

數值分析

作業三

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A.

1. gauss_solver:

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D:\GD\數值分析\HW\HW4\GaussElimination\gauss\Debug\gauss.exe
B[]]=
11.000000 22.000000 48.400000 114.400000 284.732800 735.328000 1950.593920 5278.746880
22.000000 48.400000 114.400000 284.732800 735.328000 1950.593920 5278.746880 14506.009492
48.400000 114.400000 284.732800 735.328000 1950.593920 5278.746880 14506.009492 40345.935985
114.400000 284.732800 735.328000 1950.593920 5278.746880 14506.009492 40345.935985 113308.831698
284.732800 735.328000 1950.593920 5278.746880 14506.009492 40345.935985 113308.831698 320761.065687
735.328000 1950.593920 5278.746880 14506.009492 40345.935985 113308.831698 320761.065687 914064.488189
1950.593920 5278.746880 14506.009492 40345.935985 113308.831698 320761.065687 914064.488189 2619394.996452
5278.746880 14506.009492 40345.935985 113308.831698 320761.065687 914064.488189 2619394.996452 7542213.028167
-----
d[]]=
8445.201600 22940.211092 63264.147077 176524.578775 497171.244462 1410950.999851 4029610.668303 11569873.102551
-----
After forward elimination, B[]]=
5278.746880 14506.009492 40345.935985 113308.831698 320761.065687 914064.488189 2619394.996452 7542213.028167
0.000000 -81.490040 -402.554835 -1523.758323 -5218.273072 -17002.550126 -53850.070002 -167591.235418
0.000000 0.000000 7.371462 49.191464 225.208268 880.562586 3164.674717 10809.909185
0.000000 0.000000 0.000000 -1.041043 -8.687743 -46.599482 -205.040838 -807.296802
0.000000 0.000000 0.000000 0.000000 0.129743 1.334520 8.428674 42.293754
-0.000000 0.000000 0.000000 -0.000000 0.000000 0.003663 0.044436 0.320752
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 -0.000133 -0.001872
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 -0.000002
-----
d[]]=
5295.469358 -80.449491 7.529800 -1.020676 0.131096 0.003651 -0.000133 -0.000002
-----
The solution c[]]=
1.003168 0.987231 1.021480 0.980435 1.010432 0.996739 1.000554 0.999961
-----
Error in 2-norm : 0.033720
Error in infinite-norm : 0.021480

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2. QR_Solver for New System:

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D:\GD\數值分析\HW\HW4\QRmethod_New\QR\Debug\QR.exe
A[]]=
11.000000 22.000000 48.400000 114.400000 284.732800 735.328000 1950.593920 5278.746880
22.000000 48.400000 114.400000 284.732800 735.328000 1950.593920 5278.746880 14506.009492
48.400000 114.400000 284.732800 735.328000 1950.593920 5278.746880 14506.009492 40345.935985
114.400000 284.732800 735.328000 1950.593920 5278.746880 14506.009492 40345.935985 113308.831698
284.732800 735.328000 1950.593920 5278.746880 14506.009492 40345.935985 113308.831698 320761.065687
735.328000 1950.593920 5278.746880 14506.009492 40345.935985 113308.831698 320761.065687 914064.488189
1950.593920 5278.746880 14506.009492 40345.935985 113308.831698 320761.065687 914064.488189 2619394.996452
5278.746880 14506.009492 40345.935985 113308.831698 320761.065687 914064.488189 2619394.996452 7542213.028167
-----
d[]]=
8445.201600 22940.211092 63264.147077 176524.578775 497171.244462 1410950.999851 4029610.668303 11569873.102551
-----
Householder vector=
5694.995093 22.000000 48.400000 114.400000 284.732800 735.328000 1950.593920 5278.746880
-----
A[]]=
-5683.995093 -15579.422217 -43245.863840 -121263.853259 -342848.894266 -975997.077262 -2794456.034287 -8040395.809008
0.000000 -52.847520 -184.156379 -590.211298 -1822.563487 -5523.886804 -16574.761840
0.000000 -11.868935 -83.211744 -296.228193 -965.592535 -3022.199414 -9259.784611 -28031.760947
0.000000 -28.665662 -134.359103 -487.629809 -1614.057467 -5114.409021 -15827.759170 -48311.179231
0.000000 -44.696664 -213.990380 -789.804426 -2649.650112 -8487.776433 -26503.174488 -81493.709207
0.000000 -63.834962 -311.334221 -1166.142415 -3958.889497 -12805.181458 -40306.162551 -124779.212828
0.000000 -64.899396 -322.717563 -1227.354063 -4217.936237 -13779.747784 -43733.311040 -136330.621279
0.000000 44.898024 216.057657 802.136747 2707.136988 8721.629671 27378.230425 84598.269104
-----
b[]]=
-12339470.949232 -24760.296261 -41676.969101 -71518.059463 -120187.801910 -183390.757932 -199676.587361 124468.358615
-----
Householder vector=
0.000000 -128.462187 -18.191657 -28.665662 -44.696664 -63.834962 -64.899396 44.898024
-----
A[]]=
-5683.995093 -15579.422217 -43245.863840 -121263.853259 -342848.894266 -975997.077262 -2794456.034287 -8040395.809008
0.000000 116.593252 566.721449 2118.167392 7181.132895 23207.976263 73012.513701 225961.684656
0.000000 -0.000000 4.526029 29.806145 134.915176 522.399899 1861.832466 6314.064275
0.000000 -0.000000 3.894456 26.121638 120.077139 471.024380 1697.225772 5809.553899
0.000000 -0.000000 1.580182 11.257690 54.282775 221.258061 822.493587 2888.53512
0.000000 -0.000000 -3.460267 -22.080079 -97.181468 -367.096880 -1280.140680 -4258.885888
0.000000 -0.000000 -9.709877 -64.214733 -291.835056 -1134.260818 -4056.538640 -13800.643784
0.000000 -0.000000 -0.484060 -2.534189 -8.977439 -26.639414 -70.541007 -169.143726
-----
b[]]=
-12339470.949232 332164.789612 8867.544081 8127.897254 3999.407607 -6028.845263 -19357.202909 -278.319836
-----
Householder vector=
0.000000 0.000000 16.552590 3.894456 1.580182 -3.460267 -9.709877 -0.484060
-----
A[]]=
-5683.995093 -15579.422217 -43245.863840 -121263.853259 -342848.894266 -975997.077262 -2794456.034287 -8040395.809008
0.000000 116.593252 566.721449 2118.167392 7181.132895 23207.976263 73012.513701 225961.684656
0.000000 -0.000000 -12.026561 -79.454888 -360.730192 -1400.657273 -5004.625441 -17011.380842
0.000000 -0.000000 0.000000 0.414950 3.462821 18.571799 81.701130 321.596078
0.000000 -0.000000 0.000000 0.827157 6.966317 37.674666 166.991707 661.787061
0.000000 -0.000000 0.000000 0.760599 6.431649 34.912240 155.270920 617.225629
0.000000 -0.000000 0.000000 -0.121369 -1.085661 -6.180599 -28.621481 -117.757804
0.000000 0.000000 0.000000 0.661017 5.517110 29.598070 130.260250 512.980704
-----
b[]]=

```

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D:\GD\數值分析\HW\HW4\QRmethod_New\QR\Debug\QR.exe
A[ ]=
-5683.995093 -15579.422217 -43245.863840 -121263.853259 -342848.894266 -975997.077262 -2794456.034287 -8040395.809008
0.000000 116.593252 566.721449 2118.167392 7181.132895 23207.976268 73012.513701 225961.684656
0.000000 -0.000000 -12.026561 -79.454888 -360.730192 -1400.657273 -5004.625441 -17011.380842
0.000000 -0.000000 0.000000 0.414950 3.462821 18.571799 81.701130 321.596078
0.000000 -0.000000 0.000000 0.827157 6.966317 37.674666 166.991707 661.787061
0.000000 -0.000000 0.000000 0.760599 6.431649 34.912240 155.270920 617.225629
0.000000 -0.000000 0.000000 -0.121369 -1.085661 -6.180599 -28.621481 -117.757804
0.000000 0.000000 0.000000 0.661017 5.517110 29.598070 130.260250 512.980704
-----
b[ ]=
-12339470.949232 332164.789612 -23868.875198 425.746778 874.246908 814.601037 -153.766914 679.017152
-----
Householder vector=
0.000000 0.000000 0.000000 1.788470 0.827157 0.760599 -0.121369 0.661017
A[ ]=
-5683.995093 -15579.422217 -43245.863840 -121263.853259 -342848.894266 -975997.077262 -2794456.034287 -8040395.809008
0.000000 116.593252 566.721449 2118.167392 7181.132895 23207.976268 73012.513701 225961.684656
0.000000 -0.000000 -12.026561 -79.454888 -360.730192 -1400.657273 -5004.625441 -17011.380842
0.000000 -0.000000 0.000000 -1.373520 -11.554044 -62.422398 -276.448229 -1094.771452
0.000000 -0.000000 0.000000 0.000000 0.021102 0.215310 1.349663 6.725124
0.000000 -0.000000 0.000000 0.000000 0.045290 0.467098 2.957473 14.874081
0.000000 -0.000000 0.000000 -0.000000 -0.066591 -0.684194 -4.316853 -21.640681
0.000000 0.000000 0.000000 0.000000 -0.033114 -0.337334 -2.111526 -10.507837
-----
b[ ]=
-12339470.949232 332164.789612 -23868.875198 -1446.569644 8.311199 18.343942 -26.708320 -12.989811
-----
Householder vector=
0.000000 0.000000 0.000000 0.000000 0.110697 0.045290 -0.066591 -0.033114
A[ ]=
-5683.995093 -15579.422217 -43245.863840 -121263.853259 -342848.894266 -975997.077262 -2794456.034287 -8040395.809008
0.000000 116.593252 566.721449 2118.167392 7181.132895 23207.976268 73012.513701 225961.684656
0.000000 -0.000000 -12.026561 -79.454888 -360.730192 -1400.657273 -5004.625441 -17011.380842
0.000000 -0.000000 0.000000 -1.373520 -11.554044 -62.422398 -276.448229 -1094.771452
0.000000 -0.000000 0.000000 0.000000 -0.089595 -0.920022 -5.801725 -29.070525
0.000000 -0.000000 0.000000 0.000000 0.000000 0.002595 0.031593 0.228846
0.000000 -0.000000 0.000000 -0.000000 0.000000 -0.001223 -0.014863 -0.107444
0.000000 0.000000 0.000000 0.000000 0.000000 0.002287 0.027726 0.200003
-----
b[ ]=
-12339470.949232 332164.789612 -23868.875198 -1446.569644 -35.881868 0.263034 -0.123530 0.230015
-----
Householder vector=
0.000000 0.000000 0.000000 0.000000 0.000000 0.006263 -0.001223 0.002287
A[ ]=
-5683.995093 -15579.422217 -43245.863840 -121263.853259 -342848.894266 -975997.077262 -2794456.034287 -8040395.809008
0.000000 116.593252 566.721449 2118.167392 7181.132895 23207.976268 73012.513701 225961.684656
0.000000 -0.000000 -12.026561 -79.454888 -360.730192 -1400.657273 -5004.625441 -17011.380842
0.000000 -0.000000 0.000000 -1.373520 -11.554044 -62.422398 -276.448229 -1094.771452
0.000000 -0.000000 0.000000 0.000000 -0.089595 -0.920022 -5.801725 -29.070525
0.000000 -0.000000 0.000000 0.000000 0.000000 -0.003669 -0.044584 -0.322357
0.000000 -0.000000 0.000000 -0.000000 0.000000 0.000000 0.000015 0.000209
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 -0.000090 -0.001264
-----
b[ ]=
```

```
D:\GD\數值分析\HW\HW4\QRmethod_New\QR\Debug\QR.exe
A[ ]=
-5683.995093 -15579.422217 -43245.863840 -121263.853259 -342848.894266 -975997.077262 -2794456.034287 -8040395.809008
0.000000 116.593252 566.721449 2118.167392 7181.132895 23207.976268 73012.513701 225961.684656
0.000000 -0.000000 -12.026561 -79.454888 -360.730192 -1400.657273 -5004.625441 -17011.380842
0.000000 -0.000000 0.000000 -1.373520 -11.554044 -62.422398 -276.448229 -1094.771452
0.000000 -0.000000 0.000000 0.000000 -0.089595 -0.920022 -5.801725 -29.070525
0.000000 -0.000000 0.000000 0.000000 0.000000 -0.003669 -0.044584 -0.322357
0.000000 -0.000000 0.000000 -0.000000 0.000000 0.000000 0.000015 0.000209
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 -0.000090 -0.001264
-----
b[ ]=
-12339470.949232 332164.789612 -23868.875198 -1446.569644 -35.881868 -0.370610 0.000224 -0.001354
-----
Householder vector=
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000106 -0.000090
A[ ]=
-5683.995093 -15579.422217 -43245.863840 -121263.853259 -342848.894266 -975997.077262 -2794456.034287 -8040395.809008
0.000000 116.593252 566.721449 2118.167392 7181.132895 23207.976268 73012.513701 225961.684656
0.000000 -0.000000 -12.026561 -79.454888 -360.730192 -1400.657273 -5004.625441 -17011.380842
0.000000 -0.000000 0.000000 -1.373520 -11.554044 -62.422398 -276.448229 -1094.771452
0.000000 -0.000000 0.000000 0.000000 -0.089595 -0.920022 -5.801725 -29.070525
0.000000 -0.000000 0.000000 0.000000 0.000000 -0.003669 -0.044584 -0.322357
0.000000 -0.000000 0.000000 -0.000000 0.000000 0.000000 -0.000091 -0.001281
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 -0.000001
-----
b[ ]=
-12339470.949232 332164.789612 -23868.875198 -1446.569644 -35.881868 -0.370610 -0.001373 -0.000001
-----
After QR decomposition, B[ ]=
-5683.995093 -15579.422217 -43245.863840 -121263.853259 -342848.894266 -975997.077262 -2794456.034287 -8040395.809008
0.000000 116.593252 566.721449 2118.167392 7181.132895 23207.976268 73012.513701 225961.684656
0.000000 -0.000000 -12.026561 -79.454888 -360.730192 -1400.657273 -5004.625441 -17011.380842
0.000000 -0.000000 0.000000 -1.373520 -11.554044 -62.422398 -276.448229 -1094.771452
0.000000 -0.000000 0.000000 0.000000 -0.089595 -0.920022 -5.801725 -29.070525
0.000000 -0.000000 0.000000 0.000000 0.000000 -0.003669 -0.044584 -0.322357
0.000000 -0.000000 0.000000 -0.000000 0.000000 0.000000 -0.000091 -0.001281
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 -0.000001
-----
The solution c[ ]=
1.000011 0.999910 1.000231 0.999718 1.000188 0.999930 1.000014 0.999999
-----
Error in 2-norm : 0.000426
Error in infinite-norm : 0.000231
```

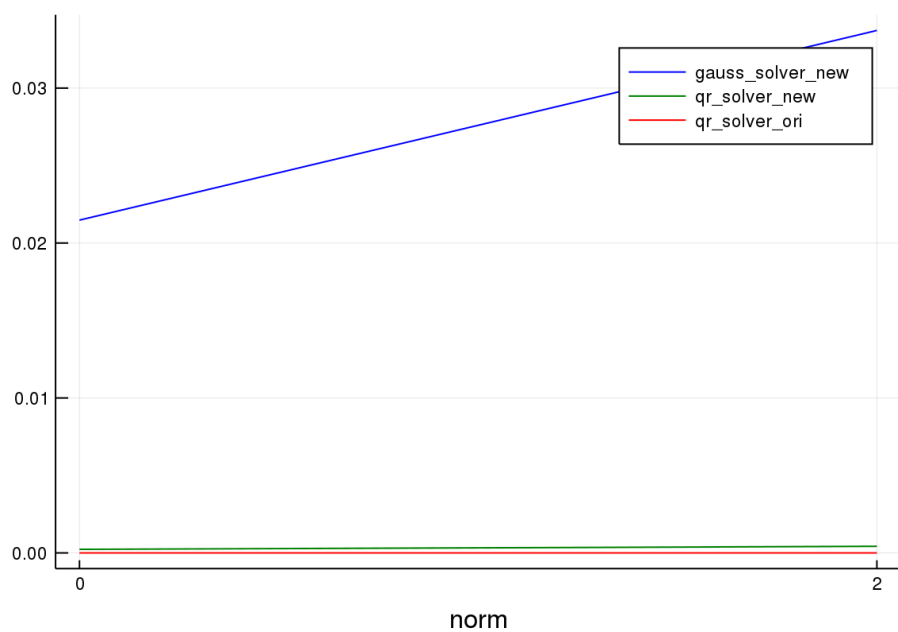
3. QR_Solver For Original System:

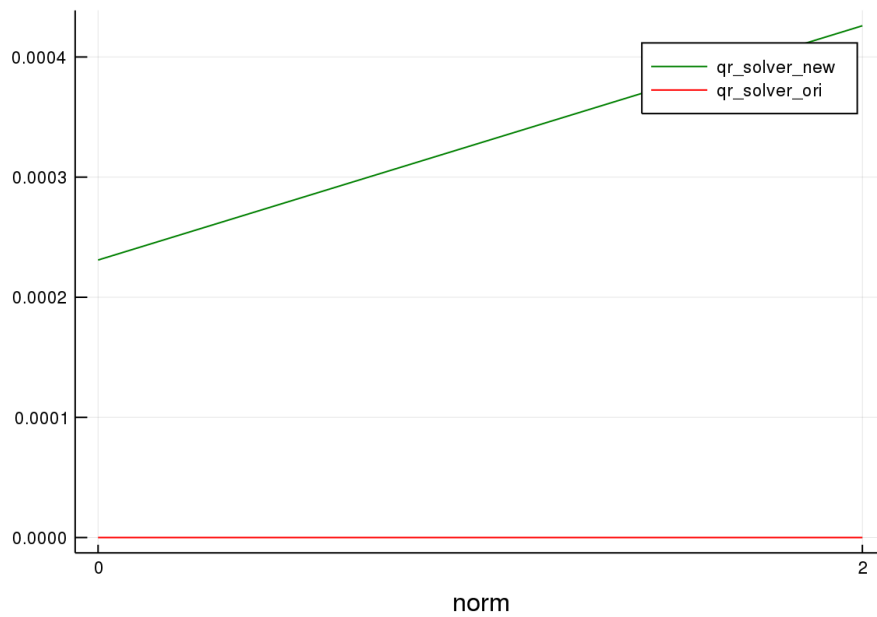
```
D:\GD\数值分析\HW\HW4\QRmethod_On\QR\Debug\QR.exe
A[i]=
1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000
1.000000 1.200000 1.440000 1.728000 2.073600 2.488320 2.985984 3.583181
1.000000 1.400000 1.960000 2.744000 3.841600 5.378240 7.529536 10.541350
1.000000 1.600000 2.560000 4.096000 6.553600 10.485760 16.777216 26.843546
1.000000 1.800000 3.240000 5.832000 10.497600 18.895680 34.012224 61.222003
1.000000 2.000000 4.000000 8.000000 16.000000 32.000000 64.000000 128.000000
1.000000 2.200000 4.840000 10.648000 23.425600 51.536320 113.379904 249.435789
1.000000 2.400000 5.760000 13.824000 33.177600 79.626240 191.102976 458.647142
1.000000 2.600000 6.760000 17.576000 45.697600 118.813760 308.915776 803.181018
1.000000 2.800000 7.840000 21.952000 61.465600 172.103680 481.890304 1349.292851
1.000000 3.000000 9.000000 27.000000 81.000000 243.000000 729.000000 2187.000000
b[i]=
8.000000 16.499085 34.394726 69.916122 136.499507 255.000000 456.465613 785.537958 1304.544154 2098.344435 3280.000000
Householder vector=
4.316625 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000
A[i]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
0.000000 -0.568338 -2.172348 -6.494373 -18.046326 -49.105169 -133.492451 -365.362963
0.000000 -0.368338 -1.652348 -5.478373 -16.278326 -46.215249 -128.948899 -358.404793
0.000000 -0.168338 -1.052348 -4.126373 -13.566326 -41.107729 -119.701219 -342.102598
0.000000 0.031662 -0.372348 -2.390373 -9.622326 -32.697809 -102.466211 -307.724140
0.000000 0.231662 0.387652 -0.222373 -4.119926 -19.593489 -72.478435 -240.946144
0.000000 0.431662 1.227652 2.425627 3.305674 -0.057169 -23.098531 -119.510355
0.000000 0.631662 2.147652 5.601627 13.057674 28.032751 54.624541 89.700999
0.000000 0.831662 3.147652 9.353627 25.577674 67.220271 172.437341 434.234874
0.000000 1.031662 4.227652 13.729627 41.345674 120.510191 345.411869 980.346708
0.000000 1.231662 5.387652 18.777627 60.880074 191.406511 592.521565 1618.053856
b[i]=
-2546.324090 -575.241966 -557.346324 -521.824929 -455.241544 -336.741051 -135.275438 193.796908 712.803103 1506.603384 2688.258949
Householder vector=
0.000000 -2.665955 -0.368338 -0.168338 0.031662 0.231662 0.431662 0.631662
A[i]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
0.000000 2.097618 8.390471 26.664916 79.071797 228.801426 656.725505 1882.381017
0.000000 0.000000 -0.192952 -0.896972 -2.860153 -7.818720 -19.769675 -47.848772
0.000000 0.000000 -0.385375 -2.032582 -7.433955 -23.559757 -69.804157 -200.172363
0.000000 -0.000000 -0.497798 -2.784192 -10.775758 -35.998394 -111.851312 -334.419693
0.000000 -0.000000 -0.530221 -3.103803 -12.559161 -43.742631 -141.145699 -436.267482
0.000000 -0.000000 -0.482644 -2.943413 -12.419364 -45.054868 -151.047958 -483.457480
0.000000 -0.000000 -0.385066 -2.285023 -9.953167 -27.813505 -132.607048 -442.871914
0.000000 -0.000000 -0.147489 -0.990634 -4.718970 -19.474542 -74.076411 -266.963825
0.000000 -0.000000 0.140088 0.897756 3.763227 12.966822 39.615954 110.522222
0.000000 -0.000000 0.507665 3.458146 16.011824 63.014585 227.443487 779.603584
b[i]=
-2546.324090 2884.132749 -79.387243 -303.388190 -496.327147 -637.348997 -695.405727 -625.855724 -366.371871 167.906068 1090.039291
Householder vector=
0.000000 0.000000 -1.364618 -0.385375 -0.497798 -0.530221 -0.482644 -0.355066
A[i]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
0.000000 2.097618 8.390471 26.664916 79.071797 228.801426 656.725505 1882.381017
0.000000 0.000000 1.171665 7.029993 29.291637 105.449893 352.626318 1131.198968
0.000000 0.000000 0.000000 0.206034 1.645876 8.427885 35.362397 132.796817
0.000000 -0.000000 0.000000 0.107479 0.952869 5.320779 23.994745 95.684256
0.000000 -0.000000 0.000000 -0.023790 -0.066620 0.267761 3.548343 21.850183
0.000000 -0.000000 0.000000 -0.139772 -1.047791 -4.993571 -19.337450 -66.447150
0.000000 -0.000000 0.000000 -0.192469 -1.587443 -8.341615 -35.711594 -136.089970
0.000000 -0.000000 0.000000 -0.123880 -1.243977 -7.232371 -33.827528 -139.531320
0.000000 -0.000000 -0.000000 0.083994 0.462607 1.338959 1.368747 -10.515763
0.000000 -0.000000 -0.000000 0.509155 4.050710 20.876377 88.904671 340.974057
b[i]=
-2546.324090 2884.132749 1626.768474 178.439009 126.060129 25.575877 -91.965734 -181.923091 -181.969077 -7.243456 455.314970
Householder vector=
0.000000 0.000000 0.000000 0.834816 0.107479 -0.023790 -0.139772 -0.192469
A[i]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
0.000000 2.097618 8.390471 26.664916 79.071797 228.801426 656.725505 1882.381017
0.000000 0.000000 1.171665 7.029993 29.291637 105.449893 352.626318 1131.198968
0.000000 0.000000 0.000000 -0.628782 -5.030253 -25.947724 -110.162550 -419.877784
0.000000 -0.000000 0.000000 0.000000 0.093343 0.895055 5.258980 24.529571
0.000000 -0.000000 0.000000 -0.000000 0.123628 1.247354 7.695329 37.599607
0.000000 -0.000000 0.000000 -0.000000 0.069987 0.761905 5.027653 26.086634
0.000000 -0.000000 0.000000 -0.000000 0.048240 -0.416210 -2.160362 -8.669111
0.000000 -0.000000 0.000000 -0.000000 -0.173318 -1.719512 -10.489512 -50.898207
0.000000 -0.000000 -0.000000 0.000000 -0.209107 -2.119720 -13.255150 -66.122754
0.000000 -0.000000 -0.000000 0.000000 -0.021071 -0.089354 0.148809 3.897069
b[i]=
-2546.324090 2884.132749 1626.768474 -561.647094 30.776949 46.665918 31.946180 -11.293924 -63.280549 -81.706731 3.935454
Householder vector=
0.000000 0.000000 0.000000 0.000000 0.000000 0.418045 0.123628 0.069987 -0.048240
A[i]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
0.000000 2.097618 8.390471 26.664916 79.071797 228.801426 656.725505 1882.381017
0.000000 0.000000 1.171665 7.029993 29.291637 105.449893 352.626318 1131.198968
0.000000 0.000000 0.000000 -0.628782 -5.030253 -25.947724 -110.162550 -419.877784
0.000000 -0.000000 0.000000 0.000000 0.324701 -3.247015 -19.972092 -97.776466
0.000000 -0.000000 0.000000 -0.000000 0.000000 0.022424 0.233774 1.430183
0.000000 -0.000000 0.000000 -0.000000 0.000000 0.068456 0.803567 5.610638
0.000000 -0.000000 0.000000 -0.000000 -0.000000 0.061764 0.751181 5.444413
0.000000 -0.000000 0.000000 -0.000000 -0.000000 -0.002247 -0.028931 -0.191198
0.000000 -0.000000 -0.000000 0.000000 -0.000000 -0.047847 -0.634507 -4.944981
0.000000 -0.000000 -0.000000 0.000000 -0.000000 0.119418 1.420525 10.061634
b[i]=
-2546.324090 2884.132749 1626.768474 -561.647094 -121.320274 1.686381 6.482661 6.257359 -0.222375 -5.627335 11.601578
Householder vector=
0.000000 0.000000 0.000000 0.000000 0.000000 0.182296 0.068456 0.061764
A[i]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
```

```
D:\GD\数值分析\HW\HW4\QRmethod_On\QR\Debug\QR.exe
A[i]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
0.000000 2.097618 8.390471 26.664916 79.071797 228.801426 656.725505 1882.381017
0.000000 0.000000 1.171665 7.029993 29.291637 105.449893 352.626318 1131.198968
0.000000 0.000000 0.000000 0.206034 1.645876 8.427885 35.362397 132.796817
0.000000 -0.000000 0.000000 0.107479 0.952869 5.320779 23.994745 95.684256
0.000000 -0.000000 0.000000 -0.023790 -0.066620 0.267761 3.548343 21.850183
0.000000 -0.000000 0.000000 -0.139772 -1.047791 -4.993571 -19.337450 -66.447150
0.000000 -0.000000 0.000000 -0.192469 -1.587443 -8.341615 -35.711594 -136.089970
0.000000 -0.000000 0.000000 -0.123880 -1.243977 -7.232371 -33.827528 -139.531320
0.000000 -0.000000 -0.000000 0.083994 0.462607 1.338959 1.368747 -10.515763
0.000000 -0.000000 -0.000000 0.509155 4.050710 20.876377 88.904671 340.974057
b[i]=
-2546.324090 2884.132749 1626.768474 178.439009 126.060129 25.575877 -91.965734 -181.923091 -181.969077 -7.243456 455.314970
Householder vector=
0.000000 0.000000 0.000000 0.834816 0.107479 -0.023790 -0.139772 -0.192469
A[i]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
0.000000 2.097618 8.390471 26.664916 79.071797 228.801426 656.725505 1882.381017
0.000000 0.000000 1.171665 7.029993 29.291637 105.449893 352.626318 1131.198968
0.000000 0.000000 0.000000 -0.628782 -5.030253 -25.947724 -110.162550 -419.877784
0.000000 -0.000000 0.000000 0.000000 0.093343 0.895055 5.258980 24.529571
0.000000 -0.000000 0.000000 -0.000000 0.123628 1.247354 7.695329 37.599607
0.000000 -0.000000 0.000000 -0.000000 0.069987 0.761905 5.027653 26.086634
0.000000 -0.000000 0.000000 -0.000000 0.048240 -0.416210 -2.160362 -8.669111
0.000000 -0.000000 0.000000 -0.000000 -0.173318 -1.719512 -10.489512 -50.898207
0.000000 -0.000000 -0.000000 0.000000 -0.209107 -2.119720 -13.255150 -66.122754
0.000000 -0.000000 -0.000000 0.000000 -0.021071 -0.089354 0.148809 3.897069
b[i]=
-2546.324090 2884.132749 1626.768474 -561.647094 30.776949 46.665918 31.946180 -11.293924 -63.280549 -81.706731 3.935454
Householder vector=
0.000000 0.000000 0.000000 0.000000 0.000000 0.182296 0.068456 0.061764
A[i]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
```

```
D:\GD\数值分析\HW\HW4\QRmethod_On\QR\Debug\QR.exe
A[ ]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
0.000000 2.097618 8.390471 26.664916 79.071797 228.801426 656.725505 1882.381017
0.000000 0.000000 1.171665 7.029993 29.291637 105.449893 352.626318 1131.198968
0.000000 0.000000 0.000000 -0.628782 -5.030253 -25.947724 -110.162550 -419.877784
0.000000 -0.000000 0.000000 0.000000 -0.324701 -3.247015 -19.972092 -97.776466
0.000000 -0.000000 0.000000 -0.000000 0.000000 -0.159872 -1.918463 -13.704715
0.000000 -0.000000 0.000000 -0.000000 0.000000 0.000000 -0.004645 -0.072842
0.000000 -0.000000 0.000000 -0.000000 -0.000000 0.000000 0.021974 0.316503
0.000000 -0.000000 0.000000 -0.000000 -0.000000 0.000000 -0.002407 -0.004676
0.000000 -0.000000 -0.000000 0.000000 -0.000000 0.000000 -0.069612 -0.972539
0.000000 -0.000000 -0.000000 0.000000 -0.000000 0.000000 0.010640 0.147083
-----
b[ ]=
-2546.324090 2884.132749 1626.768474 -561.647094 -121.320274 -15.783051 -0.077487 0.338477 -0.007083 -1.042151 0.157723
-----
Householder vector=
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 -0.078599 0.021974
A[ ]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
0.000000 2.097618 8.390471 26.664916 79.071797 228.801426 656.725505 1882.381017
0.000000 0.000000 1.171665 7.029993 29.291637 105.449893 352.626318 1131.198968
0.000000 0.000000 0.000000 -0.628782 -5.030253 -25.947724 -110.162550 -419.877784
0.000000 -0.000000 0.000000 0.000000 -0.324701 -3.247015 -19.972092 -97.776466
0.000000 -0.000000 0.000000 -0.000000 0.000000 -0.159872 -1.918463 -13.704715
0.000000 -0.000000 0.000000 -0.000000 0.000000 0.000000 0.073955 1.035364
0.000000 -0.000000 0.000000 -0.000000 -0.000000 0.000000 0.000000 0.006679
0.000000 -0.000000 0.000000 -0.000000 -0.000000 0.000000 -0.000000 0.029259
0.000000 -0.000000 0.000000 -0.000000 -0.000000 0.000000 -0.000000 0.008953
0.000000 -0.000000 -0.000000 0.000000 -0.000000 0.000000 0.000000 -0.002939
-----
b[ ]=
-2546.324090 2884.132749 1626.768474 -561.647094 -121.320274 -15.783051 1.109318 0.006679 0.029259 0.008953 -0.002939
-----
After QR decomposition, A[ ]=
-3.316625 -6.633250 -14.593149 -34.492898 -85.850169 -221.709734 -588.126196 -1591.602069
0.000000 2.097618 8.390471 26.664916 79.071797 228.801426 656.725505 1882.381017
0.000000 0.000000 1.171665 7.029993 29.291637 105.449893 352.626318 1131.198968
0.000000 0.000000 0.000000 -0.628782 -5.030253 -25.947724 -110.162550 -419.877784
0.000000 -0.000000 0.000000 0.000000 -0.324701 -3.247015 -19.972092 -97.776466
0.000000 -0.000000 0.000000 -0.000000 0.000000 -0.159872 -1.918463 -13.704715
0.000000 -0.000000 0.000000 -0.000000 0.000000 0.000000 0.073955 1.035364
0.000000 -0.000000 0.000000 -0.000000 -0.000000 0.000000 0.000000 0.006679
0.000000 -0.000000 0.000000 -0.000000 -0.000000 0.000000 -0.000000 0.029259
0.000000 -0.000000 0.000000 -0.000000 -0.000000 0.000000 -0.000000 0.008953
0.000000 -0.000000 -0.000000 0.000000 -0.000000 0.000000 0.000000 -0.002939
-----
The solution c[ ]=
1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000
Error in 2-norm : 0.000000
Error in infinite-norm : 0.000000
-
```

B.





C.

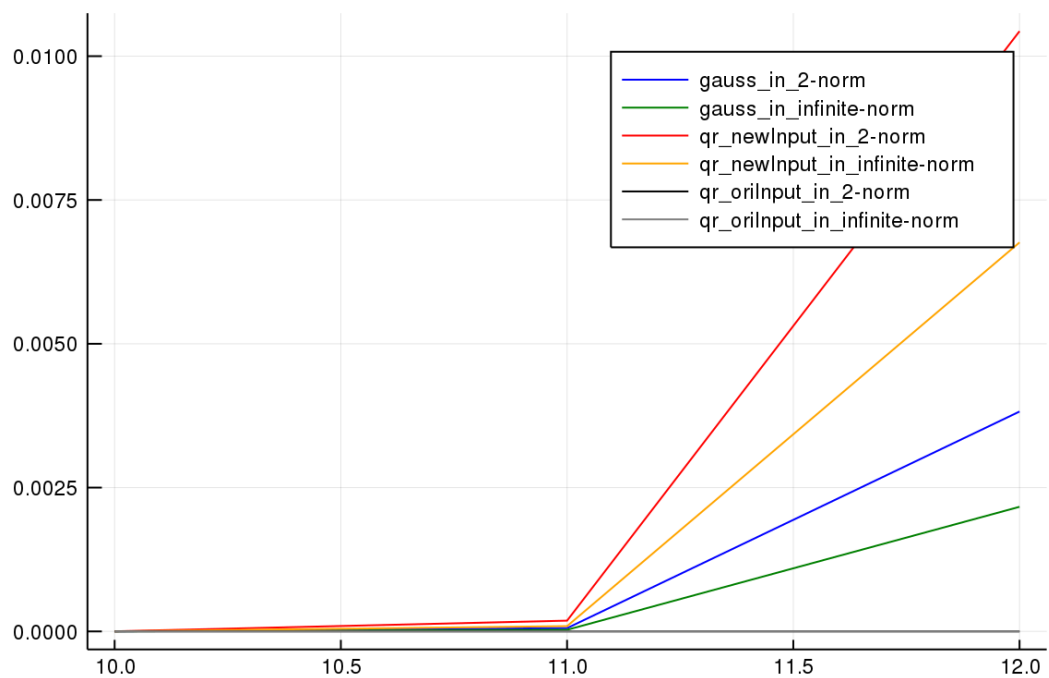
QR 在解原系統時的表現良好，誤差為零。

由第一張圖可知誤差 $\text{gauss} > \text{qr_new} > \text{qr_ori}$

D.

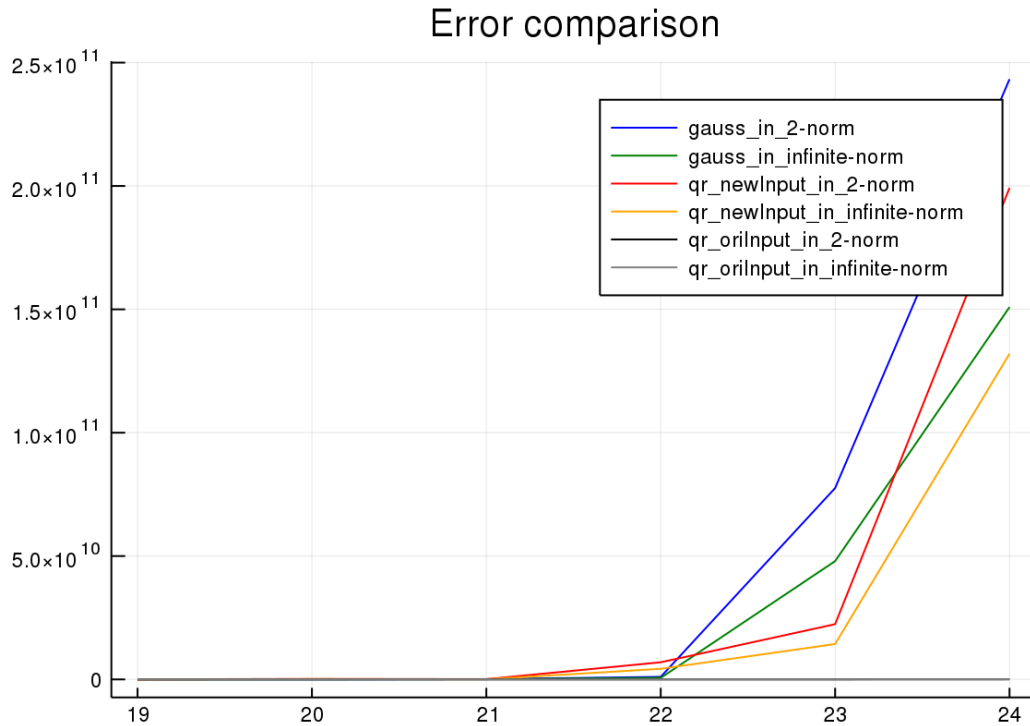
1. gauss_solver 在解新系統時誤差為 $m = 13, n = 9$ ，2-norm error = 0.8425672
- qr_solver 在解新系統的時候誤差在 $m = 13, n = 9$ 時 2-norm error = 7.28984
3. qr_solver 在解原系統的時候誤差在 $m = 13, n = 9$ 時 2-norm error = 0
4. qr_solver 在解原系統的時候誤差在 $m = 19, n = 15$ 時 2-norm error = 4.87069

Error comparison



E. 更多比較

1. $19 \leq m \leq 24, n = m - 4$



由此圖可以觀察出 `qr_solver` 在一開始失去精準度時的速度是比 `gauss_solver` 慢的，可是多了三個 degree 和三個 sample point 後可以看出 `qr_solver` 的發散速度會大於 `gauss_solver`。

2. 在原系統比較兩種 solver 的誤差，方陣大小 $19 \leq m \leq 21, n = m$

