National University of Computer and Emerging Sciences, Lahore Campus

	Course Name:	Statistical and Mathematical methods for data science	Course Code:	DS 501
	Program:	MS Data Science	Semester:	Fall 2018
	Duration:	60 Minutes	Total Marks:	35
	Paper Date:	November 16, 2018	Weight	17.5
	Section:	N/A	Page(s):	
	Exam Type:	Midterm Exam 2		

Student : Name:_____ **Roll No.**_____ **Section:**_____

Instruction/Notes:
1. One A4 cheat sheet is allowed in the exam
2. Using mobile phones or laptops as calculators is NOT allowed
3. Use of calculators is allowed. Sharing calculators is NOT allowed
4. Extra sheets will NOT be marked or graded.

QUESTION 1

Given $\mathbf{x} \in \Re^3$ and $f(\mathbf{x}) = 2x_1^2 + 5x_2^3 + 10x_3x_1$. Write the gradient and Hessian of f. (Marks 3+4)

$\nabla_{\mathbf{x}} f(\mathbf{x}) =$	$\nabla^2_{\mathbf{x}} f(\mathbf{x}) =$

QUESTION 2 (Marks: 6)

Use Gram Schmidt procedure to give an **orthonormal** set for the given set of vectors (the order of vectors should not be changed when applying the method).
$\mathbf{v}_1 = [1\ 0\ 0]^T$, $\mathbf{v}_2 = [2\ 1\ 1]^T$, $\mathbf{v}_3 = [1\ 2\ 3]^T$

Final answer:

$\mathbf{u}_1 =$

$\mathbf{u}_2 =$

$\mathbf{u}_3 =$

QUESTION 3 (Marks: 3)

Given $[4\ {-2}\ 6]^T$

L_1 norm is: _____ L_2 norm is: _____ L_∞ norm is: _____

QUESTION 4   **(Marks: 4)**
Write the complete expression for updating a when $f(a) = (1-a)^2$ is to be minimized using gradient descent. The expression should only contain the variable a. You can assume momentum $\alpha = 0$ and learning rate $\eta = 1/4$.

QUESTION 5   **(Marks: 5)**
Given the following values of the standard Normal variable:
$z_{0.10} = 1.282$, $z_{0.05} = 1.645$, $z_{0.025} = 1.960$, $z_{0.01} = 2.326$, $z_{0.005} = 2.576$.
Find the 90% confidence interval for the population mean when the sample measurements are: {0,0,0,1,2,2,3,5,5}. It is known that the population standard deviation is 2

QUESTION 6   **(Marks: 4)**
When given the following predictions and corresponding labels, fill in the confusion matrix. +1 is the positive class

prediction	1	-1	1	-1	1	-1	1
label	+1	+1	+1	-1	-1	-1	-1

TP =	FP =
FN =	TN =

QUESTION 7   **(Marks: 6)**
Find the regression coefficients via the method of least squares for the following data:

x ->	2	0	-2
target	0	-1	1