!!! Grader notice: Some of the tabbing for these matrices may appear messed up. I tried my best. Please assume they are proper matrices.

!!! I always specify the size of what the matrix should be in the "Results:"

1.

19x15

2.

17x13

3.

15x11

4.

(M-n)x(N-n)

5.

Work:

```
255*1   255*2   255*1       255     510     255

255*0   255*0   210*0   ->  0       0       0       ->  62

255*-1  255*-2  193*-2      -255    -510    -193


255*1   255*2   225*1       255     510     225

255*0   210*0   126*0   ->  0       0       0       -> 264

255*-1  193*-2  85*-1       -255    -386    -85


255*1   225*2   115*1       255     450     115

210*0   126*0   71*0    ->  0       0       0       -> 362

193*-1  85*-2   95*-1       -193    -170    -95


225*1   115*2   109*1       225     230     109

126*0   71*0    64*0    ->  0       0       0       -> 204

85*-1   95*-2   85*-1       -85     -190    -85


115*1   109*2   109*1       115     218     109

71*0    64*0    65*0    ->  0       0       0       -> 71

95*-1   85*-2   106*-1      -95     -170    -106
```

Result:

[62,264,362,204,71]

6.

All I did was plug the formula into a calculator and changed sigma to be 1.4,

and then evaluated x on the interval.

Results: The results are a 7x1 matrix, but I cant put the matrix glyph on my answer.

-3 : 0.02868

-2 : 0.10271

-1 : 0.22079

0 : 0.28495

1 : 0.22079

2 : 0.10271

3 : 0.02868

7.

With the sigma size of 1.4, the -3 to 3 boundary results in slightly over 2 (~2.14) sigmas. I think the size of seven is fine, ranging from [-3,-2,...,2,3]. By the time we hit either +/- 3 we see a value so close to zero it becomes pointless to consider anything past it. If for whatever reason we wanted 9 values ranging from -4 to 4, the coefficient would be a mere 0.00481. I believe this is overkill though. In basic statistics we generally use the 68-95-99.7 for normal distribution. Which leads me to believe anything under .02 is useless for most situations.

8.

Numbers obtained by taking the matrix from #6 and multiplying by 64 to find the closest integer number for the

numerator.

Results: 7x1 Matrix

2/64

7/64

14/64

18/64

14/64

7/64

2/64

9.

G = K7x1 * K1*7

G = MxM^T (matrix multiplied by its transformation)

Work:

c11 = 1/32 x 1/32 = 1/1024

c12 = 1/32 x 7/64 = 7/2048

c13 = 1/32 x 7/32 = 7/1024

c14 = 1/32 x 9/32 = 9/1024

c15 = 1/32 x 7/32 = 7/1024

c16 = 1/32 x 7/64 = 7/2048

c17 = 1/32 x 1/32 = 1/1024

c21 = 7/64 x 1/32 = 7/2048

c22 = 7/64 x 7/64 = 49/4096

c23 = 7/64 x 7/32 = 49/2048

c24 = 7/64 x 9/32 = 63/2048

c25 = 7/64 x 7/32 = 49/2048

c26 = 7/64 x 7/64 = 49/4096

c27 = 7/64 x 1/32 = 7/2048

c31 = 7/32 x 1/32 = 7/1024

c32 = 7/32 x 7/64 = 49/2048

c33 = 7/32 x 7/32 = 49/1024

c34 = 7/32 x 9/32 = 63/1024

c35 = 7/32 x 7/32 = 49/1024

c36 = 7/32 x 7/64 = 49/2048

c37 = 7/32 x 1/32 = 7/1024

c41 = 9/32 x 1/32 = 9/1024

c42 = 9/32 x 7/64 = 63/2048

c43 = 9/32 x 7/32 = 63/1024

c44 = 9/32 x 9/32 = 81/1024

c45 = 9/32 x 7/32 = 63/1024

c46 = 9/32 x 7/64 = 63/2048

c47 = 9/32 x 1/32 = 9/1024

c51 = 7/32 x 1/32 = 7/1024

c52 = 7/32 x 7/64 = 49/2048

c53 = 7/32 x 7/32 = 49/1024

c54 = 7/32 x 9/32 = 63/1024

c55 = 7/32 x 7/32 = 49/1024

c56 = 7/32 x 7/64 = 49/2048

c57 = 7/32 x 1/32 = 7/1024

c61 = 7/64 x 1/32 = 7/2048

c62 = 7/64 x 7/64 = 49/4096

c63 = 7/64 x 7/32 = 49/2048

c64 = 7/64 x 9/32 = 63/2048

c65 = 7/64 x 7/32 = 49/2048

c66 = 7/64 x 7/64 = 49/4096

c67 = 7/64 x 1/32 = 7/2048

c71 = 1/32 x 1/32 = 1/1024

c72 = 1/32 x 7/64 = 7/2048

c73 = 1/32 x 7/32 = 7/1024

c74 = 1/32 x 9/32 = 9/1024

c75 = 1/32 x 7/32 = 7/1024

c76 = 1/32 x 7/64 = 7/2048

c77 = 1/32 x 1/32 = 1/1024

Result: 7x7 Matrix.

| | | | | | | |
|---|---|---|---|---|---|---|
| 1/1024 | 7/2048 | 7/1024 | 9/1024 | 7/1024 | 7/2048 | 1/1024 |
| 7/2048 | 49/4096 | 49/2048 | 63/2048 | 49/2048 | 49/4096 | 7/2048 |
| 7/1024 | 49/2048 | 49/1024 | 63/1024 | 49/1024 | 49/2048 | 7/1024 |
| 9/1024 | 63/2048 | 63/1024 | 81/1024 | 63/1024 | 63/2048 | 9/1024 |
| 7/1024 | 49/2048 | 49/1024 | 63/1024 | 49/1024 | 49/2048 | 7/1024 |
| 7/2048 | 49/4096 | 49/2048 | 63/2048 | 49/2048 | 49/4096 | 7/2048 |
| 1/1024 | 7/2048 | 7/1024 | 9/1024 | 7/1024 | 7/2048 | 1/1024 |

10.

Take 2 time the original and then subtract the smoothing filter.

Two times the original can be defined as:

| | | | | | | |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The smoothing filter is defined as:

| | | | | | | |
|---|---|---|---|---|---|---|
| 1/1024 | 7/2048 | 7/1024 | 9/1024 | 7/1024 | 7/2048 | 1/1024 |
| 7/2048 | 49/4096 | 49/2048 | 63/2048 | 49/2048 | 49/4096 | 7/2048 |
| 7/1024 | 49/2048 | 49/1024 | 63/1024 | 49/1024 | 49/2048 | 7/1024 |
| 9/1024 | 63/2048 | 63/1024 | 81/1024 | 63/1024 | 63/2048 | 9/1024 |
| 7/1024 | 49/2048 | 49/1024 | 63/1024 | 49/1024 | 49/2048 | 7/1024 |
| 7/2048 | 49/4096 | 49/2048 | 63/2048 | 49/2048 | 49/4096 | 7/2048 |
| 1/1024 | 7/2048 | 7/1024 | 9/1024 | 7/1024 | 7/2048 | 1/1024 |

Result: 7x7 Matrix with a -1 scalar, note the c44 poition has a changed value (made negative because of the -1 matrix scalar)

$$
-1 \begin{vmatrix}
1/1024 & 7/2048 & 7/1024 & 9/1024 & 7/1024 & 7/2048 & 1/1024 \\
7/2048 & 49/4096 & 49/2048 & 63/2048 & 49/2048 & 49/4096 & 7/2048 \\
7/1024 & 49/2048 & 49/1024 & 63/1024 & 49/1024 & 49/2048 & 7/1024 \\
9/1024 & 63/2048 & 63/1024 & -1967/1024 & 63/1024 & 63/2048 & 9/1024 \\
7/1024 & 49/2048 & 49/1024 & 63/1024 & 49/1024 & 49/2048 & 7/1024 \\
7/2048 & 49/4096 & 49/2048 & 63/2048 & 49/2048 & 49/4096 & 7/2048 \\
1/1024 & 7/2048 & 7/1024 & 9/1024 & 7/1024 & 7/2048 & 1/1024
\end{vmatrix}
$$