

## Deterministic Models

**Problem Description:** One of Virginia's top exports is computer chips. A Virginia-based computer chip manufacturer, Super Chip, has five manufacturing facilities in the commonwealth. Each facility is capable of manufacturing Super Chip's complete portfolio of computer chips which includes 30 different chips. However, each facility has different production capacity levels. Further, as a result of each facility having different equipment and costs for set-up processes varying between facilities, the cost of manufacturing each chip is facility dependent. As part of its sales and distribution system, Super Chip distributes to 23 sales regions across the U.S. Due to variations in shipping distances and shipping material requirements, different shipping costs are associated with shipping different computer chips from each production facility to each sales region.

Super Chip would like a recommendation as to how they should carry out their production and distribution operations for the following fiscal year. Included in the recommendation, Super Chip is interested in evaluating certain strategic-level questions:

- Currently, each facility produces each of the 30 types of chips at levels that are proportional to the facility's total portion of production capacity. For example, if facility x has y% of the total production capacity across all facilities, then facility x currently produces y% of every chip's total demand. Would you recommend an alternative production policy? If so, how would the new policy compare to the current one with respect to costs?
- Super Chip has received additional cash flows that are available for capital investment. Based on your recommendation to the question above, if Super Chip was to expand the production capacity at a single facility by purchasing additional equipment, which facility should receive the investment of capital? How much would a production capacity expansion affect the total costs for production and distribution?
- It is estimated that next year's demand is going to increase by 10% across all of the sales regions. Does Super Chip have sufficient capacity to handle the estimated increase in demand? If so, what are the associated costs for filling the new demand in comparison to this year's demand?
- Super Chip is evaluating new manufacturing technologies. It is estimated that one of these new technologies could reduce production costs for all of the chips by 15%. If Super Chip was to evaluate this new manufacturing technology in one of its facilities, which facility should receive the new technology?

**Data:**

The following data can be found in the “SuperChipData.xlsx” file in Blackboard:

- Production capacity at each facility
- Demand for each computer chip in each sales region (These are orders that must be fulfilled in the fiscal year for which you are consulting.)
- Costs for shipping each computer chip from each facility to each sales region
- Production costs for each computer chip at each facility

**Report:**

Your report should be submitted electronically through Blackboard and should include the following:

- A memo, or letter, to Super Chip management outlining your recommendations
- Commented source code for any analyses
- Any supporting material that you feel is important to the decision making process (e.g., appendices, results, etc.)
- Detailed description of your model and how you have approached each step.

**You can work on the project individually.**

**Note:** This course project is intentionally open to interpretation. You will be assessed on your ability to model the problem as a math program and justify appropriate assumptions, efficiently solve the problem with available software (Gurobi and Python), accurately interpret your results in the context of the problem, and translate your results to a set of meaningful recommendations.