



UNIVERSITÀ
DEGLI STUDI
DI PADOVA



PHD COURSE
IN STATISTICS

Specialist Course | Cycle XXXVII

June, 2022 | Campus S. Caterina

Nonparametric Conditional Testing of Equivalence Hypotheses

Fortunato Pesarin

Università degli Studi di Padova

Tuesday	June 14	10.00 – 12.30 14.30 – 17.00	Room SC30
Wednesday	June 15	10.00 – 12.30 14.30 – 17.00	Room SC30

Program

<https://www.stat.unipd.it/ricerca/courses-202122-xxxvii-cycle>

Nonparametric Conditional Testing of Equivalence Hypotheses

Fortunato Pesarin | Università degli Studi di Padova

Course Description

The notion of testing for the equivalence of two treatments is widely used in bioequivalence, clinical trials, experimental analyses, pharmacostatistics, quality control, etc. Accordingly, the null hypothesis is traditionally stated as the set of effects the differences δ of which lie *outside* a suitably established equivalence interval and the alternative as the set of δ that lie inside it. It is typically operated by a Two One-Sided Test (TOST) procedure within the Intersection-Union (IU) principle (Berger, 1982; Schuirmann, 1987; Wellek, 2010). In the literature related solutions are customarily based on likelihood techniques, which in turn are rather difficult or even impossible to compute except for the normal case. To cope with most intriguing limitations of likelihood methods an approach based on the nonparametric conditional (permutation) theory has been provided by Arboretti et Al. (2018).

Additionally, to go beyond the point null hypothesis in traditional two-sided testing an approach based on Roy's Union-Intersection (UI) principle, by still staying within the permutation theory and a TOST procedure, has been provided by Pesarin et Al. (2016). The UI-TOST approach, effectively a mirror image of IU-TOST, assumes a null hypothesis where δ lies *inside* the equivalence interval against the alternative that it lies outside. Thus, the testing for equivalence can rationally be analyzed by both approaches but, as the two differ in terms of the mirror-like roles assigned to the hypotheses under study, they are not meaningfully comparable.

Our main goal is to look into these problems and to provide a sort of parallel analysis of both approaches (Arboretti et Al., 2021) by highlighting the related requirements, properties, limitations, difficulties, and pitfalls so as to get practitioners and methodologists properly acquainted with their correct use in practical and theoretical contexts.

Main Contents

- Introduction to the testing of equivalence
 - The Union-Intersection TOST approach
 - The Intersection-Union TOST approach
- Main problems and difficulties of likelihood-based solutions
- The nonparametric conditional approach
 - Some theory of nonparametric conditional (permutation) testing
 - The nonparametric combination (NPC) testing approach
- Analysis of UI-NPC solution to equivalence testing
- Analysis of IU-NPC solution to equivalence testing
- Discussion of some application examples
- UI-NPC and IU-NPC limit behaviour
- Extensions and future researches