Math 2173 Spring 2021 Recitation Handout 3

Group Member 1: _____

Group Member 2: _____

Group Member 3: _____

Group Member 4: _____

Group Member 5: _____

Group Member 6: _____

Below is a checklist of instructions to follow when completing this assignment. Failure to follow these directions will result in penalty on your final score and/or in some problems not being graded. If multiple directions are not followed, then it is also possible that the assignment will not be accepted for any credit at all. Please contact your TA or make a post on the discussion boards for this course if you have any questions about this assignment or these directions.

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Checklist of Instructions	
	Please clearly write the names of all group members working on this assignment in the spaces allotted above.
	This assignment must be completed by a group of 3, 4, 5, or 6 members.
	This assignment is to be uploaded to gradescope as a pdf file no later than 11:59 PM EST on Sunday, January 31.
	The assignment will be uploaded by 1 group member, and that group member will be responsible for manually entering the names of all other collaborators into gradescope.
	This assignment must be completed using this template. You may either print this template to write on it and then scan it (pages ordered correctly) into a pdf file, or you may write directly on the template using programs such as notability.
	If you need more space than what is given to solve a given problem, then you will find blank pages provided at the end of this template. At the end of each problem section of this assignment you will find a space in which to indicate on what page your work is continued in case you used additional pages to complete your solution. You must provide the page number on which your work is continued in the alloted space, or write 'N/A' incase you did not use any additional pages.
	On the additional pages, you will also find space in which to indicate which problem the page is being used for, and if the page is used then that space must also be filled.
	To complete this handout, you may use your textbook, class notes, discussions with your TA and group members, and any resources that are available on Carmen. You should not receive any help from the MSLC or people outside of your group when solving these problems. You may discuss these problems on the Carmen discussion boards, but you should not provide your entire solution when answering a such question, you should only give a hint or a helpful idea.

(Ungraded Optional Problem) Problem 13.9.53: Economists model the output of manufacturing systems using production functions that have many of the same properties as utility functions. The family of Cobb-Douglas production functions has the form $P = f(K, L) = CK^a L^{1-a}$, where K represents capital, L represents labor, and C and a are positive real numbers with $0 < a < 1$. If the cost of capital is p dollars per unit, the cost of labor is q dollars per unit, and the total available budget is B, then the constraint takes the form $pK + qL = B$. Find the values of K and L that maximize the production function

$$P = f(K, L) = K^{\frac{1}{2}} L^{\frac{1}{2}} \tag{1}$$

subject to

$$20K + 30L = 300, \tag{2}$$

assuming $K \geq 0$ and $L \geq 0$.

Our personal notes for (the ungraded and optional) Problem 13.9.53 are continued on page Page 3

Problem 13.9.54 (7 points): Economists model the output of manufacturing systems using production functions that have many of the same properties as utility functions. The family of Cobb-Douglas production functions has the form $P = f(K, L) = CK^a L^{1-a}$, where K represents capital, L represents labor, and C and a are positive real numbers with $0 < a < 1$. If the cost of capital is p dollars per unit, the cost of labor is q dollars per unit, and the total available budget is B, then the constraint takes the form $pK + qL = B$. Find the values of K and L that maximize the production function

$$P = f(K, L) = 10K^{\frac{1}{3}} L^{\frac{2}{3}} \tag{3}$$

subject to

$$30K + 60L = 360, \tag{4}$$

assuming $K \geq 0$ and $L \geq 0$.

Our work for problem 13.9.54 is continued on page

Problem 13.9.55 (10 points): Given the production function $P = f(K, L) = K^a L^{1-a}$ and the budget constraint $pK + qL = B$, where a, p, q, and B are given, show that P is maximized when $K = aB/p$ and $L = (1 - a)B/q$.

Problem 13.9.30 (10 points): Find the point on the plane $2x + 3y + 6z - 10 = 0$ closest to the point $(-2, 5, 1)$ by using the method of Lagrange Multipliers.

Our work for the problem 13.9.30 is continued on page

Problem 13.9.46 (10 points): Find the absolute minimum and absolute maximum values of the function

$$f(x, y) = x^2 + 4y^2 + 1 \tag{5}$$

over the region

$$R = \{(x, y) : x^2 + 4y^2 \leq 1\}. \tag{6}$$

You should know how to solve this type of problem using lagrange multipliers, but you can also avoid using lagrange multipliers and parameterization of the boundary in this particular problem (and still receive full credit) if you think about it carefully. You will not receive full credit for this problem if your solution involves parameterization of the boundary.

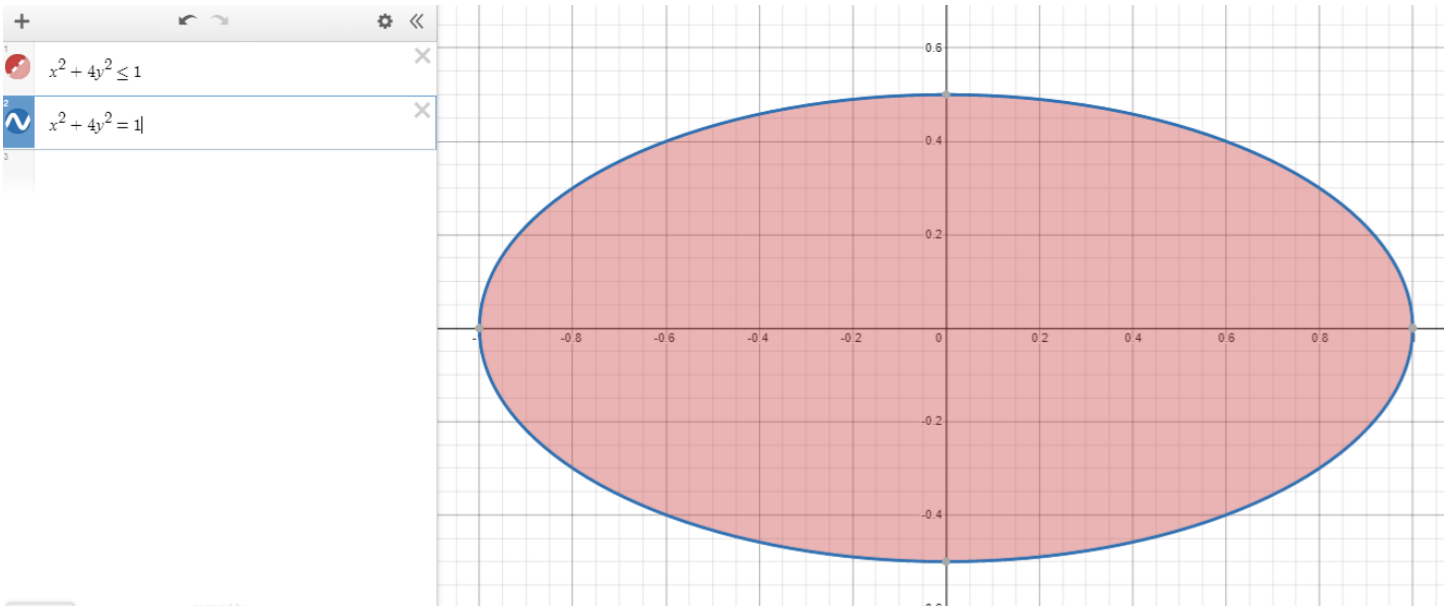

FIGURE 1. The interior of the R is shaded in red and the boundary of R is blue.

Problem 13.9.16 (13 points): Use the method of Lagrange multipliers to find the absolute maximum and minimum of the function

$$f(x, y, z) = xyz \tag{7}$$

subject to the constraint

$$x^2 + 2y^2 + 4z^2 = 9. \tag{8}$$

Please remember to use the 0 product property when solving this problem and solving any systems of equations that arise. You should have 14 critical points that satisfy the system of equations given by the method of Lagrange Multipliers.

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