Syllabus spring 2015

The latest news can be found on KTH Social (www.kth.se/social/course/EG2311). It is also possible to contact the involved teachers:

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Learning Outcomes

This is a course for students who are interested in pursuing an academic career. Participants will be given the possibility to work closely with a supervisor to specialise in a topic of interest for on-going research in electric power systems.

To pass the course, the students should show that they are able to

- carry out a literature review of a specific topic, i.e., to summarise the state-of-the-art and identify possibilities for further research,
- develop and apply relevant models and computation methods on basic problems within a given field.

Learning Activities

As the aim of the course is to develop the students ability to carry out research, it is natural that most of the learning in the course will be depending on self-studies, such as reading textbooks, technical reports, master and doctoral theses and scientific papers, and of course the students' own research efforts. In addition to this, students will get supervision from an experience researcher in the field, who will teach the students concerning good research practice as well as provide guidance on how to solve different research problems.

Projects

The number of students in this course is limited by the number of supervisors. Some supervisors might offer alternative projects, but can still only supervise one student. Below is a list of projects offered in 2015.

Monte Carlo simulation of multi-area electricity markets

Supervisor: Mikael Amelin
Recommended courses: EG2200/05 Power generation operation and planning, EG2080 Monte Carlo methods in engineering

In many power system studies it is necessary to simulate the operation cost and reliability of this system. The classical probabilistic production cost simulation method is however too limited for modern power systems, due to the limitations in modelling the transmission system, correlated random variables and the rules of the electricity market. Monte Carlo simulation does not suffer from these limitation, but requires a large computational effort. Therefore, there is a need to use variance reduction techniques to reduce the computational burden of Monte Carlo simulations of electricity markets.

The aim of this project is to study efficient applications of variance reduction techniques on Monte Carlo simulation of a power system divided in several areas. Earlier studies have shown that complementary random numbers, control variates and stratified sampling are useful for this kind of simulation; however, in order to apply these methods on larger systems, it will be necessary to find methods to estimate appropriate values for important design parameters in the Monte Carlo simulation.

This project involves a lot of Matlab and GAMS programming, and previous experience of these softwares is an advantage. Knowledge of object oriented programming is also very useful.

Seasonal planning for studies of the flesibility of the Swedish power system

Supervisor: Mikael Amelin
Recommended courses: EG2200/05 Power generation operation and planning, EG2220 Power generation, environment and markets

The Swedish Parliament has set up a “planning frame” of 30 TWh wind energy per year in 2020. To achieve this target, the installed wind power capacity in Sweden would have to be around 12 000 MW compared to about 3 700 MW at the end of 2012. Such a large-scale expansion of continuously varying generation would of course result in an increased need for the capability of the power system to maintain the balance between generation and consumption. Therefore, it is important to study the flexibility of the Swedish power system. Earlier studies at the Dept. of Electric Power Systems have presented a model of the power system in Sweden and its capability to balance wind power generation, local consumption as well as transmission to neighbouring areas. This model covers the operation of the power system during a week, with a time resolution of one hour.

The aim of this project is to add a seasonal planning module to the existing model. The objective of the seasonal planning model should be to determine have much water that can be used during each week of a year. In order to do that, it will be necessary to consider the uncertainty of load, precipitation and wind power generation in the future. Therefore, the seasonal planning module must be formulated as a stochastic optimisation problem.

Besides GAMS programming, this project also requires a lot of data acquisition.

Applying high performance computation to linear Nash equilibrium solver for renewable penetration studies.

Supervisor: Mohammad Reza Hesamzadeh
Required skills: Computer programming, optimisation theory.

Over the past decades, two policies were changed the electricity industry drastically. The first one is the liberalisation of the electricity industry. The old vertically integrated electricity industry is now liberalised and divided into private generation sector, regulated transmission and distribution sector, and retailing sector. The emphasis has been put on forces of competition to delver efficient outcomes. The second policy is high level of renewable energy penetration. These two polices have made the analysis of electricity industry very complex and challenging. The linear Nash equilibrium (LiNE) solver is a computational platform developed in Electricity Market Research Group at KTH to model the oligopolistic markets. The modelling of renewable energy sources in the LiNE solver has made the LiNE solver very complex to be run on normal computers. This project seeks methods and algorithms for decomposing the optimisation problem of LiNE solver to easier subproblems. The designed decomposed algorithm must be coded in a programming language and run on super-computer facilities at KTH.

Examination

This course is examined based on your project work. In order to pass the course, you will need to summarise your project work as instructed by your supervisor. In general you will have to prepare at least a written report and an oral presentation on your work.

Your work will be evaluated on several criteria, as described below. For each criteria, you will get a score between 0 and 2 points. Your final grade will be based on the sum of your score for each criteria as listed in table 1.

Table 1 Grading.

Total score	Grade
5–6	A
3–4	B
2	C
1	D
0	E

Literature review

To receive one point for the literature review, the student should have carried out a literature review that gives a good overview of the state-of-the-art in the field. In order to get two points, the literature review should be well organised and also include an analysis of the trends in the field. Moreover, the literature review should highlight problems that require further research.

Problem solving

The problem solving refers to the students' ability to solve technical problems in his or her project. To receive one point, the student should be able to solve problems according to guidelines provided by the supervisor. In order to get two points, the student should also be able to find own solutions (i.e., without guidance from the supervisor) or to suggest alternative solutions.

Documentation

This criteria refers to the students' ability to present his or her findings according to the format requested by the supervisor. To receive one point, the student should be able to present the results of the project in the required format and with a good language. Moreover, the results should be presented in such a way that it is clear what have been done and how the conclusions are justified. In order to get two points, the students analysis should be well-structured and include a quite deep analysis of the topic. The student should also be able to put the project in a context, i.e., to describe and discuss the background and the motivation of the project.