OM 352, Fall 2023 **HW 6** **Assigned: 19 Oct. 2023**
Due: 11:59 PM, 25 Oct. 2023

Instructions: Each assignment will include a PDF file (like this one) with the assignment questions and an Excel file, with an Answers sheet and any data or models that we provide you with. You must download both the PDF and Excel files. You have to enter your answers in the Answers sheet of the same Excel file you have downloaded, then save and upload the Excel file. You must upload the same Excel file you downloaded. Further instructions are provided in the Online Assignment Tools Guide (see **Assignments** in eClass).

Put your answers in the appropriate cells (salmon-colored cells) in the **Answers** sheet. Use paste special … values to for all numerical answers. The other cells in the Answers sheet are locked, which means you won't be able to enter values into those cells. Do not change the format of cells in the Answers sheet. Save your file with the appropriate name and in the appropriate format ("HW#_ID.xlsx").

Marking will be based on the answers in the Answers worksheet of the file you upload. We will only look at the rest of the file if there is an appeal (and even then, the answers in the Answers sheet take precedence.) If you wish to appeal a mark, then the file you uploaded must include your supporting work for each question. It is a good idea to make one worksheet for each question.

Total points: 20, of which 1 point is for following the submission instructions provided above.

Part 1: WestPlast Revisited (11 pts.)

The "WestPlast" worksheet has data for a modified version of the WestPlast case. WestPlast is no longer interested in maximizing the PCI index. They are only interested in maximizing their revenue now. The revenue per thousands of tons from each product, demand (in thousands tons), and contract (in thousands tons) are given in the "WestPlast" worksheet. The following questions are independent of each other, meaning that the assumptions in one question do not carry over to other questions.

1. (2 pts. feasibility, 1 pt. consistency, 1 pt. optimality) Find the production plan that maximizes the total revenue. The amount produced of each product should be ≤ demand, and ≥ contract. The total production should be ≤ capacity. Report the production amount for each product and the total revenue.

Suppose that it is possible to break (that is, not fulfil) a contract for a product by paying a penalty of $100,000 per contract. If a contract is broken, then WestPlast loses all the demand of that contract.

2. (3 pts. feasibility, 2 pts. consistency, 2 pts. optimality) Find the production plan that maximizes the total revenue minus total penalties for breaking contracts. The amount produced of each product should be ≤ demand, and ≥ contract, unless the contract for that product is broken—if so, then the amount produced must be zero. The total production should be ≤ capacity. Report, for each product, how much to produce and whether to break the contract (this is a binary decision; use 1 to indicate you want to break a contract and use 0 to indicate you do not want to break a contract). Also report the total revenue and the total cost of penalties.

   Hint: Do not use IF statements for this question as it makes the model nonlinear. Think of how you can use the binary decisions (whether to break a contract) to construct necessary lower and upper bounds for produced amounts.

Part 2: Santiago Electric (8 pts.)

Start by reading the Santiago Electric case on page 103 in the course pack. As mentioned in the case, you need to decide how much to use from each coal type in the power plant. Your plan has to produce 1,300,000 calories at least. Moreover, your plan should not produce more than 60,000 kg of SO_2 and 100,000 kg of CO_2 emissions. The "Santiago" worksheet provides data for the case. Note that some inputs are slightly different from those in the course pack. Also, there is a limited amount available from

each coal that you can use in production (which is given in "Santiago" worksheet). For this assignment, ignore the last paragraph of the case in the course pack.

As a check to see you have set up the model correctly, using 100 tons of each coal type produces 1,221,900 calories (which violates the minimum calories constraint), 62,200 kg of SO2 (which violates the maximum SO2 emissions constraint), and 91,500 kg of CO2 (which respects the maximum CO2 emissions constraint). This solution is not feasible. The total cost of this solution is $350,300.

3. (3 pts. for feasibility, 3 pts. for consistency, 2 pts. for optimality) Find the optimal coal mix to use, so as to minimize the total cost while producing enough calories and respecting the coal availability constraints and the SO2 and CO2 emission limits. Report the amount to use from each type, the total SO2 emission, the total CO2 emission, and the total cost. The amount used from each coal type can be fractional.