CMPS 142 HW 1

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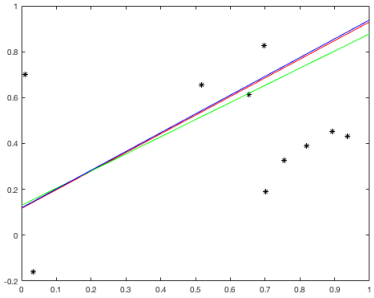
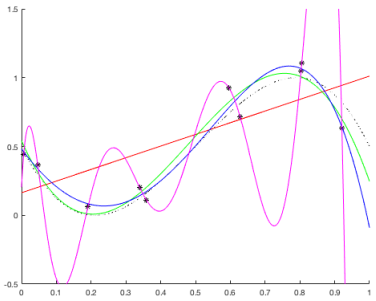
1 Question 1



Question 1 (d) C												
Generative Model 1	L(1) Error	L(2) Error	L(infinity) Error		Generative Model 2	L(1) Error	L(2) Error	L(infinity) Error		Generative Model 3	L(1) Error	L(2) Error	L(infinity) Error
w(1)	0.4662	0.0514	0.1341		w(1)	9.21	74.1891	8.6043		w(1)	0.1713	0.0052	0.0516
w(2)	0.4967	0.0504	0.1265		w(2)	14.9424	58.7843	6.7298		w(2)	0.1771	0.0051	0.0496
w(infinity)	0.5251	0.0508	0.1193		w(infinity)	37.5457	143.8511	4.3754		w(infinity)	0.194	0.0061	0.0394

Question 1 (d) D												
Generative Model 1	L(1) Error	L(2) Error	L(infinity) Error		Generative Model 2	L(1) Error	L(2) Error	L(infinity) Error		Generative Model 3	L(1) Error	L(2) Error	L(infinity) Error
w(1)	78.0787	9.6504	0.335		w(1)	1.0e+05 * 0.0047	1.0e+05 * 0.0528	1.0e+05 * 0.0005		w(1)	64.7068	9.2482	0.5458
w(2)	78.1169	9.6406	0.3357		w(2)	1.0e+05 * 0.0047	1.0e+05 * 0.0528	1.0e+05 * 0.0005		w(2)	61.0935	8.7973	0.5131
w(infinity)	82.4714	10.9106	0.3208		w(infinity)	1.0e+05 * 0.1463	1.0e+05 * 3.1099	1.0e+05 * 0.0004		w(infinity)	85.9879	12.6615	0.4268

2 Question 2



Question 2 (b) C			
Generative Model 1	L(2) Error	Generative Model 2	L(2) Error
c1	0.0239	c1	0.0808
c3	0.0024	c3	0.0063
c5	6.60E-06	c5	0.0013
c9	2.34E-12	c9	0.007

Question 2 (b) D			
Generative Model 1	L(2) Error	Generative Model 2	L(2) Error
c1	0.0631	c1	0.0511
c3	0.0353	c3	0.0093
c5	2.42E-02	c5	0.0092
c9	1.45E-02	c9	0.0092

3 Question 3

(a)

$$
\begin{aligned}
L2err &= \min_{w} \sum_{i=1}^{t} (\hat{x}_i - x_i)^2 \\
&= (\hat{y} - y)^T (\hat{y} - y) \\
&= (xw - y)^T (xw - y) \\
&= (w^T x^T - y^T)(xw - y) \\
&= w^T (x^T x) w - (w^T x^T) - (y^T xw) + (y^T y) \\
&= w^T (A) w - (w^T b) - (b^T w) + c \\
&= w^T (A) w - 2bw + c \\
&= Aw - 2b \\
\nabla f &= x^T xw - 2x^T y \\
H &= x^T x \\
&\forall z, z^T H z \geq 0 \\
&(z^T x^T)(xz) = 0 \\
&u^T u = \sum_{i=1}^{t} u_i^2 \geq 0
\end{aligned}
$$

(b)

The gradient and Hessian of $f(x)$ is respectively:

$$
\nabla f(x) = \begin{bmatrix} -400 * (x_2 - x_1^2) * x_1 - 2 * (1 - x_1) \\ 200 * (x_2 - x_1^2) \end{bmatrix}
$$

$$
\nabla^2 f(x) = \begin{bmatrix} -400 * (x_2 - 3 * x_1^2) + 2 & -400 * x_1 \\ -400 * x_1 & 200 \end{bmatrix}
$$

Next, we solve for $\nabla f(x) = 0$. We find that $x = (1, 1)^T$. Because $f(1, 1) = 0$ and $f \geq 0$, we can assume that f is a local minimum. When we plug in f(1, 1), we get:

$$
\begin{bmatrix} 802 & -400 \\ -400 & 200 \end{bmatrix}
$$

Because the eigenvalues are positive, x^* is the only local minimizer.