

# T1E simulation

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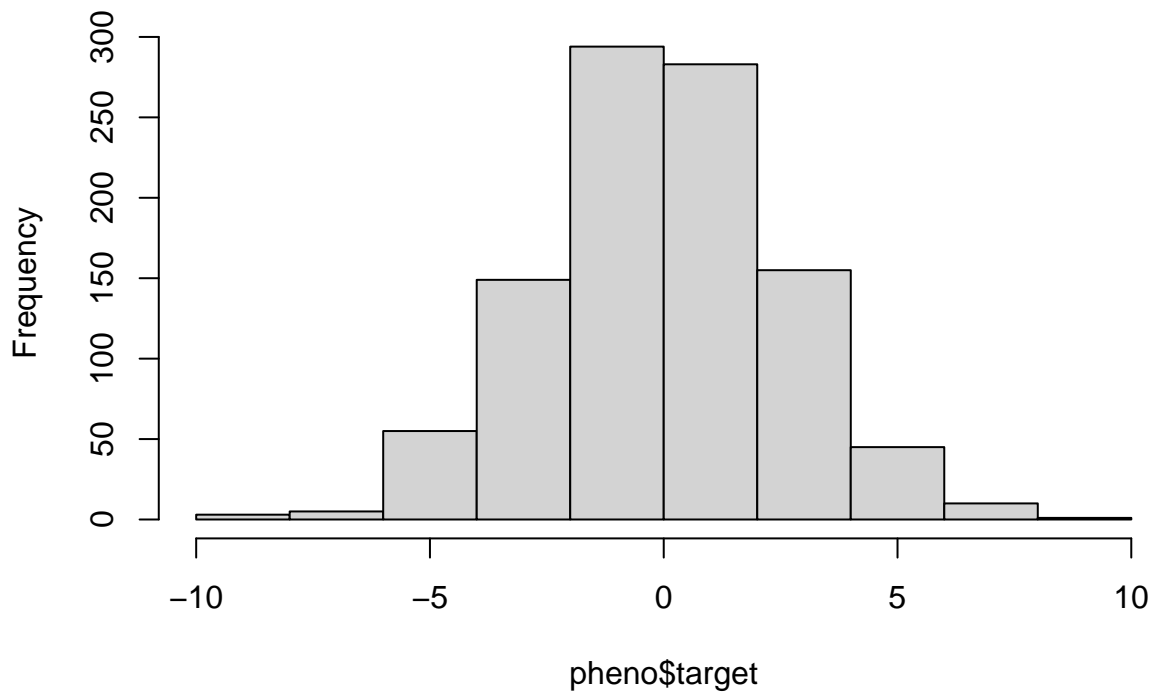
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This document is a bit informal, but I hope it's informative!

## Parameter set-up

- sample size  $N = 10^3$
- Number of replicates:  $10^5$
- Genotypes are generated  $G \sim \text{Bin}(2, \text{maf})$ ,  $\text{maf} \sim \text{Unif}[0.05, 0.5]$
- Target phenotypes  $Y_i \sim N(X_i^T \beta, 1)$ , where  $X_i = (1, x_{1,i}, x_{2,i})$  and  $x_{1,i}, x_{2,i} \sim N(0, 1)$ .
- Surrogate  $S_i \sim N(X_i^T \beta + \rho(Y_i - X_i^T \beta), 1 - \rho^2)$ .
- Code is borrowed from zack's github.
- $\rho \in \{0, 0.25, 0.5, 0.75\}$
- missing rate of target phenotype  $m \in \{0, 0.25, 0.5, 0.75\}$
- $\beta = (1, 1, 2)$

## Histogram of simulated phenotype (1 simulation)



## Result

With  $10^5$  replicates, i did not see inflated t1e for surrogate?

Table 1: Proportion of test making type I error

mssing	rho	oracle	target	surrogate	bivariate
0.00	0.00	0.0533	0.0533	0.0485	0.0536
0.00	0.25	0.0476	0.0476	0.0507	0.0477
0.00	0.50	0.0521	0.0521	0.0472	0.0524
0.00	0.75	0.0502	0.0502	0.0501	0.0506
0.25	0.00	0.0467	0.0482	0.0499	0.0490
0.25	0.25	0.0515	0.0527	0.0477	0.0526
0.25	0.50	0.0498	0.0489	0.0493	0.0487
0.25	0.75	0.0465	0.0465	0.0514	0.0459
0.50	0.00	0.0460	0.0485	0.0531	0.0490
0.50	0.25	0.0496	0.0503	0.0489	0.0519
0.50	0.50	0.0464	0.0485	0.0517	0.0521
0.50	0.75	0.0451	0.0469	0.0455	0.0455
0.75	0.00	0.0516	0.0492	0.0557	0.0508
0.75	0.25	0.0490	0.0458	0.0473	0.0485
0.75	0.50	0.0522	0.0538	0.0528	0.0537
0.75	0.75	0.0482	0.0461	0.0511	0.0503

Table 2: Average chi-square statistics across SNPs

mssing	rho	oracle	target	surrogate	bivariate
0.00	0.00	1.0193158	1.0193158	1.0004463	1.0182931
0.00	0.25	0.9849388	0.9849388	1.0206058	0.9840180
0.00	0.50	1.0063118	1.0063118	0.9933942	1.0055761
0.00	0.75	0.9929731	0.9929731	0.9979674	0.9925479
0.25	0.00	0.9682505	0.9713777	0.9894460	0.9711188
0.25	0.25	1.0272859	1.0037359	1.0012578	1.0051600
0.25	0.50	0.9921073	0.9964570	1.0115526	0.9928354
0.25	0.75	0.9787546	0.9765307	0.9932768	0.9774005
0.50	0.00	0.9804158	1.0061353	1.0126629	1.0055045
0.50	0.25	0.9937003	0.9993893	0.9909091	1.0006089
0.50	0.50	0.9902432	1.0188351	0.9990690	1.0123671
0.50	0.75	0.9671142	0.9749440	0.9710154	0.9782051
0.75	0.00	1.0023667	0.9963442	1.0170356	0.9985226
0.75	0.25	0.9836043	0.9923247	0.9888692	0.9899218
0.75	0.50	1.0064411	1.0322930	1.0017166	1.0427510
0.75	0.75	0.9963109	0.9956175	1.0031639	0.9967741