

## Directional multivariate tests rejecting null and negative effects in all variables

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This talk deals with the problem of testing whether at least one of many variables in a multivariate normal distribution has a mean  $\mu_i$  which is larger than zero. This problem arises, for example, in clinical trials where treatment success is assessed by many endpoints and it is desired to establish that at least one of them shows a positive response to the treatment.

Many directed multivariate tests for restricted alternatives like e.g. the likelihood-ratio test (Perlman, 1969) for  $A : \mu_i \geq 0 \forall i$  have been derived in the literature. However, these tests usually consider only the single-point null hypothesis  $H_0 : \mu_i = 0 \forall i$ . In many practical applications this is a drawback because it can lead to rejection of  $H_0$  when all observed means are negative (Silvapulle, 1997).

We present two exact multivariate tests for the alternative  $A : \mu_i \leq 0 \forall i$ . One of them is a modification of Follmann's half-space  $T^2$ -test (Follmann, 1996). The other is a modification of the standardized-sum test suggested by Läuter (1996).

The power of these tests is investigated by simulations. In addition an application to clinical trial data will be presented.

## References

- [1] Follmann, D (1996) A simple multivariate test for one-sided alternatives. Journal of the American Statistical Association 91: 854-861.
- [2] Läuter J (1996) Exact  $t$  and  $F$  tests for analyzing studies with multiple endpoints. Biometrics 52: 964-970.
- [3] Perlman MD (1969) One-sided testing problems in multivariate analysis. Annals of Mathematical Statistics 40: 549-567.
- [4] Silvapulle, MJ (1997) A curious example involving the likelihood ratio test against one-sided alternatives. The American Statistician 51: 178-181.