IEM 5013 Intro to Optimization
Homework 1

HW Policy: This assignment can be done individually or with a partner i.e., maximum team size is two. A student can be part of exactly one submission. In order to include your name in the team's submission you must have made a substantial contribution by actively and continuously participating in the development of your team's assignment submission. Any violation will be treated as academic dishonesty.

Problems:

1. (30 points) A company sells many household products through an online catalog. The company needs substantial warehouse space for storing its goods. Plans are now being made for leasing warehouse storage space over the next 5 months. Just how much space will be required in each of these months is listed in the table below.

Month	Space required in sq-ft
1	30,000
2	20,000
3	40,000
4	10,000
5	50,000

Leasing period in months	Cost per sq-ft leased
1	\$65
2	\$100
3	\$135
4	\$160
5	\$190

Assume that several leases of different durations, over different time windows, and different amounts warehouse space can be held concurrently, over the planning horizon. Formulate a linear optimization model to help the company identify an optimal combination of leases that meets its needs.

Hint. It is useful to understand the cost trade-off in this problem. On the one hand, as the space requirements are quite different month-to-month, one could lease only the amount needed each month on a month-to-month basis, i.e., using only one month leases. On the other hand, the monthly cost of leasing space for multiple consecutive months at once, is less compared to an equivalent collection of multiple one month leases. The other extreme is to lease the maximum amount needed for the entire 5 months in a single lease. Of course, these are two extreme approaches to meeting the demand, and we can envision many combinations of leases of different durations that are held concurrently to meet demand when aggregated.

2. (20 points) A round-the-clock manufacturing company has minimal daily requirements for workers in each of its 4-hour periods as listed in Table 1. Workers may be employed to work in a shift consisting of either two consecutive periods, or three consecutive periods. Period 1 follows immediately after period 6. Formulate a linear optimization model to find a schedule that minimizes total labor cost, assuming worker salary is proportional to the number of periods worked in a shift.

Table 1: Requirements for the worker scheduling problem

Time of day	Period	Minimum # required
2:00–6:00	1	20
6:00–10:00	2	50
10:00–14:00	3	80
14:00–18:00	4	100
18:00–22:00	5	40
22:00–2:00	6	30