15 *

    0.1110
    0.2220
   -0.0555
    0.1110
    0.4441
    0.4441
    0.0555
    0.4441
   -0.4441
    0.2776
    0.1665
    0.1388
   -0.2220
    0.3331
    0.3886
    0.3331
    0.0694
    0.6661
   -0.4441
   -0.3331


N1 =

   5.7038e-15


N2 =

   1.4737e-15
```

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