

Stigler's Diet Problem

Solution with OpenRules Rule Solver

The problem is offered as a Decision Management Community [Challenge October-2026](#):

Stigler's Diet Problem is one of the classical problems in Operational Research. The problem finds its origin in the work of Nobel laureate George Stigler (1944), who posed this as a mathematical exercise, not as eating recommendations:

For a moderately active man weighing 154 pounds, how much of each of 77 foods should be eaten on a daily basis so that the man's intake of nine nutrients will be at least equal to the [recommended dietary allowances](#) in 1943, with the cost of the diet being minimal?

You can find more details, the nutrients and commodities lists, along with a possible solution, at the [OR-Tools website](#).

Glossary

Glossary glossary				
Variables	Business Concept	Attribute	Type	Used As
Nutrients	DietProblem	nutrients	Nutrient[]	in
Foods		foods	Food[]	in
AnnualCost		annualCost	double	out
NutrientsPerDay		nutrientsPerDay	Nutrient[]	out
Name	Nutrient	name	String	in
DailyIntake		dailyIntake	double	in
Commodity	Food	commodity	String	in
Units		units	String	in
Price		price	double	in
NutrientQuantities		nutrientQuantities	double[]	in

Test Data

We copied the OR-Tools data to Excel and added two lines to the headers.

DecisionData Nutrient nutrients	
Name	DailyIntake
Calories (calories)	3
Protein (grams)	70
Calcium (grams)	0.8
Iron (milligrams)	12
Vitamin A (IU)	5
Thiamine (Vitamin B1) (milligrams)	1.8
Riboflavin (Vitamin B2) (milligrams)	2.7
Niacin (milligrams)	18
Ascorbic Acid (Vitamin C) (milligrams)	75

DecisionData Food foods											
Commodity	Units	Price	NutrientQuantities								
Wheat Flour (Enriched)	10 lb.	36	45	1411	2	365	0	55	33	441	0
Macaroni	1 lb.	14.1	12	418	0.7	54	0	3.2	1.9	68	0
Wheat Cereal (Enriched)	28 oz.	24.2	12	377	14	175	0	14	8.8	114	0
Corn Flakes	8 oz.	7.1	11	252	0.1	56	0	14	2.3	68	0
Corn Meal	1 lb.	4.6	36	897	1.7	99	30.9	17	7.9	106	0
Hominy Grits	24 oz.	8.5	29	680	0.8	80	0	11	1.6	110	0
Rice	1 lb.	7.5	21	460	0.6	41	0	2	4.8	60	0
Rolled Oats	1 lb.	7.1	25	907	5.1	341	0	37	8.9	64	0
White Bread (Enriched)	1 lb.	7.9	15	488	2.5	115	0	14	8.5	126	0
Whole Wheat Bread	1 lb.	9.1	12	484	2.7	125	0	14	6.4	160	0
Rye Bread	1 lb.	9.1	12	439	1.1	82	0	9.9	3	66	0
Pound Cake	1 lb.	24.8	8	130	0.4	31	18.9	2.8	3	17	0
Soda Crackers	1 lb.	15.1	13	288	0.5	50	0	0	0	0	0
Milk	1 qt.	11	6.1	310	11	18	16.8	4	16	7	177
Evaporated Milk (can)	14.5 oz.	6.7	8.4	422	15	9	26	3	24	11	60
Butter	1 lb.	30.8	11	9	0.2	3	44.2	0	0.2	2	0
Oleomargarine	1 lb.	16.1	21	17	0.6	6	55.8	0.2	0	0	0
Eggs	1 doz.	32.6	2.9	238	1	52	18.6	2.8	6.5	1	0
Cheese (Cheddar)	1 lb.	24.2	7.4	448	16	19	28.1	0.8	10	4	0
Cream	1/2 pt	14.1	2.5	40	1.7	2	16.0	0.6	2.5	0	17

...

DecisionTest testCases		
#	Define	Define
Test ID	Nutrients	Foods
1	nutrients	foods

Business Logic

We implemented it in a Java class “SolverProblem” that utilizes [JavaSolver](#).

Problem Definition

```
package com.openrules.diet;

import javax.constraints.Solution;
import javax.constraints.VarReal;

import com.jasolver.JavaSolver;

public class SolverProblem extends JavaSolver {

    Nutrient[] nutrients;
    Food[] foods;
    double MAX = 1000000;

    public SolverProblem(Nutrient[] nutrients, Food[] foods ) {
        this.nutrients = nutrients;
        this.foods = foods;
    }

    public void define() {

        // problem unknowns
        VarReal[] foodVars = new VarReal[foods.length];
        for(int i = 0; i < foods.length; i++) {
            Food f = foods[i];
            foodVars[i] = csp.variableReal(f.getCommodity(), 0, MAX);
        }

        // objective
        VarReal annualCost = csp.sum(foodVars);
        annualCost.setName("AnnualCost");
        csp.add(annualCost);
        setObjectiveReal(annualCost);

        // min daily intake constraints
        VarReal[][] consumedNutrients = new VarReal[nutrients.length][foods.length];
        for(int i = 0; i < nutrients.length; i++) {
            Nutrient nutrient = nutrients[i];
            for(int j = 0; j < foods.length; j++) {
                Food f = foods[j];
                String name = "consumedNutrients["+i+","+j+"]";
                consumedNutrients[i][j] = csp.variableReal(name, 0, MAX);
                csp.post(consumedNutrients[i][j], "=", foodVars[j].multiply(f.getNutrientQuantities()[i]));
            }
            VarReal totalConsumedNutrients = csp.sum(consumedNutrients[i]);
            csp.add("totalConsumedNutrients-" + nutrient.getName(),totalConsumedNutrients);
            System.out.println("post " + totalConsumedNutrients + " >= " + nutrient.getDailyIntake()*365);
            csp.post(totalConsumedNutrients,">=",nutrient.getDailyIntake()*365);
        }
    }
}
```

Problem Resolution

```
public Solution solve() {
    Solution solution = minimize();
    if (solution == null) {
        csp.log("No Solutions");
    } else {
        System.out.println("\nOptimal Solution with Annual Cost: " + solution.getValueReal("AnnualCost"));
        System.out.println("\nAnnual foods:");
        for(Food f : foods) {
            String commodity = f.getCommodity();
            double value = solution.getValueReal(commodity);
            if (value > 0.0) {
                System.out.println(commodity + " = $" + format(value));
            }
        }
        System.out.println("\nNutrients per day:");
        for(Nutrient n : nutrients) {
            String name = "totalConsumedNutrients-" + n.getName();
            double value = solution.getValueReal(name);
            System.out.println(n.getName() + ": " + format(value/365) + " (min " + n.getDailyIntake() + ")");
        }
        csp.getSolver().logStats();
    }
    return solution;
}
```

Applied Linear Solvers

We tried different linear/MIP solvers by changing the property “SOLVER” inside the “test.bat”:

```
@echo off
cd %~dp0
set SOLVER=Scip
rem set SOLVER=CLP
rem set SOLVER=ojAlgo
call mvn clean test -e
```

They all produced good results:

Optimal Solution with Annual Cost: 39.66173222474965

Annual foods:

Wheat Flour (Enriched) = \$10.77

Crisco = \$0.00

Liver (Beef) = \$0.69

Cabbage = \$4.09

Spinach = \$1.83

Navy Beans, Dried = \$22.28

Nutrients per day:

Calories (calories): 3.00 (min 3.0)

Protein (grams): 147.41 (min 70.0)

Calcium (grams): 0.80 (min 0.800000011920929)

Iron (milligrams): 60.47 (min 12.0)

Vitamin A (IU): 5.00 (min 5.0)

Thiamine (Vitamin B1) (milligrams): 4.12 (min 1.7999999523162842)

Riboflavin (Vitamin B2) (milligrams): 2.70 (min 2.700000047683716)

Niacin (milligrams): 27.32 (min 18.0)

Ascorbic Acid (Vitamin C) (milligrams): 75.00 (min 75.0)

*** Execution Profile ***

Execution time: 1622 msec