Report on Exam 1

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Point Distribution (N=29)

Range	90+	82.5+	80+	77.5+	72.5+	70+	67.5+	62.5+	60+	57.5+	52.5+	50+	50-
Grade	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
Frequency	1	6	1	1	1	1	1	9	2	1	0	2	3

Summary The results on the in-class version of Exam 1 were surprisingly low, with a median score of 67 and average score of 68. That being said 8 of 29 students earned the equivalent of an A with scores of 80 or higher, but there were three students earning an equivalent of an F by earning less than 50. The high score was 92.

#1 Equation of Planes, Vector Operations. **(a)** In order to find the equation of a plane one needs to find the cross-product of any two displacement vectors you are confident lie in that plane, because that cross-product will give you the normal to the plane. The cross-product can be a very tricky operation to compute accurately. Be careful! **(b)** If you have two planes, they are either parallel (i.e. their normal vectors are in the same direction) or they are not. Planes are infinite in size, so if they are not parallel they must intersect! How does one find the distance between two parallel planes if one know the normal vector and can find any point on either of the planes?

#2 Gradient, Directional Derivative, Tangent Planes. **(a)** Suppose you are given the direction a vector points in and its magnitude, can you then write down that vector in its component form? This is precisely the information you are given about the gradient vector in this question, and the gradient and a unit vector is what you need to compute a directional derivative. **(b)** In how many directions can one be orthogonal to a vector in three-dimensions? **(c)** If you have the level sets of $M(x, y, z)$ we know that one can find the equation of a tangent plane to this 3-D surface. But if you have $w = M(x, y, z)$ isn't this 4-dimensional?

#3 Partial Derivatives, Multivariable Functions, Cross-sections, Level Sets. **(a)**This problem is about estimating partial derivatives. **(b)** Note that in you are looking for a number greater than a negative number, then a positive number (or a less negative number) will satisfy this result. **(c)** Note carefully where your sketches have zeroes and their maximum and minimum values on the given domain. All the information for the cross-sections is in the contour diagram!

BONUS Limits, Continuity. This question is about the continuity of the given function. What is the definition of continuity of a function $f(x, y)$ at a point (a, b)? How would choosing the value of A determine whether $g(x, y)$ is continuous everywhere. (Do we know that g is continuous everywhere where $(x, y) \neq (0, 0)$? WHY?