Syllabus for TIME SERIES ANALYSIS

Lecturer: Gregory G. Kantorovich  
Class teacher: Boris B. Demeshev

Course description:

Time Series Analysis (Master level) is an elective course designed for the first year Master students of “Finantial Analytic” Program. This is an intermediate course of Time Series Theory for the students specializing in the field of Finance and Banking. Its prerequisites are Statistics, Econometrics, the knowledge of economic theory and computer-based information systems is necessary as well. The course is taught in English.

The stress in the course is made on the sense of facts and methods of time series analysis. Conclusions and proofs are given for some basic formulas and models; this enables the students to understand the principles of economic theory. The main stress is made on the economic interpretation and applications of considered economic models.

Learning objectives:

The students should get acquainted with the main concepts of Time Series theory and methods of analysis. They should know how to use them in examining financial processes and should understand methods, ideas, results and conclusions that can be met in the majority of books and articles on economics and finance. In this course, students should master traditional methods of Time Series analysis, intended mainly for working with time series data. Students should understand the differences between cross-sections and time series, and those specific economic problems, which occur while working with data of these types.

Learning outcomes

Students should become skillful in analysis and modelling of stochastic processes of ARMA \( (p, d, q) \) models, get acquainted with co-integration and error correction models, autoregressive models with distributed lags, understand their application in economics. Considered methods and models should be mastered by practice using real economic data and modern economic software Econometric views and R.

The methods:

The following methods and forms of study are used in the course:
- Lectures;
- practices in computer class;
- self-study in computer class (doing home assignments using R and Econometric views, work with financial data, appliances in Internet);
- self-study with literature.

In total the course includes 28 hours of the lectures and 28 hours of practices and classes.

It is assumed that lectures and seminars are attended. The main form of control is the examination at the end of the course. Before the exam students have to demonstrate econometric research based on data gathered under the supervision of the teacher.

To get a good mark in the exam students have to show absolute knowledge of the bases of the course, hand in all home assignments and well written examination research.
Main reading:


Supplementary reading:


Grade determination:

This course includes 1 control work. The main form of control is the written exam. Necessary conditions for a good exam grade are well-done control work (40% of the final grade). The exam work gives 60% of the final grade.

Course outline:

1. Stochastic process and its main characteristics

2. Autoregressive-moving average models ARMA (p,q)

3. Coefficient estimation in ARMA (p,q) processes. Box-Jenkins’ approach

4. Forecasting in the framework of Box-Jenkins model
   Forecasting, trend and seasonality in Box-Jenkins model.
5. **Non-stationary time series**

Non-stationary time series. Time series with non-stationary variance. Non-stationary mean. ARIMA (p,d,q) models. The use of Box-Jenkins methodology to determination of order of integration.

6. **The unit root problem**

The unit root problem. Spurious trends and regressions. Unit root tests (Dickey-Fuller). ADF test and the choice of the number of lags. Other unit root tests.

7. **Unit root and structure changes**

Non-stationary time series, TSP or DSP: methodology of research. Segmented trends and structure changes.

8. **Regressive dynamic models**

Regressive dynamic models. Autoregressive models with distributed lags (ADL).

9. **Vector autoregression model and co-integration**


10. **Causality in time series**

Granger causality. Hypothesis testing on rational expectations. Hypothesis testing on market efficiency.

**Teaching hours for topics and activities:**

<table>
<thead>
<tr>
<th>No</th>
<th>Topics titles</th>
<th>TOTAL (hours)</th>
<th>Contact hours</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lectures</td>
<td>Classes</td>
</tr>
<tr>
<td>1.</td>
<td>Stochastic process and its main characteristics</td>
<td>10</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>2.</td>
<td>Autoregressive-moving average models ARMA (p,q)</td>
<td>12</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Estimation of coefficients of ARMA (p,q) processes. Box-Jenkins’ approach</td>
<td>10</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>4.</td>
<td>Forecasting in Box-Jenkins model</td>
<td>10</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Control work</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Non-stationary time series</td>
<td>10</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>6.</td>
<td>Unit root problems</td>
<td>10</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>7.</td>
<td>Unit root and structure changes</td>
<td>12</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>Regressive dynamic models</td>
<td>12</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>9.</td>
<td>Vector autoregressive model and co-integration</td>
<td>14</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>Causality in time series</td>
<td>10</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Final exam</strong></td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>Total:</strong></td>
<td><strong>114</strong></td>
<td><strong>12</strong></td>
<td><strong>86</strong></td>
</tr>
</tbody>
</table>