Study programmes: Bachelor studies – Astronomy and Astrophysics

Course name: Astronomical data processing 2

Lecturers: Dušan Marčeta

Status: Optional

ECTS: 5

Attendance prerequisites: None

Course aims: Acquisition of general and specific knowledge of the processing of large and individual observation results and the development of methods of theory and practice based on numerical, probabilistic and statistical characteristics of the astronomical experimental material. Development of analytical and synthetic skills of a student for effective treatment of observation results.

Course outcome: Upon completion of the course, the student has the necessary theoretical and practical knowledge of processing all recognizable types of observational results (endogenous, exogenous, qualitative, quantitative) and the ability to perform independently the final part of an astronomical experiment using mathematics tools and computing.

Course content: Introduction to probability and statistics. Axioms of probability theory. Random variables. Limit theorems. The law of large numbers and the central limit theorem. Sampling and general population. Distributions, confidence intervals and levels of significance, parameter estimates and significance tests. Normal distribution of probability for one or more random variables. Bayes theorem and derivation of the most probable distribution parameters of observations set. Empirical distribution of probability of selected types of astronomical observations and their comparison with assumed theoretical distributions. Kolmogorov, Pearson and Mises critria. Homogeneity of observation subgroups: Student, Wilcoxon and Ficher criteria. Identification of observation errors: objectively and subjectively determining the limits of the confidence interval. Identification of systematic variations in the observed random variable: Abbe's criterion. Statistical testing of the dependence between known astronomical and geophysical phenomena: Solar activity and perturbation of the geomagnetic field, parallax and its proper motion of the star, mass and absolute magnitudes of the star, period and brightness of Cefeides, etc. Identification of oscillatory variations in the observation series. Periodogram and spectral analysis: direct Fourier transforms and transformations of the autocovariate function of a random process. Limitations of astronomical time series and unwanted effects. Methods: Blackman and Tukey, Hamming and others.

Literature:

1. D. Đurović: Matematička obrada astronomskih posmatranja (1974)
2. S. Šegan: 15 lectures from «Лекције по реду и без реда»,
3. Astronomical Almanac (2000), Appendix.
4. J. V. Wall, C. R. Jenkins, Practical Statistics for Astronomers, Cambridge,
5. 2003 Astronomical Almanac

Number of hours: 4	**Lecures: 2**	**Tutorials: 2**	**Laboratory: -**	**Research: -**

Teaching and learning methods: Frontal / Individual / Group

Assessment (maximal 100 points)

Course assignments	**points**	**Final exam**	**points**
Lectures	20	Written exam	-
Exercises / Tutorials	30	Oral exam	20
Colloquia	20	Written-oral exam	-
Essay / Project	10		