### Module: Econophysics: Non-Equilibrium Statistics

<table>
<thead>
<tr>
<th>Code</th>
<th>71778</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction language</td>
<td>German or English</td>
</tr>
<tr>
<td>ECTS credits</td>
<td>6</td>
</tr>
<tr>
<td>Credit hours</td>
<td>5</td>
</tr>
<tr>
<td>Duration</td>
<td>1 semester</td>
</tr>
<tr>
<td>Cycle</td>
<td>Irregularly</td>
</tr>
<tr>
<td>Coordinator</td>
<td>Prof. Joachim Ankerhold</td>
</tr>
<tr>
<td>Lecturer</td>
<td>Dr. Jürgen Stockburger</td>
</tr>
<tr>
<td>Allocation to study programmes</td>
<td>Physics M.Sc., elective module, 1st or 2nd semester, Wirtschaftsphysik M.Sc., elective module, 1st - 3rd semester</td>
</tr>
<tr>
<td>Formal prerequisites</td>
<td>None</td>
</tr>
<tr>
<td>Recommended prerequisites</td>
<td>Basic knowledge of Probability Theory</td>
</tr>
</tbody>
</table>
| Learning objectives | Students who successfully passed this module:  
- know formal methods of advanced statistical physics  
- are able to apply the learned statistical methods in both scientific and interdisciplinary contexts |
| Syllabus           | Stochastics in economic and physical systems  
- stochastic processes, Markov chains  
- Ito processes  
- application: Black-Scholes theory  
- physical model: Langevin equation  
- birth and death processes  
Dynamics and statistics of open systems  
- Liouville equation  
- projector formalism  
- master equation and Fokker-Planck equation  
- Open Quantum Systems  
Solution method  
- time scale separation and related approximations  
- path integral methods  
Elements of Information Theory and applications  
- basic concepts of Information Theory  
- relations with the entropy of the thermal statistics  
- data processing by entropy maximization |
| Literature         | |
| Teaching and learning methods | Lecture (3 hours per week)  
Exercise (2 hours per week) |
| Workload                  | 45 hours lecture (attendance time)  
|                         | 30 hours exercise (attendance time)  
|                         | 105 hours self-study and exam preparation  
| Total:                   | 180 hours  
| Assessment               | Written or oral examination. A prerequisite for the participation in the examination is an ungraded course achievement. Form and scope of the examination and of the course achievement are determined and notified by the lecturer at the beginning of the course.  
| Examination              | 12075 Econophysics: Non-Equilibrium Statistics (precourse)  
|                         | 12074 Econophysics: Non-Equilibrium Statistics  
| Grading procedure        | The module grade is the examination grade.  
| Basis for                | Research in the area of Econophysics and Theoretical Physics  