1. (4 points) Please refer to the Waffle House Case Study and answer the following questions (Problem 4.4):

Based on your analysis in Problem 3 of Homework 2 (Problem 4.3 of the Waffle House Case Study), answer the following questions:

   a. (1 point) Suppose once again that your operations management team estimates from experience that the region is likely to be without electricity for three days following a storm and that lost profits are $5,000 per day. How many generators should be purchased to minimize the maximum regret?

   The minimum of the maximum regret of this case is achieved with the purchase of 15 generators. This leads to a maximum regret of $15000.

   b. (1 point) What is the impact of your decision about the number of generators to purchase if electricity is actually out for four days?

   If the electricity is actually out for 4 days instead of 3, then the maximum regret function will be \( \max(19000*(D-Q),1000*(Q-D)) \). With the decision of purchasing 15 generators in the beginning of the season gives a maximum regret of $19000. And the minimum is achieved with 16 generators, with maximum regret of $16000. This change leads to the purchase of 1 extra generator compared to the case of part a.

   c. (2 points) What are the advantages and disadvantages of using a model that minimizes maximum regret in determining how many generators to procure?

   This objective ensures that we will never be worse than the maximum regret of the decision chosen, given that it is minimizing the possible maximum loss in each case of Q. But it is very sensitive to the inputs: lost profit per day and days with power outage after a hurricane attack and possible total demand (maximum D). And this model may be too conservative, because the cost of underage is much higher than the cost of overage.
2. (4 points) In the “Simulation Models for Humanitarian Relief” presentation:
   a. (2 points) What are the advantages to use simulation in the analysis of Guinea worm disease in Sudan?

   Simulation allows us to see the possible outputs of different policies and resource allocations without actually doing it. It also gives the flexibility on the system variables to see how the decisions/policies should react to each change (“what if” questions). Simulation also allows us to model and analyze complex situations and systems which are not that easy to model mathematically.

   b. (2 points) Give an example on your life that can be improved by analyzing it using simulation. List possible simulation inputs and outputs of your example.

   Answer may vary. Depends on the example chosen.

3. (6 points) Refer to “A minimal technology routing system for meals on wheels” by John J. Bartholdi, III, and answer the following questions:
   a. (2 points) Question 2 Before the system was redesigned the MOW drivers reported seeing each other on the routes several times a day. Why does this indicate an inefficient set of routes?

   When the drivers see each other several times, this means that the zones covered by different trucks, and the routes of these trucks are overlapping. If we can have only one truck serving these customers, then the total distance traveled by the trucks will be smaller for sure. Therefore, it indicates inefficiency in the current routing.

   b. (2 points) Question 5 The spacefilling curve heuristic seems to ignore travel time and distance but nevertheless produces relatively short routes; how is this possible?

   The spacefilling curve heuristic follows a single curve that tries to cover the entire area under consideration. It visits each small “square” only once following a unique order, moving from one square to an adjacent square (hence, it does consider distances). Given these characteristics, when we assign the visiting order following this curve, we have a route which is at most 25% longer in distance travelled than the optimal traveling salesman problem (TSP) solution.
c. (2 points) **Question 6** Can the spacefilling curve heuristic be used to route a vehicle in a city that has a large lake or park through which traffic cannot pass? What problems might this cause the routing system? Explain.

It can be used (it is a heuristic), but the resulting solution quality may not be that good (or the solution may be infeasible). The spacefilling curve heuristic may define a route that has to cross this large lake or park several times. This heuristic assumes that we can travel between any two points in straight lines. When there is a large lake or park in the city, this assumption is violated.

4. (4 points) Refer to Zahra, S.A., et al., *A typology of social entrepreneurs: Motives, search processes and ethical challenges*, Journal of Business Venturing (2008), and answer the questions:

a. (2 points) Which are the three types of social entrepreneurs that this paper addresses? What are the differences between them?

The three types of social entrepreneurs are social bricoleur, social constructionist and social engineer. The differences are based on what they do, how they do it, and the scope of their work. The social bricoleur acts locally within their expertise zone. The effects are local, and almost always visible in short term. The social constructionists cover wider scope. They work and structure to provide socially helpful goods and services that are not done or inefficiently done by current government and/or organizations. These effects need to take longer to show, and impact larger region. The social engineers look for newer and more efficient systems than the current one. The impacts affect to the whole system.

b. (2 points) What are the ethical challenges that each type of social entrepreneur faces?

Social Bricoleur: efficiency of the allocation process they use in creating a public good. (How is the social wealth generated best allocated? Who gets access to this wealth and how? Etc.)

Social Constructionist: opportunistic and coercive behaviors might become a serious problem in the ventures that Social Constructionists lead.

Social Engineer: They may use non-ethical means to achieve the ethical goal. But the ethical goal does not justify the non-ethical means. Also they may place their needs and ego ahead of the venture or organization that they serve.
5. (2 points) Visit the website of your favorite non-governmental organization. What is their mission? What is their vision? (Refer to the 1-page handout distributed by Professor Terry Blum in class.)

Answer may vary depending on the webpage chosen.

6. (3 points) Refer to the “Modeling Pandemic Influenza” presentation.
   a. (1 point) On Slide 14, explain why the “percentage of infected population” curve has an increase-decrease type shape. (These are also called “diffusion” curves, and are seen in other settings as well. For example, in the marketing literature, similar curves are used to model the “diffusion” of new products into the market.)

In the beginning, the size of the “susceptible” population is larger. Therefore, the spread of the disease is faster and there is an increase in the percentage of infected population. After a certain time, previously infected people recover and are immune to the disease, i.e., the size of the susceptible population becomes smaller. This is why after a certain time the percentage of infected population decreases.

   b. (2 points) On Slide 14, explain why the peak infectivity and infection attack rate (IAR) are lower, and the peak day is later, when \( R_0 = 1.5 \) compared to when \( R_0 = 2.1 \). (Recall that is \( R_0 \) the average number of people an infected individual is expected to infect.)

A smaller \( R_0 \) means that the average number of people infected by an infected individual is smaller, i.e., the disease is less contagious. Hence, it leads to a lower and later peak infectivity, and also a lower infection attack rate.