

# Mathematical analysis of human visual perception

Wiebe Pestman  
w.r.pestman@tele2.nl

February, 14th - 14:00 to 16:00

This lecture provides several examples of elementary mathematical applications to a very interesting biological research project at the University of Utrecht (Holland). The central topic in this project was the visual perception of images by human brains. More specifically, efforts were done to get some grip on the perception of so-called *bi-stable* images. Examples of bi-stable images will be given in the lecture. When human beings observe bi-stable images, the perception of the image through the brains alternates. Thus one can measure so-called flip-over times. These flip-over times show, with an incredibly high precision, basic probability distributions. To be more precise, they seem to fit perfectly in the family of gamma distributions (see for example [3]).

In the past several conjectures have been made as to the probabilistic behaviour of the flip-over times. For example, the shape parameter in the fitted gamma distributions gave rise to interesting conjectures about the way human brains are dealing with bi-stable images (see [1], [2]). Our research showed that some of these conjectures are most likely correct, some of them partly correct and some of them most likely false.

This lecture only assumes the participants to have some basic knowledge of mathematical analysis. Some basic knowledge of probability theory would be nice. Most of the lecture will be accessible to all undergraduate students in mathematics.

## References

- [1] J.W. BRASCAMP, R. V. EE, W.R. PESTMAN, A.V. V. D. BERG  
*Distributions of alternation rates in various forms of bistable perception*, Journal of Vision, 5 (4), p. 287-298 (2006).
- [2] J.W. LEVELT  
*Note on the distribution of dominance times in binocular rivalry*, British Journal of Psychology, 58 (1), p. 143-145 (1967).
- [3] W.R. PESTMAN  
*Mathematical Statistics (second edition)*.

Walter de Gruyter Verlag, Berlin (2009).