

### Exams Practice Questions

- a) Define Stochastic Models, Random Walk, Gambler's ruin and Linear Programming
- b) What is stochastic programming and how does it differ from deterministic optimization?
- c) Compare risk-neutral and risk-averse approaches in stochastic optimization.
- d) Define a 1D random walk and how it can be implemented using NumPy.
- e) Extend the concept to 2D random walks and visualize them using matplotlib.
- f) How does uncertainty influence objective functions and constraints in optimization models?
- g) Explain the concept of two-stage stochastic programming with recourse.
- h) What are the key assumptions behind modeling uncertainty using probability distributions?
- i) Provide 5 applications of Random Walks
- j) In what ways does stochastic programming improve decision-making under uncertainty in healthcare?
- k) Distinguish the following types of graphs i.e. simple, Multigraph, Pseudograph, Directed and Directed Multigraph
- l) Differentiate between convex and non-convex optimization with examples relevant to machine learning.
- m) How does stochastic gradient descent (SGD) differ from batch gradient descent in terms of convergence and computational efficiency?
- n) What is the role of Lagrange multipliers in constrained optimization?
- o) How are random variables used to represent uncertain demands in logistics?
- p) What are the challenges of solving large-scale stochastic programming problems in finance?
- q) Describe the role of Monte Carlo simulation in stochastic decision models
- a) How can stochastic programming be applied to optimize portfolio allocation?
- b) Describe a real-life stochastic model used in supply chain logistics.
- c) In healthcare, how can stochastic models aid in patient flow or inventory decisions?
- d) What is the role of time-dependent uncertainty in modeling stock prices?
- e) How does simulating stochastic demand help in warehouse inventory management?
- a) How can `scipy.optimize.linprog` be used to solve linear programming problems?
- b) What are the differences between the Simplex algorithm and Gradient Descent?
- c) How does `pulp` handle integer and mixed-integer linear programming problems in Python?
- d) Explain the convexity requirements for using convex optimization solvers like `cvxpy`.
- e) Demonstrate how to model and solve a basic transportation problem using `pulp`.
- a) What is the significance of random walks in modeling stock price movements?
- b) Describe how repeated random sampling (e.g., Monte Carlo) is used to approximate distributions.
- c) How can Monte Carlo simulations be used to estimate  $\pi$ ?
- d) How does accuracy scale with the number of samples?
- e) Describe how importance sampling improves estimation in high-dimensional integration.

- f) Q18. Implement a basic Markov Chain Monte Carlo (MCMC) sampling procedure for a given posterior distribution.
- a) What are the differences between an adjacency matrix and an adjacency list?
- b) How can you model and analyze social networks using networkx in Python?
- c) What algorithm would you use to solve the shortest path problem, and how is it implemented?
- d) Describe a Complete Bipartite graphs
- e) How can graph models be used for optimizing road logistics or delivery networks?
- f) Explain the application of graph theory in modeling hospital referral systems or patient transfers.