

Challenge October 2026

Stigler's Diet Problem

A solution with IBM OPL CPLEX by Alex Fleischer
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This diet problem is very good to explain what optimization is and is an example provided by IBM to explain cplex python API:

<https://ibmdecisionoptimization.github.io/docplex-doc/mp/diet.html>

which I translated to OPL in 2022 because to me that's much easier to read for humans.

Anyway I am glad to use OPL CPLEX now to solve with the original values by Stigler.

The OPL model .mod

```
{string} Foods = ...;  
{string} Nutrients = ...;
```

```
float minDailyReq[Nutrients] = ...;  
// how much nutrient n provided by 1 unit of food f  
float fn[Foods][Nutrients] = ...;
```

```
// -----  
// Decision variables  
// -----  
// how much dollars to spend for each food  
dvar float+ x[Foods];
```

```
// -----  
// Objective  
// -----  
dexpr float cost= // Yearly cost.  
    sum(f in Foods) x[f];
```

```

minimize cost;
// -----
// Constraints
// -----
subject to {
    // for each nutrient n, reach requirement
    forall(n in Nutrients){
        NutrientMin:
            sum(f in Foods) fn[f][n] * x[f]/365 >= minDailyReq[n];
    }
}

execute display
{
    for(var f in Foods)
        if (x[f]!=0) writeln("food ",f," : ",x[f]);
    writeln("Cost = ",cost);
}

```

And the data .dat

```

Foods = {
    "Wheat Flour (Enriched)",
    "Macaroni",
    "Wheat Cereal (Enriched)",
    "Corn Flakes",
    "Corn Meal",
    "Hominy Grits",
    "Rice",
    "Rolled Oats",
    "White Bread (Enriched)",
    "Whole Wheat Bread",
    "Rye Bread",
    "Pound Cake",
    "Soda Crackers",
    "Milk",
    "Evaporated Milk (can)",
    "Butter",
    "Oleomargarine",
}

```

"Eggs",
"Cheese (Cheddar)",
"Cream",
"Peanut Butter",
"Mayonnaise",
"Crisco",
"Lard",
"Sirloin Steak",
"Round Steak",
"Rib Roast",
"Chuck Roast",
"Plate",
"Liver (Beef)",
"Leg of Lamb",
"Lamb Chops (Rib)",
"Pork Chops",
"Pork Loin Roast",
"Bacon",
"Ham, smoked",
"Salt Pork",
"Roasting Chicken",
"Veal Cutlets",
"Salmon, Pink (can)",
"Apples",
"Bananas",
"Lemons",
"Oranges",
"Green Beans",
"Cabbage",
"Carrots",
"Celery",
"Lettuce",
"Onions",
"Potatoes",
"Spinach",
"Sweet Potatoes",
"Peaches (can)",
"Pears (can)",
"Pineapple (can)",
"Asparagus (can)",

```
"Green Beans (can)",  
"Pork and Beans (can)",  
"Corn (can)",  
"Peas (can)",  
"Tomatoes (can)",  
"Tomato Soup (can)",  
"Peaches, Dried",  
"Prunes, Dried",  
"Raisins, Dried",  
"Peas, Dried",  
"Lima Beans, Dried",  
"Navy Beans, Dried",  
"Coffee",  
"Tea",  
"Cocoa",  
"Chocolate",  
"Sugar",  
"Corn Syrup",  
"Molasses",  
"Strawberry Preserves"  
};
```

```
Nutrients = {  
  "Calories (kcal)",  
  "Protein (g)",  
  "Calcium (g)",  
  "Iron (mg)",  
  "Vitamin A (KIU)",  
  "Vitamin B1 (mg)",  
  "Vitamin B2 (mg)",  
  "Niacin (mg)",  
  "Vitamin C (mg)"  
};
```

```
// The Stigler diet mandated that these minimums be met per day:  
minDailyReq = [  
  3,  
  70,  
  0.8,  
  12,
```

5,
1.8,
2.7,
18,
75
];

fn = [
[44.7,1411,2,365,0,55.4,33.3,441,0],
[11.6,418,0.7,54,0,3.2,1.9,68,0],
[11.8,377,14.4,175,0,14.4,8.8,114,0],
[11.4,252,0.1,56,0,13.5,2.3,68,0],
[36.0,897,1.7,99,30.9,17.4,7.9,106,0],
[28.6,680,0.8,80,0,10.6,1.6,110,0],
[21.2,460,0.6,41,0,2,4.8,60,0],
[25.3,907,5.1,341,0,37.1,8.9,64,0],
[15.0,488,2.5,115,0,13.8,8.5,126,0],
[12.2,484,2.7,125,0,13.9,6.4,160,0],
[12.4,439,1.1,82,0,9.9,3,66,0],
[8.0,130,0.4,31,18.9,2.8,3,17,0],
[12.5,288,0.5,50,0,0,0,0,0],
[6.1,310,10.5,18,16.8,4,16,7,177],
[8.4,422,15.1,9,26,3,23.5,11,60],
[10.8,9,0.2,3,44.2,0,0.2,2,0],
[20.6,17,0.6,6,55.8,0.2,0,0,0],
[2.9,238,1.0,52,18.6,2.8,6.5,1,0],
[7.4,448,16.4,19,28.1,0.8,10.3,4,0],
[3.5,49,1.7,3,16.9,0.6,2.5,0,17],
[15.7,661,1.0,48,0,9.6,8.1,471,0],
[8.6,18,0.2,8,2.7,0.4,0.5,0,0],
[20.1,0,0,0,0,0,0,0,0],
[41.7,0,0,0,0.2,0,0.5,5,0],
[2.9,166,0.1,34,0.2,2.1,2.9,69,0],
[2.2,214,0.1,32,0.4,2.5,2.4,87,0],
[3.4,213,0.1,33,0,0,2,0,0],
[3.6,309,0.2,46,0.4,1,4,120,0],
[8.5,404,0.2,62,0,0.9,0,0,0],
[2.2,333,0.2,139,169.2,6.4,50.8,316,525],

[3.1,245,0.1,20,0,2.8,3.9,86,0],
[3.3,140,0.1,15,0,1.7,2.7,54,0],
[3.5,196,0.2,30,0,17.4,2.7,60,0],
[4.4,249,0.3,37,0,18.2,3.6,79,0],
[10.4,152,0.2,23,0,1.8,1.8,71,0],
[6.7,212,0.2,31,0,9.9,3.3,50,0],
[18.8,164,0.1,26,0,1.4,1.8,0,0],
[1.8,184,0.1,30,0.1,0.9,1.8,68,46],
[1.7,156,0.1,24,0,1.4,2.4,57,0],
[5.8,705,6.8,45,3.5,1,4.9,209,0],
[5.8,27,0.5,36,7.3,3.6,2.7,5,544],
[4.9,60,0.4,30,17.4,2.5,3.5,28,498],
[1.0,21,0.5,14,0,0.5,0,4,952],
[2.2,40,1.1,18,11.1,3.6,1.3,10,1998],
[2.4,138,3.7,80,69,4.3,5.8,37,862],
[2.6,125,4.0,36,7.2,9,4.5,26,5369],
[2.7,73,2.8,43,188.5,6.1,4.3,89,608],
[0.9,51,3.0,23,0.9,1.4,1.4,9,313],
[0.4,27,1.1,22,112.4,1.8,3.4,11,449],
[5.8,166,3.8,59,16.6,4.7,5.9,21,1184],
[14.3,336,1.8,118,6.7,29.4,7.1,198,2522],
[1.1,106,0,138,918.4,5.7,13.8,33,2755],
[9.6,138,2.7,54,290.7,8.4,5.4,83,1912],
[3.7,20,0.4,10,21.5,0.5,1,31,196],
[3.0,8,0.3,8,0.8,0.8,0.8,5,81],
[2.4,16,0.4,8,2,2.8,0.8,7,399],
[0.4,33,0.3,12,16.3,1.4,2.1,17,272],
[1.0,54,2,65,53.9,1.6,4.3,32,431],
[7.5,364,4,134,3.5,8.3,7.7,56,0],
[5.2,136,0.2,16,12,1.6,2.7,42,218],
[2.3,136,0.6,45,34.9,4.9,2.5,37,370],
[1.3,63,0.7,38,53.2,3.4,2.5,36,1253],
[1.6,71,0.6,43,57.9,3.5,2.4,67,862],
[8.5,87,1.7,173,86.8,1.2,4.3,55,57],
[12.8,99,2.5,154,85.7,3.9,4.3,65,257],
[13.5,104,2.5,136,4.5,6.3,1.4,24,136],
[20.0,1367,4.2,345,2.9,28.7,18.4,162,0],
[17.4,1055,3.7,459,5.1,26.9,38.2,93,0],
[26.9,1691,11.4,792,0,38.4,24.6,217,0],
[0,0,0,0,0,4,5.1,50,0],

```
[0,0,0,0,0,0,2.3,42,0],  
[8.7,237,3,72,0,2,11.9,40,0],  
[8.0,77,1.3,39,0,0.9,3.4,14,0],  
[34.9,0,0,0,0,0,0,0,0],  
[14.7,0,0.5,74,0,0,0,5,0],  
[9.0,0,10.3,244,0,1.9,7.5,146,0],  
[6.4,11,0.4,7,0.2,0.2,0.4,3,0]  
];
```

Which gives in less than 1s

```
food Wheat Flour (Enriched) : 10.774457512  
food Liver (Beef) : 0.690783411  
food Cabbage : 4.093268865  
food Spinach : 1.82779607  
food Navy Beans, Dried : 22.275425687  
Cost = 39.661731545
```