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Course 565/665 Lecturer Prof. Cavagnero

Day 2.12.04 Date 9:55 am

Notes Taken By Jiang Hong Total Number of Pages

$f(x,y)$ partial derivatives, total differential.

exact differential, $\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial^2 f}{\partial y \partial x}$, state function

satisfy Euler relationship has exact differential

Euler relation: for $s(x,y)\,dx + t(x,y)\,dy$

$$\left(\frac{\partial s}{\partial y}\right)_x = \left(\frac{\partial t}{\partial x}\right)_y$$

Given $f(x,y)$, first ~~find~~ critical points.

$$df = \left(\frac{\partial f}{\partial x}\right)_y dx + \left(\frac{\partial f}{\partial y}\right)_x dy = 0$$

or $\left(\frac{\partial f}{\partial x}\right)_y = 0$; $\left(\frac{\partial f}{\partial y}\right)_x = 0$ $\left(\left.\frac{\partial f}{\partial x_i}\right|_{j \neq i} = 0 \right)$

then use

Hessian test:

$$\left(\frac{\partial^2 f}{\partial x^2}\right) \cdot \left(\frac{\partial^2 f}{\partial y^2}\right) - \left(\frac{\partial^2 f}{\partial x \partial y}\right) = \Delta$$

If $\frac{\partial^2 f}{\partial x^2} > 0$, $\frac{\partial^2 f}{\partial y^2} > 0$, and $\Delta > 0$ have minimum

$\frac{\partial^2 f}{\partial x^2} < 0$, $\frac{\partial^2 f}{\partial y^2} < 0$, $\Delta > 0$, maximum

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Lagrange multiplier method:

used to find extreman for $f(x, y)$ where the function is subject to a "constraint" ($g(x, y) = 0$).

$$\left(\frac{\partial f}{\partial x}\right)_y = \left(\frac{\partial g}{\partial x}\right)_y \cdot \lambda$$

$$\left(\frac{\partial f}{\partial y}\right)_x = \left(\frac{\partial g}{\partial y}\right)_x \cdot \lambda$$

$$\left(\frac{\partial f}{\partial x}\right)_y - \lambda\left(\frac{\partial g}{\partial x}\right)_y = 0$$

$$\left(\frac{\partial f}{\partial y}\right)_x - \lambda\left(\frac{\partial g}{\partial y}\right)_x = 0$$

in general. $\left(\frac{\partial f}{\partial x}\right)_{yz} - \lambda\left(\frac{\partial g}{\partial x}\right)_{yz} - \beta\left(\frac{\partial h}{\partial x}\right)_{yz} = 0$

...

if there are constraints $g(x, y) = 0$

$h(x, y) = 0$.

2 of 2.