Work Package 3.1:
Scaling and correlations in the Nordic spot electricity market data

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Description

Work Package
Report on the use of the Hurst coefficient and correlation with power law decay for the project data

Goals
- Obtain time series data
- Analyse the Hurst exponent
- Analyse correlations and stationarity
- Identify trends, periodicities
Collaboration

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<tr>
<th>Queen Mary</th>
<th>LIUC-Università Cattaneo</th>
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<tr>
<td>- David Arrowsmith</td>
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<td>- Hartmut Erzgräber*</td>
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<td>- Wolfram Just</td>
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<td>- Hugo Touchette</td>
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<td><strong>Long range correlations</strong></td>
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<td>- Fernanda Strozzi</td>
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<td><strong>Stationarity</strong></td>
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<th>JRC, EU</th>
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<td>- Eugénio Gutiérrez</td>
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<td>- José-Manuel Zaldívar</td>
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<td><strong>Data, analysis</strong></td>
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Price per hour for the Nordic day-ahead exchange market
Many countries joining in that period
Previous results

Scaling

- Weron, Przybyłowicz (2000)
  - Hurst analysis: $H < 1/2$
  - Anti-persistent behavior
- Simonsen (2003)
  - Average wavelet method: $H = 0.41$
- Byström (2005)
  - Extreme-value statistics

Time series generation

- Perelló et al. (2006)
  - GARCH model
- Weron et al. (2004)
  - Jump diffusion
- Vehviläinen et al. (2005)
  - Mid-term modeling with climate factor
Long range correlations

- **Autocorrelation:**
  \[ C(\tau) = \langle s(t)s(t + \tau) \rangle \sim \tau^{-\beta} \]

- **Power spectrum:**
  \[ S(\omega) \sim |\omega|^{\beta-1} \]

- **Hurst exponent:**
  \[ H = 1 - \frac{\beta}{2} \]

- **R/S analysis:**
  \[ R(\tau)/S(\tau) \sim \tau^{H} \]

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<th>Anti-persistent</th>
<th>Uncorrelated</th>
<th>Persistent</th>
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<td>( H )</td>
<td>( H &lt; 1/2 )</td>
<td>( H = 1/2 )</td>
<td>( H &gt; 1/2 )</td>
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Manmade results: Periodicities

- Weekly periodic trends?
- Whole sample
  - No periodicity
- Fixed-hour sampling
  - Day: Periodicity
  - Night: No periodicity
- Effect on $H$?
Manmade results: Time-varying correlations

- **Fixed-hour samples:**
  - $H$ different for different methods
  - $H$ dips at 9am and 6pm

- **Time-varying window:**
  - Longer time-window $\Rightarrow$ less variation in $H$
  - Multiscaling properties: $H$ changes at different time resolutions
Conclusions

- Long-range correlation: $H < 1/2$ (anti-persistent)
- Data not characterized by a single $H$
- Fixed-hour variations
- Time-window variations
- Multiscaling behavior of $H$
- Consequences for trading?
Publications

Time Series analysis and long range correlations of Nordic spot electricity market data
To be submitted to Physica A, January 2008
QMUL report, July 2007

Application of non-linear time series analysis techniques to the Nordic spot electricity market data
Submitted to Physica D, October 2007
LIUC report, October 2007