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Mark Stemmler

Person-Centered Methods

Configural Frequency Analysis (CFA) and Other Methods for the Analysis of Contingency Tables

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Preface

The idea for this book came to me while I was teaching courses during the summer at The Methodology Center at Penn State (Director: Linda Collins). Teaching classes on person-centered methods which do not belong to the standard curriculum at German or American universities was very inspiring to me. The interaction with the students helped me to understand how to explain the content of this class so that it is easy to understand and showed to me how much the students liked this different look at statistics.

This book will take an easy-to-understand look at the statistical approach called the *person-centered method*. Instead of analyzing means, variances and covariances of scale scores as in the common variable-centered approach, the person-centered approach analyzes persons or objects grouped according to their characteristic patterns or configurations in contingency tables. The main focus of the book will be on ***Configural Frequency Analysis*** (CFA; Lienert and Krauth 1975) which is a statistical method that looks for over- and under-frequented cells or patterns. Over-frequented means that the observations in this cell or configuration are observed more often than expected, under-frequented means that this cell or configuration is observed less often than expected. In CFA a pattern or configuration that contains more observed cases than expected is called a *type*; similarly, a pattern or configuration that is less observed than expected are called an *antitype*. CFA is similar to log-linear modeling. In log-linear modeling the goal is to come up with a fitting model including all important variables. Instead of fitting a model, CFA looks at the significant residuals of a log-linear model.

CFA was invented by Gustav A. Lienert, an Austrian physician and professor of psychology, who died in 2001. I was lucky to have met Gustav A. Lienert, who was a very inspiring and enthusiastic person. I am thankful for his cheerfulness and his support. I was introduced to 'Herrn Lienert' by Alexander von Eye (Psychology Professor at Michigan State and University of Vienna). I am very thankful to Alex who has introduced me to the field of categorical data analysis.

A number of ideas presented here (especially those in Chap. 6) were proposed by Erwin Lautsch. They were all published in a series of Special Issues on CFA (guest

editor together with Alexander von Eye) in the German Journal called Psychology Science (formerly known as the Psychologische Beiträge). Thank you Erwin for sharing your ideas!

One important asset to this book was the development of the R-package ***confreq*** (derived from **con**figural **freq**uency analysis). The open source software R is available at no cost and is developing in a fast and progressive manner. An R-package was also important because there was no readily available software for configural frequency analysis (with exception of a somewhat outdated DOS software written in FORTRAN). ***Confreq*** was written by Jörg-Hendrik Heine (LMU Munich). I met Jörg at our annual statistical meetings in Rothenberge (Northern Germany) organized by Christian Tarnai and Jost Reinecke. Jörg worked diligently on this package for more than 2 years including several setbacks. Many thanks to you Jörg! I am also thankful to Rainer Alexandrowicz (who I also met in Rothenberge) who worked on Stirlings's formula for using the binomial test as part of ***confreq***.

My thanks go out to Amanda Applegate and Heather Foran for proof reading my English. In addition, Heather also addressed to me all the relevant sections which were difficult to understand and not well explained. Her methodological perspective was extremely essential for my writing! Thanks also to Hannah Bracken at Springer for her support in leading my book endeavor.

Finally, I offer my deepest thanks to my wife Susanne and my son Quincy. Thanks for giving me so much comfort and for energizing my life.

Erlangen, Germany Mark Stemmler
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Reference

Lienert, G. A., & Krauth, J. (1975). Configural frequency analysis as a statistical tool for defining types. *Educational Psychology and Measurement, 35*, 231–238.

Contents

Chapter 1
Introducing Person-Centered Methods

Abstract This chapter explains the term *person-centered methods* and how ***Configural Frequency Analysis*** **(CFA)** works. Instead of analyzing means, variances and covariances of scale scores as in the common variable-centered approach, the person-centered approach analyzes persons or objects grouped according to their characteristic configurations in contingency tables. CFA is a statistical method that looks for over- and under-frequented cells or patterns. Over-frequented means, that the observations in this cell or configuration are observed more often than expected, under-frequented means that this configurations is observed less often than expected. In CFA a pattern or configuration that contains more observed cases than expected is called a *type*; similarly, configurations that are less observed than expected are called an *antitype*. In addition, Meehl's paradox (Meehl, J Consult Psychol 14:165–171, 1950) is explained. Meehl's paradox postulates that it is possible to have a bivariate relationship with a zero association or correlation but also a higher order association or correlation. Meehl argued for investigating higher order interactions (beyond bivariate interactions), which can be detected with CFA.

1.1 What Is Configural Frequency Analysis (CFA) Good for?

This chapter takes an easy-to-understand look at the statistical approach called the *person-centered method*. Instead of analyzing means, variances and covariances of scale scores as in the common variable-centered approach, the person-centered approach analyzes persons or objects grouped according to their characteristic patterns or configurations in contingency tables (see Bergman & Magnusson, 1997; Bergman, von Eye, & Magnusson, 2006; Reinecke & Tarnai, 2008; Stemmler & von Eye, 2012). The observed patterns are arranged in tables, ordered by their indices. A certain position in such a table, denoted by a pattern or configuration, is called a cell (Victor, 1989). Such tables are called contingency tables. The main focus of the book will be on ***Configural Frequency Analysis*** (CFA; Lautsch & von Weber,

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