8. Lagrange multiplier steps

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Synthesize

We saw in this section a geometric justification for using a method called **Lagrange multipliers** . This is a method used to optimize a function $f(x, y)$ (find the max or min) along a **constraint** curve C, where the curve can be described as a level curve $g(x, y) = k$ for some function $g(x, y)$. A summary of the steps is given below.

1. Solve the following system of equations

$$\nabla f(x,y) = \lambda \nabla g(x,y) \quad (4.177)$$

$$g(x,y) = k \quad (4.178)$$

   for x and y. (The scalar λ is called the **Lagrange multiplier** .)

2. Compute the value of $f(x, y)$ at each point found in Step 1.

3. Identify which points give the maxima and minima of $f(x, y)$.

> **Remark 8.1** Lagrange Multipliers is a method whose solution will always find the maxima and minima along a curve. However, this can still be an very hard problem! It turns a hard problem (finding the maximum subject to a constraint) into a potentially still very hard problem (you have to solve a non linear system of equations in Step 1). The examples that we give you to practice this method will be carefully constructed so that they can be solved by hand.

Method for solving general constrained optimization problems

The process to solve a general constrained optimization problem is as follows. Suppose we want to find the absolute maximum (or minimum) of a differentiable function $f(x, y)$ on a closed and bounded region R.

1. Check if $f(x, y)$ has any critical points in R (i.e., check if $\nabla f(x, y) = 0$ inside R).

2. Describe the boundary of R as a level curve $g(x, y) = k$.

3. Solve the following system of equations

$$\nabla f(x,y) = \lambda \nabla g(x,y) \quad (4.179)$$

$$g(x,y) = k \quad (4.180)$$

   for x and y. (The scalar λ is called the **Lagrange multiplier** .)

4. Compute the value of $f(x, y)$ at each point found in Steps 1 and 3.

5. Identify which points give the absolute maximum (or minimum) of $f(x, y)$.

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"Describe the boundary of R as a level curve"
"Describe the boundary of R as a level curve" In general, isn't this hard to do? I'd think a general arbitrary b... 2

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[STAFF] Error in first paragraph
This is a method used to optimize a function f(x,y) (find the max or min) along a constraint curve C,**where there curve** can be de... 2

very logical approach
This is a lot more logical than my textbooks approach of comparing where the constraint curve is tangent to the level curves of the f... 3

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