

## Description of Additional Supplementary Files

**File Name:** Supplementary Data 1

**Description:** Detailed simulation results under no ancestry-specific effects. Comparison between GAUDI without LD clumping, GAUDI with LD clumping, PRSice and pPRS. We varied heritability to be 0.2 and 0.6, proportion of causal variants ( $p_{\text{causal}}$ ) to be 0.05, 0.5 and 1, the maximum LD  $R^2$  between causal SNPs to be 0.2 and 0.5, and evaluated three different causal variants MAF settings. Each experiment was repeated for 10 times.

**File Name:** Supplementary Data 2

**Description:** Performance comparison of GAUDI to PRSice and PRS-CSx in the UKB trait screening. GAUDI and PRSice leverages the same training individuals (UKB AFR,  $N \sim 7000$ ), while PRS-CSx leverages GWAS summary statistics from both UKB AFR ( $N \sim 7000$ ) and UKB EUR ( $N \sim 430,000$ ). All the numbers are mean  $R^2$  across five outer-loop cross validations.