10. Summary

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Summarize

Big Picture

1. Linearization means finding a matrix that approximates a given function near a point.
2. The matrix acts like a converter whose input is a small change in the input and whose output is the approximate change in the output.
3. It is often easier or faster to work with the approximation instead of the original function.

Mechanics

1. The converter matrix is called **the Jacobian matrix**.
2. To find it, compute the **matrix of partial derivatives** and evaluate at the given point.

Ask Yourself

What size is the Jacobian matrix?

It depends on the function that is being approximated. Since the input to the Jacobian matrix is one number for each variable, the number of columns equals the number of input variables. Since the output of the Jacobian matrix is one number for every output variable, the number of rows is equal to the number of output variables.

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Do we have to use matrices to do linear approximation?

No, in principle you can do all the steps of linear approximation without using a matrix at all. However, there will always be a “hidden matrix" that is driving the problem. This is the Jacobian matrix.

One advantage of working with matrices is that they are a standard mathematical gadget, and there are many good tools for dealing with them. Furthermore, drawing attention to the “hidden matrix" often lends further insight to the problem.

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