

# PHASE TRANSITION AND UQ IN VARIABLE SELECTION AND MULTIPLE TESTING

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Abstract: We study the problem of identifying the set of active variables, termed in the literature as variable selection or multiple hypothesis testing, depending on the pursued criteria. For a general distribution-free setting of non-normal, possibly dependent observations and a generalized notion of active set, we propose a procedure that is used simultaneously for the both tasks, variable selection and multiple testing. The procedure is based on the risk hull minimization method, but can also be obtained as a result of an empirical Bayes approach or a penalization strategy. We address its quality via various criteria: the Hamming risk, FDR, FPR, FWER, NDR, FNR, and various multiple testing risks, e.g.,  $MTR=FDR+NDR$ . For these criteria we establish the optimality of our procedure and exhibit the peculiar phase transition phenomenon. Finally, we introduce and study, for the first time, the optimal uncertainty quantification problem in the variable selection and multiple testing context.