MA153 Lesson 18

LESSON 18 - Chain Rule

22 September, 2008

Outline

1. Admin
2. Last Class
   - Tangent Planes and Linear Approximations
3. Chain Rule
   - Course Guide
   - Definitions
   - Homework Help
4. Look Forward

Admin

1. Project Questions?

Admin

2. Guest Lecture - Friday, 26 September, Dean's Hour

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Tangent Planes and Linear Approximations

1. Equation of a Tangent Plane:

$$z - z_0 = f_x(x_0, y_0)(x - x_0) + f_y(x_0, y_0)(y - y_0)$$

Tangent Planes and Linear Approximations

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2. Linear Approximation:

$$f(x, y) \approx f(a, b) + f_x(a, b)(x - a) + f_y(a, b)(y - b)$$

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$$dz = f_x(x, y)dx + f_y(x, y)dy = \frac{\partial z}{\partial x}dx + \frac{\partial z}{\partial y}dy$$

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4. $$dz = f_x(x, y)(x - a) + f_y(x, y)(y - b)$$

Homework Help

Questions? - Homework Help

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Objectives

The Chain Rule - 14.5

1. Use the chain rule to differentiate a function of several variables.
2. Use tree diagrams to represent the chain rule.
3. HOMEWORK PROBLEMS: 1, 5, 11, 23, 42

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Definitions

1. Remember the Chain Rule? Some call it u substitution:

Definitions

2. Suppose that $z = f(x, y)$ is a differentiable function of x and y, where $x = g(t)$ and $y = h(t)$ are both differentiable functions of t. Then z is a differentiable function of t and

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Definitions

4. $$\frac{dz}{dt} = \frac{\partial z}{\partial x}\frac{dx}{dt} + \frac{\partial z}{\partial y}\frac{dy}{dt}$$

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2. $$\frac{\partial z}{\partial s} = \frac{\partial z}{\partial x}\frac{\partial x}{\partial s} + \frac{\partial z}{\partial y}\frac{\partial y}{\partial s} \qquad \frac{\partial z}{\partial t} = \frac{\partial z}{\partial x}\frac{\partial x}{\partial t} + \frac{\partial z}{\partial y}\frac{\partial y}{\partial t}$$

Definitions

1. Suppose that u is a differentiable function of n variables $x_1, x_2, ..., x_n$ and each x_j is a differentiable function of the m variables $t_1, t_2, ..., t_m$. Then u is a function of $t_1, t_2, ..., t_m$ and

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2. $$\frac{\partial u}{\partial t_i} = \frac{\partial u}{\partial x_1}\frac{\partial x_1}{\partial t_i} + \frac{\partial u}{\partial x_2}\frac{\partial x_2}{\partial t_i} + ... + \frac{\partial u}{\partial x_n}\frac{\partial x_n}{\partial t_i}$$

Definitions

1. Use Tree Diagrams

Definitions

1. Use Tree Diagrams
2. Draw branches from the dependent variable

Implicit Differentiation

1. The Chain Rule can help us in Implicit Differentiation

Implicit Differentiation

1. The Chain Rule can help us in Implicit Differentiation
2. $$\frac{dy}{dx} = -\frac{\frac{\partial F}{\partial x}}{\frac{\partial F}{\partial y}} = -\frac{F_x}{F_y}$$

Board Work

1. Problem 15, Page 907

Board Work

1. Problem 15, Page 907
2. Problem 17, Page 907

Board Work

1. Problem 15, Page 907
3. Problem 30, Page 908

Board Work

1. Problem 15, Page 907

4. Problem 35, Page 908

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Homework Help

Look Forward

Directional Derivatives and the Gradient Vector I - 14.6

1. Understand the analytic formulations and geometric meaning of the directional derivative.
2. Determine the directional derivative of a function of two or more variables.
3. Understand the geometric meanings of the gradient vector: A normal vector to a surface, the direction of greatest change, a perpendicular vector to contour curves and surfaces, a vector with length equal to the maximum value of the directional derivative.
4. Determine the gradient vector of a function of two or more variables.
5. Determine the tangent plane to a level surface.
6. HOMEWORK PROBLEMS: 6, 8, 11

Questions?

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