**TIM 155: Final Exam**

**Spring 2017**

**Due** **Tuesday, June 14, via email to** **bhaddad@ucsc.edu** **no later than 7:00 pm.**

This is open-book open-notes, but you must work on the exam ***alone***, not as a group, and not in consultation with any other person. If you have clarifying questions, it is OK to email the professor, although I may not get back to you right away with an answer.

1.You are a water-rate consultant. Refer to the Water Rate excel spreadsheet in the exam section of the website (it has the same background data as found in Problem Set 8).

The residents in the mutual water company we analyzed in Problem Set 8 have finally noticed that the Board is considering changing the rate structure. After all the work you and the Board have already done, they are now calling for more changes. They have divided into two camps. The ***Conservers*** are deeply concerned about drawing down the aquifer (since all the water used in the territory is groundwater). They insist on a rate program that maximizes incentives to use less water. The ***Predictables*** are deeply frustrated that the cost of water seems to fluctuate as new problems emerge in the aging and poorly-designed infrastructure. They want certainty about their bi-monthly bill so they can plan ahead, and they want no surprise assessments when something unanticipated happens.

The Board of Directors have also chimed in. They want:

* **no new members** until all the existing members have meters installed.
* to finance improvements and repairs to the existing infrastructure through *Special Charges*.
* a new Fire Readiness Fund that will have $50,000 in it after one year.
* To fix the “deficit removal” line in the existing target annual budget – it should be positive $6,000, not negative ($6,000) since it is a budget expense.
* To add back all consulting money they took out because your rates just went up and they are willing to pay for your services in the coming year.

No one wants to run a deficit.

Here is your task. Prepare TWO sets of excel budgets/rate plans, both of which satisfy the Board of Directors, while one satisfies the ***Conservers***; the other the ***Predictables***. Each of your two budgets should have the following:

1. A sentence or two that convinces each group that you understand what they want. (1 point each)
2. A revised budget. It is likely that the target annual costs and some line items will different for the two budgets. (1 point each)
3. A rate plan that achieves the group’s goals. (1 point each)
4. (This part you only have to do once.) Explain everything that is different between the two budgets and rate plans and how the differences directly contribute to achieving the goals sought by each of the groups. If you in your expert opinion needed to NOT achieve one of the goals set by one of the groups or the Board, explain why you chose not to. (1 point total)

2. For the Sankey Diagram in Week 10’s readings,

1. what are the tiny arrows on the left hand side indicating? Is their meaning the same as the many other larger arrows? (1 point)
2. If you were to introduce Direct Potable Reuse as a major water source in the US, how would the Sankey Diagram depict it? Assume that wastewater treatment plants are upgraded to generate potable water that is directly introduced into urban piping systems. Draw and explain how you would include this source of water. (1 point). *Hint – any kind of drawing can be uploaded – ideally one embedded in your exam, but if necessary you can email a photograph of a hand drawing.*

3. Take a look at the large spreadsheet of 2015 hourly power consumption of metered UCSC buildings. The goal is develop a hypothesis about which building has the greatest potential for energy efficiency improvements based on the data in the spreadsheet.

a. First suggest and verbally justify a hypothesis about what is the best target for energy efficiency improvements. *(Hint: Hypothesis examples could be “the goal of lower overnight energy consumption is the easiest approach to energy consumption reductions” or “reducing peak summertime consumption…”.)* (2 points)

b. Now examine the data based on your hypothesis. Find a building that you think has consumption qualities that would lend itself to reductions based on your approach. Refer to graphs or data to explain why you chose that building. (2 points)

c. Give some examples of the kinds of actions you might take to reduce energy consumption consistent with your target approach from 3.a and your selected building in 3.b. (2 points)

4. You have been approached to represent farmers who believed they were falsely accused in Problem Set 4, Question 1.g. They own the fields next to the lake, and the pollution dispersion model suggests that they are contributing tonnes of pollutants each year to the lake. They are now on trial for breaking pollution laws. Your job is to write a set of arguments they can use to convince a judge that the pollution dispersion model cannot be relied upon to accurately depict what is happening in the lake and on their fields. Present at least 3 challenges to the model and what might be different about the results in Q 1.g if the model were more accurate. *(Hint: you might focus on the simplifying assumptions and how they influence the results of the equation.)* (6 points)

1. Write a short memo to Deborah the solar sales manager explaining why her sales force should (or shouldn’t) adopt the SAM model when generating proposals for potential residential and commercial solar customers. Include a SAM report and explain what in your opinion are the three most important data points or depictions provided in the report. The SAM report should be based on a typical single family residence in Sacramento, California, where Deborah has her offices. (3 points)
2. A theme of this course has concerned the appropriate roles for the public and private sectors in supplying energy and water. For one energy and/or water topic presented in a lecture or reading this quarter, first explain the water and/or energy supply situation and say where you found it. Then describe the roles of the public and private sectors in providing the water and/or energy. (The *Energy System Analysis Matrix* from HW 3 might be useful to you here.) Having laid out this background, explain whether you believe the balance of public and private sector involvement is best in this case. If you think it is, say why. If you think it isn’t, explain whether you think there should be more public and/or private sector participation, and why. (4 points)
3. Bonus Question: In one of our initial lectures, we worked on developing an energy balance for the Pajaro Valley. For up to 2 bonus points, provide the following:
* Types and quantities of energy entering the Pajaro Valley *from all sources.*
* Transformations of each type of energy to other forms while in the Pajaro Valley
* Types and quantities of energy leaving the Pajaro Valley *in any and all forms.*
* *List all sources of information*.