Métodos de Apoio à Decisão
Assignment 1: Gasoline blending

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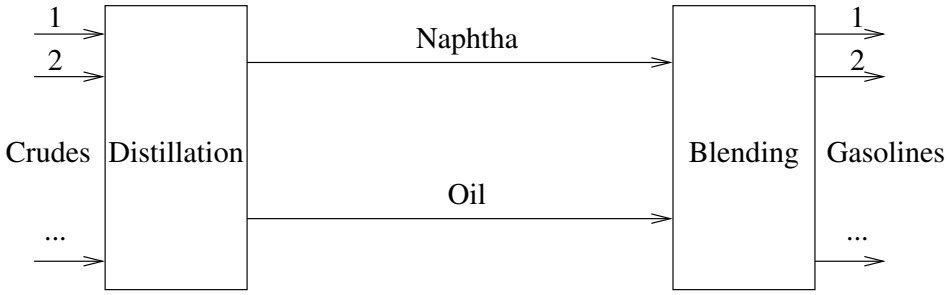
In this assignment there will be some questions based on the following exercises. In the assignment's class there will be a set of questions in *Codex*, with the computers set up as in previous classes. The AMPL book and the classes' slides will be available for consulting.

Exercise 1

Galco Oil manufactures several types of gasoline in a process that involves two steps: distillation and blending, to produce petrols and fuels that are sold.

Product flow in a refinery.



Distillation separates each crude oil into intermidiate products (fractions) known as naphtha, light oil and residuum, according to their boiling points. Naphtha and oil have octane numbers of 10 and 6, respectively. The fractions into which one barrel of each type of crude splits are given, for example, as in the following table:

	NAPHTHA	OIL
C1	0.50	0.42
C2	0.60	0.38
C3	0.55	0.41

Each of the fractions has known octane ratings:

	OCTANE RATING
NAPHTHA	10
OIL	6

Residuum is considered as a small amount of wastage in distillation. It costs \$3 to distill each barrel of crude, and Galco's refinery can distill up to 14,000 barrels of crude daily.

The different types of gasoline being sold differ in their octane rating. The blends to form each type of gas must have at least a given average octane rating. It is assumed that octane numbers blend linearly by volume; the blending process has a much larger capacity than the distillery, and the blending cost is \$1 per barrel of input processed. Galco's customers require the following amounts of each gasoline, as in the following table.

	OCTANE RATING	DEMAND
G1	10	3000
G2	9	2000
G3	8	1000

The company considers it an obligation to meet these demands. Galco also has the option of advertising to stimulate demand for its products. Each dollar spent daily in advertising a particular type of gas increases the daily demand for that type of gas by 10 barrels. For example, if Galco decides to spend \$20 daily in advertising gas 2, then the daily demand for gas 2 will increase by $20(10) = 200$ barrels.

The sales price per barrel of gasoline and the purchase price per barrel of crude oil are given; an example follows.

Sales price per barrel		Purchase price per barrel	
G1	70	C1	45
G2	60	C2	35
G3	50	C3	25

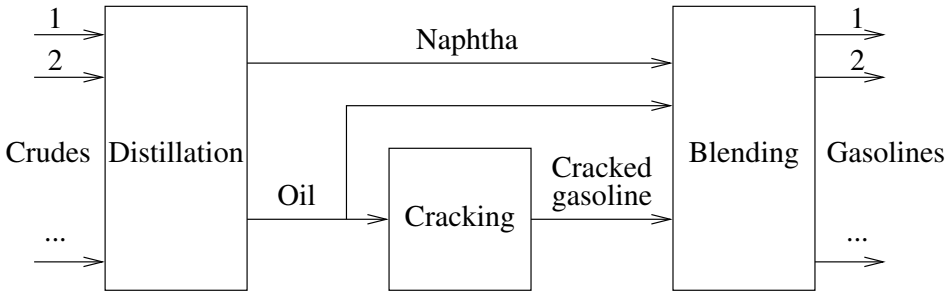
Galco can purchase up to 5,000 barrels of each type of crude oil daily.
Determine the plan that will enable Galco to maximize daily profits (profits = revenues − costs).

(Hint: it may help to have explicit variables for the inputs (crudes), intermediate products, and final products. In that case, the blending process may be modeled as in one of the previous exercises — see blending.mod and blending.dat)

Exercise 2

The refined oil can either be used directly for blending or be put through a process known as catalytic cracking. The catalytic cracker produces cracked gasoline, wiht an octane number of 15. The refinery's cracking capacity is limited to 3500 barrels of oil per day, with a cost of $4 per barrel.

Product flow including cracking.



Determine the plan that will enable Galco to maximize daily profits with the added possibility of cracking.

(Hint: consider the inputs at the blending step equal to the outputs of the distillation minus the inputs of cracking, plus the outputs of cracking.)

Note 1: *You will be able to use* `glpsol` *and/or the commercial software AMPL (*`https://ampl.com`*); a version with a license for this course is available in* `https://www.dcc.fc.up.pt/~jpp/AMPL`*.*

Note 2: *You will be given scratch paper. Please do not use any other materials or electronic devices during the class.*