Data Science For Engineers
NPTEL PMRF Live Sessions

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Multivariate Optimization with Equality Constraints

Why constrained optimization?

Constrained Optimization Problem

A constrained optimization problem with equality constraints has the form:

Lagrangian Function

For the constrained optimization problem, the Lagrangian function is defined as:

Optimality Conditions

At the optimal point,

Practice questions

Geometric Interpretation

The constrained optimum occurs where the gradient of the objective function is a linear combination of the gradients of the constraint functions.

What does this mean geometrically?

Practice question

Multiple Equality Constraints

For problems with multiple equality constraints,

Multiple Constraints

Practice question

Multivariate Optimization with Inequality Constraints

These problems are more complex because we must determine which constraints are active or inactive at the optimal solution.

Constrained Optimization Problem

Karush-Kuhn-Tucker (KKT) Conditions

Active and inactive constraints

- **Active constraint**:
- **Inactive constraint**:

Practice question

Introduction to Data Science

1. **Classification Problems:** Assign labels
   - Binary classification
   - Multiclass classification

2. **Function Approximation Problems:** Find mathematical relationships between input variables and output responses.

Practice question

Why are there so many models?

Data Analysis Problem-Solving Framework

Five-Step Problem-Solving Framework

1. **Problem Definition**
2. **Problem Characterization**
3. **Solution Conceptualization**
4. **Method Identification**
5. **Implementation & Assessment**

Data Imputation

Matrix Methods for Data Imputation

Practice question

Practice question