Contents

AMSC 460 - HW16

```
clear all; format compact; close all; syms f(x) x y z
```

Problem 1

(a) Using MATLAB's backslash command, find the solution to the normal equations $A^T Ax = A^T b$.

```
A = [1+10^(-8) -1;-1 1;1 -1]
b = [2;1;-1]
```

```
A =
    1.0000   -1.0000
   -1.0000    1.0000
    1.0000   -1.0000
b =
     2
     1
    -1
```

```
AT = A.';
B = AT*A;
C = AT*b;
x1 = B\C
```

```
Warning: Matrix is close to singular or badly scaled. Results may be
inaccurate. RCOND =  2.896879e-17.
x1 =
   1.0e+07 *
    5.7533
    5.7533
```

(b)Using MATLAB's \texttt{qr} command and backslash, find the solution to the triangular system $\widehat{R}x = (Q^T b)_{1:n}$. Compare this to the solution to the normal equations. How far apart are the answers? Compute the distance in a norm of your choice.

```
[Q,R] = qr(A)
```

```
Q =
   -0.5774   -0.8165   -0.0000
    0.5774   -0.4082    0.7071
   -0.5774    0.4082    0.7071
R =
   -1.7321    1.7321
         0   -0.0000
         0         0
```

```
Qt = Q.'
D = Qt*b
x2 = R\D
distance = abs(x1-x2)
norm(x1-x2)
```

```
Qt =
   -0.5774    0.5774   -0.5774
   -0.8165   -0.4082    0.4082
   -0.0000    0.7071    0.7071
D =
   -0.0000
   -2.4495
   -0.0000
x2 =
   1.0e+08 *
    3.0000
    3.0000
distance =
   1.0e+08 *
    2.4247
    2.4247
ans =
   3.4290e+08
```

(c)Using MATLAB's \texttt{cond} command, what are the condition numbers of A, A^TA, and $\widehat{R}$? Which condition number should we worry about in double precision floating point arithmetic? Which computed answer is more accurate?

```
cond(A)
```

```
ans =
   4.2426e+08
```

Condition number of A, \$AˆT

```
cond(B)
cond(R)
% Since all of the items are much larger than 1 so both moethods are bad
% Therefore the QR decomposition is more accurate
```

```
ans =
   1.7998e+16
ans =
   4.2426e+08
```