

Assignment 2: Simulated Annealing and Simple Null Spaces

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1. Compute the value of a common stock where the underlying asset has a mean return of \$ 5.00 and the standard deviation is \$ 3.00 (note that this is a call option with a strike price of \$ 0.00).
2. An important reformulation of the standard consumption problem is the household production formulation. In this formulation, consumers do not derive utility from goods that they purchase, but transform purchased goods into consumption goods through a production process. Assume that the consumer maximizes the traditional Cobb-Douglas utility function subject to a linear production relationship

$$\begin{aligned} & \max_{x_1, x_2, x_3, z_1, z_2, z_3, z_4} x_1^{0.30} x_2^{0.20} x_3^{0.35} \\ \text{s.t. } & -x_1 - 0.75x_2 - 0.35x_3 + 0.75z_1 + 0.95z_2 - 0.05z_3 + 0.45z_4 \geq 0.00 \\ & -0.45x_1 + 0.05x_2 - 0.15x_3 + 0.25z_1 + 0.15z_2 + 0.75z_3 - 0.15z_4 \geq 0.00 \\ & 5.00z_1 + 3.50z_2 + 1.75z_3 + 2.50z_4 \leq 100.00 \end{aligned} \tag{1}$$

where x_i $i = 1, 2, 3$ are the consumption goods and z_i $i = 1, 2, 3, 4$ are the production items. Note that the third equation is the income constraint. For this assignment

- a. Compute the Null Space for the linear constraints.
- b. Compute the project gradient and Hessian at the point $x_1 = 50.655$, $x_2 = 85.000$, $x_3 = 149.830$, $z_1 = -173.320$, $z_2 = 387.63$, $z_3 = 3.273$, and $z_4 = -158.334$.