Mariana Kamel

ECE 619

HW #5

1) $$g(x) = \begin{bmatrix} x_1^2 - 0.1 x_1 x_2 \\ x_2^2 - 0.1 x_1 x_2 \end{bmatrix}$$

a) Newton - Raphson update:

$$x^{k+1} = x^k - \bar{J}(x^k)^{-1} \cdot g(x^k)$$

where $$\bar{J}(x^k) = \begin{bmatrix} \frac{dg_1}{dx_1} & \frac{dg_1}{dx_2} \\ \frac{dg_2}{dx_1} & \frac{dg_2}{dx_2} \end{bmatrix}$$

$$= \begin{bmatrix} \overset{a}{2x_1 - 0.1 x_2} & \overset{b}{-0.1 x_1} \\ \overset{c}{-0.1 x_2} & \overset{d}{2x_2 - 0.1 x_1} \end{bmatrix}$$

$$\bar{J}(x)^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$

$$\frac{1}{ad-bc} = \frac{5}{x_1^2 - 20x_1x_2 + x_2^2}$$

$$\therefore \bar{J}(x)^{-1} = \frac{5}{x_1^2 - 20x_1x_2 + x_2^2}\begin{bmatrix} 2x_2 - 0.1x_1 & 0.1x_1 \\ 0.1x_2 & 2x_1 - 0.1x_2 \end{bmatrix}$$

as long as $J(x)^{-1}$ exists then $g(x) = 0$ has a solution

b) see attached matlab file "hw5_1"

	iterations		
	1	2	3
$x =$	$\begin{bmatrix} 0.5 \\ 1 \end{bmatrix}$	$\begin{bmatrix} 0.25 \\ 0.5 \end{bmatrix}$	$\begin{bmatrix} 0.125 \\ 0.25 \end{bmatrix}$

c) $$\tilde{J}(x) = \begin{bmatrix} 2x_1 - 0.1x_2 & 0 \\ 0 & 2x_2 - 0.1x_1 \end{bmatrix}$$

d) see attached m file "hw5-1"

	iterations				
	1	2	3	4	5
$x =$	$\begin{bmatrix} 0.556 \\ 1.0256 \end{bmatrix}$	$\begin{bmatrix} 0.306 \\ 0.527 \end{bmatrix}$	$\begin{bmatrix} 0.167 \\ 0.271 \end{bmatrix}$	$\begin{bmatrix} 0.091 \\ 0.14 \end{bmatrix}$	$\begin{bmatrix} 0.049 \\ 0.071 \end{bmatrix}$

e) both acheived a max error of less than 0.3 after the second iteration.

Therefore, for this particular problem there was no difference when using exact and approximate Jacobian.

This is due to the fact that the Jacobian is well conditioned.

2) see attached m file "hw5_2"

3), 4) and 5)

The attached matlab file "hw5_3and4" solves both linear regression (LR) and artificial neural network (ANN) for each hour:

a) using the first 6 months for training and using the last 6 months for testing

	H06	H12	H18	H24
LR-RMSE	13.02	16.78	25.8	15.97
ANN-RMSE	14.84	15.39	60.5	26.85

Note

ANN results in a different value for RMSE with different network each new run for the matlab code.

b) random separation of data

	H06	H12	H18	H24
LR-RMSE	10.65	15.57	21.7	13.31
ANN-RMSE	11.44	25.53	33.7	32.12

From the obtained results it ~~is~~ can be said that linear regression performed better than ANN, and that linear regression is more consistant in predicting a model ~~whether~~ however the data is seperated. On the other hand ANN is greatly affected by the definition and choice of the ~~tes~~ trainning data set.