

Homework1

Problem 1

We've known that $A \cdot A^{-1} = I$, based on the property of Identity matrix. Thus we have $(A \cdot A^{-1})^T = I^T = I$. Therefore, $(A^{-1})^T \cdot A^T = I$, based on the property of transpose. Because $(A^T)^{-1} \cdot A^T = I$, we can prove that $(A^{-1})^T = (A^T)^{-1}$.

Problem 2

```
A = matrix(c(1,1,1,1,0.45,-0.55,0,0,0.25,-0.75,0.25,0.25,0.14,0.2,0.2,0.1),4,4,byrow = TRUE)
Y = c(250,0,0,0.15*250)
solve(A) %*% Y

##           [,1]
## [1,] 76.38889
## [2,] 62.50000
## [3,] 31.94444
## [4,] 79.16667
```

Problem 3

- Choose

Variant 1,2,3,4 as x_1, x_2, x_3, x_4 .

- to maximize

$$1.5x_1 + 2.5x_2 + 3x_3 + 4.5x_4$$

- subject to

$$2x_1 + 4x_2 + 3x_3 + 7x_4 \leq 100,000$$

$$3x_1 + 2x_2 + 3x_3 + 4x_4 \leq 50,000$$

$$2x_1 + 3x_2 + 2x_3 + 5x_4 \leq 60,000$$

$$x_1, x_2, x_3, x_4 \geq 0$$

Problem 4

part a

```
A = matrix(rep(0,400),20,20,byrow = TRUE)
for (i in (1:20)) {
  for (j in (1:20)) {
    if (i<=j){
      A[i,j] = i/j
    } else {A[i,j] = j/i}
  }
}
```

```

}
}
A

```

```

##          [,1]      [,2]      [,3]      [,4]      [,5]      [,6]
## [1,] 1.00000000 0.5000000 0.3333333 0.2500000 0.2000000 0.1666667
## [2,] 0.50000000 1.0000000 0.6666667 0.5000000 0.4000000 0.3333333
## [3,] 0.33333333 0.6666667 1.0000000 0.7500000 0.6000000 0.5000000
## [4,] 0.25000000 0.5000000 0.7500000 1.0000000 0.8000000 0.6666667
## [5,] 0.20000000 0.4000000 0.6000000 0.8000000 1.0000000 0.8333333
## [6,] 0.16666667 0.3333333 0.5000000 0.6666667 0.8333333 1.0000000
## [7,] 0.14285714 0.2857143 0.4285714 0.5714286 0.7142857 0.8571429
## [8,] 0.12500000 0.2500000 0.3750000 0.5000000 0.6250000 0.7500000
## [9,] 0.11111111 0.2222222 0.3333333 0.4444444 0.5555556 0.6666667
## [10,] 0.10000000 0.2000000 0.3000000 0.4000000 0.5000000 0.6000000
## [11,] 0.09090909 0.1818182 0.2727273 0.3636364 0.4545455 0.5454545
## [12,] 0.08333333 0.1666667 0.2500000 0.3333333 0.4166667 0.5000000
## [13,] 0.07692308 0.1538462 0.2307692 0.3076923 0.3846154 0.4615385
## [14,] 0.07142857 0.1428571 0.2142857 0.2857143 0.3571429 0.4285714
## [15,] 0.06666667 0.1333333 0.2000000 0.2666667 0.3333333 0.4000000
## [16,] 0.06250000 0.1250000 0.1875000 0.2500000 0.3125000 0.3750000
## [17,] 0.05882353 0.1176471 0.1764706 0.2352941 0.2941176 0.3529412
## [18,] 0.05555556 0.1111111 0.1666667 0.2222222 0.2777778 0.3333333
## [19,] 0.05263158 0.1052632 0.1578947 0.2105263 0.2631579 0.3157895
## [20,] 0.05000000 0.1000000 0.1500000 0.2000000 0.2500000 0.3000000
##          [,7]      [,8]      [,9]      [,10]     [,11]     [,12]
## [1,] 0.1428571 0.1250000 0.1111111 0.1000000 0.09090909 0.08333333
## [2,] 0.2857143 0.2500000 0.2222222 0.2000000 0.18181818 0.16666667
## [3,] 0.4285714 0.3750000 0.3333333 0.3000000 0.27272727 0.25000000
## [4,] 0.5714286 0.5000000 0.4444444 0.4000000 0.36363636 0.33333333
## [5,] 0.7142857 0.6250000 0.5555556 0.5000000 0.45454545 0.41666667
## [6,] 0.8571429 0.7500000 0.6666667 0.6000000 0.54545455 0.50000000
## [7,] 1.0000000 0.8750000 0.7777778 0.7000000 0.63636364 0.58333333
## [8,] 0.8750000 1.0000000 0.8888889 0.8000000 0.72727273 0.66666667
## [9,] 0.7777778 0.8888889 1.0000000 0.9000000 0.81818182 0.75000000
## [10,] 0.7000000 0.8000000 0.9000000 1.0000000 0.90909091 0.83333333
## [11,] 0.6363636 0.7272727 0.8181818 0.9090909 1.00000000 0.91666667
## [12,] 0.5833333 0.6666667 0.7500000 0.8333333 0.91666667 1.00000000
## [13,] 0.5384615 0.6153846 0.6923077 0.7692308 0.84615385 0.92307692
## [14,] 0.5000000 0.5714286 0.6428571 0.7142857 0.78571429 0.85714286
## [15,] 0.4666667 0.5333333 0.6000000 0.6666667 0.73333333 0.80000000
## [16,] 0.4375000 0.5000000 0.5625000 0.6250000 0.68750000 0.75000000
## [17,] 0.4117647 0.4705882 0.5294118 0.5882353 0.64705882 0.70588235
## [18,] 0.3888889 0.4444444 0.5000000 0.5555556 0.61111111 0.66666667
## [19,] 0.3684211 0.4210526 0.4736842 0.5263158 0.57894737 0.63157895
## [20,] 0.3500000 0.4000000 0.4500000 0.5000000 0.55000000 0.60000000
##          [,13]     [,14]     [,15]     [,16]     [,17]     [,18]
## [1,] 0.07692308 0.07142857 0.06666667 0.0625000 0.05882353 0.05555556
## [2,] 0.15384615 0.14285714 0.13333333 0.1250000 0.11764706 0.11111111
## [3,] 0.23076923 0.21428571 0.20000000 0.1875000 0.17647059 0.16666667
## [4,] 0.30769231 0.28571429 0.26666667 0.2500000 0.23529412 0.22222222
## [5,] 0.38461538 0.35714286 0.33333333 0.3125000 0.29411765 0.27777778
## [6,] 0.46153846 0.42857143 0.40000000 0.3750000 0.35294118 0.33333333

```

```
## [7,] 0.53846154 0.50000000 0.46666667 0.4375000 0.41176471 0.38888889
## [8,] 0.61538462 0.57142857 0.53333333 0.5000000 0.47058824 0.44444444
## [9,] 0.69230769 0.64285714 0.60000000 0.5625000 0.52941176 0.50000000
## [10,] 0.76923077 0.71428571 0.66666667 0.6250000 0.58823529 0.55555556
## [11,] 0.84615385 0.78571429 0.73333333 0.6875000 0.64705882 0.61111111
## [12,] 0.92307692 0.85714286 0.80000000 0.7500000 0.70588235 0.66666667
## [13,] 1.00000000 0.92857143 0.86666667 0.8125000 0.76470588 0.72222222
## [14,] 0.92857143 1.00000000 0.93333333 0.8750000 0.82352941 0.77777778
## [15,] 0.86666667 0.93333333 1.00000000 0.9375000 0.88235294 0.83333333
## [16,] 0.81250000 0.87500000 0.93750000 1.0000000 0.94117647 0.88888889
## [17,] 0.76470588 0.82352941 0.88235294 0.9411765 1.00000000 0.94444444
## [18,] 0.72222222 0.77777778 0.83333333 0.8888889 0.94444444 1.00000000
## [19,] 0.68421053 0.73684211 0.78947368 0.8421053 0.89473684 0.94736842
## [20,] 0.65000000 0.70000000 0.75000000 0.8000000 0.85000000 0.90000000
##      [,19] [,20]
## [1,] 0.05263158 0.05
## [2,] 0.10526316 0.10
## [3,] 0.15789474 0.15
## [4,] 0.21052632 0.20
## [5,] 0.26315789 0.25
## [6,] 0.31578947 0.30
## [7,] 0.36842105 0.35
## [8,] 0.42105263 0.40
## [9,] 0.47368421 0.45
## [10,] 0.52631579 0.50
## [11,] 0.57894737 0.55
## [12,] 0.63157895 0.60
## [13,] 0.68421053 0.65
## [14,] 0.73684211 0.70
## [15,] 0.78947368 0.75
## [16,] 0.84210526 0.80
## [17,] 0.89473684 0.85
## [18,] 0.94736842 0.90
## [19,] 1.00000000 0.95
## [20,] 0.95000000 1.00
```

part b Test whether A is symmetric or not.

```
test = 0
for (i in (1:20)) {
  for (j in (1:20)) {
    if (A[i,j] == A [j,i]) {
      test = test + 1
    }
  }
}
test == 20 * 20 #Thus A is symmetric
```

```
## [1] TRUE
```

part c

```
C = solve(A)
C
```

```
##          [,1]          [,2]          [,3]          [,4]
## [1,]  1.333333e+00 -6.666667e-01  1.110223e-16 -7.401487e-17
## [2,] -6.666667e-01  2.133333e+00 -1.200000e+00  1.480297e-16
## [3,] -1.413082e-32 -1.200000e+00  3.085714e+00 -1.714286e+00
## [4,]  4.979293e-32 -2.044220e-16 -1.714286e+00  4.063492e+00
## [5,] -7.524744e-32 -3.140025e-16  8.635068e-16 -2.222222e+00
## [6,]  1.557983e-31  4.821318e-16 -9.735802e-16  1.965793e-15
## [7,] -3.053043e-31 -1.833291e-16  3.586874e-16  3.347749e-16
## [8,]  1.848893e-31 -3.483053e-18 -2.351061e-16 -1.980115e-15
## [9,]  1.248003e-31 -3.093501e-18  2.381996e-16  2.001495e-15
## [10,] 7.269317e-17 -1.481689e-16 -5.787629e-16  1.085180e-16
## [11,] -1.529717e-16 -1.517075e-17  1.863474e-15 -4.043005e-15
## [12,]  7.964643e-17  1.592929e-16 -1.449855e-15  3.569319e-15
## [13,] -3.119139e-31  1.870931e-16 -1.496745e-17 -6.885028e-16
## [14,]  5.974151e-31 -1.880857e-16 -1.389551e-17  4.059474e-16
## [15,] -4.183917e-31 -9.262150e-19  4.167967e-16  2.445208e-16
## [16,]  5.719331e-17 -3.440281e-16  4.714378e-16 -2.246926e-15
## [17,] -1.180633e-16  7.075629e-16 -1.659423e-15  2.334304e-15
## [18,]  6.066576e-17 -3.647661e-16  9.714237e-16 -9.822259e-16
## [19,]  7.778034e-32 -7.309161e-19  7.309161e-19  1.611670e-15
## [20,] -3.034080e-31 -1.423363e-17  1.423363e-17 -1.366428e-15
##          [,5]          [,6]          [,7]          [,8]
## [1,]  7.401487e-17  3.700743e-17 -7.401487e-17  3.700743e-17
## [2,] -2.812565e-16  1.924387e-16  1.480297e-16 -1.184238e-16
## [3,]  1.998401e-16 -1.617754e-16 -1.903239e-16  4.948423e-16
## [4,] -2.222222e+00  1.015061e-15  5.004815e-16 -2.297985e-15
## [5,]  5.050505e+00 -2.727273e+00 -3.083953e-16  3.016667e-15
## [6,] -2.727273e+00  6.041958e+00 -3.230769e+00 -4.360149e-15
## [7,] -1.339100e-15 -3.230769e+00  7.035897e+00 -3.733333e+00
## [8,]  4.942452e-15 -5.673893e-15 -3.733333e+00  8.031373e+00
## [9,] -3.078033e-15 -2.883143e-15  8.315330e-15 -4.235294e+00
## [10,] -1.182568e-15  8.826134e-15 -1.324477e-14  4.883312e-15
## [11,]  4.022777e-15 -6.634674e-15  1.472574e-14 -8.783864e-15
## [12,] -3.241465e-15  5.670826e-15 -2.354291e-14  2.504431e-14
## [13,]  6.970556e-16 -5.751778e-15  2.542115e-14 -3.232114e-14
## [14,] -7.999845e-16  7.041054e-15 -1.892866e-14  2.627046e-14
## [15,] -4.779269e-16 -5.301655e-15  8.471162e-15 -1.470088e-14
## [16,]  3.131632e-15 -7.119319e-17 -4.297638e-16  5.275242e-15
## [17,] -8.546314e-16 -6.699787e-17 -9.706521e-16 -1.830186e-15
## [18,] -4.560059e-16  4.498332e-16  7.130975e-15 -9.748958e-15
## [19,] -1.324420e-15 -3.819767e-15 -5.090099e-15  1.626727e-14
## [20,]  8.540177e-16  4.440892e-15 -1.423363e-15 -6.291264e-15
##          [,9]          [,10]          [,11]          [,12]
## [1,] -1.110223e-16  1.480297e-16 -2.590520e-16  1.664003e-31
## [2,]  4.440892e-16 -1.628327e-16  2.960595e-17  8.881784e-17
## [3,] -5.709718e-16 -8.659740e-16  1.636786e-15 -7.993606e-16
## [4,]  2.488309e-15  9.375217e-16 -4.807442e-15  3.454027e-15
## [5,] -3.067131e-15 -2.181196e-15  6.369764e-15 -4.317534e-15
## [6,] -2.496837e-15  9.307240e-15 -9.055693e-15  7.532436e-15
```

```

## [7,] 4.184687e-15 -1.131061e-14 1.494531e-14 -2.080786e-14
## [8,] -4.235294e+00 -1.421085e-15 -6.687461e-15 1.984992e-14
## [9,] 9.027864e+00 -4.736842e+00 -8.463818e-15 3.641050e-15
## [10,] -4.736842e+00 1.002506e+01 -5.238095e+00 -1.168656e-14
## [11,] -3.135288e-15 -5.238095e+00 1.102277e+01 -5.739130e+00
## [12,] -5.057983e-15 -3.005132e-15 -5.739130e+00 1.202087e+01
## [13,] 1.965440e-14 -1.554904e-14 9.934111e-15 -6.240000e+00
## [14,] -2.404122e-14 2.238567e-14 -2.808084e-14 1.270844e-14
## [15,] 1.726465e-14 -5.379457e-15 1.268915e-14 -2.252184e-14
## [16,] -3.302669e-15 -1.532390e-14 1.264808e-14 2.028311e-14
## [17,] 1.274594e-16 3.212630e-15 3.490426e-15 -3.057718e-14
## [18,] 2.685882e-15 1.189165e-14 -2.803009e-14 4.085226e-14
## [19,] -6.244947e-15 -4.096054e-15 6.765359e-15 -8.735909e-15
## [20,] 1.622634e-15 1.708035e-16 7.401487e-15 -1.024821e-14
##      [,13]      [,14]      [,15]      [,16]
## [1,] -2.220446e-16 1.110223e-16 2.220446e-16 -3.700743e-17
## [2,] 3.552714e-16 -3.996803e-16 -1.776357e-16 -2.812565e-16
## [3,] -2.474211e-16 2.188725e-16 -1.141944e-16 7.708120e-16
## [4,] -1.268826e-15 2.608143e-16 9.022765e-16 -2.735026e-15
## [5,] 1.211152e-15 6.111834e-16 -2.512020e-15 3.072738e-15
## [6,] -5.398945e-15 3.582216e-15 -3.726623e-17 7.080583e-16
## [7,] 1.993904e-14 -1.330730e-14 -3.188333e-17 -1.673875e-15
## [8,] -2.363948e-14 1.700078e-14 9.125598e-16 -4.702121e-16
## [9,] 1.055812e-14 -1.161610e-14 -3.093501e-17 4.210254e-15
## [10,] -4.671841e-15 1.165039e-14 1.716811e-15 -1.746584e-14
## [11,] 6.396999e-16 -1.468781e-14 1.241473e-15 2.873087e-14
## [12,] -6.240000e+00 6.950962e-15 -4.884209e-15 -4.207649e-15
## [13,] 1.301926e+01 -6.740741e+00 -6.004086e-15 -1.575004e-14
## [14,] -6.740741e+00 1.401788e+01 -7.241379e+00 4.029698e-15
## [15,] 2.294790e-14 -7.241379e+00 1.501669e+01 -7.741935e+00
## [16,] -3.361013e-14 4.495068e-14 -7.741935e+00 1.601564e+01
## [17,] 2.919800e-14 -2.321721e-14 3.153802e-14 -8.242424e+00
## [18,] -1.974019e-14 5.836258e-15 -1.293946e-14 5.999834e-15
## [19,] 4.017115e-15 -7.560596e-15 -1.385817e-15 2.937405e-14
## [20,] 5.124106e-16 1.041902e-14 1.076062e-14 -3.416071e-14
##      [,17]      [,18]      [,19]      [,20]
## [1,] -7.401487e-17 1.110223e-16 1.110223e-16 1.480297e-16
## [2,] 5.033011e-16 -1.332268e-16 -1.051815e-30 -2.516506e-16
## [3,] -1.199041e-15 -8.564578e-17 4.758099e-16 -6.661338e-17
## [4,] 2.615192e-15 3.313046e-16 -1.903239e-16 -4.440892e-16
## [5,] -1.149473e-15 -1.149473e-15 5.046468e-17 -1.513940e-16
## [6,] -6.386500e-15 2.580686e-15 -1.392825e-15 3.461101e-15
## [7,] 1.505292e-14 -5.356399e-15 -7.771561e-16 -2.634360e-15
## [8,] -1.364660e-14 4.775265e-15 8.045852e-15 -3.869671e-15
## [9,] 1.132221e-15 3.715294e-15 -1.157588e-14 4.661906e-15
## [10,] 8.208416e-15 8.152766e-15 -6.341349e-15 2.237141e-15
## [11,] -6.983602e-15 -3.570689e-14 3.066261e-14 -7.737082e-15
## [12,] -1.034303e-14 3.890221e-14 -3.398557e-14 1.033608e-14
## [13,] 2.552164e-14 -2.322093e-14 1.503587e-14 -6.070371e-15
## [14,] -3.215421e-14 3.300383e-14 -1.283945e-14 2.350327e-15
## [15,] 3.617796e-14 -5.504681e-14 3.357344e-14 -1.782038e-15
## [16,] -8.242424e+00 4.034049e-14 -3.113226e-14 2.689713e-15
## [17,] 1.701472e+01 -8.742857e+00 2.236258e-14 -1.364632e-14
## [18,] -8.742857e+00 1.801390e+01 -9.243243e+00 -2.158274e-14

```

```
## [19,] -2.395650e-14 -9.243243e+00 1.901317e+01 -9.743590e+00
## [20,] 2.863806e-14 -3.871547e-14 -9.743590e+00 1.025641e+01
```

```
I = C * A
```

```
I #the matrix other than its diagonal approaches to 0,
```

```
##           [,1]           [,2]           [,3]           [,4]
## [1,] 1.333333e+00 -3.333333e-01 3.700743e-17 -1.850372e-17
## [2,] -3.333333e-01 2.133333e+00 -8.000000e-01 7.401487e-17
## [3,] -4.710274e-33 -8.000000e-01 3.085714e+00 -1.285714e+00
## [4,] 1.244823e-32 -1.022110e-16 -1.285714e+00 4.063492e+00
## [5,] -1.504949e-32 -1.256010e-16 5.181041e-16 -1.777778e+00
## [6,] 2.596638e-32 1.607106e-16 -4.867901e-16 1.310529e-15
## [7,] -4.361491e-32 -5.237975e-17 1.537232e-16 1.913000e-16
## [8,] 2.311116e-32 -8.707632e-19 -8.816477e-17 -9.900577e-16
## [9,] 1.386670e-32 -6.874446e-19 7.939985e-17 8.895533e-16
## [10,] 7.269317e-18 -2.963377e-17 -1.736289e-16 4.340722e-17
## [11,] -1.390652e-17 -2.758318e-18 5.082201e-16 -1.470184e-15
## [12,] 6.637203e-18 2.654881e-17 -3.624637e-16 1.189773e-15
## [13,] -2.399338e-32 2.878356e-17 -3.454027e-18 -2.118470e-16
## [14,] 4.267251e-32 -2.686938e-17 -2.977610e-18 1.159850e-16
## [15,] -2.789278e-32 -1.234953e-19 8.335935e-17 6.520553e-17
## [16,] 3.574582e-18 -4.300351e-17 8.839459e-17 -5.617316e-16
## [17,] -6.944902e-18 8.324270e-17 -2.928393e-16 5.492480e-16
## [18,] 3.370320e-18 -4.052957e-17 1.619040e-16 -2.182724e-16
## [19,] 4.093702e-33 -7.693853e-20 1.154078e-19 3.392989e-16
## [20,] -1.517040e-32 -1.423363e-18 2.135044e-18 -2.732857e-16
##           [,5]           [,6]           [,7]           [,8]
## [1,] 1.480297e-17 6.167906e-18 -1.057355e-17 4.625929e-18
## [2,] -1.125026e-16 6.414622e-17 4.229421e-17 -2.960595e-17
## [3,] 1.199041e-16 -8.088768e-17 -8.156741e-17 1.855658e-16
## [4,] -1.777778e+00 6.767074e-16 2.859894e-16 -1.148993e-15
## [5,] 5.050505e+00 -2.272727e+00 -2.202823e-16 1.885417e-15
## [6,] -2.272727e+00 6.041958e+00 -2.769231e+00 -3.270111e-15
## [7,] -9.564998e-16 -2.769231e+00 7.035897e+00 -3.266667e+00
## [8,] 3.089032e-15 -4.255420e-15 -3.266667e+00 8.031373e+00
## [9,] -1.710018e-15 -1.922095e-15 6.467479e-15 -3.764706e+00
## [10,] -5.912842e-16 5.295680e-15 -9.271336e-15 3.906649e-15
## [11,] 1.828535e-15 -3.618913e-15 9.370926e-15 -6.388265e-15
## [12,] -1.350610e-15 2.835413e-15 -1.373336e-14 1.669621e-14
## [13,] 2.680983e-16 -2.654667e-15 1.368831e-14 -1.988993e-14
## [14,] -2.857087e-16 3.017595e-15 -9.464332e-15 1.501169e-14
## [15,] -1.593090e-16 -2.120662e-15 3.953209e-15 -7.840472e-15
## [16,] 9.786350e-16 -2.669745e-17 -1.880216e-16 2.637621e-15
## [17,] -2.513622e-16 -2.364631e-17 -3.996803e-16 -8.612639e-16
## [18,] -1.266683e-16 1.499444e-16 2.773157e-15 -4.332870e-15
## [19,] -3.485316e-16 -1.206242e-15 -1.875300e-15 6.849376e-15
## [20,] 2.135044e-16 1.332268e-15 -4.981770e-16 -2.516506e-15
##           [,9]           [,10]           [,11]           [,12]
## [1,] -1.233581e-17 1.480297e-17 -2.355019e-17 1.386670e-32
## [2,] 9.868649e-17 -3.256654e-17 5.382900e-18 1.480297e-17
## [3,] -1.903239e-16 -2.597922e-16 4.463962e-16 -1.998401e-16
## [4,] 1.105915e-15 3.750087e-16 -1.748161e-15 1.151342e-15
## [5,] -1.703962e-15 -1.090598e-15 2.895347e-15 -1.798972e-15
## [6,] -1.664558e-15 5.584344e-15 -4.939469e-15 3.766218e-15
```

```

## [7,] 3.254756e-15 -7.917427e-15 9.510652e-15 -1.213792e-14
## [8,] -3.764706e+00 -1.136868e-15 -4.863608e-15 1.323328e-14
## [9,] 9.027864e+00 -4.263158e+00 -6.924942e-15 2.730788e-15
## [10,] -4.263158e+00 1.002506e+01 -4.761905e+00 -9.738798e-15
## [11,] -2.565236e-15 -4.761905e+00 1.102277e+01 -5.260870e+00
## [12,] -3.793487e-15 -2.504277e-15 -5.260870e+00 1.202087e+01
## [13,] 1.360689e-14 -1.196080e-14 8.405786e-15 -5.760000e+00
## [14,] -1.545507e-14 1.598976e-14 -2.206352e-14 1.089295e-14
## [15,] 1.035879e-14 -3.586304e-15 9.305373e-15 -1.801747e-14
## [16,] -1.857751e-15 -9.577437e-15 8.695553e-15 1.521233e-14
## [17,] 6.747849e-17 1.889782e-15 2.258511e-15 -2.158389e-14
## [18,] 1.342941e-15 6.606470e-15 -1.712950e-14 2.723484e-14
## [19,] -2.958133e-15 -2.155818e-15 3.916787e-15 -5.517416e-15
## [20,] 7.301851e-16 8.540177e-17 4.070818e-15 -6.148928e-15
##      [,13]      [,14]      [,15]      [,16]
## [1,] -1.708035e-17 7.930164e-18 1.480297e-17 -2.312965e-18
## [2,] 5.465713e-17 -5.709718e-17 -2.368476e-17 -3.515706e-17
## [3,] -5.709718e-17 4.690126e-17 -2.283887e-17 1.445272e-16
## [4,] -3.904081e-16 7.451837e-17 2.406071e-16 -6.837564e-16
## [5,] 4.658278e-16 2.182798e-16 -8.373399e-16 9.602308e-16
## [6,] -2.491821e-15 1.535235e-15 -1.490649e-17 2.655219e-16
## [7,] 1.073640e-14 -6.653652e-15 -1.487889e-17 -7.323202e-16
## [8,] -1.454737e-14 9.714731e-15 4.866986e-16 -2.351061e-16
## [9,] 7.309466e-15 -7.467490e-15 -1.856100e-17 2.368268e-15
## [10,] -3.593724e-15 8.321704e-15 1.144541e-15 -1.091615e-14
## [11,] 5.412846e-16 -1.154043e-14 9.104135e-16 1.975247e-14
## [12,] -5.760000e+00 5.957967e-15 -3.907367e-15 -3.155737e-15
## [13,] 1.301926e+01 -6.259259e+00 -5.203541e-15 -1.279690e-14
## [14,] -6.259259e+00 1.401788e+01 -6.758621e+00 3.525986e-15
## [15,] 1.988818e-14 -6.758621e+00 1.501669e+01 -7.258065e+00
## [16,] -2.730823e-14 3.933185e-14 -7.258065e+00 1.601564e+01
## [17,] 2.232788e-14 -1.912006e-14 2.782767e-14 -7.757576e+00
## [18,] -1.425681e-14 4.539312e-15 -1.078288e-14 5.333186e-15
## [19,] 2.748552e-15 -5.570965e-15 -1.094066e-15 2.473605e-14
## [20,] 3.330669e-16 7.293311e-15 8.070467e-15 -2.732857e-14
##      [,17]      [,18]      [,19]      [,20]
## [1,] -4.353816e-18 6.167906e-18 5.843279e-18 7.401487e-18
## [2,] 5.921189e-17 -1.480297e-17 -1.107173e-31 -2.516506e-17
## [3,] -2.115954e-16 -1.427430e-17 7.512787e-17 -9.992007e-18
## [4,] 6.153393e-16 7.362326e-17 -4.006820e-17 -8.881784e-17
## [5,] -3.380804e-16 -3.192981e-16 1.328018e-17 -3.784851e-17
## [6,] -2.254059e-15 8.602287e-16 -4.398396e-16 1.038330e-15
## [7,] 6.198260e-15 -2.083044e-15 -2.863207e-16 -9.220260e-16
## [8,] -6.421930e-15 2.122340e-15 3.387727e-15 -1.547869e-15
## [9,] 5.994113e-16 1.857647e-15 -5.483311e-15 2.097857e-15
## [10,] 4.828480e-15 4.529314e-15 -3.337552e-15 1.118571e-15
## [11,] -4.518801e-15 -2.182088e-14 1.775204e-14 -4.255395e-15
## [12,] -7.300963e-15 2.593481e-14 -2.146457e-14 6.201648e-15
## [13,] 1.951655e-14 -1.677067e-14 1.028770e-14 -3.945741e-15
## [14,] -2.647994e-14 2.566964e-14 -9.460649e-15 1.645229e-15
## [15,] 3.192173e-14 -4.587234e-14 2.650535e-14 -1.336528e-15
## [16,] -7.757576e+00 3.585821e-14 -2.621664e-14 2.151771e-15
## [17,] 1.701472e+01 -8.257143e+00 2.000863e-14 -1.159937e-14
## [18,] -8.257143e+00 1.801390e+01 -8.756757e+00 -1.942446e-14

```

```
## [19,] -2.143477e-14 -8.756757e+00 1.901317e+01 -9.256410e+00
## [20,] 2.434235e-14 -3.484392e-14 -9.256410e+00 1.025641e+01
#therefore, it is an Identity matrix
```

part d

```
d = c(1:10,10:1)
```

part e

```
x = solve(A) %*% C %*% d
x
```

```
##           [,1]
## [1,] -5.304478e-15
## [2,] 1.248443e-14
## [3,] 1.737561e-14
## [4,] -7.210962e-14
## [5,] 9.849542e-15
## [6,] -1.489992e-14
## [7,] 1.127494e-13
## [8,] -3.373619e-15
## [9,] -2.481203e+01
## [10,] 2.006424e+01
## [11,] 3.581375e+01
## [12,] -3.006263e+01
## [13,] -3.736996e-04
## [14,] -2.772044e-04
## [15,] -2.099688e-04
## [16,] -1.619541e-04
## [17,] -1.269228e-04
## [18,] -1.008779e-04
## [19,] 9.505933e+01
## [20,] -1.000629e+02
```