Syllabus
EG2210: Electricity Market Analysis
JANUARY-MARCH 2017

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Textbook: D. R. Biggar, M. R. Hesamzadeh, *The Economics of Electricity Markets.* John Wiley & Sons, 2014.

Materials: Parts I, III, IV, VI, VII, VIII of the textbook and handouts during the course.

Course description: The course "Electricity Market Analysis" provides post-graduate students with an advanced knowledge of the theory of liberalized electricity markets. The course starts with introductions to fundamental concepts in microeconomics, electricity networks. It then provides an overall overview of the liberalized power markets. During the course, post-graduate students employ different optimization and equilibrium approaches to analyze variety of electricity market issues. The course is recommended for students with electrical engineering, economics, or mathematics background.

Exam: The Master Level of the course gives 7.5 credits and it is examined by lab projects (20% of the total grade) and a written exam (80% of the total grade).

- The exercises, quizzes and worked examples are designed to help students in understanding different concepts of the course. There are five quizzes scheduled for this course. These quizzes do not have any share of the final grade and are just for students to examine their knowledge of the course.
- Projects in Electricity Market Lab are designed to give students hands-on experience on different topics of the course. Each student individually submits a report containing all the projects where he or she explains the approach for doing each project. The deadline for the submission of the report will be one week before the exam (exact submission date will be announced). All projects need to be done using the Plexos software. An introductory workshop on Plexos will be given to the students in the beginning of the course and the pdf version of the tutorial will be posted on-line. There are scheduled teaching assistant hours where students can ask questions they have on the projects. The projects report (total 100 points) account for the 20% of the final grade.

  The headlines of the projects are:

  1. Power System Modeling and Optimal Dispatch (20 points)
  2. Handling the Transmission Limits in Power Systems (20 points)
  3. Hydro Power (20 points)
  4. Market Power (20 points)
  5. Transmission-Generation Expansion Planning (20 points)

- Exam is written and is given twice a year. To attend the exam it is required to register in advance using KTH "My pages", which can be accessed from the student web site (www.kth.se/student/minasidor). The premises of the exam can be changed depending on the number of examinees. Check the course web page for detailed information before the exam (the central KTH exam schedule is not always updated in time).

To pass the course, it is necessary to score at least 51 points out of 100 in total (exam + projects). Students who have failed the course but are close to the requirement for passing (i.e., 45-50 points) may write a supplementary test. If the result of this test is approved, the student will get the grade E. The date of the extra test is decided by the course examiner after consulting the concerned students. However, the student must notify his or her intention to write the supplementary test no later than one month after the exam.

The following aids are allowed at the exams and extra tests:

1. Calculator without information relevant to the course.
2. One handwritten, single-sided A4-page with your own notes (original, not a copy), which should be handed in together with the exam.

The final grade is calculated based on the following table.

Lab + Exam	Grade
91-100	A
81-90	B
71-80	C
61-70	D
51-60	E
45-50	Fx
0-44	F

The PhD level of this course gives 10 credits to the interested post-graduate students. The extra 2.5 credits are evaluated based on a research paper carried out by the post-graduate student. The interested students should set an appointment with course examiner to discuss a research topic for their research papers.

Intended Learning Outcomes (ILOs)

The aim of the course is that the students learn methods and models for how the price is formed in an electricity market. The course comprises background information about possible ways to design an electricity market, impact from congestions, risk analysis and market power. Applied optimization is shown to be one suitable method to simulate market behaviour.
To pass the course, the students should show that they are able to:

- Describe the principles of how an electricity market can be organised,
- Describe treatment of flexible load,
- Describe methods to handle congestion in power markets,
- Describe methods for analyzing prices in markets with limited competition,
- Describe basic methods for financial risk management in power markets,
- Describe methods to handle externalities, such as environmental problems, in electricity markets,
- Perform calculations of pricing in small systems with one of the above characteristics.

To receive a higher grade, students should also show that they are able to:

- Analyze pricing in larger power systems with combinations of several of the above named characteristics,
- Apply methods for analyzing the trade off between low prices and reliability in larger power systems,
- Formulate market simulation problems with mathematical expressions,
- Analyze investment dynamics in electricity markets.

Preliminary Schedule

The lectures will be given in English. Plexos tutorial and teaching assistant hours will take place in the computer room (Osquldas väg 10, 8th Floor, Room A-822). The preliminary schedule is listed below.

Date and Time			Topic	Venue
Wed	18 Jan	10:00-12:00	A review of relevant topics from microeconomics	Q33
Wed	18 Jan	13:00-15:00	A review of relevant topics from microeconomics	Q31
Thu	19 Jan	13:00-15:00	Electricity Industry overview	Q34
Thu	19 Jan	15:00-17:00	Efficient short-term operation with no network constraints	Q34
Fri	20 Jan	8:00-10:00	Efficient short-term operation with no network constraints	Q31
Wed	25 Jan	10:00-12:00	Representing network constraints: Nodal pricing	Q31
Thu	26 Jan	13:00-15:00	Representing network constraints: Zonal pricing	Q34
Thu	26 Jan	15:00-17:00	Efficient investment in generation and consumption assets	Q34
Fri	27 Jan	8:00-10:00	Market-based investment in generation and consumption assets	Q34
Mon	30 Jan	8:00-10:00	Risk management	V32
Wed	1 Feb	10:00-12:00	Risk management	Q33
Wed	1 Feb	13:00-15:00	Risk management	Q33
Thu	2 Feb	13:00-15:00	Market power: Theory and Practice	Q36
Thu	2 Feb	15:00-17:00	Market power: Complementarity models	Q31
Wed	8 Feb	10:00-12:00	Market power: Complementarity models	L52
Thu	9 Feb	13:00-15:00	Market power: Complementarity models	Q34
Thu	9 Feb	15:00-17:00	Market Power: Network congestion	Q34
Fri	10 Feb	8:00-10:00	Market Power: Network congestion	Q2
Wed	15 Feb	10:00-12:00	Mitigating market power	Q33
Wed	15 Feb	13:00-15:00	Mitigating market power	Q31
Thu	16 Feb	13:00-15:00	Modelling and forecasting electricity prices: Regression	V22
Thu	16 Feb	15:00-17:00	Modelling and forecasting electricity prices: Cointegration	V32
Fri	17 Feb	8:00-10:00	Modelling and forecasting electricity prices: Volatility, VaR, Quantile methods	Q31
Wed	22 Feb	10:00-12:00	Modelling and forecasting electricity prices: Volatility, VaR, Quantile methods	Q34
Wed	22 Feb	13:00-15:00	Modelling and forecasting electricity prices: Regime-switching	Q33
Thu	23 Feb	13:00-15:00	Modelling and forecasting electricity prices: Regime-switching	Q34
Thu	23 Feb	15:00-17:00	Efficient investment in network assets	Q34
Fri	24 Feb	8:00-10:00	Efficient investment in network assets	V22
Wed	1 Mar	10:00-12:00	Regulation of transmission investment	L52
Wed	1 Mar	13:00-15:00	Merchant transmission investment	Q33
Thu	2 Mar	13:00-15:00	Australian Electricity Market: Design and Operation	Q2
Thu	2 Mar	15:00-17:00	Nordic-Baltic Electricity Market: Design and Operation	Q2
Fri	3 Mar	8:00-10:00	Reserve	Q31
Mon	6 Mar	10:00-12:00	Reserve	V22

Final Exam

Friday 17 March, 8:00-12:00.