MAE/ENE 539 - Term Project

The final term project will challenge you to integrate the methods and skills developed in the course in order to formulate a research question, develop an appropriate model, and debug, solve, and interpret the results. We will prioritize working with realistic systems, not test systems. As a result, baseline data for a handful of systems geared toward different problem types will be curated, including at least one each suitable for detailed capacity expansion, unit commitment and economic dispatch w/transport flow constraints, and detailed DC optimal power flow problems. Modeling other systems is allowed in consultation with the professor, but students should budget for the time required to collect and format all relevant datasets.
No team projects are allowed.

There will be three milestones for the project:

1. One-page project proposal (Due **November 9**)
2. Initial model formulation and test run (Due **November 20**)
3. Final report (Due **December 8**; Dean's Date)

Test Systems/Data

The following four test systems will be provided as inputs for your term projects:

1. ERCOT (Texas) 3-zone system for capacity expansion (from HW 5)
2. WECC (Western U.S.) 6-zone system for capacity expansion
3. WECC 12-zone system for unit commitment w/transport flows (at 3 levels of generator aggregation)
4. ERCOT system for optimal power flow

Data sets for these systems will be provided on the course Github page and published over the following days (with full set prior to November 9).

You may also wish to explore other data sets from previously published papers, but be sure you review the data source and are confident it meets your needs for the project.

One-page project proposal (November 9)

This short write-up should include:

- Choice of system (including data sources if not using course-provided datasets)
- (Short) motivation and proposed research question
- Computational model(s) to be used
- Additional datasets required (e.g., policy scenarios, demand and RE profiles, cost sensitivities…)
- Preliminary expectations of what you will find (you will not be graded on their accuracy)

Initial model formulation and test run (November 20)

Prior to running the full model and relevant sensitivities, you will code and run your model for a small test system for which you can predict the results. Getting to this point will force you to debug many aspects of your code, hence plan accordingly.

In this assignment, you will turn in (a) well-documented Julia code and data files, and (b) a 2-3 page write-up. The write-up should include:

- Model description, including definition of decision variables and key parameters and mathematical formulation of objective function and constraints
- Test system and data description
- Expected and actual model results
- Discussion of unexpected difficulties in coding the test

Final report (December 4)

The final written report will allow you to demonstrate your grasp of key concepts of the course and move beyond what was covered in lecture and homework. It is not expected to be a complete draft ready for journal submission or inclusion in a dissertation, but it should be a polished document that is well written, concise, and, above all, replicable. It should be structured along the lines of a technical report, including sections on:

- **Introduction**: context and motivation, research question(s)
- **Methods**: complete description of the optimization model(s) (including mathematical formulation of constraints and objective) and narrative description of variables and logic
- **Data**: summary of data sources and tables of key inputs relevant to the problem
- **Results**: qualitative description of the findings, suitable number of figures and tables (3-5), and computational times (if relevant)
- **Discussion**: Did you answer the research question(s)? What limitations does your approach have? What is some possible future work?
- **Appendix**: list of all variable definitions; you may also include a second appendix section with any data, parameter values, or additional results you wish to reference as supplementary material rather than in the main text (be sure to reference all tables/figures here within the main text at the appropriate point in the discussion).

You need not use these exact headings or structure, but be sure to cover all of the above material. The report is expected to be around 10 pages (single-spaced), not including the appendix.

In addition, all model and data files--including documentation on how to replicate--should also be submitted as a zip file.

Assessment

The project milestones will be graded as follows (adding up to 45% of your total grade in the course):

Project proposal	5%
Initial model formulation	10%
Final report	30%