**SYLLABUS TO THE SUBJECT/SYLABUS DO PRZEDMIOTU**

|  |  |
| --- | --- |
| Item Name/Nazwa przedmiotu | **High-frequency data modeling** |
| Direction/Kierunek | Management |
| Form of study/Forma studiów | Stationary |
| Level of education/Poziom kształcenia | Second degree |
| Year/Rok | 2 |
| Semester/Semestr | 3 |
| Guide unit/Jednostka prowadząca | Department of Econometrics and Statistics |
| Drafter/Osoba sporządzająca  | dr Aneta Włodarczyk |
| Profile/Profil  | General academic |
| Number of ECTS credits/Liczba punktów ECTS | 5 |

**TYPE OF CLASSES - NUMBER OF HOURS PER SEMESTER/RODZAJ ZAJĘĆ – LICZBA GODZIN W SEMESTRZE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Lecture/Wykład | Exercise/Ćwiczenia | Laboratory/Laboratorium | Project/Projekt | Seminar/Seminarium |
| **15E** |  | **30** |  |  |

**COURSE DESCRIPTION/OPIS PRZEDMIOTU**

**PURPOSE OF THE COURSE/CEL PRZEDMIOTU**

**C1.** To familiarize students with time series models that allow the description of properties characteristic of high-frequency data.

**C2.** Developing competences to identify properties of high-frequency data and construct time series models describing these properties using the Gretl program.

**C3.** To familiarize students with the possibilities of using time series models in the investment decision-making process.

**PREREQUISITES FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCIES/WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI**

1. The student has general knowledge of mathematics, statistics and econometrics.
2. The student has skills in using Excel software.

**LEARNING OUTCOMES/EFEKTY UCZENIA SIĘ**

**EU 1**. The student defines the properties of high-frequency data and distinguishes time series models that describe these properties.

**EU 2**. The student estimates and verifies time series models for high-frequency data in Gretl.

**EU 3**. The student lists and characterizes the parameters of investments in financial instruments.

**EU 4**. The student estimates and interprets selected parameters of investments in financial instruments based on high-frequency data.

**CURRICULUM CONTENT/TREŚCI PROGRAMOWE**

|  |  |
| --- | --- |
| **Form of classes/Forma zajęć –LECTURE/ WYKŁAD** | **Number of hours/Ilość godzin** |
| **W1** Decomposition of time series into deterministic and stochastic components. Trend and periodic fluctuation models. | **1** |
| **W2 - W3** Determination of the degree of process integration: ADF test, KPSS test. | **2** |
| **W4** Identification of selected properties of high-frequency time series. | **1** |
| **W5 - W6** Conditional mean modeling: White noise process, autoregressive model, moving average model, ARMA model. | **2** |
| **W7 - W8** Conditional variance modeling: generalized autoregressive conditional heteroskedasticity models (GARCH). | **2** |
| **W9** Parameters of investments in financial instruments. | **1** |
| **W10** Market risk measures:volatility measures and downside risk measures. | **1** |
| **W11 - W12** Risk measures: value at risk and expected shortfall. Using ARMA-GARCH models in estimating VaR. | **2** |
| **W13** Sensitivity risk measures: Sharpe model. | **1** |
| **W14 - W15** Market risk hedging strategies: using time series models. | **2** |
| **Form of classes/Forma zajęć –LABORATORY/LABORATORIUM** | **Number of hours/Ilość godzin** |
| **L1- L2** High-frequency database construction. Introduction to Gretl software. | **2** |
| **L3- L4** Time series decomposition: estimation and verification of trend model and periodic fluctuation models. | **2** |
| **L5- L6** Determining the degree of process integration: performing the ADF test, KPSS test in Gretl. | **2** |
| **L7 - L8** Identification of selected properties of high-frequency time series. Performing statistical tests in Gretl. | **2** |
| **L9 - L10** Linear time series models.Identification, estimation and verification of autoregressive models in Gretl. | **2** |
| **L11 - L12** Identification, estimation and verification of ARMA models in Gretl. | **2** |
| **L13 - L14** Modeling conditional volatility of high-frequency data. Identification of the ARCH effect in Gretl. | **2** |
| **L15 - L16** Estimation and verification of GARCH models in Gretl. | **2** |
| **L17 - L18** Basic parameters of investments in financial instruments. Estimation and interpretation of volatility risk measures. | **2** |
| **L19 – L20** Estimation and interpretation of downside risk measures. | **2** |
| **L21 – L22** Using ARMA-GARCH models to estimate value at risk and expected shortfall. | **2** |
| **L23 – L24** Estimation and interpretation of sensitivity risk measures. | **2** |
| **L25 – L26** Market risk hedging strategies: estimating regression model parameters for high-frequency spot and futures data. | **2** |
| **L27 – L28** Market risk hedging strategies using futures contracts. | **2** |
| **L29 – L30** Final colloquium. | **2** |

**DIDACTIC TOOLS/NARZĘDZIA DYDAKTYCZNE**

1. Audiovisual equipment
2. Blackboard, chalk, markers
3. Books, scientific journals, databases
4. Computers, software Gretl and Excel
5. E-learning platform

**METHODS OF ASSESSMENT (F- FORMATIVE, P - SUMMATIVE)/SPOSOBY OCENY ( F – FORMUJĄCA, P – PODSUMOWUJĄCA)**

F1. Performing a laboratory exercise

F2. Participation in the discussion (activity during classes)

P1. Colloquium

P2 Exam

**STUDENT WORKLOAD/OBCIĄŻENIE PRACĄ STUDENTA**

|  |  |
| --- | --- |
| **Form of activity/Forma aktywności** | **Average hours to complete an activity/Średnia liczba godzin na zrealizowanie aktywności**  |
| **[h]** | **ECTS** |
| Contact hours with the teacher (lecture, exercise)/Godziny kontaktowe kontaktowe z nauczycielem (wykłady, ćwiczenia) | 45 | 1,8 |
| Preparing for the laboratory/Przygotowanie do labolatorium | 59 | 2,36 |
| Reading the indicated literature/Zapoznanie się ze wskazaną literaturą | 16 | 0,64 |
| Consultations**/**Konsultacje | 5 | 0,2 |
| **TOTAL NUMBER OF ECTS POINTS FOR ITEM/SUMARYCZNA LICZBA PUNKTÓW ECTS****DLA PRZEDMIOTU** | **125** | **5**  |

**BASIC AND SUPPLEMENTARY LITERATURE/LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA**

 **Basic Literature/Literatura podstawowa:**

1. Adkins, L. C., Using gretl for Principles of Econometrics, 2018, https://www.learneconometrics.com/gretl/poe5/using\_gretl\_for\_POE5.pdf

2. Brockwell, P.J., Davis, R.A., Introduction to Time Series and Forecasting, Springer International Publishing AG, 2016.

3. Tsay, R. S., Analysis of Financial Time Series, Wiley John&Sons Inc., 2010.

4. Mills, T.C., Econometric Modelling of Financial Time Series, Cambridge University Press, 2008.

5. Jorion, P., Value at Risk, 3rd Ed.: The New Benchmark for Managing Financial Risk, McGraw-Hill Education Ltd., 2006.

**Supplementary Literature/Literatura uzupełniająca**

1. Włodarczyk A., *Regime-dependent assessment of the European Union Aviation Allowances price risk*, Dynamic Econometric Models, Vol. 17, 2017, s. 129-145.

2. Włodarczyk A., Zawada M., *Expected Shortfall as a Tool Supporting Risk Management in Energy Company*, [in:] *Vision 2025: Education Excellence and Management of Innovations Through Sustainable Economic Competitive Advantage,* Soliman K.S. (red.), IBIMA Conference Proceedings, 2019, 11629-11640.

**INSTRUCTOR OF THE COURSE (NAME, SURNAME, E-MAIL ADDRESS)/PROWADZĄCY ZAJĘCIA (IMIĘ, NAZWISKO, ADRES E-MAIL)**

1. Aneta Włodarczyk, aneta.włodarczyk@pcz.pl

2. Marcin Zawada, marcin.zawada@pcz.pl

**MATRIX OF THE IMPLEMENTATION OF LEARNING OUTCOMES/MACIERZ REALIZACJI EFEKTÓW UCZENIA SIĘ**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Learning Outcome/Efekt uczenia się** | **Reference an effect to program-wide defined effects/ Odniesienie danego efektu do efektów zdefiniowanych dla całego programu**  | **Course objectives/Cele przedmiotu** | **Curriculum content/Treści programowe** | **Teaching tools/Narzędzia dydaktyczne** | **Method of evaluation/Sposób oceny** |
| EU 1 | K\_W05, K\_W06  | C1 | W 1– W 8 | 1-5 | P2 |
| EU 2 | K\_U01, K\_U03, K\_U06, K\_K03 | C1, C2 | L 1 – L16 | 1-5 | F1 |
| EU 3 | K\_W06, K\_W09 | C3 | W 9 – W 15 | 1-5 | F2, P2 |
| EU 4 | K\_U03, K\_U06, K\_K03 | C3 |  L 17– L 30 | 1-5 | F1, P1 |

**FORM OF ASSESSMENT - DETAILS/FORMY OCENY – SZCZEGÓŁY**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Per grade 2/****Na ocenę 2** | **Per grade 3/****Na ocenę 3** | **Per grade 4/****Na ocenę 4** | **Per grade 5/****Na ocenę 5** |
| **Effect 1/ Efekt 1** | The student does not know the properties of high-frequency data and does not distinguish between time series models describing these properties | The student defines the properties of high-frequency data or distinguishes time series models describing these properties in the range of 51-70% | The student defines the properties of high-frequency data and distinguishes time series models describing these properties in the range of 71-90% | The student defines the properties of high-frequency data and distinguishes time series models describing these properties in the range of 91-100% |
| **Effect 2/****Efekt 2** | The student is unable to estimate time series models for high-frequency data in Gretl. | The student has mastered the skills of estimating and verifying time series models for high-frequency data in the Gretl program in the range of 51-70% | The student has mastered the skills of estimating and verifying time series models for high-frequency data in the Gretl program in the range of 71-90%80%70% | The student has mastered the skills of estimating and verifying time series models for high-frequency data in the Gretl program in the range of 91-100% |
| **Effect 3/****Efekt 3** | The student does not list or characterize the parameters of investments in financial instruments. | The student lists and characterizes the parameters of investments in financial instruments in the range of 51-70% | The student lists and characterizes the parameters of investments in financial instruments in the range of 71-90% | The student lists and characterizes the parameters of investments in financial instruments in the range of 91-100% |
| **Effect 4/****Efekt 4** | The student does not estimate or interpret selected parameters of investments in financial instruments based on high-frequency data. | The student has mastered the skills of estimating and interpreting selected parameters of investments in financial instruments based on high-frequency data in the range of 51-70% | . The student has mastered the skills of estimating and interpreting selected parameters of investments in financial instruments based on high-frequency data in the range of 71-90% | The student has mastered the skills of estimating and interpreting selected parameters of investments in financial instruments based on high-frequency data in the range of 91-100% |

\*A 3.5 half grade is awarded in the case of full credit for the learning outcomes with a 3.0 grade, but the student has not fully absorbed the learning for a 4.0 grade. A half-grade of 4.5 is awarded in the case of full credit for the learning outcomes with a 4.0 grade, but the student has not fully assimilated the learning outcomes for a grade of 5.0./ \*Ocena połówkowa 3.5 jest wystawiana w przypadku pełnego zaliczenia efektów uczenia się na ocenę 3.0, ale student nie przyswoił w pełni uczenia się na ocenę 4.0. Ocena połówkowa 4.5 jest wystawiana w przypadku pełnego zaliczenia efektów uczenia się na ocenę 4.0, ale student nie przyswoił w pełni efektów uczenia się na ocenę 5.0.

**OTHER USEFUL INFORMAION ABOUT THE ITEM/INNE PRZYDATNE INFORMACJE O PRZEDMIOCIE**

Information where you can read presentations for classes, etc. - Information is provided during the first class and sent electronically to the addresses of individual dean’s groups./ Informacje, gdzie można zapoznać się z prezentacjami na zajęcia itp. - Informacje udzielane są podczas pierwszych zajęć i przesyłane drogą elektroniczną na adresy poszczególnych grup dziekańskich

Information on the place of classes - Information can be found on the website of the Faculty of Management and in the USOS system./ Informacja o miejscu zajęć – Informacje znajdują się na stronie internetowej Wydziału Zarządzania oraz w systemie USOS.

Information on the date of classes (day of the week/time) - Information can be found on the website of the Faculty of Management and in the USOS system./ Informacja o terminie zajęć (dzień tygodnia/godzina) – Informacje znajdują się na stronie internetowej Wydziału Zarządzania oraz w systemie USOS

Information about consultations (hours + place) - Information is given during the first classes, it is also available on the website of the Faculty of Management./ Informacje na temat  godzin i miejsca konsultacji znajdują się na stronie internetowej Wydziału Zarządzania oraz podawane są na pierwszych zajęciach ze studentami.