**Graphical user interface, application

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**Subject**: Monte Carlo Simulations.

**Aim**: Understand what a Monte Carlo Simulation (MCS) represents in its entirety and at a low-level. Show a methodology to developing an MCS. Demonstrate a MCS non-relative to stock data and then stock data forecast. Analyses both case studies and further develop the stock data forecasting MCS.

Introduction

**Topic/Introduction**:

A Monte Carlo simulation, or applied method is a computational algorithm used to estimate the potential outcomes of randomly evolving events. Developed by John von Neumann and Stanislaw Ulam when working on the Manhattan Project to improve decision making under uncertainty ([REF](https://www.ibm.com/cloud/learn/monte-carlo-simulation)). It was named after the city Monte Carlo which is in the Principality of Monaco: named aptly due to the casinos in Monte Carlo which each introduce elements of chance and randomness.

Instances in which numerical solutions are unnecessarily difficult or computationally expense to find presents the case for the Monte Carlo method to be used. Furthermore, the application in forecast modelling, risk assessment and so forth allows for a larger degree of accuracy as opposed to human intuition ([REF – 2](https://en.wikipedia.org/wiki/Monte_Carlo_method)).

A Monte Carlo simulation builds a model of possible results by leveraging random sampling for any factor with inherent uncertainty. This process is then repeated for each simulation, recalculating and each time using a different set of random samples between the set bounds.

The ensuing paper discusses applied Monte Carlo methods for *The Lifeguard Problem* and *Stock Data Forecasting*. The emphasis of this paper is on the *Stock Data Forecasting* study.

Method:

Introducing Monte Carlo methods varies from case to case but generally follows a particular pattern;

1. Define the domain. Identify the dependant variable/s: predicted using random sampling. Identify the independent variable/s to drive the prediction.
2. Generating inputs randomly from a probability distribution over the independent variable/s. Historical data or subjective judgement can be used to define the bounds of likely values.
3. Run the simulations and aggregate the results until the data is representative of the near infinite number of results. The data set can then be analysed ([REF](https://www.ibm.com/cloud/learn/monte-carlo-simulation)).

Case Studies.

**Case Study**: *Lifeguard Problem*:

The lifeguard problem represents an optimization problem. That is, determining the optimum position for the lifeguard to enter the water as (s)he is quicker running than swimming.

Posing the question and solving analytically: *a lifeguard swims at a rate of 3ft/s but can run at a rate of 15ft/s. (s)He spots a drowning child 200m down the shore and 50m out to sea. How far down the shore should the lifeguard run before swimming*? ([REF](https://ltcconline.net/greenl/courses/115/applications/opt.htm))

Diagram

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Figure: (REF)

Solving the above results that the lifeguard should enter the water 182.3 feet down the beach and then proceed to swim to the drowning child. In doing so the lifeguard will reach the swimmer in 22.762s.

*How does it relate to Monte Carlo and how is Monte Carlo used*?

Given input is the distance to enter the shore, the simulated random values are the time, an output of the objective function, therefore the lowest produced time correlates to the distance the lifeguard should swim down the shore to reach the drowning child in the lowest time, therefore optimise.

This is an optimization problem. The independent variable is the horizontal which correlates to the distance in which the lifeguard should enter the water to swim to the child. The dependant variable is the time in which the lifeguard takes to reach the swimmer, therefore the minimum time correlates to how far the lifeguard should run down the beach before he starts to swim.

Probability distribution of the input is uniform therefore we use a uniform probability distribution for the dependant variables.

**Case Study**: *Stock Data Forecasting*:

**Universe Definition**.

**Pseudocode**.

Results.

Results.

Discussion.

Discussion.

Future Work.

Future Work.