Individual Assignment #1 – Linear Programming Fundamentals

**Susan Wong’s Personal Budgeting Model**

Aditya Shah (101521301)

The Below Document contains 2 methods

1. First is giving more money in longer term base but the amount of investment is not going to be linear and can be more adjustable.
2. Second is giving less money but the amount of investment from money saved will be linear which gives a comfort of not spending time to analyze each month’s amount of investment.

**SENSITIVITY ANALYSIS** AND **SOLUTION IMPLEMENTATION** IS DONE USING METHOD 2

**Method 1**

**Decision Variables**

The variables to for the case study are:

= Amount invested in **1-month** investments in month

= Amount invested in **3-month** investments in month

= Amount invested in **7-month** investments in month

**The Objective Function**

The objective is to maximize the total investment plan over the year.

Maximize Z =

Here, 0.005 = Yield on 1-month investment (6% annual nominal)

0.02 = Yield on 3-month investment (8% annual nominal)

0.06 = Yield on 7-month investment (12% annual nominal)

This amount is going to set aside to use it in a different investment

**Model Constraints**

Susan must cover her monthly expenses, which include rent, utilities, and other living costs. The constraints for each month are:

**January:**

Here

changes over every month

**February:**

**March:**

**April:**

**May:**

**June:**

**July:**

**August:**

**September:**

**October:**

**November:**

**December:**

**Method 2**

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**Sensitivity Analysis**

**Combined Sensitivity Analysis for Both Processes**

In the first scenario, where Susan’s entire $3,800 is used for budgeting and invested in a combination of 1-month, 3-month, and 7-month investments, **marginal values** demonstrate that every additional dollar allocated to higher-yielding 7-month investments has a more substantial impact on her total savings. **Sensitivity ranges** highlight that even slight fluctuations in interest rates for 7-month investments significantly affect the final amount, as these provide the highest returns (12%). **Shadow prices** indicate that any additional income or savings directly increases her ability to invest and maximize returns, with the most substantial effect seen in months where she has more liquidity for long-term investments. Removing constraints, like reducing monthly bills, would allow more funds for investment, increasing savings. Conversely, adding constraints, like higher bills, would reduce her ability to allocate money toward investments.

In the second scenario, where $3,500 of the $3,800 is invested elsewhere, leaving only $300 for budgeting, liquidity becomes a critical factor. With fewer funds available for immediate use, Susan is more reliant on short-term investments (1-month and 3-month) to meet her monthly expenses. **Constraint impacts** are more severe in this case, as higher expenses or reduced income could quickly deplete her available funds. **Shadow prices** show that any increase in income or reduction in monthly bills has a more pronounced effect here, as it directly improves her liquidity and allows her to invest more in higher-yield options. **Sensitivity ranges** suggest that the lack of flexibility reduces the overall financial performance, with smaller returns compared to the first scenario due to the reduced ability to invest in 7-month options. Removing constraints, like lowering bills, would have a greater positive impact in this scenario, whereas adding constraints would make it difficult for Susan to maintain sufficient liquidity and meet expenses.

In summary, the first scenario, where the full $3,800 is used for budgeting and investments, offers more flexibility and higher overall returns due to better long-term investment opportunities. In contrast, the second scenario, with only $300 for budgeting, is more sensitive to liquidity constraints and less effective in maximizing financial performance.

**Solution Implementation Summary**

In the first scenario, where Susan allocates the entire $3,800 toward her monthly budgeting and investment strategy, the goal is to efficiently manage her funds across 1-month, 3-month, and 7-month investment options. The strategy optimizes for both liquidity and long-term returns, with higher allocations toward 7-month investments when liquidity needs are lower, as they offer the highest return at 12%. Shorter-term investments (1-month and 3-month) are used to maintain liquidity, allowing Susan to cover her monthly expenses while generating returns of 6% and 8% respectively.

In the second scenario, where $3,500 of the initial savings is invested elsewhere, Susan has only $300 available for her budget. As a result, liquidity becomes more constrained, and the focus shifts toward using shorter-term investments (1-month and 3-month) to ensure she can meet her monthly expenses. This strategy limits her ability to capitalize on higher long-term returns, as fewer funds are available for the 7-month investments, resulting in lower overall returns.

**Recommendations**

For Scenario 2 (with 3800):

* **Maximize 7-Month Investments**: Continue prioritizing 7-month investments for higher returns but adjust for liquidity needs during months with higher expenses.
* **Increase Short-Term Flexibility**: Shift a small portion to 1-month or 3-month investments in months with higher bills to ensure easier cash access.
* **Regular Budget Review**: Periodically assess her budget and adjust investment allocations based on her changing financial needs.
* **Automate Adjustments**: Implement automatic reallocation of funds when expenses exceed a threshold to ensure sufficient liquidity.

For Scenario 2 (without 3800):

* **Prioritize Liquidity**: Focus more on 1-month and 3-month investments to cover immediate expenses, given the restricted liquidity.
* **Cut Unnecessary Expenses**: Reduce discretionary spending to free up more funds for investment and long-term growth.
* **Review the $3,500 Investment**: Reevaluate the $3,500 invested elsewhere to ensure its yielding sufficient returns and liquidity.
* **Rebalance After Key Expenses**: After major payments, rebalance investments toward higher-yielding 7-month options when more funds are available.