Module 3: Univariate, Multivariate Calculus and Optimization

1 Graphs and Models.
2 Linear Models and Rates of Change.
3 Functions and their graphs.
4 Fitting models to data.
5 A preview of Calculus.
6 Finding limits graphically and numerically.
7 Evaluating limits analytically.
8 Continuity and One sided limits.
9 Infinite Limits.
10 The derivative and the tangent line problem.
11 Basic Differentiation rules and rates of change.
12 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
13 **Coding Assignment 10.**
14 Product and Quitient rule and higher order derivatives.
15 The chain rule.
16 Implicit Differantiation.
17 Increasing and Decreasing Functions and First Drivative test.
18 Concavity, Convexity, Non Convexity and Second Derivative test.
19 Unconstrained and Constrained Optimization Problems.
20 Convex Optimization Problems.
21 Solving Unconstrained Convex Optimization Problems
21.1 First Order Algorithm : Gradient Descent Algorithm for Univariate Functions.
21.2 Second Order Algorithm : Newton's Method for Univariate Functions.
21.3 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
21.4 **Coding Assignment 11.**
21.5 Introduction to Multivariate Functions.
21.6 Partial Derivatives.
21.7 Directional Derivatives and Gradients.
21.8 Tangent Planes and Normal Lines.
21.9 Extreme Value Theorem for Multivariate Functions.
21.10 First Order Algorithm : Gradient Descent Algorithm for Multivariate Functions.
21.11 Second Order Algorithm : Newton's Method for Multivariate Functions.
21.12 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
21.13 **Coding Assignment 12.**
22 Solving Constrained Convex Optimization Problems
22.1 Equality and Inequality Constraints, Active Sets and Binding Constraints.
22.2 Feasible Sets, Feasible Points, Interior and Boundary Points.
22.3 Barrier and Penalty Methods for solving Constrained Optimization Problems.
22.4 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
22.5 **Coding Assignment 13.**
22.6 What is Primal Problem ?
22.7 Primal Problem and its objective function.
22.8 Introduction to the Dual to Primal problem.
22.9 What is a Dual Problem ?
22.10 Introduction to Dual Variables.
22.11 Why Dual problem ?
22.12 Duality.