Exercises - Section 2: Lecture 9 - Cutting-stock and Bin-packing - Questions

1.   A carpet manufacturer produces rolls of carpet of a standard width. Each roll is 200 feet long.
        Their B2B customers purchase carpet in lengths of 50 feet, 75 feet, or 100 feet. List all of the
        patterns of carpet that can be cut from a 200-foot roll into combinations of 50, 75, and 100 feet
        plus scrap (if any), e.g., "two 50-foot rolls and one 100-foot roll". Separate "compete patterns"
        (that don't have enough scrap to add another roll) from "incomplete" patterns – for example, a
        pattern of "three 50-foot rolls" has excess that is large enough to be used for another 50-foot
        roll, so it would be considered "incomplete".

2.   A float glass manufacturer produces sheets of glass that are a standard thickness and width, and
        are 10 feet long. From these sheets of glass, the manufacturer cuts window panes that are 3, 5,
        or 6 feet long. List all of the patterns of windows that can be cut from a 10-foot sheet into
        combinations of 3, 5, and 6 feet. List both complete patterns and incomplete patterns.

3.   The carpet manufacturer in question 1 has to meet a demand of 25 50-foot rolls, 12 75-foot
        rolls, and 15 100-foot rolls. Wasted (scrap) carpet costs on average $5/foot when cut with a
        complete pattern and $2/foot when cut with an incomplete pattern (because there's enough
        left over to cut another roll from it later that can be sold, albeit at reduced cost).

        Create mathematical and gurobipy models that the manufacturer can use to meet all of its
        demand in a way that minimizes the cost of wasted carpet. Solve the gurobipy model.

4.   The float glass manufacturer in question 2 has to meet a demand of 47 3-foot windows, 103 5-
        foot windows, and 112 6-foot windows. Wasted (scrap) glass costs $8/foot whether from a
        complete pattern or an incomplete pattern. Create mathematical and gurobipy models that the
        manufacturer can use to meet all of its demand in a way that minimizes the cost of wasted glass.
        Solve the gurobipy model.

5.   What if the float glass manufacturer in questions 2 and 4 increased its standard glass sheet size
        from 10 feet to 11 feet? Adjust your answer to question 2 and your models in question 4, and
        solve the new gurobipy model. Does it seem valuable for the manufacturer to change its
        standard sheet size to 11 feet?

6. A moving company has large moving trucks that it uses to carry customers' belongings from one city to another. The moving company charges customers at three different levels: a full truck, a half truck, and a quarter-truck. Customers are charged as the smallest level they can fit into. (So, a customer whose belongings take 0.4 truck volume would be charged as a half-truck.) List

7. Trucks cost $1000 to operate from Atlanta to New York. The company has demand for 10 quarter-trucks, 4 half-trucks, and 1 full truck from Atlanta to New York. Create mathematical and gurobipy models to determine the least-expensive set of trucks the company can use to satisfy its Atlanta-to-New-York demand. Solve the gurobipy model.

8. The company has now decided to purchase two additional sizes of trucks: ¾ the size of their large trucks and ½ the size of their large trucks. List all of the patterns of load levels that can fit into each of these two new truck sizes. Describe the patterns in terms of large-truck sizes; for example, for a ½-size truck, the pattern "One half-truck" would fill it entirely.

9. Full-size trucks cost $1000 to operate from Atlanta to New York, ¾-size trucks cost $800, and ½-size trucks cost $700. As in question 7, the company has demand for 10 quarter-trucks, 4 half-trucks, and 1 full truck from Atlanta to New York. Create mathematical and gurobipy models to determine the least-expensive set of trucks the company can use to satisfy its Atlanta-to-New-York demand.

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