

DEPARTMENT OF STATISTICS COLLOQUIUM SERIES

Texas A&M University

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REGIME-SWITCHING DYNAMICS OF SHORT-TERM WIND POWER FLUCTUATIONS

ABSTRACT:

Wind energy has so far been the renewable energy with the most successful development throughout Europe, while the most new capacities installed over the last year has been in the US. The stochastic nature of wind generation uncover new challenges for economic and safe management of power systems and electricity markets. Over the last few years, a number of scientific problems have been defined from those practical challenges. Most of them relate to the forecasting of the power output from wind power capacities, at various spatial (i.e., local or regional) and temporal (i.e., from few minutes to few days ahead) scales. Especially for the case of large offshore wind farms, concentrating a large capacity in a small area, the fluctuations of wind power production at temporal scales from minutes to hours may be particularly difficult to accommodate. When observing wind power production data averaged at a few-minute rate, one observes successive periods with fluctuations of various dynamical nature, and of smaller and larger magnitude, which cannot be explained (so far) by the evolution of some explanatory variable. A relevant proposal is then to capture this regime-switching behaviour with an approach relying on Markov-Switching AutoRegressive (MSAR) models. An appropriate parameterization of the model coefficients is introduced, along with an adaptive estimation method allowing to accommodate long-term variations in the process characteristics. The objective criterion to be recursively optimized is based on penalized maximum-likelihood, with exponential forgetting of past observations. MSAR models are then employed for 1-step ahead point and probabilistic forecasting of 10-minute resolution time-series of wind power at two large offshore wind farms in Denmark. They are favourably compared against persistence and AutoRegressive (AR) models. The interest of MSAR models for interval/density forecasting is discussed, as well as their possible extension to MSAR-GARCH models, thus allowing dynamics in both mean and variance in each regime combined to a regime-switching mechanism relying on a hidden Markov chain.

DATE: Thursday, April 30, 2009

TIME: 11:10 a.m. – 12:10 p.m.

PLACE: Room 150, Blocker

Refreshments will be served in the Statistics Conference Room at 10:30 am for those attending the seminar.