1. (5 points) In the “Resource Allocation for Malaria Prevention” case:
   1. (1 point) Which problems are solved with the solution approach offered in this
      presentation?
      The focus of this project is to develop an efficient and effective resource
      allocation methodology, with the goal of maximizing the number of people, who
      are at risk of malaria, protected by a prevention method. Decisions include:
      • Where to locate Distribution Centers (DCs)
      • How many DCs to open
      • When DCs should be open
      • What regions DCs should serve
      • When to cover each zone
      • Number of people to protect in each zone
      • Labor, trucks, equipment, insecticide/nets to base at DCs
      • Labor, trucks, equipment to allocate to each zone

   2. (2 points) What are the 3 heuristic variations in the solution approach? Why is
      it necessary to use 3 different heuristics?
      The solution approach prioritizes the zone assignment by three different criteria:
      greatest risk first, greatest population first and greatest combined risk and population
      first. The reason for using three different heuristics is to search for alternative “good”
      solutions for the problem, since heuristics do not guarantee to find the best solution.

   3. (2 points) What conclusions can we derive from the sensitivity analysis? What
      is the benefit of sensitivity analysis in this context?
      The sensitivity analysis shows that estimated values of the spray effectiveness and
      the spray rate (which are input to the model) significantly affect the solution. If the
      value of spray effectiveness or spray rate is over-estimated by 40%, the objective
      function is reduced by 55% and 35%, respectively. The benefit of doing the
      sensitivity analysis is to see how the objective function value and the solution
      changes when the input parameters are not estimated accurately. In particular, if the
      solution is more sensitive to the (in)accuracy of certain parameters, we can focus our
      efforts on accurately estimating the values of those parameters with the goal of
      obtaining a robust solution.
2. (7 points) For this assignment, please read the following article:
To download this paper, please open the page [http://www.library.gatech.edu/search/databases.php](http://www.library.gatech.edu/search/databases.php) and go to the database Web of Science, after you log in, search for Optimization of community health in Title.

Answer the following questions based on your reading of the article:

1. (1 point) What are the main services a community health center (CHC) should cover?
   A CHC should have at least the following services: general health center services, dental services, prenatal care and gynecology (OBGyn) and mental health and substance abuse counseling (M/SA).

2. (1 point) Why did the authors use estimated data instead of using real data?
   There are no publicly available data at a county level or smaller geographical level for healthcare need. Therefore, the authors combined the US Census data at the county level (% population of each category defined by US Census at county level), the National Health and Nutrition Examination Survey (NHANES), and the Behavioral Risk Factor Surveillance System (BRFSS) to estimate the data of healthcare need at county level.

3. (1 point) Explain the motivation behind the objective function.
   The objective function tries to maximize the overall health condition. The coefficients of the objective function represent the importance of each service in the overall health condition. When the objective function is maximized, it tries to maximize the overall health condition of the region in the study.

4. If we change the objective function to minimizing the total operating cost:
   (a) (1 point) Write the new objective function using the notation in this paper.
   \[
   \text{Min} \sum_i FL_i c_i + \sum_{ijk} FS_{ik} s_{ijk} + \sum_{ijl} VS_{ij} y_{ijl}
   \]
   (b) (1 point) If a CHC_i should cover K_i units of the weighted patients, write down the constraints associated with the weighted patients.
5. (2 points) Why does the paper do sensitivity analysis on the budget constraint? What is the conclusion of this analysis?
The budget is the primary parameter which can be adjusted by a policy change; all the other constraints are settled once we have the population of each county and the “capacity” of a CHC. Sensitivity on the budget constraint is also used for analyzing the possibility of the system expansion in coverage. The results indicate that the current budget level can only cover less than 40% of the area studied, while increasing it to $110,000,000 could lead to 90% of coverage. Increasing the budget beyond $110,000,000 leads to diminishing marginal returns.

3. (5 points) Please refer to the Waffle House Case Study and answer the following questions (Problem 4.3):
Suppose that the realized demand for generators is $D$ and the total quantity of generators purchased is $Q$. Estimates indicate that electricity will be out for three days in the event of a major hurricane and lost profit at stores unable to open is projected to be $5,000. Generators cost $1,000. Complete the following steps to analyze the generator procurement problem using an alternative objective, namely to minimize the maximum regret experienced. (Regret is defined as the difference between the realized cost of a procurement decision and the cost of an optimal decision that would have been made with a priori knowledge of the demand for generators.)

1. (1 point) Express the realized cost of a decision to purchase $Q$ generators, including procurement cost for generators and the cost of lost sales, in terms of $Q$ and $D$.
   \[1000 \cdot Q + 15000 \cdot \max(0, D - Q)\]

2. (1 point) If a planner knew a priori what the total demand for generators would be, what is the optimal cost the planner would incur? Express this cost in terms of $Q$ and $D$.
   \[1000 \cdot D\]

3. (1 point) Express the regret incurred as a result of a decision to purchase $Q$ generators when $D$ are actually needed in terms of these two variables.
4. (2 points) Using the expressions you developed, complete Table 5, which summarizes the realized costs and the regret of procurement decisions. In this scenario, assume that the maximum number of generators that could possibly be needed in a season is 16.

\[
1000 \times Q + 15000 \times \max(0, D - Q) - 1000 \times D \\
= 1000 \times (Q - D) + 15000 \times \max(0, D - Q) \\
= \max(14000 \times (D - Q), 1000 \times (Q - D))
\]

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<th>Q</th>
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<th>Realized Cost if D=16</th>
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4. (3 points) Read the article *Can Steven Chu Win the Fight Over Global Warming?* by M. Grunwald, Time, August 23, 2009.
http://www.time.com/time/world/article/0,8599,1916078,00.html.
Answer the following questions based on your reading of the article.

5.

1. (1 point) What are some of the plans that the current government shows interests in pursuing energy efficiency and carbon emission reduction?
The current government is trying to give mandates and incentives to people who get cars that consume less fuel, or appliances, factories or buildings that uses less power. It also pushes investments for renewable resources, like solar and wind energy, along with a smarter grid to exploit them. Trying to increase significantly in funding for federal energy research and development is another fact that shows the current government’s interest in this topic.

2. (1 point) What are some of the low-emission game changers in Chu's consideration?
Artificial photosynthesis and advanced batteries are the low-emission game changers in Chu’s consideration.

3. (1 point) What are the facts that leads Chu to say China will be the world's largest producer of renewables by 2010?
Because every Chinese leader that Chu had met are considering the carbon emission seriously. They are making a huge push into solar and wind energy. Also, they already have more fuel efficient cars, and developing for more advanced transmission lines.