CT5141 Assignment 1

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Topic Solving a Unit Commitment (electricity generator scheduling) problem using linear programming.

Deadline 6pm Friday 14 October (end Week 6).

Problem In a small country there are 12 generators of four types: Hydroelectric, Solid fuel, Gas, Solar. Each generator has a lower and upper bound on its electricity production per hour (in MW/h). Between these bounds, production is not limited to discrete levels. Each generator also has a cost for producing each MW, and produces a certain amount of CO2 per MW. All of this information is given in `generator_info.csv`.

The maximum supply from any Solar generator depends on the time of day. Relative to the generator's maximum, it can achieve 50% from 6am to 10.59am, 100% from 11am to 3.59pm, 50% from 4pm to 6.59pm, and 0% otherwise. This is given in `solar_curve.csv`.

The Solid fuel generators cannot change their amount of production from one hour to the next. (And they cannot change from any non-zero value to zero or vice versa.)

The demand from electricity customers varies by hour of the day. This is given in `demand.csv`. If we over-supply relative to demand, it can damage the electricity infrastructure. If we under-supply, then some customers can't boil their kettles.

Our job is to design a production schedule for all plants.

Different generators have different costs per MW, and we want to minimise total cost. Different generators also have different CO_2 emissions per MW, and we want to minimise this also. We will solve two versions of the problem: one where we minimise total cost, and one where we minimise total emissions.

Starter code

A snippet of starter code is provided in Bb.

Requirements Formulate both versions of the problem. State the formulation in the report. Explain why we can use linear programming to solve these problems. Then code them and solve them. Report the solutions and the values of the objective. Visualise and interpret the solutions and the differences between them. Compare the total cost for both solutions, and the total emissions for

both solutions. Explain one case where we observe *multiple equal optima* in the solution(s). The report should be very short, e.g. 500 words, with some equations and graphics as needed.

For the code, use Python and any linear programming library you prefer (e.g. OR-Tools). Avoid hard-coding any aspects of the problem or data.

Grading This is worth 20% of the module. Grading is weighted as follows:

- 40% Formulation
- 30% Code
- 30% Visualisation and interpretation of results.

Partial credit will be awarded for partial solutions.

Possible penalties: incorrect submission format, missing names/IDs, and other deviations from the spec.

Support Students are encouraged to show their work in progress during lab time. For queries, please post questions on the Discussion Board, but do not post details of your work in progress – instead send email directly to me in those cases.

Submission When finished, make a single `.ipynb` file containing both the report and code. Your name(s) and student ID(s) should be noted at the top of the notebook, as in the starter code. Submit by going to Blackboard / CT5141 / Assessment.

Groups You may choose to work alone, or in a group of two students. However, you may not work with a student you have already worked with in any other MScAI module group assignment. In a group, both students should submit on Blackboard, but the submissions will be assumed to be identical. Both students must work together on all aspects.

Policy Students are reminded of the University's policy on plagiarism. Students may discuss the assignment with other students/groups but must not look at other students' work (including students from previous years), or allow others to look at theirs. Any online sources used must be cited with URL and date of access in a comment. Materials from CT5141 need not be cited. By submitting, you declare that you have abided by these conditions. Suspected infringements will be investigated, including by interview, and may be referred to University of Galway authorities.