Final team Assignment
Analytics for a Better World

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1 Final Team Assignment

Consider again the Feed Calculator case, with the data as provided with the Excel workbook.
You became familiar with that data via this notebook.
Please open now the companion notebook to this assignment. This new notebook extracts the parameters from the data that are relevant for this assignment. You may make your own copy of this notebook and use these parameters in your own code.
In this assignment we consider again the Feed Calculator model, extended with additional constraints. Your assignment has four parts.

1.1 Linear model

Consider the same model as in Lecture 8 and extend it to include the 'combined ingredient rules' that you see extracted in the the companion notebook. These rules stipulate upper bounds for several combinations of ingredients. For example, the first combined ingredient rule specifies that the total sum of cotton, sunflower, gncake and copra may not exceed 0.17 (17%) of the total feed mix. Note that some ingredients are specified as "unavailable", such ingredients can be discarded from our model. Thus the first rule combination can be reduced to the sum amount of cotton and sunflower.

1.2 Minimize the number of ingredients used

The model you created in 1.1 is linear, with non-negative real valued variables. Extend this model by adding a binary variable that states for each ingredient whether it is included in the mix. Alter the model to minimize the number of ingredients used in the mix, while satisfying all requirements, and find the minimal number of ingredients needed. This would be a reasonable approach in the case that the farmer needs to import each ingredient from a different supplier.

1.3 Minimum cost for the minimum number of ingredients

Now knowing the minimal number of ingredients necessary to satisfy the requirements, we want to minimize the cost while using the minimal number of ingredients in the mix. Add the number found in 1.2 as a mutable parameter to your model. Determine the mix with the lowest cost for that number of ingredients. Note that the ingredients used in the lowest cost solution may not be the same (albeit in the same number) as the ingredients found in 1.2.

1.4 Navigating the trade-off

You must have noticed that the two previous objectives (minimum cost and minimum number of ingredients used) do not agree. After solving for two contradictory objectives, you are now asked to suggest a good trade-off: a solution that utilizes few ingredients yet still achieves a relatively low cost. We could visualize this trade-off by plotting the minimum cost as a function of the number of ingredients in the feed. The eventual trade-off chosen is subjective, there is no clear answer, but we ask you to choose a "good" solution and motivate your choice in the report.

Format Report

Write a report answering the questions above. The answer for questions 1.1, 1.2 and 1.3 should include:

- The mathematical model: clearly describe the objective function, constraints, and all parameters and variables used.

- Objective value: minimal value obtained by the objective function (cost / number of ingredients).

- Solution: values of all variables after running the optimization (how much of each ingredient to include in the mix).

The report should be at most 3 pages (lettersize 11 pt), and written in English. You can use Word, and for equations you can use either Word's equation editor, or add a clear picture of the handwritten equations/model. Of course you can also use other word processing software (e.g. LaTeX).

Make sure to register your **group of three** via the Groups page on Canvas. Only **one** person of your group should submit the assignment.

Deliverables: You have to hand in: 1. Report 2. Python code (.ipynb file)
Deadline submission: October 31, 11.59 PM.
Submit: https://canvas.uva.nl/courses/38641/assignments/416391