Essentials of Statistical Analysis and Psychometrics in Human Sciences

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Preface

Statistics has been established as a science since the late 19th and early 20th centuries. Today, the roles of statistics are so wide that it is considered as a language of science or science learning of data. Researchers are using statistics in many fields to organize, analyze, and summarize data. Today is the Era of Big Data, and thus various new statistical methods have been developed and applied not only in research but also in the society.

However, it is us who collect data, analyze them, and interpret the results. There are many advanced analysis methods. It becomes easier to use data analysis. But, unless we have thorough understanding about statistical analysis a1l1cepts, it is difficult to utilize the results efficiently and appropriately. The important point is that we have to understand not only the superficial process of the data analysis but the logic behind the statistical analysis methods.

The aim of this book is to provide thoughts and ideas of statistical analysis with various practical examples to· those who are interested in human science, especially studying human mind. In studying human mind, we find out constructs such as intelligence or personality which are abstract and.do not exist physically. Therefore, in order to measure and assess those constructs, a certain theories and techniques are required. In this book, I focus on these theories and techniques which are not usually considered in most of other statistics textbooks.

The readers are mainly assumed to be undergraduate students, graduate students, and researchers in psychology, nursing, public health, medical, education, sociology, welfare, and so on. Moreover, this book can also support everyone who is using statistical analysis methods since the basic ideas of statistics are common in all disciplines.

This book includes 22 chapters. In Chapters I to 6, introduction about basic concepts and arguments of statistics are provided. We consider why statistical analysis is necessary in studying

human mind, such as psychology whose disciplines are subjective to the human mind in Chapter 1. After data collection methods and ethical considerations are discussed in Chapter 2, data types and data structures are introduced in Chapter 3, and summarization of data is explained in Chapter 4. In Chapter 5, distribution statistics such as mean and standard deviation are introduced. In Chapter' '6, covariances and correlation coefficients are considered.

In Chapter 7, we introduce test theories which concerns about measuring constructs. This chapter distinguishes this book from other ordinary statistics books. Unlike weight machines or thermometers, there are no standard specifications for scales or tests to measure constructs. Whether we can measure what we want to is still uncertain just by gathering items. It is necessary to collect evidences which convince us to measure what we want to. In this chapter, these are discussed.

In Chapters 8 to 10, the basic logic of' statistical inferences is provided. Using simple examples, logical structures of statistical analysis are explained. Chapter 8 is a preparing part of the following chapters. We require understanding an important term in statistics, that is, standard error. Some characteristics of probabi1ity distributions which are often utilized in statistical 'analysis are algo explained. The logic of statistical testing is introduced in Chapter 9. The logic of statistical estimations is provided in Chapter 10. Estimation of sample size using confidence intervals is also discussed.

In Chapters 11 to 16, several popular analysis methods such as *t* test, analysis of variance, non-parametric methods, correlation coefficients, contingency tables, and analysis of proportions are overviewed. In Chapters 17 to 22, multivariate data analysis related to linear regression and· structural equation modeling are discussed. Chapter 17 describes random vector, partial correlation coefficient and single regression analysis. Chapter 18 discusses multiple regression analysis. From Chapters 19 to 22, we consider the structural equation modeling. Basic ideas of structural equation modeling, path analysis, model evaluation, factor analysis, and more complicated models are discussed.

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