Calculus III Video Library (Multivariable Calculus)

Introduction to Functions of Several Variables

Introduction to Functions of Two Variables with Applications
Introduction to Functions of Two Variables
Ex: Function Values of a Function of Two Variables Using a Table
Ex: Evaluate a Function of Two Variables (Cobb-Douglas Production Function)
Ex: Function Values of a Function of Two Variables (Square Root)
Ex: Function Values of a Function of Two Variables (Polynomial)
Ex: Function Values of a Function of Two Variables (Fraction)
Ex: Function Values of a Function of Two Variables (Exponential)
Ex 1: Determine the Domain of a Function of Two Variables
Ex 2: Determine the Domain of a Function of Two Variables
Level Curves of Function of Two Variables
Ex 1: Determine a Function Value Using a Contour Map
Ex 2: Determine a Function Value Using a Contour Map
Ex: Determine if a Function is Increasing or Decreasing in a Direction Using a Contour Map

Limits and Partial Derivatives of Functions of Two Variables

Limits of Functions of Two Variables
Ex: Limit of a Function of Two Variables (Origin - DNE)
Ex: Limit of a Function of Two Variables (Origin - Exist)
Ex: Limit of a Function of Two Variables (Not Origin - Exist - Direct Substitution)
Ex: Limit of a Function of Two Variables (Not Origin - DNE)
First Order Partial Derivatives
Ex: Estimate the Value of a Partial Derivative Using a Contour Map
Ex: Determine a Partial Derivative Function of an

Double Integrals

Approximate the Volume of Pool With The Midpoint Rule Using a Table of Values
Double Integral Approximation Using Midpoint Rule Using Level Curves
Ex: Double Integral Approximation Using Midpoint Rule - f(x,y)=ax+by
Integrating Functions of Two Variables
Introduction to Double Integrals and Volume
Double Integrals and Volume over a General Region - Part 1
Double Integrals and Volume over a General Region - Part 2
Evaluating Double Integrals
Ex: Double Integrals - Describe a Region of Integration (Triangle)
Ex: Double Integrals - Describe a Region of Integration (Quadratic)
Ex: Double Integrals - Describe a Region of Integration (Advanced)
Ex 1: Evaluate a Double Integral Over a Rectangular Region to Find a Volume - f(x,y)=c
Ex 2: Evaluate a Double Integral Over a Rectangular Region to Find a Volume - f(x,y)=c
Ex: Evaluate a Double Integral Over a Rectangular Region to Find a Volume - f(x,y)=ax
Ex: Evaluate a Double Integral Over a Rectangular Region - f(x,y)=ax+by
Ex: Evaluate a Double Integral to Determine Volume (Basic)
Ex: Evaluate a Double Integral to Determine Volume - Change Order of Integration
Ex: Evaluate a Double Integral Over a Rectangular Region to Find a Volume - f(x,y)=x/y
Use a Double Integral to Find the Volume Under a Paraboloid Over a Rectangular Region
Evaluate a Double Integral Using Substitution Over a Rectangular Region - f(x,y)=(xy^2)/(x^2+1)
Evaluate a Double Integral Using Substitution Over a Rectangular Region - f(x,y)=(ax+by)^n
Evaluate a Double Integral Using Substitution Over a Rectangular Region - f(x,y)=xysin(x^2+y^2)

Vector Fields

Introduction to Vector Fields
The Divergence of a Vector Field
Ex 1: Determine the Divergence of a Vector Field
Ex 2: Determine the Divergence of a Vector Field
Ex: Determine the Sign of the Divergence from the Graph of a Vector Field
The Curl of a Vector Field
Ex 1: Determine the Curl of a Vector Field
Ex 2: Determine the Curl of a Vector Field
Ex 1: Determine the Curl of a Vector Field (2D)
Ex 2: Determine the Curl of a Vector Field (2D)
Conservative Vector Fields

Line Integrals

Defining a Smooth Parameterization of a Path
Ex 1A: Determine a Piecewise Smooth Parameterization for a Curve (Triangle)
Ex 1B: Determine a Piecewise Smooth Parameterization for a Curve (Triangle)
Ex 2: Determine a Piecewise Smooth Parameterization for a Curve
Ex: Determine Parametric Equations for an Ellipse
Line Integrals in R^2
Line Integrals in R^3
Line Integral of Vector Fields
Line Integrals in Differential Form
Evaluate a Line Integral of y with Respect to Arc Length (Area)
Evaluate a Line Integral of xy^2 with Respect to Arc Length C: Half Cirlce (Area)
Evaluate a Line Integral of xy with Respect to Arc Length (Mass of Wire)
Evaluate a Line Integral of x^2+y^2+z^2 with Respect to Arc Length(Mass of Wire)
Evaluate a Line Integral of x^3y^2 with Respect to x (Differential Form)
Evaluate the Line Integral of x^2z Along a Line Segment

Exponential Function of Two Variables
Ex: Determine a Partial Derivative Function of an Polynomial Function of Two Variables
Ex: Find Partial Derivative Values for a Polynomial Function of Two Variables
Ex: Find Partial Derivative Values for a Square Root Function of Two Variables
Ex: Find the Partial Derivatives of the Cobb Douglas Production Function
Ex: Find the Partial Derivative of a Function of Three Variables (Square Root)
Ex: Application of First Order Partial Derivative (Change in Production)
Second Order Partial Derivatives
Ex: Find First and Second Order Partial Derivatives
Ex: Determine Second Order Partial Derivatives
Differentials of Functions of Two Variables
Applications of Differentials of Functions of Several Variables

The Chain Rule and Directional Derivatives, and the Gradient Functions of Two Variables

The Chain Rule for Functions of Two Variables With One Independent Variable
The Chain Rule for Functions of Two Variables With Two Independent Variable
Ex: Chain Rule - Function of Two Variables with One Independent Variable
Ex: Chain Rule - Function of Two Variables with Two Independent Variable
Ex: Chain Rule - Function of Two Variables with Three Independent Variable
Application of Chain Rule of a Function of Two Variables - Change of Volume
Implicit Differentiation of Functions in One Variable using Partial Derivatives
Partial Implicit Differentiation
Directional Derivatives
The Gradient
Ex: Find the Gradient of the Function f(x,y)=xy
Ex: Find the Gradient of the Function f(x,y)=e^(2x)sin(3y)
Ex: Find the Gradient of the Function f(x,y)=5xsin(xy)

Evaluate a Double Integral Over a General Region - f(x,y)=ax+by
Evaluate a Double Integral Over a General Region - f(x,y)=xy^2
Evaluate a Double Integral Over a General Region with Substitution - f(x,y)=e^(x/y)
Average Value of a Function of Two Variables
Fubini's Theorem
Setting up a Double Integral Using Both Orders of Integration
Double Integrals: Changing the Order of Integration
Double Integrals: Changing the Order of Integration - Example 1
Double Integrals: Changing the Order of Integration - Example 2

Double Integrals in Polar Coordinates

Introduction to Double Integrals in Polar Coordinates
Double Integrals in Polar Coordinates - Example 1
Double Integrals in Polar Coordinates - Example 2
Area Using Double Integrals in Polar Coordinates - Example 1
Area Using Double Integrals in Polar Coordinates - Example 2
Double Integrals in Polar Form - Volume of a Right Circular Cylinder (f(x,y) over a circle)
Double Integrals in Polar Form - Volume of a Half Sphere Over a Circle
Evaluate a Double Integral in Polar Form - f(x,y)=ax+by Over a Half-Circle
Evaluate a Double Integral in Polar Form - f(x,y)=cos(x^2+y^2) Over a Ring
Volume of a Drilled Sphere Using a Double Integral in Polar Form
Double Integrals in Polar Form - Volume Bounded by Two Paraboloids

Applications of Double Integrals: Mass, Center of Mass, Jacobian

in 3D
Evaluate a Line Integral of in Differential Form
Evaluate a Line Integral of F*dr
Line Integral Application - Work of a Charged Particle
Determining the Potential Function of a Conservative Vector Field
The Fundamental Theorem of Line Integrals - Part 1
The Fundamental Theorem of Line Integrals - Part 2
Fundamental Theorem of Line Integrals - Closed Path/Curve
Ex 1: Fundamental Theorem of Line Integrals - Given Vector Field in a Plane
Ex 2: Fundamental Theorem of Line Integrals - Given Vector Field in a Plane (Not Conservative)
Ex 3: Fundamental Theorem of Line Integrals - Given Vector Field in a Plane
Ex 4: Fundamental Theorem of Line Integrals - Given Vector Field in Space
Green's Theorem - Part 1
Green's Theorem - Part 2
Ex: Use Green's Theorem to Evaluate a Line Integral (Rectangle)
Ex: Use Green's Theorem to Evaluate a Line Integral (Polar)
Ex: Use Green's Theorem to Evaluate a Line Integral (Negative Orientation)
Ex: Use Green's Theorem to Determine Area of a Region Enclosed by a Curve
Determining Area using Line Integrals
Flux Form of Green's Theorem

Surface Integrals

Parameterized Surfaces
Area of a Parameterized Surface
Surface Integral with Explicit Surface Part 1
Surface Integral with Explicit Surface Part 2
Ex: Surface Area of a Function of Two Variables (Surface Integral)
Surface Integrals with Parameterized Surface - Part 1
Surface Integrals with Parameterized Surface - Part 2
Ex: Surface Area of a Parametric Surface (Surface Integral)

Find the Gradient Vector Field of f(x,y)=x^3y^5
Find the Gradient Vector Field of f(x,y)=ln(2x+5y)
Ex: Use the Gradient to Find the Maximum Rate of Increase of f(x,y)=(4y^5)/x from a Point
Ex 1: Find a Value of a Directional Derivative - f(x,y)=xy
Ex 2: Find a Value of a Directional Derivative - f(x,y)=x^n*y^m
Ex 3: Find a Value of a Directional Derivative - f(x,y)=ln(x^2+y^2)

Normal Vectors and Tangent Planes to Functions of Two Variables

Determining a Unit Normal Vector to a Surface
Verifying the Equation of a Tangent Plane to a Surface
Determining the Equation of a Tangent Plane
Ex 1: Find the Equation of a Tangent Plane to a Surface
Ex 2: Find the Equation of a Tangent Plane to a Surface (Exponential)
Ex 3: Find the Equation of a Tangent Plane to a Surface (Trigonometric)
Find a Linear Approximation to a Function of Two Variables and Estimate a Function Value

Relative Extrema and Applications to Functions of Two Variables

Determining the Relative Extrema of a Function of Two Variables
Ex 1: Classify Critical Points as Extrema or Saddle Points - Function of Two Variables
Ex 2: Classify Critical Points as Extrema or Saddle Points - Function of Two Variables
Ex: Determine Relative Extrema for a Function of Two Variables
Absolute Extrema of Functions of Two Variables
Applications of Extrema of Functions of Two Variables I
Applications of Extrema of Functions of Two Variables II
Applications of Extrema of Functions of Two Variables III
Ex: Determine the Quantity to Maximize Revenue - Function of Two Variables
Ex: Minimize Cost to Make Open Top Box - Function of Two Variables

Double Integrals - Find the Mass of a Lamina Over a Region in the xy Plane
Double Integrals - Find the Center Mass of a Lamina Over a Region Using Polar Coordinates
Double Integrals - Find the Total Charge Over a Triangular Region
Double Integrals - Find a Probability Using the Exponential Density Function: P(x<a,y<b)
Double Integrals - Surface Area over a Rectangular Region (Basic)
Double Integrals - Surface Area over a Circle Using Polar Coordinates (Basic)
Double Integrals - Surface Area of a Vector Values Function Over a Region
Find the Jacobian Given x=au+bv, y=u^2+cv
Evaluate a Double Integral of ax+by Over Parallelogram Given Transformation Equations (Jacobian)
Evaluate a Double Integral of ax+by Over Parallelogram (Jacobian)
Evaluate a Double Integral of x^2 Over an Ellipse Using a Change of Variables (Jacobian, Polar)

Triple Integrals

Introduction to Triple Integrals
Evaluating Triple Integrals – Example
Ex 1: Set Up and Evaluate a Triple Integral of z - Part 1: Limits of Integration
Ex 1: Set Up and Evaluate a Triple Integral of z - Part 2: Evaluate the Triple Integral
Ex 2: Set up and Evaluate a Triple Integral of 2xz
Ex 3: Set Up and Evaluate a Triple Integral of y - Part 1: Limits of Integration
Ex 3: Set Up and Evaluate a Triple Integral of y - Part 2: Evaluate the Triple Integral
Ex 4: Set up and Evaluate a Triple Integral of x+y-4z
Triple Integrals and Volume - Part 1
Triple Integrals and Volume - Part 2
Triple Integrals and Volume - Part 3
Set up a Triple Integral to Determine Volume (Rectangular Coordinates)
Determine Limits of Integration for a Triple Integral - Region of Integration is a Tetrahedron

Surface Integral of a Vector Field - Part 1
Surface Integral of a Vector Field - Part 2
Ex: Evaluate a Surface Integral (Parametric Surface - Helicoid)
Ex: Evaluate a Surface Integral (Basic Explicit Surface - Plane Over Rectangle)
Ex: Evaluate a Surface Integral Using Polar Coordinates- Implicit Surface (Cone)
Ex: Evaluate a Flux Integral with Surface Given Explicitly
Ex: Evaluate a Flux Integral with Surface Given Parametrically
Ex: Using a Flux Integral to Determine a Mass Flow Rate
Stoke's Theorem - Part 1
Stoke's Theorem - Part 2
Ex 1: Using Stoke's Theorem to Evaluate a Line Integral as a Surface Integral
Ex 2: Using Stoke's Theorem to Evaluate a Line Integral as a Surface Integral
Ex 1: Using Stoke's Theorem to Evaluate a Surface Integral as a Line Integral
Ex 2: Using Stoke's Theorem to Evaluate a Surface Integral as a Line Integral
The Divergence Theorem - Part 1
The Divergence Theorem - Part 2
Ex: Use the Divergence Theorem to Evaluate a Flux Integral (Rectangular Coordinates)
Ex: Use the Divergence Theorem to Evaluate a Flux Integral (Cylindrical Coordinates)
Ex: Use the Divergence Theorem to Evaluate a Flux Integral (Spherical Coordinates)

Graphing Calculator

Determine the value of the derivative function on the graphing calculator
Determining the value of a definite integral on the graphing calculator
Sequences on the TI84 Graphing Calculator
Sequences and Series on the TI84
Graph Partial Sums of an Infinite Series on the TI84
Graphing Parametric Equations in the TI84

Lagrange Multipliers - Part 1 Lagrange Multipliers - Part 2 Maximize a Cobb Douglas Production Function Using Lagrange Multipliers Maximize a Function of Two Variable Under a Constraint Using Lagrange Multipliers - f(x,y)=x^2y Minimize a Cost Function of Two Variable Under a Constraint Using Lagrange Multipliers Lagrange Multipliers: Find the Max and Min of a Function of Two Variables	Use a Triple Integral to Determine Volume Ex 1 (Rectangular Coordinates) Use a Triple Integral to Determine Volume Ex 2 (Rectangular Coordinates) Triple Integrals: Find the Volume of a Tetrahedron Given the Vertices Application of Triple Integrals: Mass Changing the Order of Triple Integrals Triple Integrals in Cylindrical and Spherical Coordinates Triple Integrals Using Cylindrical Coordinates Triple Integral and Volume Using Cylindrical Coordinates Rewrite Triple Integrals Using Cylindrical Coordinates Use a Triple Integral to Determine Volume Ex 1 (Cylindrical Coordinates) Introduction to Triple Integrals Using Spherical Coordinates Triple Integrals and Volume using Spherical Coordinates Evaluate a Triple Integral Using Cylindrical Coordinates - Triple Integral of e^z Evaluate a Triple Integral Using Spherical Coordinates - Triple Integral of 1/(x^2+y^2+z^2) Find the Moment of Inertia about the z-axis of a Solid Using Triple Integrals Find the Center of Mass of a Solid Using Triple Integrals A Change of Variables for a Double Integral: Jacobian Example of a Change of Variables for a Double Integral: Jacobian A Change of Variables for a Triple Integral: Jacobian	