**Management Report on Optimization Problems**

**NasaMist Production Model for Minimum Production Cost**

In producing the pharmaceutical drug NasaMist, the company employs four distinct chemical entities – the primes numbered one through four. Three distinct active ingredients, A, B, and C are also constituted in this production, for which, their inclusion must adhere to specific constraints of percentage composition. The analysis utilized the Simplex LP optimization model approach, with pounds of each chemical used as the decision variables, to determine the minimally optimal way for producing a batch of 1000 pounds of the drug, given the specific production constraints that must be followed.

The optimization model results indicate that the minimum cost solution uses 0 pounds of chemical 1, 460 pounds of chemical 2, (meeting the 100lb minimum), 459 pounds of chemical 3 (meeting the 450 lb minimum), and 90 pounds of chemical 4. This punctilious combination satisfies all the ingredient percentage and chemical amount constraints while minimizing the total cost to $10,810 for producing 1000 pounds of NasaMist (See the embedded Excel output file illustrating this feat).



Further inquisitions via sensitivity analysis involved modulating the percentage of active ingredient A from 6% to 12% within the model, to observe its effect on production cost variations. The results show that varying the percentage between 6% to 8% does not affect the total cost of production. However, increasing the required amount of ingredient A to 9% and more makes production infeasible. Consequently, this treatise recommends producing NasaMist using the minimum cost quantities identified in the optimization model, whilst monitoring and maintaining the percentage of active ingredient A at 8% or lower to avoid production issues and cost increases. The model produces an effective tool to determine optimal production amounts and costs but should be updated if the prices or ingredient concentrations change.

**Figure 1**

*Sensitivity of Production Cost to Ingredient A Variations*

**Optimal Radiation Effect**

When treating brain tumors with radiation, it is critical to maximize radiation exposure to tumor tissue while minimizing exposure to healthy tissue. Exceeding the tissue’s irradiation threshold induces catastrophic collateral damage to healthy areas, further compromising patient safety and recovery. Thus, an optimization routine identified the ideal combination of radiation beams to maximize the radiation delivered to tumorous regions without subjecting any healthy regions to more than 60 radiation units. In the optimization model, the decision variable was binary, indicating whether a beam was selected for the model or not for an optimal radiation effect.

The optimized solution uses beams 2, 3, 4, and 6, producing an optimal radiation effect of 228 units on tumor regions while meeting all normal tissue constraints (please see the embedded Excel analysis file). This model provides an effective way to determine the ideal beam intensities and orientations that maximize tumor radiation exposure while protecting healthy tissues. Periodically, re-optimizing as needed will ensure patients receive the most effective treatment.

