

**THE APPLICATION OF
STATISTICAL METHODS TO
THE PROBLEMS OF
PSYCHOPHYSICS**

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The Application of Statistical Methods to the Problems of Psychophysics by F. M. Urban

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F. M. URBAN

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*With the compliments of
author.*

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OF PSYCHOPHYSICS

revised BY
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PREFACE

The following study deals with the methods which serve for the determination of the threshold of difference. These methods can be easily adapted to the determination of the maximum and minimum stimulation, so that it seemed justified to refer in the title of the book to the problems of psychophysics in general. These problems are treated by such propositions of the calculus of probabilities as apply to the results of observations of statistical numbers of relative frequency. The term "statistical method" has two slightly different meanings. The first refers to the method of collecting observations on a group of individuals or on one individual at different times. The data obtained in this way must be subjected to some kind of treatment and the term "statistical method" refers in its second meaning to every algorithm for the numerical evaluation of these data or to every definite method by which conclusions can be drawn from them. One may say in general that a problem is treated statistically, if the data are collected with a view to determining certain numbers of frequency which serve as a basis for further deductions.

Some of the ideas expounded in this book date back a considerable time. The considerations of the last chapter originated in the course of a study of some physical phenomena and they were followed up later on in connection with a study of the law of Gompertz-Makeham. Most of the formulae of the third chapter have been known to me for several years, and the idea of a purely formal treatment of the results of psychological experiments came to me in the course of the experiments of Mr. Kobilecki, which were reported lately in the "Psychologische Studien". These small ideas, however, would have remained undeveloped for a long time, had not Prof. Witmer brought to my knowledge an experimental arrangement which could be adapted to the purposes of this investigation. It is so extremely easy to have brilliant ideas in psychology that theoretical discussions justly meet with a certain

distrust, if they are not supported by adequate experimental material. The impossibility of deciding on an experimental procedure which would yield suitable material for the test of the theoretical deductions was the chief reason for not publishing this analysis of the psychophysical methods before. This delay of more than five years proved to be a very fortunate circumstance, not only because the growth of such ideas is very slow, but also because the problems of psychophysics have been the subject of several important publications in the last years. Wundt, Müller, Lipps and Titchener, have treated of the psychophysical methods in the last few years; especially by the work of Titchener is the literature on this problem opened up as it was never before. A similar great help for the analysis of the psychophysical methods was found in Czuber's work on the calculus of probabilities and in those parts of the "Encyklopädie der Mathematischen Wissenschaften" which deal with the calculus of probabilities and its application to statistics. Comparatively little reference to literature is made in this book. Constant reference to work previously done was out of the question, because it would have made the book too voluminous, and occasional quotations are of little or no use. Add to this that the present investigation has not the same starting point as the treatises of the previous authors, and that, therefore, it would have been necessary to argue against views which in themselves are interesting and of merit. This would have given an entirely erroneous impression of my opinion of the value of these views, and hence it seemed best to describe in separate papers the different phases of the development of the psychophysical methods. In so far as the English literature is concerned this presentation will be given in one of the reports on "Die Psychologie in Amerika", which appear from time to time in the *Archiv für die gesammte Psychologie*.

In working out the numerical results it was made a rule to repeat the computation independently whenever it was not possible to apply a thoroughgoing check. The course of the calculations is given in great detail. This was done in order to illustrate the theoretical deductions by numerical examples, and to show that the actual application of the methods described here is simple and that it is shorter than the methods used at present. This

remark refers especially to the method of just perceptible differences, which requires four times as many experiments as the new method to give the result with the same degree of accuracy. Great care was taken to present all the deductions in as simple a form as possible. Mr. Titchener's work has set a standard for such treatment, and it may be hoped that the following considerations will be intelligible to everyone who has gone through the "Manual". This does not mean that all the theorems used are spoken of in this work, but that they are such that they might be understood by every one who can read Mr. Titchener's book. This rule of avoiding complicated deductions made necessary the curtailing of a demonstration in the third chapter at the place where reference is made to Bruns's theorem of the conservation of the $\phi(\gamma)$ -type. The complete solution of the problem would have required a long demonstration of a very technical character, in which some of the more complicated functions are used. It therefore seemed best to give it at some other place.

TABLE OF CONTENTS.

	PAGE.
CHAPTER I. DESCRIPTION OF THE EXPERIMENTS.....	1
CHAPTER II. THE STATISTICAL NUMBERS OF RELATIVE FREQUENCY	19
CHAPTER III. ON THE METHOD OF JUST PERCEPTIBLE DIF- FERENCES	40
CHAPTER IV. THE EQUALITY CASES	99
CHAPTER V. THE PSYCHOMETRIC FUNCTIONS	106
CHAPTER VI. A GENERAL INQUIRY CONCERNING THE PSY- CHOMETRIC FUNCTIONS	139