

Applications of Stigler’s Diet Problem

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Stigler’s diet problem is a common example of a linear programming problem. I will review some of its applications and position them within their political and legal contexts.

In the diet problem, we are given a list of foods. For each food item, we know its nutrient values and cost. The associated linear programming problem asks for a diet, given by a selection of foods in various quantities, that minimizes the total cost while respecting certain constraints about total nutrient contents.

1 Minimum Wage

George Stigler introduced the diet problem in 1945 [7]. Using a list of 77 foods and 9 nutrients, he computed a vector which indicated that \$39.93 was enough to feed an adult man in 1939. This cost estimate was much lower than that of food economists. The US Bureau of Home Economics estimated that a bare minimal diet cost \$78 - \$104 for the same year. Stigler explains this gap by stating “*tax-supported bureaucrats and professors may also have another reason for certain of their practices.*” He does not elaborate what that other reason may be.

I posit that we must understand Stigler’s calculation in the context of his other work. In 1946 he himself [8] makes this connection in his paper arguing against the minimum wage, where he writes that “*we seek to abolish poverty in good part because it leads to undernourishment.*” He goes on to argue that if income assistance is provided then this must either be accompanied by a dietary education programme or any assistance must be provided “*in kind, expertly chosen.*” Thus I argue that Stigler introduced the diet problem as an argument for his policy preference.

2 Incarceration

In 1971, Sitansu Mitra of Penn State University started working with the Pennsylvania Department of Corrections to apply Stigler’s diet problem to the food for incarcerated people. He describes [5] this project to provide a nutritionally adequate diet at minimum cost as “*fully operational with high success*” in 1975, and that the New York City Department of Corrections started a similar program. This effort appears to have found broader adoption, for in 1984 Hy, Feig and Regoli [4] published educational materials on linear programming for criminal justice administration in which every example is a variant on Stigler’s diet problem.

A recent report [6] describes a timeline of prison food, according to which a serious decline in availability and quality of food started in the 1970s. This decline is in part attributed to a rigid central planning of food services designed to supply the required calories and nutrients but nothing more. In a questionnaire among incarcerated individuals, 94% of respondents indicated that they couldn’t eat enough to feel full.

3 Blockade

In 2007, Israel closed the land and sea borders of the Gaza Strip to people and goods. Documents from the Ministry of Defense [1, 2] describe that “*the deputy defense minister approved*

allowing 106 trucks carrying basic humanitarian products into the Gaza Strip, including 77 basic food products.” These documents describe calculations performed to identify a minimal subsistence basket, sufficient to avert the development of malnutrition. This minimal basket is used to conclude that 106 trucks allows for adequate nutritional intake, though the document the documents recommends a nutritional education programme to make this possible.

The documents contain extensive tables prescribing intakes per food group for different gender and age groups, accurate to 0.01 gram per day. Certain features of the documents suggest that a variant of Stigler’s LP may have been used. The calculation finds a lower bound of 88.8 trucks, which is to the 89 trucks of food underlying the 106 policy. Legal scholars describe that these calculations may have played an important part in Israel’s interpretation of the applicable laws of armed conflict [3].

4 The Right to Adequate Food

The International Covenant on Economic, Social and Cultural Rights prescribes a number of universal human rights, which includes the right to adequate food. In 1999 the UN Committee for Economic, Social and Cultural Rights further describes this right as a broad right: food must be available, accessible, free from harmful substances, culturally acceptable and much more. In particular the committee writes that

The right to adequate food shall therefore not be interpreted in a narrow or restrictive sense which equates it with a minimum package of calories, proteins and other specific nutrients. [9].

I argue that the assumptions underlying Stigler’s diet problem are in fundamental conflict with this interpretation, and that these faulty assumptions directly lead to the problems described in the previous sections.

References

- [1] Coordinator of Government Activities in the Territories. Food consumption in the Gaza Strip - red lines, January 2008.
- [2] Gisha. Reader: "food consumption in the Gaza Strip - red lines", 2012.
- [3] Aeyal Gross and Tamar Feldman. We didn’t want to hear the word calories: Rethinking food security, food power, and food sovereignty—lessons from the Gaza closure. *Berkeley Journal of International Law*, 33:379–441, 2015.
- [4] Ronald John Hy, Douglas Feig, and Robert M. Regoli. Linear programming in criminal justice administration. *American Journal of Criminal Justice*, 8(2):195–213, June 1984.
- [5] Sitansu S. Mitra. Application of operations research methods to correctional problems. *Correctional Psychologist*, 2(2):169–179, June 1975.
- [6] Leslie Sobel, Kathryn Stroud, and Marika Weinstein. Eating behind bars: Ending the hidden punishment of food in prison, 2020.
- [7] George J Stigler. The cost of subsistence. *Journal of Farm Economics*, 27(2):303–314, 1945.
- [8] George J Stigler. The economics of minimum wage legislation. *The American Economic Review*, 36(3):358–365, 1946.
- [9] UN Committee on Economic, Social and Cultural Rights. E/c.12/1999/5: General comment no. 12 on the right to adequate food: Substantive issues arising in the implementation of the international covenant on economic, social and cultural rights, May 1999.