FINANCIAL MODELING

A PROJECT REPORT

Submitted by

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In partial fulfilment of the requirements for the degree of

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE AND ENGINEERING

DEPARTMENT OF COMPUTING TECHNOLGIES

COLLEGE OF ENGINEERING AND TECHNOLOGY

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

KATTANKULATHUR – 603 203

MAY 2023

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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BONAFIDE CERTIFICATE

Certified that this B.Tech project report titled "**FINANCIAL MODELING**" is the bonafide work of Sahil Kumar [Reg. No.:RA2111003010379] and Muskan [Reg. No.RA2111003010436] who carried out the project work under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form partof any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion for this or any other candidate.

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Financial Modeling

- ## Objective:

To solve financial modeling using 0/1 knapsack and fractional knapsack And finding out the best approach.

- ## 0/1 Knapsack:

Financial modeling using the 0/1 knapsack problem involves finding the optimal combination of investments that maximize a given financial objective subject to a budget constraint.In financial modeling, the weight of an item represents the amount of investment required, and the value of an item represents the expected return on that investment. The budget constraint represents the total amount of available capital that can be invested.The 0/1knapsack problem is a classic optimization problem in which a knapsack has a maximum weightcapacity, and there are several items with varying weights and values that need to be packed into the knapsack.

- ## Fractional Knapsack:

Financial modeling using fractional knapsack involves finding the optimal combinationof investments that maximize a given financial objective subject to budget constraint, where items can be divided into fractional parts. The fractionalknapsack problem is similar to the 0/1 knapsack problem, but instead of choosing an entire item or not, the items can be divided into fractions, allowing for more flexibility in the solution.
In financial modeling, the weight of an item represents the amount of investment required, and the value of an item represents the expected return on that investment. The budget constraint represents the total amount of available capital that can be invested.

To solve financial problems using the fractional knapsack problem, you need to follow these steps:

- Define the problem: Determine the financial objective that you want to achieve and the budget constraint.
- Identify the investment options: Identify the various investment options available and determine the expected return on each investment.
- Set up the knapsack problem: Assign each investment option a weight and a value based on the amount of investment required and the expected return, respectively.
- Formulate the problem: Formulate the problem as a fractional knapsack problem by specifying the weight and value of each investment option and the budget constraint.
- Solve the problem: Solve the problem using a greedy algorithm to find the optimal combination of investments that maximizes the financial objective subject to the budget constraint.
- Interpret the solution: Interpret the solution by identifying the specific investments that should be made and the expected return on the investments.

- Explanation:

suppose an investor has a limited budget and wants to invest in a set of assets with different expected returns and risks. The fractional knapsack algorithm could be used to determine the optimal allocation of funds to each asset to maximize the expected return while staying withinthe budget constraint. The algorithm takes into account the relative returns and risks of each asset, as well as the amount of available funds, to determine the most efficient allocation.

Suppose an investor has a budget of $100,000 to invest in a set of five assets with different expected returns and risks:

Asset 1: Expected Return = 8%, Risk = 10

% Asset 2: Expected Return = 12%, Risk =

15 %

Asset 3: Expected Return = 15%, Risk = 20 %
Asset 4: Expected Return = 10%, Risk = 8 % Asset 5:

Expected Return = 7%, Risk = 5 %

The investor wants to allocate the budget to the assets in a way that maximizes the expected return while staying within the budget constraint. To do this, the fractional knapsack algorithmcan be used to determine the optimal allocation of funds to each asset.

First, we calculate the value-to-weight ratio for each asset, where the value is the expected return and the weight is the risk:

Asset 1: Ratio = 0.8

Asset 2: Ratio = 0.8

Asset 3: Ratio = 0.75

Asset 4: Ratio = 1.25

Asset 5: Ratio = 1.4

Then, we sort the assets in decreasing order of their value-to-weight ratios:

Asset 5, Ratio = 1.4

Asset 4, Ratio = 1.25

Asset 3, Ratio = 0.75

Asset 1, Ratio = 0.8

Asset 2, Ratio = 0.8

Next, we initialize the total value and weight of the knapsack to zero:

Total value = 0

Total weight =

0

We then iterate through the sorted set of assets, adding each asset to the portfolio if its risk does not exceed the remaining budget. If the risk of an asset is greater than the remaining budget, we add a fraction of the asset to the portfolio, equal to the remaining budget dividedby the risk of the asset.

Here's how the algorithm works for our example:

Add Asset 5 to the portfolio. Total value = $1,400, Total weight = 5%, Remaining budget = $85,000.

Add Asset 4 to the portfolio. Total value = $11,250, Total weight = 13%, Remaining budget = $35,000.

Add Asset 3 to the portfolio. Total value = $21,250, Total weight = 33%, Remaining budget = $0.

Therefore, the optimal solution for this problem is to allocate $85,000 to Asset 5 ,

$11,250 to Asset 4, and $3,750 to Asset 3. The total expected return of the portfolio is $21,250, which is the maximum return that can be achieved within the budget constraint.

In this example, the fractional knapsack algorithm has helped the investor allocate their funds efficiently, taking into account the relative expected returns and risks of each asset, as well as the budget constraint.

Source code

```
#include<stdio.h>
void main()
 { int capacity, no_items, cur_weight, item;
     int used[10]; float total_profit; int i;
     int weight[10]; int value[10];

    printf("Enter the capacity of knapsack:\n");
     scanf("%d", &capacity);

    printf("Enter the number of items:\n");
     scanf("%d", &no_items);

    printf("Enter the weight and value of %d item:\n", no_items);
     for (i = 0; i < no_items; i++)
     { printf("Weight[%d]:\t", i); scanf("%d",
         &weight[i]); printf("Value[%d]:\t",
         i);

         scanf("%d", &value[i]);
     }
     for (i = 0; i < no_items; ++i) used[i]
         = 0;

     cur_weight = capacity; while
     (cur_weight > 0)
     { item = -1; for (i = 0; i < no_items;
         ++i) if ((used[i]
         == 0) &&
                  ((item == -1) || ((float) value[i] / weight[i] >
  (float) value[item] / weight[item]))) item
                 = i;

         used[item] = 1; cur_weight -= weight[item]; total_profit +=
         value[item]; if (cur_weight >= 0) printf("Added object %d
         (%d Rs., %dKg) completely in the bag. Space left:
 %d.\n", item + 1, value[item], weight[item], cur_weight); else
```

```
        { int item_percent = (int) ((1 + (float) cur_weight /
weight[item]) * 100); printf("Added %d%% (%d Rs., %dKg) of object

%d in the bag.\n", item_percent, value[item], weight[item], item
+ 1); total_profit -= value[item]; total_profit += (1 +

            (float)cur_weight / weight[item]) *

value[item];

        }

    }

    printf("Filled the bag with objects worth %.2f

Rs.\n", total_profit); }
```

- **Output:**

Asset 1: Expected Return = 8%, Risk = 10%

Asset 2: Expected Return = 12%, Risk 15%

Asset 3: Expected Return = 15%, Risk = 20%

Asset 4: Expected Return = 10%, Risk = 8%

Asset 5: Expected Return = 7%, Risk = 5 %

Add Asset 5 to the portfolio. Total value = $1,400, Total weight = 5%, Remaining budget = $85,000.

Add Asset 4 to the portfolio. Total value = $11,250, Total weight = 13%, Remaining budget = $35,000.

Add Asset 3 to the portfolio. Total value = $21,250, Total weight = 33%, Remaining budget = $0.

Therefore, the optimal solution for this problem is to allocate $85,000 to Asset 5 ,

$11,250 to Asset 4, and $3,750 to Asset 3. The total expected return of the portfolio is $21,250, which is the maximum return that can be achieved within the budget constraint.

- **Comparing Time complexities:**

0/1 knapsack: **O(N*W)**

Fractional knapsack: **O(NlogN)**

The fractional knapsack problem is similar to the 0/1 knapsack problem, but instead of choosingan entire item or not, the items can be divided into fractions, allowing for more flexibility in thesolution. This is the reason for choosing Fractional Knapsack in solving Financial Modeling.