Project Topic: Sensitive Analysis of Mathematical Formulation

# Mathematical Formulation:

Let's consider a basic mathematical formulation for a simple sensitivity analysis scenario. Suppose you have a linear model representing the profitability of a project:

Profit=*a*×Variable1​+*b*×Variable2​+*c*×Variable3​+…+*n*× Variable*n*

Where:

* *a*, *b*, *c*, …, *n* are the coefficients of each variable.
* Variable1, Variable2, …, Variablen are the input variables.

## Problem Scenario:

Let's say your objective is to maximize profit. You've identified three key variables:

Variable1, Variable2, Variable3Variable1​, Variable2​, Variable3​.

The initial baseline scenario is:

Profit=2×Variable1+3×Variable2+1×Variable3

Your baseline values are Variable1=5, Variable2=8, Variable3=10, resulting in a profit of 2×5+3×8+1×10=412×5+3×8+1×10=41.

## Sensitivity Analysis:

1. **Change in Variable 1:** Vary Variable1Variable1​ by ±2 units and observe the impact on profit.

Profit=2×(Variable1±2) +3×Variable2+1×Variable3

Calculate new profits and compare with the baseline.

1. **Change in Variable 2:** Vary Variable2Variable2​ by ±1 unit and observe the impact on profit.

Profit=2×Variable1+3×(Variable2±1) +1×Variable3 ​

Again, calculate new profits and compare.

1. **Change in Variable 3:** Vary Variable3Variable3​ by ±3 units and observe the impact on profit.

Profit=2×Variable1+3×Variable2+1×(Variable3±3)

Calculate new profits and compare.

## Solutions:

**Variable 1 Sensitivity:**

Increase by 2 units: Profit increases to 2×7+3×8+1×10=472×7+3×8+1×10=47.

Decrease by 2 units: Profit decreases to 2×3+3×8+1×10=362×3+3×8+1×10=36.

**Variable 2 Sensitivity:**

Increase by 1 unit: Profit increases to 2×5+3×9+1×10=442×5+3×9+1×10=44.

Decrease by 1 unit: Profit decreases to 2×5+3×7+1×10=382×5+3×7+1×10=38.

**Variable 3 Sensitivity:**

Increase by 3 units: Profit increases to 2×5+3×8+1×13=502×5+3×8+1×13=50.

Decrease by 3 units: Profit decreases to 2×5+3×8+1×7=322×5+3×8+1×7=32.

These results help identify the sensitivity of the profit to changes in each variable, providing insights for decision-making.

## Conclusion:

1. **Variable Sensitivity Analysis:**
   * **Variable 1:** The profit is sensitive to changes in Variable 1. Increasing Variable 1 leads to a higher profit, while decreasing it results in lower profitability.
   * **Variable 2:** Profit is moderately sensitive to changes in Variable 2. Increasing Variable 2 leads to a modest increase in profit, while decreasing it has a moderate negative impact.
   * **Variable 3:** Profit is highly sensitive to changes in Variable 3. Increasing Variable 3 significantly boosts profit, while decreasing it has a substantial negative impact.
2. **Key Drivers of Profitability:**
   * **Variable 3 is Critical:** The analysis suggests that Variable 3 has the most significant impact on profitability. Any strategic decisions or interventions related to Variable 3 are likely to have a substantial effect on the project's overall profitability.
   * **Variable 1 is Important:** While not as influential as Variable 3, Variable 1 still plays a crucial role. It's important to monitor and manage Variable 1 to ensure positive outcomes.
3. **Risk Mitigation and Optimization:**
   * **Diversification:** Given the sensitivity to Variable 3, it might be advisable to explore options for diversification or risk mitigation strategies related to Variable 3 to stabilize profits.
   * **Optimization:** Variable 1 and Variable 2 can be optimized to maximize profit. However, decisions regarding Variable 3 should be made cautiously, considering its high impact.
4. **Scenario Planning:**
   * **Future Scenarios:** To enhance decision-making, consider various future scenarios by combining changes in multiple variables. This will provide a more comprehensive understanding of potential outcomes under different conditions.
5. **Continuous Monitoring:**
   * **Dynamic Environment:** The business environment is dynamic, and variables may change over time. Regularly monitor key variables and update the sensitivity analysis to reflect changes in the project's landscape.
6. **Documentation and Communication:**
   * **Assumptions and Limitations:** Clearly document the assumptions made during the sensitivity analysis. Communicate the results and their implications to stakeholders, ensuring a shared understanding of the project's sensitivity to key variables.

In conclusion, sensitivity analysis provides valuable insights into the project's vulnerability to changes in key variables. Understanding these sensitivities enables informed decision-making, risk management, and strategic planning for the success of the project.

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