Mathematical Statistics - opis przedmiotu

Informacje ogólne

Nazwa przedmiotu	Mathematical Statistics
Kod przedmiotu	11.1-WK-MATP-MS-S22
Wydział	Wydział Matematyki, Informatyki i Ekonometrii
Kierunek	WMIiE - oferta ERASMUS
Profil	-
Rodzaj studiów	Program Erasmus
Semestr rozpoczęcia	semestr zimowy 2022/2023

Informacje o przedmiocie

Semestr	2
Liczba punktów ECTS do zdobycia	6
Typ przedmiotu	obieralny
Język nauczania	angielski
Sylabus opracował	• dr hab. Stefan Zontek, prof. UZ • dr Ewa Synówka

Formy zajęć

Forma zajęć	Liczba godzin w semestrze (stacjonarne)	Liczba godzin w tygodniu (stacjonarne)	Liczba godzin w semestrze (niestacjonarne)	Liczba godzin w tygodniu (niestacjonarne)	Forma zaliczenia
Wykład	30	2	-	-	Egzamin
Laboratorium	15	1	-	-	Zaliczenie na ocenę
Ćwiczenia	30	2	-	-	Zaliczenie na ocenę

Cel przedmiotu

Theoretical background of statistical inference.

Wymagania wstępne

Passed lecture on probability theory.

Zakres tematyczny

Lecture

1. Normal distribution and other connected distributions.
Random variable and its basic characteristics, normal random variable (revision). Chi-square distribution, t-Student's distribution, F-Snedecor's distribution.
2. Statistical model.
Aim of statistical research, statistical space, random sample, theorem on convergence of empirical distribution functions.
Distributions of same sample statistics, Fisher theorem.
Sufficient statistics, factorial theorem. Complete statistics.
Exponential family of distributions, natural space of parameters, a general form of sufficient statistic, Lehmann theorem.
3. Theory of estimation.
The best unbiased estimator, Lehmann-Scheffe theorem, Rao-Blackwell theorem. Moments method, maximum likelihood method.
Confident intervals.
4. Theory of testing statistical hypothesis.
Introduction.
Most powerful tests, Neyman-Pearson lemma.

Class

1. Revision and amplification information from probability theory. Normal distribution and its properties. Using statistical tables. Distribution of random vectors and its basic characteristics. Distribution of a function of random vector.
2. Independence of random variables. Distribution of a random sample. Examples of random variables, which are not statistic. Application of Fisher theorem.
3. Proving sufficiency by definition and by factorial criterion.
4. Examples of models from the exponential family of distributions, a form of sufficient statistics, problem of completeness.
5. Calculation of the expected value and the variance of selected estimators, problem of unbiasedness.
6. Construction of the best unbiased estimator using Lehmann-Scheffe theorem and Rao-Blackwell theorem.
7. Application of moments method and maximum likelihood method to estimation.
8. Construction of confidence intervals for parameters of selected statistical models. Calculations of interval estimates with using proper statistical tables.
9. Calculation of power functions.
10. Construction of the most powerful tests for testing selected statistical hypothesis.

Laboratory

1. An introduction to chosen statistical package.
2. Properties of some probability distributions. Calculation of probabilities. Calculation of critical values and quantiles random variables.
3. Use of the central limit theorem and illustration of its effects.
4. Illustrate the impact of parameters of the normal distribution on sample.(simulations).
5. Illustrate the theorem on the convergence of empirical distribution function.
6. Confidence intervals for parameters of a normal distribution. Analysis of the impact of the confidence level and the size of the sample on length of confidence intervals.
7. Calculating the probability of type I error and the probability of type II error. The power of a test.
8. Tests for the mean and the variance of a normal distribution. The definition of p-value. Use of confidence intervals for testing.

Metody kształcenia

Lecture traditional. Class - solving problems from prepared lists. Laboratory - using the selected statistical package to analysis data.

Efekty uczenia się i metody weryfikacji osiągania efektów uczenia się

Opis efektu	Symbole efektów	Metody weryfikacji	Forma zajęć
Student can check assumptions of Lehmann theorem, show that usually used estimators are unbiased or not and can obtain estimators using moments method and maximum likelihood method for selected models.		• egzamin - ustny, opisowy, testowy i inne • obserwacja i ocena aktywności na zajęciach • test	• Wykład • Laboratorium • Ćwiczenia
Student is able to properly interpret confidence intervals and can obtain its using method of central function.		• egzamin - ustny, opisowy, testowy i inne • obserwacja i ocena aktywności na zajęciach • test	• Wykład • Laboratorium • Ćwiczenia
Student can take a decision on acceptation or not for testing selected hypothesis using statistical tables.		• egzamin - ustny, opisowy, testowy i inne • obserwacja i ocena aktywności na zajęciach • test	• Wykład • Laboratorium • Ćwiczenia
A student knows that the statistical surveys give an approximate knowledge of the unknown distributions of variables; the distributions of the basic statistics of sample from the normal distribution, and use them to calculate probabilities and how to obtain confidence intervals for chosen parameters and interpret the result.		• egzamin - ustny, opisowy, testowy i inne • obserwacja i ocena aktywności na zajęciach • test	• Wykład • Laboratorium • Ćwiczenia
Student know that statistical research give approximate knowledge on studied phenomenon.		• egzamin - ustny, opisowy, testowy i inne • obserwacja i ocena aktywności na zajęciach • test	• Wykład • Laboratorium • Ćwiczenia
Using statistical tests, a student knows how to make a decision on acceptance or rejection of statistical hypotheses; can calculate the probability of type I and II error and is able to determine the power of a test.		• egzamin - ustny, opisowy, testowy i inne • obserwacja i ocena aktywności na zajęciach • test	• Wykład • Laboratorium • Ćwiczenia
Student can specify distribution of some statistics for normal model and give nontrivial sufficient statistics for selected models using the factorial theorem.		• egzamin - ustny, opisowy, testowy i inne • obserwacja i ocena aktywności na zajęciach • test	• Wykład • Laboratorium • Ćwiczenia

Warunki zaliczenia

1. Class - tests with problems on different level of difficulties, which allow to assess, that student posses learning outcomes on minimal level.

2. Laboratory - checking students prepare for class and their active participation in class; tests with the tasks of different difficulty (The condition of a positive grade from laboratory is to obtain of at least 50% of the maximum sum of points from the written tests).

3. Lecture – exam with questions from theory (definitions, theorems and its applications).

To take an exam student has to obtain positive grade from class. To complete the course one has to obtain positive grade form exam. The course grade consists of a grade from class (30%), a grade from laboratory (20%) and a grade from exam (50%).

Literatura podstawowa

1. P. J. Bickel, K. A. Doksum, Mathematical Statistics, Holden-Day, Inc. San Francisco, 1977.
2. R. V. Hogg, A. T. Craig, Introduction to Mathematical Statistics, Macmillan Publishing Co., Inc. NEW YORK 1978.
3. G. James, D. Witten, T. Hastie, R. Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer 2013

Literatura uzupełniająca

1. D. Aczel, Complete Business Statistics, Sounderpandian, Jayavel, 2008.
2. K. Black, Business Statistics For Contemporary Decision Making, 6th Edition, John Wiley & Sons, Inc. 2010.
3. P. Bruce, A. Bruce, P. Gedeck, Practical Statistics for Data Scientists. 50+ Essential Concepts Using R and Python, O'Reilly 2020.

Uwagi

Zmodyfikowane przez dr Alina Szelecka (ostatnia modyfikacja: 04-07-2022 14:42)