Kevin O'Brien 18 November 2008

1 Multiple Comparison Procedures.

Classification of Hypotheses

	declared non-significant	declared significant	Total
true null hypotheses	U	V	m.o
non-true null hypotheses	T	S	m-m.o
Total	m-R	R	m

Legend

m.0 is the number of true null hypotheses

m - m.0 is the number of false null hypotheses

V is the number of Type I errors (hypotheses declared significant when they are actually from the null distribution).

T is the number of Type II errors (hypotheses declared not significant when they are actually from the alternative distribution).

R is an observable random variable.

S, T , U, and V are unobservable random variables.

U is the number of true negatives

V is the number of false positives

T is the number of false negatives

S is the number of true positives

.

.

Key Definitions of Hypotheses

Familywise Error Rate(FWER)

Familywise error rate (FWER) is the probability of making one or more type I errors among all the hypotheses when performing multiple pairwise tests. Further to the classification table previously we define it as follows:

$$FWER = 1 - P(V = 0)$$

False Discovery Rate(FDR)

The False Discovery Rate (FDR) of a set of hypotheses is the expected proportions of false positives in the set of hypotheses. (Controls based on other methods are based on controlling the chance of any false positives). FDR is more sensitive than previous approaches on account of the fact it takes a more lenient approach to false positives. Benjamini Hochberg define a variable Q which is the proportion of errors committed by falsely rejected null hypotheses, and furthermore they define the FDR as the expected value of Q.

$$FDR = E(Q) = E(V/R)$$

Difficulties with Classical MCPs

Benjamini and Hochberg(1995) Set out several flaws with the classical MCP approaches. One in particular is that often control of the FWER is not particularly needed. Another issue is that classical procedures that control the FWER in the strong sense, at levels convention to single-comparsion, tend to have substantially less power than procedures based on each comparison individually, at the same level of significance.

Some Approaches in Literature

We look at Multiple comparison procedures to ascertain whether or not it is possible to examine the methodologies described in the relevant academic papers.

Hochberg (1998)

Simes (1986)

Hommel (1988)

Benjamini Hochberg (1995) state that these procedures overcome the difficulties mentioned previously, while maintaining use of FWER control. This paper proposes the FDR as an alternative to the FWER.

Bonferroni Procedure

In several of the papers, the Bonferroni correction is cited as 'very conservative'.It is also referred to as the classical approach.Benjamini remarks hat the Bonferroni procedure requires control over the FWER in the strong sense, a conservative type I error rate control against any configuration of the hypotheses tested.

Simes(1986)

Simes proposed a modified Bonferroni procedure for a test of an overall hypothesis, which a composite of several component hypotheses.He bases his method

on ordered p-values of individual tests (P(1)=...=P(N)).
Following the closure principle, however, it may be used as a step-down procedure as a multiple testing procedureIt is a less conservative procedure than the classical Bonferroni procedure. It is suitable for testing multiple hypotheses testing where the hypotheses are strongly correlated. it is comparatively simpler to apply.

Hommel(1988) - Multiple Test Procedure

Further to Simes (1986), Hommel proposes a multiple test procedure based on the individual hypotheses. He remarks that it is not strictly less powerful than Holm's procedure , and that in many cases it is more powerful.

Shaffer(1986)

Hommel remarks that Shaffer (1976) makes improvements on Holms General procedure.

Principle of Closed Test Procedures

. This principles , which was postulated by Marcus et al (1976)

Coherence

Coherence is an logical property for multiple tests postulated by Gabriel (1969). It states that if a hypothesis is retained, all of its implications also have to be retained.

Other Matters.

Bayesian computation with R - Jim Alberts

Further to your study group proposal , I have begun working on the Alberts book , concentrating on the first five chapter.

Statistical events in 2009

further to the conversation in the Castletroy hotel, I have made some provisional arrangements for the conference in Vancouver in May 2009. Is there any other events you suggest? I am considering going to the R users Conference in Rennes , France in July 2009.

Literary Review

Would you suggest I also start writing a formal literary review.