Operations Research, Spring 2015
Pre-lecture Problems for Lecture 9

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Note. The deadline of submitting the pre-lecture problem is ***5:00pm, April 30, 2015***. Please submit a hard copy of your work ***into the instructor's mailbox***. Late submissions will not be accepted. Each student must submit her/his individual work. Submit ONLY the problem that counts for grades.

1. (0 point) Six towns locate at the following six points on a Cartesian plane: $(0, 60)$, $(20, 50)$, $(30, 20)$, $(40, 80)$, $(50, 50)$, and $(90, 60)$ (in km). Currently a company owns six retail stores, one in each town. The weekly sales of a product in these stores are 10000, 15000, 12000, 8000, 20000, and 3000. The company currently has one distribution center (DC) in town 3. It plans to build some more DCs for the retail stores to replenish from. The construction costs of building a DC in these towns are $200000, $180000, $160000, $190000, $150000, and $200000. A truck can carry 500 units of this product. The shipping cost for a truck to move 1 km is $1. The existing DC and any newly built DC can be used for 5 years. There is no capacity limit for a DC. Transportation between two locations can be done by traveling through the straight line connecting them.

   (a) Formulate the problem of minimizing the 5-year total construction and shipping costs as an integer program if DCs can only be built in towns.

   (b) Suppose DCs may also be built in the following locations: $(0, 20)$, $(20, 40)$, $(40, 30)$, and $(60, 40)$. Do Part (a) again.

2. (0 point) Ten jobs should be scheduled on one single machine. The processing times for these jobs are 6, 9, 3, 5, 10, 6, 3, 9, 7, and 10 (in hours) The due times for these jobs are 50, 53, 55, 56, 59, 60, 62, 67, 68, and 70 (in hours).

   (a) Formulate the scheduling problem of minimizing total tardiness as an integer program.

   (b) Suppose that some precedence rules must be followed: Job 1 must be finished before job 5 can start, job 3 must be finished before job 4 can start, jobs 5 and 6 must be finished before job 7 can start, and job 6 must be finished before jobs 9 and 10 can start. Do Part (a) again.

3. (10 point) Consider Problem 1 again.

   (a) Suppose the company wants to build some more DCs (beside the one currently in town 3) so that for each retail store the closest DC is within 40 km. Formulate an integer program that finds a construction plan that achieves this goal with the minimum construction cost.

   (b) Formulate an integer program that finds how to travel through each of the six towns exactly once and then return to the origin with the minimum distance.