

MTH5114 Linear Programming and Game Theory, Spring 2024
Week 2 Coursework Questions **Viresh Patel**

These exercises should be completed individually and submitted (together with those of weeks 1 and 3) via the course QMPlus page by 9am on Monday 19 February 2024.

Make sure you clearly write your **name** and **student ID** number at the top of your submission:

1. An energy company uses three different processes for generating electricity. One of the processes uses wind energy (and so requires no fuel), while the other two consume a combination of biofuel and natural gas. Each process also requires some amount of labour and emits some amount of carbon dioxide. The amount of biofuel (in Mg) and natural gas (in mcf = mega cubic feet) consumed, the labour required (in person-hours), the carbon dioxide (CO₂) emitted (in Mg), and the power generated (in MWh) per day of operation of each process is as follows:

Process	Electricity generated	CO ₂ produced	Labour required	Biofuel required	Natural gas required
1	20	0	20	0	0
2	32	12	13	10	15
3	85	29	18	30	40

Each MWh of electricity can be sold at £144 and there is no limit on the amount that can be sold. Over its next planning period, the company has 320 person-hours for labour, 75 Mg of biofuel, and 90 mcf of natural gas available.

- (a) The company emits all the CO₂ it produces into the atmosphere. Due to environmental regulations, they cannot emit more than 215Mg of CO₂ in this period. The company wants to know how to operate its processes to generate as much revenue as possible (you may assume that there is no limit on the number of days a process can be run in this period). Give a linear program that models this problem and state what each of your variables represents. You do not need to solve this program.
- (b) The company decides to make use of a new carbon capture method whereby it can convert some of the CO₂ that it produces into a safe form that is not emitted. Converting 1 Mg of CO₂ in this way costs £5. The other resource constraints remain as stated. The company wants to know how to operate its processes to generate as much revenue as possible now also making use of carbon capture (you may assume that there is no limit on the number of days that the processes can operate in this period). Give a linear program that models this problem. You do not need to solve this program.