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Psignifit 4: Pain-free Bayesian Inference for Psychometric Functions

33.4040, Sunday, 17-May, 8:30 am - 12:30 pm, Pavilion
Session: Spatial Vision: Models and mechanisms

Heiko Schütt[1], Stefan Harmeling[5], Jakob Macke[2,4], Felix Wichmann[1,2,3]; [1]Neural Information Processing Group, Faculty of Science, University of Tübingen, Germany, [2]Bernstein Center for Computational Neuroscience, Tübingen, Germany, [3]Empirical Inference Department, Max Planck Institute for Intelligent Systems, Tübingen, Germany, [4]Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [5]Institut für Informatik, Heinrich-Heine-Universität Düsseldorf, Germany

Psychometric functions are frequently used in vision science to model task performance. These sigmoid functions can be fit to data using likelihood maximization, but this ignores the reliability or variance of the point estimates. In contrast Bayesian methods automatically calculate this reliability. However, using Bayesian methods in practice usually requires expert knowledge, user interaction and computation time. Also most methods---including Bayesian ones---are vulnerable to non-stationary observers (whose performance is not constant). For such observers all methods, which assume a stationary binomial observer are overconfident in the estimates. We present Psignifit 4, a new method for fitting psychometric functions, which provides an efficient Bayesian analysis based on numerical integration, which requires little user-interaction and runs in seconds on a common office computer. Additionally it fits a beta-binomial model increasing the stability against non-stationarity and contains standard settings including a heuristic to set the prior based on the interval of stimulus levels in the experimental data. Obviously all properties of the analysis can be adjusted. To test our method it was run on extensive simulated datasets. First we tested the numerical accuracy of our method with different settings and found settings which calculate a good estimate fast and reliably. Testing the statistical properties, we find that our method calculates correct or slightly conservative confidence intervals in all tested conditions, including different sampling schemes, beta-binomial observers, other non-stationary observers and adaptive methods. When enough data was collected to overcome the small sample bias caused by the prior, the point estimates are also essentially unbiased. In summary we present a user-friendly, fast, correct and comprehensively tested Bayesian method to fit psychometric functions, which handles non-stationary observers well and is freely available as an MATLAB implementation online.

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