

# Supplementary Materials for “Multiple Testing under Dependence via Semiparametric Graphical Models”

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## Appendix 1. Sensitivity Analysis of $\lambda$

We test three different values for  $\lambda$ , namely 0.2, 0.5 and 0.8, and repeat the simulations in the main text. In the main text, we only report the results for the chain dependence structure with  $\phi = 0.8$  under Model 1 due to the limitation of space. In this appendix, we have the space to report all the configurations. Figure 1 is for the chain structure with  $\phi = 0.8$  and  $\phi = 0.6$  and  $f_1$  is from model 1. Figure 2 is for the chain structure with  $\phi = 0.8$  and  $\phi = 0.6$  and  $f_1$  is from model 2. Figure 3 is for the grid structure with  $\phi = 0.8$  and  $\phi = 0.6$  and  $f_1$  is from model 1. Figure 4 is for the grid structure with  $\phi = 0.8$  and  $\phi = 0.6$  and  $f_1$  is from model 2.

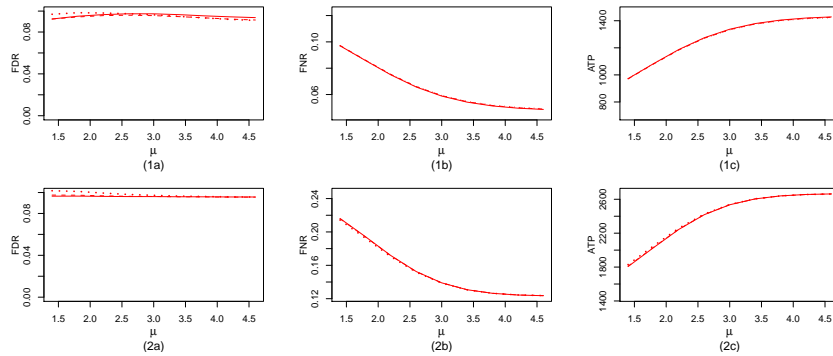


Figure 1: Performance of our procedure when  $\lambda$  is 0.2 (dotted lines), 0.5 (dashed lines) and 0.8 (solid lines) when (1)  $\phi = 0.8$  and (2)  $\phi = 0.6$  in terms of (a) FDR (b) FNR and (c) ATP when the dependence structure is chain and  $f_1$  is from model 1.

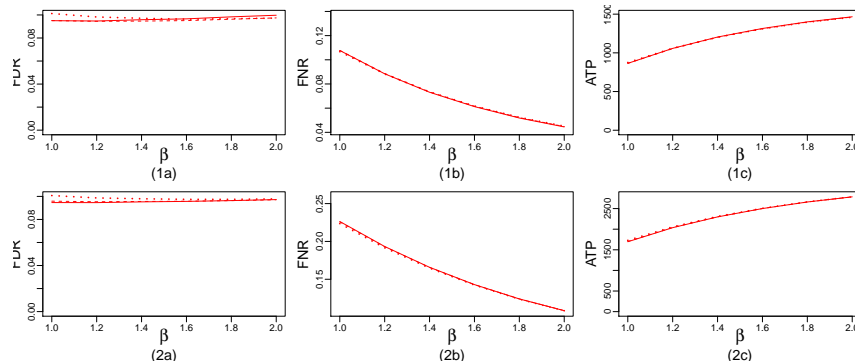


Figure 2: Performance of our procedure when  $\lambda$  is 0.2 (dotted lines), 0.5 (dashed lines) and 0.8 (solid lines) when (1)  $\phi = 0.8$  and (2)  $\phi = 0.6$  in terms of (a) FDR (b) FNR and (c) ATP when the dependence structure is chain and  $f_1$  is from model 2.

## Appendix 2. ROC/PR Curves for Other Configurations

In the main text, we only show the ROC curve and the PR curve for  $\mu = 1.4$ . Here we provide all the ROC curves and PR curves for the other eight values of  $\mu$  in Figure 5 and Figure 6.

## Appendix 3. Validation of the GWAS Findings on the Second Dataset

In the main text, we applied our procedure on a real-world GWAS on breast cancer and identified 18 SNPs which can be potentially associated with breast cancer. In addition to their association evidence in the literature, we further validate the 18 SNPs on a second cohort which include 162 breast cancer cases and 162 controls.

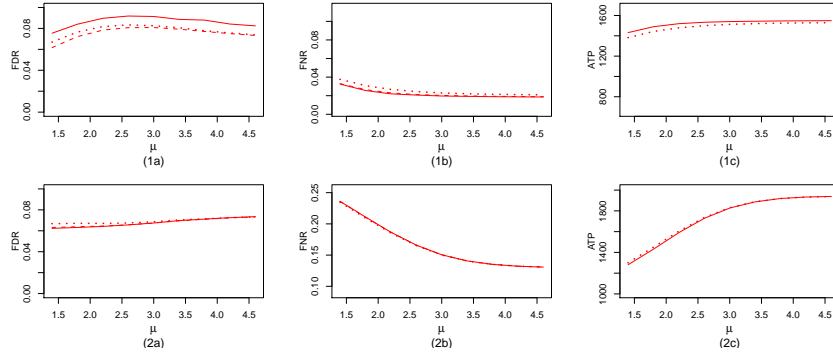


Figure 3: Performance of our procedure when  $\lambda$  is 0.2 (dotted lines), 0.5 (dashed lines) and 0.8 (solid lines) when (1)  $\phi = 0.8$  and (2)  $\phi = 0.6$  in terms of (a) FDR (b) FNR and (c) ATP when the dependence structure is grid and  $f_1$  is from model 1.

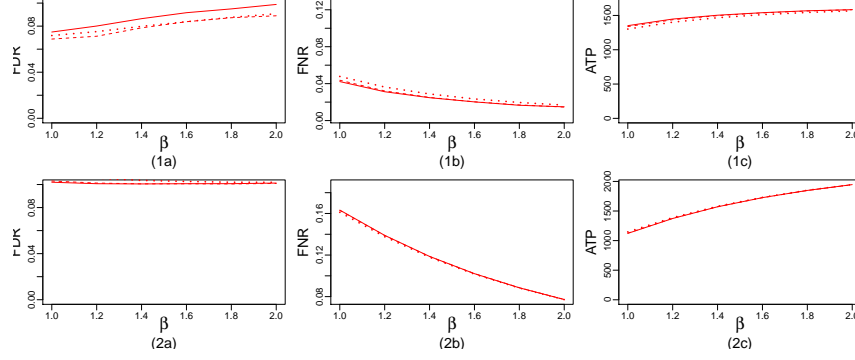


Figure 4: Performance of our procedure when  $\lambda$  is 0.2 (dotted lines), 0.5 (dashed lines) and 0.8 (solid lines) when (1)  $\phi = 0.8$  and (2)  $\phi = 0.6$  in terms of (a) FDR (b) FNR and (c) ATP when the dependence structure is grid and  $f_1$  is from model 2.

On the second cohort, we calculate the odds-ratio of the 18 SNPs, as listed in Table 1. It turns out that 16 of them show a moderate level of association. The five SNPs in the first cluster (on Chr2) have odds-ratio around 1.17-1.20. The four SNPs in the second cluster (on Chr2) have odds-ratio around 1.15-1.17. The two SNPs in the third cluster (on Chr4) have odds-ratio around 1.02. The four SNPs in the fourth cluster (on Chr9) have odds-ratio around 1.06-1.08. The three SNPs in the last cluster (on Chr10) have odds-ratio around 1.15-1.20.

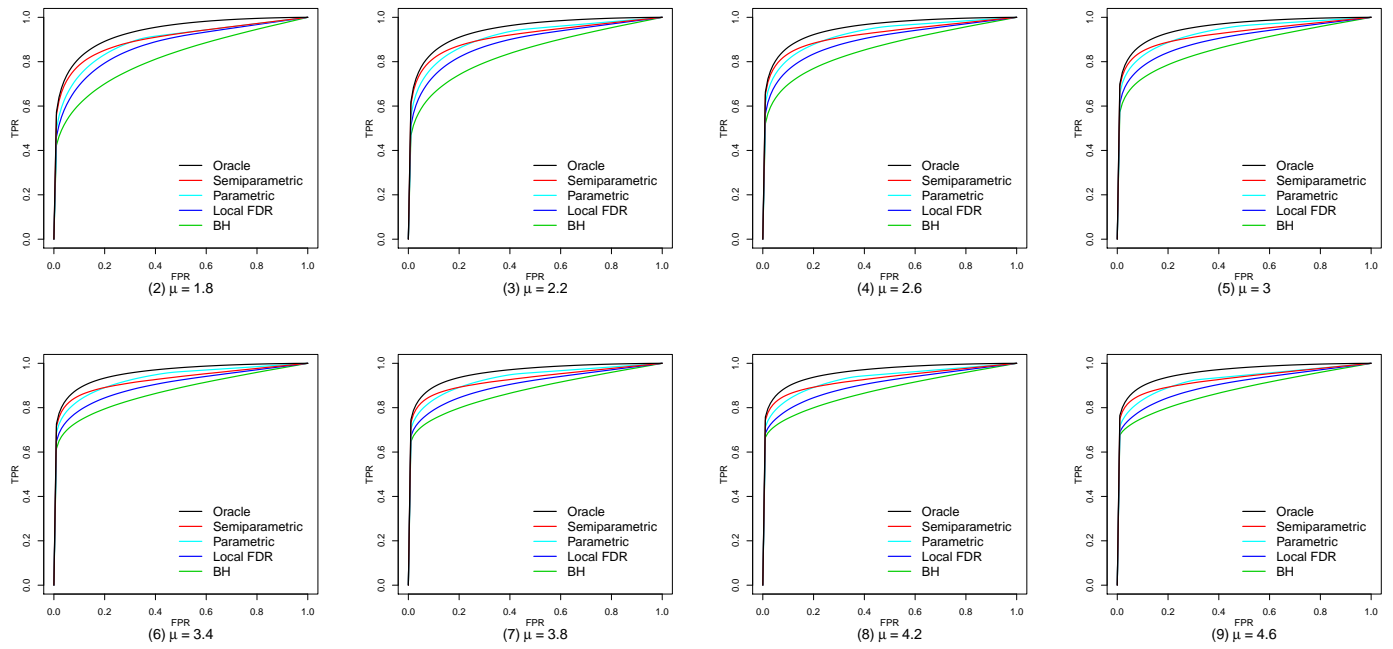


Figure 5: ROC curves.

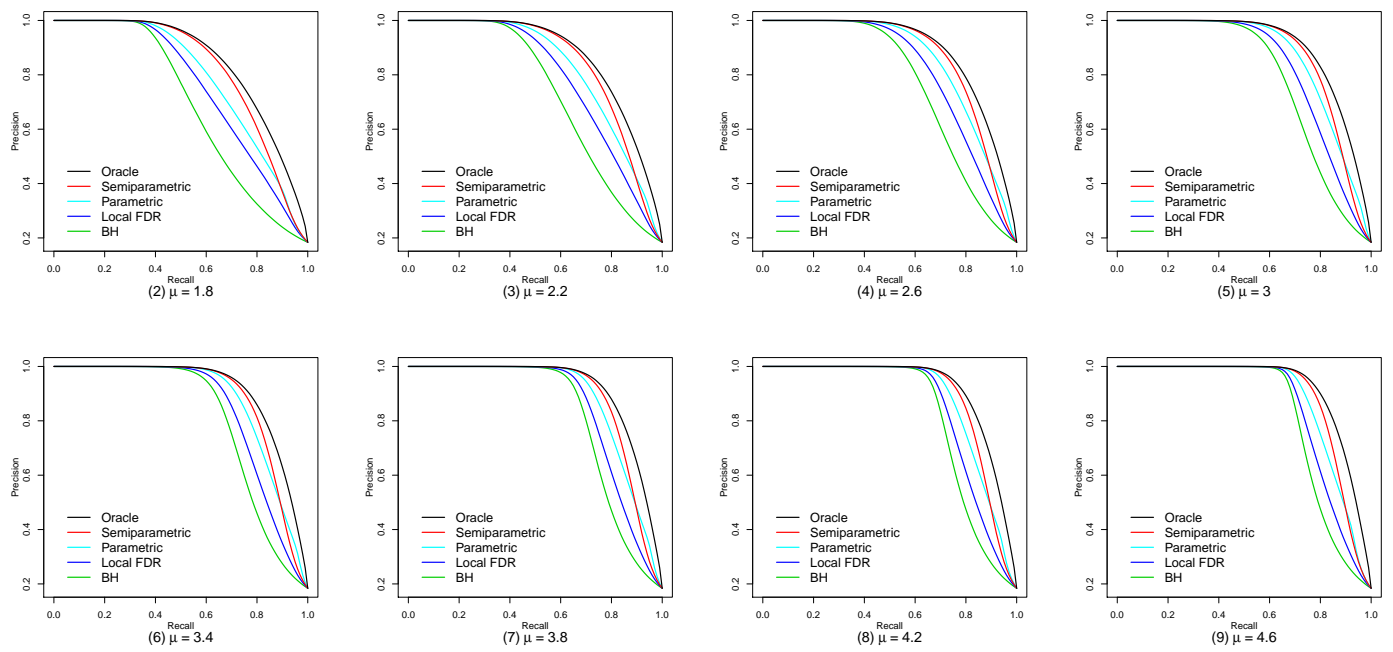


Figure 6: PR curves.

Table 1: Clusters of SNPs identified by our procedure					
dbSNP ID	CHR	PHYPOS	LIS	<i>P</i> -VALUE	ODDS-RATIO ON SECOND DATASET
RS2288118	2	86221768	0	1.8E-04	1.18
RS1991106	2	86227832	0.0048	8.4E-04	1.17
RS1075622	2	86249588	0.0040	7.5E-05	1.15
RS2367202	2	86257194	0.0025	1.7E-04	1.18
RS1025104	2	86262322	0.0025	1.8E-04	1.20
RS4398317	2	136817773	0	5.3E-04	1.17
RS4954580	2	136820035	0.0047	9.4E-04	1.15
RS4440020	2	136824059	0.0039	8.3E-04	1.17
RS4075810	2	136836877	0.0058	8.8E-04	1.15
RS1970801	4	96427703	0.0072	1.2E-04	1.02
RS11097457	4	96433991	0.0083	1.9E-04	1.02
RS10819865	9	100730611	0	3.2E-04	1.06
RS1338733	9	100737703	0.0020	1.5E-04	1.08
RS1571581	9	100738024	0.0038	1.9E-04	1.07
RS12553370	9	100756745	0.0040	7.0E-04	1.07
RS11200014	10	123324920	0.0071	2.3E-05	1.20
RS1219648	10	123336180	0.0065	2.8E-05	1.15
RS2420946	10	123341314	0.0023	2.8E-05	1.15