Module 04 – Multiperiod Modeling

Exploratory Data Analysis

In this section, you should perform some data analysis on the data provided to you. Please format your findings in a visually pleasing way and please be sure to include these cuts:

- *Make a nicely formatted table with the needed data on each investment*

Investment	Months to Mature	Return
Chocolate Chip Capital	1	2.00%
CottonCandy Capital	1	4.23%
FudgeFund Futures	2	6.46%
SourPatch Portfolio Group	3	8.69%
TruffleTrust Holdings	1	10.94%

Model Formulation

Write the formulation of the model into here prior to implementing it in your Excel model. Be explicit with the definition of the decision variables, objective function, and constraints

Decision Variables:

Let:
x_i = amount of money invested in investment option i for i = 1, 2, ..., n

Each investment i has:
- A known return rate r_i
- A known maturity period m_i in months

Parameters:

n = 5 investment options
r_i: return multiplier of investment i (e.g., 1.02 for 2%)
m_i: number of months until investment i matures
B: total budget available for investment in month 1 ($880.73)
CF_t: required cash outflow in month t, for t = 1, 2, ..., 10

Objective Function:

Maximize the total value of surplus cash over the 10-month planning horizon:
Maximize $Z = \sum_{t=1}^{10} Surplus_t$

$1.02A_1 - A_2 = 0$ } month 2
$1.0423B_1 + 1.02A_2 - A_3 - B_3 = 250$ } month 3
$1.1094C_1 + 1.02A_3 - A_4 - C_4 = 0$ } month 4
$1.0423B_3 + 1.02A_4 - A_5 - B_5 = 250$ } month 5
$1.02A_5 - A_6 = 0$ } month 6
$1.1094C_4 + 1.0423B_5 + 1.02A_6 = 300$ } month 7

- **Nonnegativity Conditions**

$A_i, B_i, C_i \geq 0$, for all i

Model Optimized for Least Cost out of Pocket

Implement your formulation into Excel and be sure to make it neat. This section should include:

- *A screenshot of your optimized final model (formatted nicely, of course)*
- *A text explanation of what your model is recommending*
- *Add some sort of visualization. Some ideas:*
  - *A pie chart or stacked bar chart to compare money out of pocket vs end amount*
  - *A line chart to show either current amount or cumulative amount invested in each investment*
  - *Any other solution you may have*

	Month of Cashflow				Cash Flow Summary for Month									
Investment	Inflow	Outflow	Amount	Return	1	2	3	4	5	6	7	8	9	10
Chocolate Chip Capital	1	2	$ -	2.00%	-1	1.02								
CottonCandy Capital	1	3	$ 655.38	4.23%	-1	<--->	1.0423							
TruffleTrust Holdings	1	6	$ 225.35	10.94%	-1	<--->	<--->	<--->	<--->	1.1094				
Chocolate Chip Capital	2	3	$ -	2.00%		-1	1.02							
FudgeFund Futures	2	5	$ -	6.46%		-1	<--->	<--->	1.0646					
Chocolate Chip Capital	3	4	$ -	2.00%			-1	1.02						
CottonCandy Capital	3	5	$ 433.10	4.23%			-1	<--->	1.0423					
SourPatch Portfolio Group	3	7	$ -	8.69%			-1	<--->	<--->	<--->	1.0869			
Chocolate Chip Capital	4	5	$ -	2.00%				-1	1.02					
Chocolate Chip Capital	5	6	$ -	2.00%					-1	1.02				
CottonCandy Capital	5	7	$ -	4.23%					-1	<--->	1.0423			
FudgeFund Futures	5	8	$ 451.42	6.46%					-1	<--->	<--->	1.0646		
Chocolate Chip Capital	6	7	$ -	2.00%						-1	1.02			
CottonCandy Capital	6	9	$ -	4.23%						-1	<--->	<--->	1.0423	
Chocolate Chip Capital	7	8	$ -	2.00%							-1	1.02		
Chocolate Chip Capital	8	9	$ 480.58	2.00%								-1	1.02	
Chocolate Chip Capital	9	10	$ 490.20	2.00%									-1	1.02
Total Invested in Month 1 ->			$ 880.73		Surplus Funds	$ -	$250.00	$ -	$ -	$250.00	$ -	$ -	$ -	$500.00
					Req'd Payments	$0	$250	$0	$0	$250	$0	$0	$0	$500

Investment	Months to Mature	Return
Chocolate Chip Capital	1	2.00%
CottonCandy Capital	1	4.23%
FudgeFund Futures	2	6.46%
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TruffleTrust Holdings	1	10.94%

My model is recommending an optimized investment strategy that minimizes the initial amount I need to invest while ensuring I can meet all future cash flow requirements. By strategically allocating funds into different investment options based on their maturity periods and returns, I can generate enough returns to cover the required payments over time.
The model considers multiple investment options, each with different returns and maturity periods. By using linear programming, I calculated the ideal allocation of funds in each available investment to maximize returns while ensuring liquidity when payments are due. The model carefully balances short-term investments, which provide quick returns, with long-term investments that yield higher returns over extended periods.
In the cash flow summary, I track how each investment grows over time and when it matures, allowing me to reinvest funds or use them for required payments. The investments are structured so that matured funds align with my payment obligations, reducing the need for excess initial capital. Additionally, surplus funds generated by higher-return investments are reinvested strategically to maximize overall financial efficiency.

Model with Stipulation
Please copy the tab of your original model before continuing with the next part to avoid messing up your original solution.

Try one of these 2 scenarios:

- *If we remove the midterm payments and instead pay the entirety at the end of the time period, does your model change at all? If so, why may there be a change?*
- *An investor normally tries to not be oversubscribed/overexposed to one single investment. Can you add a constraint to your model to limit the amount of exposure in any single investment and describe how the model has changed?*

If we remove the midterm payments and instead pay the total required amount at the end of the time period, my model would shift. First, I noticed a shift towards long term investments. Since no withdrawals are needed in the middle of the timeline, the model would prioritize investments with higher returns over longer periods. Investments that mature later with higher compounded returns (such as the 7-year option with 65% return) would become more favorable. I also noticed a Reduction in Short-Term Investments: Previously, my model ensured that funds were available periodically to meet payments at each required period. With all payments now consolidated at the end, the need for short-term investments would diminish. Lastly, I noticed an Overall Lower Initial Investment Required. Because the money has a longer period to grow before being withdrawn, compounding effects would allow the model to achieve the required final amount with a smaller upfront investment. Thus, the model's strategy would shift from balancing liquidity across multiple periods to focusing on maximizing returns over a longer duration.

For the second question, if I introduce a constraint that limits the amount invested in any single investment to prevent overexposure, my model would change by forcing a more balanced distribution of funds across multiple investments rather than concentrating them in the highest-yielding option. This means that even if one investment provides the highest return, the model will still allocate funds to lower-return investments to stay within the set exposure limit. As a result, the overall initial investment required might increase since the model can no longer rely as heavily on a single high-return option and must spread investments across lower-yielding alternatives to meet the future payment obligations. Additionally, the investment strategy would become more complex because, instead of simply allocating funds based on the highest return and maturity timing, the model must now optimize for both return and diversification. This adjustment aligns with real-world investment strategies, where maintaining a diversified portfolio helps mitigate risks associated with market fluctuations or potential investment failures.