

Introduction to Statistics in Astronomy

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This short course will give an overview and an introduction to several examples of statistical techniques that are commonly used in Astronomy.

- Overview, why statistics?, basic definitions, characteristic functions, probability and errors, properties of some common distributions, estimating location and scale
- Combining variables - error propagation, Central Limit theorem, random numbers, Bayes' theorem, Rayleigh distribution, likelihood of identifications in catalogues, order statistics and NN distributions, correlation and covariance.
- Introduction to time series analysis - statistics of Fourier transforms, Shannon's sampling theorem, periodicity estimation. Combination of signals, convolution (smearing, blurring), optimal detection of signals/objects, cross-correlation (radial velocities)
- Bayes theorem again, parameter estimation/model fitting, Maximum Likelihood estimators, Least-Squares, optimal spectral extraction, numerical techniques for model fitting.
- Confidence intervals & Hypothesis testing: correlation tests, KS, Chisq, binned -v- unbinned data, information criteria, which model ? how many parameters ? low detection rates.
- Processing CCD data, direct imaging and spectroscopy, aliasing and Shannon's sampling theorem, interpolation, stacking, image detection and parameterisation
- Introduction to digital image processing methods: filtering, direct methods, Fourier methods; Wiener filters, entropy and information, image restoration.
- Multivariate analysis and Classification - PCA, ICA, ANNs, linear discriminants, genetic algorithms.