

附录 1

模拟设定中完全异质、部分异质和完全同质三种情形的系数取值如下：

1. 完全异质。

$$\beta_{1,\cdot} = \beta_{2,\cdot} = (\underbrace{-1.5, \dots, -1.5}_5, \underbrace{-1, \dots, -1}_5)^T, \beta_{3,\cdot} = \beta_{4,\cdot} = (\underbrace{-1, \dots, -1}_5, \underbrace{1, \dots, 1}_5)^T,$$

$$\beta_{5,\cdot} = \beta_{6,\cdot} = (\underbrace{-0.5, \dots, -0.5}_5, \underbrace{0.5, \dots, 0.5}_5)^T, \beta_{7,\cdot} = \beta_{8,\cdot} = (-1, -1, -1, 0.5, 0.5, 0.5, 1, 1, 1, 1)^T,$$

$$\beta_{9,\cdot} = \beta_{10,\cdot} = (1, 1, 1, 1, 0.5, 0.5, 0.5, -1, -1, -1)^T。$$

重要变量在所有自变量中占比 10%时，

$$\beta_{j,\cdot} = (\underbrace{0, \dots, 0}_{10})^T, j = 11, \dots, 100。$$

重要变量在所有自变量中占比为 20%时，

$$\beta_{j,\cdot} = \beta_{j-10,\cdot}, j = 11, \dots, 20, \beta_{j,\cdot} = (\underbrace{0, \dots, 0}_{10})^T, j = 21, \dots, 100。$$

2. 部分异质。

$$\beta_{1,\cdot} = (\underbrace{1, \dots, 1}_{10})^T, \beta_{2,\cdot} = (\underbrace{0.5, \dots, 0.5}_{10})^T, \beta_{3,\cdot} = (\underbrace{-1, \dots, -1}_{10})^T,$$

$$\beta_{4,\cdot} = (\underbrace{1.5, \dots, 1.5}_{10})^T, \beta_{5,\cdot} = (\underbrace{-0.5, \dots, -0.5}_{10})^T, \beta_{6,\cdot} = (\underbrace{1, \dots, 1}_5, \underbrace{0.5, \dots, 0.5}_5)^T,$$

$$\beta_{7,\cdot} = (\underbrace{-1, \dots, -1}_5, \underbrace{-0.5, \dots, -0.5}_5)^T,$$

$$\beta_{8,\cdot} = (-1, -1, -1, 0.5, 0.5, 0.5, 1, 1, 1, 1)^T, \beta_{9,\cdot} = (-1, -1, -1, 0, 0, 0, 1, 1, 1, 1)^T,$$

$$\beta_{10,\cdot} = (-1, -1, -1, -0.5, -0.5, -0.5, 0.5, 0.5, 1, 1)^T。$$

重要变量在所有自变量中占比 10%时，

$$\beta_{j,\cdot} = (\underbrace{0, \dots, 0}_{10})^T, j = 11, \dots, 100。$$

重要变量在所有自变量中占比为 20%时，

$$\beta_{j,\cdot} = \beta_{j-10,\cdot}, j = 11, \dots, 20, \beta_{j,\cdot} = (\underbrace{0, \dots, 0}_{10})^T, j = 21, \dots, 100。$$

3. 完全同质。

$$\beta_{1,\cdot} = \beta_{2,\cdot} = \beta_{3,\cdot} = (\underbrace{-\dots, -1.5}_{10})^T, \beta_{4,\cdot} = (\underbrace{-1, \dots, -1}_{10})^T, \beta_{5,\cdot} = (\underbrace{-0.5, \dots, -0.5}_{10})^T,$$

$$\beta_{6,\cdot} = (\underbrace{0.5, \dots, 0.5}_{10})^T, \beta_{7,\cdot} = (\underbrace{1, \dots, 1}_{10})^T, \beta_{8,\cdot} = \beta_{9,\cdot} = \beta_{10,\cdot} = (\underbrace{1.5, \dots, 1.5}_{10})^T。$$

重要变在所有自变量中占比 10%时，

$$\beta_{j,\cdot} = (\underbrace{0, \dots, 0}_{10})^T, j = 11, \dots, 100。$$

重要变量在所有自变量中占比为 20%时，

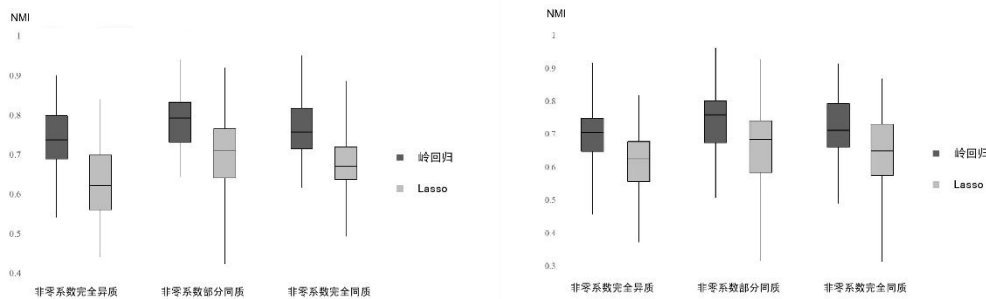
$$\boldsymbol{\beta}_{j,\cdot} = \boldsymbol{\beta}_{j-10,\cdot}, j=11, \dots, 20, \quad \boldsymbol{\beta}_{j,\cdot} = (\underbrace{0, \dots, 0}_{10})^T, j=21, \dots, 100。$$

附表 1		24 种 数值模拟设定	
样本均匀			
重要变量在所有自变量中占比 10%		重要变量在所有自变量中占比 20%	
系数完全异质	$\varepsilon_k^i \sim N(0,1)$	系数完全异质	$\varepsilon_k^i \sim N(0,1)$
	$\varepsilon_k^i \sim N(0,2)$		$\varepsilon_k^i \sim N(0,2)$
系数部分异质	$\varepsilon_k^i \sim N(0,1)$	系数部分异质	$\varepsilon_k^i \sim N(0,1)$
	$\varepsilon_k^i \sim N(0,2)$		$\varepsilon_k^i \sim N(0,2)$
系数完全同质	$\varepsilon_k^i \sim N(0,1)$	系数完全同质	$\varepsilon_k^i \sim N(0,1)$
	$\varepsilon_k^i \sim N(0,2)$		$\varepsilon_k^i \sim N(0,2)$
样本非均匀			
重要变量在所有自变量中占比 10%		重要变量在所有自变量中占比 20%	
系数完全异质	$\varepsilon_k^i \sim N(0,1)$	系数完全异质	$\varepsilon_k^i \sim N(0,1)$
	$\varepsilon_k^i \sim N(0,2)$		$\varepsilon_k^i \sim N(0,2)$
系数部分异质	$\varepsilon_k^i \sim N(0,1)$	系数部分异质	$\varepsilon_k^i \sim N(0,1)$
	$\varepsilon_k^i \sim N(0,2)$		$\varepsilon_k^i \sim N(0,2)$
系数完全同质	$\varepsilon_k^i \sim N(0,1)$	系数完全同质	$\varepsilon_k^i \sim N(0,1)$
	$\varepsilon_k^i \sim N(0,2)$		$\varepsilon_k^i \sim N(0,2)$

附表 2 样本均匀、重要变量占比 20% 的模拟结果

	$\varepsilon_k^i \sim N(0,1)$						$\varepsilon_k^i \sim N(0,2)$					
	MD-CARDS	MD-CARDS1	融合惩罚	成对惩罚	独立AdaLasso	合并AdaLasso	MD-CARDS	MD-CARDS1	融合惩罚	成对惩罚	独立AdaLasso	合并AdaLasso
	非零系数完全异质											
NMI	0.90 (0.06)	0.85 (0.15)	0.73 (0.08)	0.75 (0.15)	0.51 (0.00)	0.81 (0.00)	0.87 (0.06)	0.81 (0.11)	0.70 (0.08)	0.72 (0.10)	0.51 (0.00)	0.81 (0.00)
TP	194.43 (3.22)	182.91 (6.45)	175.93 (9.32)	180.44 (12.97)	153.56 (10.87)	150.32 (10.53)	190.84 (5.27)	181.68 (7.98)	172.27 (11.23)	174.36 (15.02)	145.34 (15.67)	143.22 (11.10)
FP	6.63 (0.32)	10.42 (1.73)	25.31 (6.69)	19.16 (9.01)	67.91 (10.32)	40.84 (13.59)	7.57 (0.53)	13.84 (2.88)	31.11 (12.03)	25.69 (13.188)	70.21 (13.13)	55.15 (14.35)
估计	3.94 (0.06)	4.93 (0.82)	6.15 (1.72)	5.20 (3.57)	8.89 (1.43)	10.18 (4.01)	4.04 (0.05)	6.24 (0.96)	7.98 (1.94)	6.88 (5.11)	12.22 (2.54)	12.25 (3.93)
RMSE	5.16 (0.61)	6.66 (1.23)	7.41 (1.20)	7.03 (2.00)	17.40 (5.21)	19.84 (6.48)	6.11 (0.74)	8.01 (1.55)	9.40 (3.87)	8.27 (3.58)	21.67 (6.59)	20.76 (10.77)
	非零系数部分异质											
NMI	0.90 (0.09)	0.87 (0.07)	0.71 (0.08)	0.77 (0.10)	0.51 (0.00)	0.85 (0.00)	0.90 (0.07)	0.82 (0.07)	0.69 (0.09)	0.75 (0.16)	0.51 (0.00)	0.85 (0.00)
TP	196.29 (2.59)	190.35 (4.76)	180.39 (3.81)	182.63 (9.41)	166.04 (7.28)	167.06 (13.44)	194.94 (1.24)	185.00 (3.98)	176.28 (5.10)	175.77 (12.74)	160.87 (7.99)	160.73 (13.00)
FP	3.31 (0.10)	4.90 (0.84)	18.76 (5.29)	16.50 (9.47)	59.07 (9.65)	33.86 (5.52)	4.00 (0.65)	6.72 (1.05)	32.56 (13.25)	20.91 (10.95)	77.52 (7.57)	48.69 (10.99)
估计	0.27 (0.03)	0.73 (0.08)	1.64 (0.29)	1.36 (0.72)	5.18 (1.00)	6.15 (1.87)	0.37 (0.02)	0.89 (0.16)	1.99 (0.16)	2.04 (0.88)	6.14 (1.94)	6.52 (1.88)
RMSE	1.51 (0.31)	2.07 (0.62)	4.03 (0.82)	3.14 (1.84)	10.46 (3.53)	8.98 (2.01)	1.03 (0.33)	2.58 (0.45)	4.45 (0.86)	4.55 (1.93)	11.86 (4.39)	9.19 (2.96)
	非零系数完全同质											
NMI	0.91 (0.00)	0.87 (0.04)	0.77 (0.06)	0.79 (0.09)	0.51 (0.00)	1.00 (0.00)	0.90 (0.04)	0.80 (0.05)	0.76 (0.06)	0.79 (0.18)	0.51 (0.00)	1.00 (0.00)
TP	195.23 (1.48)	192.45 (3.03)	181.05 (4.92)	180.43 (8.22)	171.03 (6.34)	196.78 (1.37)	193.81 (2.03)	184.00 (5.63)	176.92 (4.62)	175.03 (8.77)	165.65 (8.12)	195.06 (1.57)
FP	2.90 (0.54)	3.69 (0.78)	14.54 (3.18)	10.70 (7.25)	33.87 (7.58)	2.01 (0.77)	3.10 (0.56)	5.97 (0.41)	16.48 (4.39)	11.68 (8.55)	48.40 (6.19)	2.48 (0.95)
估计	0.31 (0.05)	0.58 (0.14)	1.74 (0.35)	1.54 (0.78)	2.57 (0.09)	0.21 (0.01)	0.36 (0.05)	1.39 (0.26)	1.85 (0.49)	1.95 (1.03)	3.17 (0.12)	0.30 (0.03)
RMSE	1.38 (0.09)	2.41 (0.52)	3.07 (0.13)	3.25 (1.01)	5.88 (0.11)	1.16 (0.28)	1.55 (0.13)	2.93 (0.77)	4.10 (0.28)	4.58 (1.61)	6.96 (0.35)	1.29 (0.33)

	$\varepsilon_k^i \sim N(0,1)$						$\varepsilon_k^i \sim N(0,2)$					
	MD-CARDS	MD-CARDS1	融合惩罚	成对惩罚	独立AdaLasso	合并AdaLasso	MD-CARDS	MD-CARDS1	融合惩罚	成对惩罚	独立AdaLasso	合并AdaLasso
	非零系数完全异质											
NMI	0.92 (0.04)	0.84 (0.06)	0.70 (0.08)	0.73 (0.16)	0.51 (0.00)	0.89 (0.00)	0.91 (0.03)	0.82 (0.06)	0.69 (0.08)	0.72 (0.16)	0.51 (0.00)	0.89 (0.00)
TP	89.50 (5.40)	85.07 (5.71)	79.93 (6.32)	84.05 (8.56)	4.35 (7.78)	74.33 (6.87)	88.61 (4.49)	82.30 (7.02)	75.42 (6.88)	82.82 (8.88)	70.07 (8.81)	73.82 (6.23)
FP	10.62 (5.05)	11.53 (4.31)	71.79 (16.47)	26.18 (15.01)	108.22 (19.06)	85.13 (5.19)	13.14 (3.86)	12.10 (5.86)	69.79 (16.47)	35.70 (15.61)	111.53 (17.40)	88.82 (5.91)
估计	5.26 (2.36)	7.48 (2.56)	12.04 (3.56)	7.63 (4.01)	14.95 (3.10)	9.18 (1.78)	6.98 (3.00)	9.03 (3.95)	13.49 (3.19)	8.22 (6.67)	17.83 (3.77)	10.62 (2.57)
RMSE	10.16 (0.92)	10.98 (1.93)	48.41 (3.92)	18.07 (5.74)	103.20 (10.52)	32.03 (5.70)	15.91 (1.33)	19.39 (3.74)	52.65 (5.37)	27.17 (6.34)	114.26 (9.89)	26.83 (6.49)
	非零系数部分异质											
NMI	0.91 (0.04)	0.87 (0.04)	0.67 (0.07)	0.73 (0.17)	0.53 (0.00)	0.89 (0.00)	0.90 (0.04)	0.85 (0.05)	0.65 (0.07)	0.70 (0.18)	0.53 (0.00)	0.89 (0.00)
TP	90.29 (6.03)	85.92 (4.69)	78.96 (6.80)	84.12 (7.98)	78.89 (9.06)	84.01 (6.43)	88.25 (6.24)	84.14 (6.20)	77.93 (7.10)	79.49 (8.40)	77.14 (7.48)	82.24 (7.91)
FP	7.03 (6.00)	8.05 (2.28)	40.76 (16.09)	25.62 (14.51)	109.78 (12.49)	27.72 (5.88)	9.90 (6.95)	10.75 (8.92)	80.17 (19.75)	34.03 (17.65)	113.05 (12.58)	34.94 (5.92)
估计	3.25 (1.01)	4.23 (2.09)	8.32 (3.63)	6.79 (3.67)	14.22 (3.10)	5.89 (1.02)	5.29 (2.30)	7.95 (2.74)	10.07 (8.86)	8.05 (5.21)	18.67 (4.80)	6.88 (1.57)
RMSE	3.39 (0.31)	5.78 (2.76)	19.50 (2.51)	17.84 (5.17)	90.47 (10.87)	15.23 (3.56)	9.31 (0.867)	11.45 (3.88)	38.45 (2.71)	24.31 (6.33)	99.52 (15.82)	19.64 (3.91)
	非零系数完全同质											
NMI	0.96	0.93	0.69	0.76	0.51	1.00	0.92	0.90	0.67	0.73	0.51	1.00



附图1 样本均匀 10%重要变量设置下根据系数初始估计值构建的数据集分组与数据集真实分组的 NMI,

模拟结果重复 100 次。左: $\varepsilon_k^i \sim N(0,1)$, 右: $\varepsilon_k^i \sim N(0,2)$ 。

	(0.03)	(0.07)	(0.07)	(0.18)	(0.00)	(0.00)	(0.04)	(0.10)	(0.08)	(0.14)	(0.00)	(0.00)
TP	92.61	86.20	81.43	85.91	74.31	100.00	90.68	85.92	79.93	80.24	89.67	100.00
	(5.07)	(3.74)	(6.01)	(8.66)	(7.07)	(0.00)	(4.60)	(6.33)	(6.32)	(9.01)	(14.63)	(0.00)
FP	3.45	3.98	68.76	27.14	78.93	1.27	8.59	9.83	68.76	33.27	89.67	3.95
	(3.74)	(1.35)	(16.09)	(17.65)	(10.20)	(0.21)	(6.22)	(3.15)	(16.09)	(19.49)	(14.63)	(1.19)
估计	2.55	4.07	8.84	6.05	16.96	1.10	4.23	5.82	11.15	7.23	17.89	1.29
RMSE	(0.81)	(1.27)	(3.09)	(3.17)	(2.96)	(0.01)	(1.65)	(1.88)	(3.60)	(3.89)	(2.67)	(0.03)
预测	5.35	6.18	14.34	15.23	56.55	1.07	6.09	9.54	31.05	18.63	67.23	1.35
RMSE	(1.27)	(1.45)	(2.37)	(4.52)	(12.06)	(0.13)	(1.99)	(2.56)	(3.93)	(5.90)	(13.57)	(0.11)

附表 3

样本非均匀、重要变量占比 10% 的模拟结果

附表 4

样本非均匀、重要变量、占比 20% 的模拟结果

	$\varepsilon_k^i \sim N(0,1)$						$\varepsilon_k^i \sim N(0,2)$					
	MD-CARDS	MD-CARDS1	融合惩罚	成对惩罚	独立AdaLasso	合并AdaLasso	MD-CARDS	MD-CARDS1	融合惩罚	成对惩罚	独立AdaLasso	合并AdaLasso
	非零系数完全异质											
NMI	0.88	0.79	0.70	0.76	0.51	0.81	0.87	0.77	0.70	0.72	0.51	0.81
	(0.06)	(0.06)	(0.08)	(0.10)	(0.00)	(0.00)	(0.06)	(0.07)	(0.08)	(0.15)	(0.00)	(0.00)
TP	178.25	30.51	155.71	167.55	147.28	160.66	175.79	164.53	145.50	161.29	142.18	155.94
	(12.33)	(19.64)	(19.24)	(15.63)	(13.07)	(15.46)	(13.19)	(11.54)	(18.25)	(16.23)	(11.31)	(11.75)
FP	28.21	168.06	66.41	37.82	143.01	159.03	39.34	41.45	70.48	50.90	152.18	169.53
	(25.76)	(13.93)	(15.40)	(17.91)	(17.26)	(6.20)	(26.83)	(16.16)	(18.23)	(18.93)	(24.19)	(12.78)
估计	11.64	15.27	22.43	16.34	35.68	18.56	15.01	18.56	24.45	19.36	38.92	20.94
RMSE	(4.46)	(3.88)	(7.58)	(7.35)	(4.90)	(5.86)	(5.67)	(5.32)	(8.18)	(8.39)	(5.20)	(4.96)
预测	16.72	19.43	50.67	23.13	66.20	58.28	20.26	25.83	58.49	29.18	99.83	60.47
RMSE	(4.85)	(4.32)	(6.79)	(8.14)	(8.11)	(8.56)	(5.34)	(7.38)	(4.15)	(10.46)	(12.43)	(8.99)
	非零系数部分异质											
NMI	0.87	0.82	0.62	0.75	0.51	0.85	0.85	0.80	0.60	0.72	0.51	0.85
	(0.09)	(0.09)	(0.06)	(0.17)	(0.01)	(0.00)	(0.10)	(0.10)	(0.07)	(0.16)	(0.01)	(0.00)
TP	183.50	177.23	165.68	170.94	150.82	164.85	179.25	172.56	154.64	165.53	145.39	159.36
	(12.79)	(14.57)	(23.74)	(13.37)	(14.69)	(9.82)	(13.01)	(15.06)	(23.43)	(15.95)	(15.50)	(10.29)
FP	15.76	16.98	50.83	29.48	130.75	117.23	25.08	27.80	91.38	36.83	143.04	148.57
	(7.34)	(7.70)	(14.38)	(12.29)	(23.92)	(16.45)	(10.86)	(11.47)	(52.12)	(15.84)	(28.63)	(10.29)
估计	5.63	8.92	12.27	8.92	16.87	15.45	6.63	9.23	27.38	13.52	21.98	36.88
RMSE	(1.82)	(2.43)	(6.79)	(5.18)	(3.90)	(3.13)	(0.58)	(2.99)	(4.90)	(6.18)	(14.77)	(7.59)
预测	10.57	14.34	25.45	19.47	68.93	47.18	11.67	16.73	29.41	22.32	77.86	78.43
RMSE	(2.51)	(4.88)	(3.00)	(7.75)	(7.51)	(5.78)	(3.73)	(3.84)	(4.48)	(8.98)	(7.25)	(7.19)
	非零系数完全同质											

NMI	0.91 (0.05)	0.85 (0.05)	0.69 (0.06)	0.77 (0.09)	0.51 (0.01)	1.00 (0.00)	0.90 (0.06)	0.83 (0.08)	0.69 (0.06)	0.75 (0.14)	0.51 (0.01)	1.00 (0.00)
TP	179.04 (13.36)	167.01 (22.47)	143.71 (21.47)	158.67 (15.61)	149.07 (19.06)	194.18 (4.96)	172.93 (13.87)	163.95 (15.62)	140.61 (21.76)	153.10 (14.17)	135.43 (18.04)	192.23 (6.17)
FP	20.93 (30.65)	22.11 (14.64)	153.72 (55.44)	45.87 (19.74)	174.59 (17.76)	2.12 (0.72)	32.79 (31.36)	33.43 (17.58)	162.83 (52.67)	47.25 (21.02)	190.06 (26.76)	3.00 (0.69)
估计	5.17 (2.38)	5.23 (1.49)	10.55 (2.91)	7.38 (4.71)	16.03 (4.14)	1.74 (0.72)	5.86 (2.16)	6.05 (2.42)	12.45 (3.91)	9.43 (5.64)	18.97 (5.04)	2.73 (0.77)
RMSE	7.01 (1.57)	8.93 (2.10)	14.07 (1.88)	16.79 (4.38)	65.11 (7.71)	1.73 (0.33)	8.43 (1.46)	9.66 (2.38)	15.87 (1.68)	16.74 (5.81)	72.87 (8.10)	2.50 (0.52)

附表 5 效应异质性识别结果比较

	完全异质	部分异质	完全同质
MD-CARDS	9	4	7
融合惩罚	40	8	0
融合惩罚 1	18	21	11
成对惩罚	15	41	11
独立 AdaLasso	0	0	0
合并 AdaLasso	0	0	97

附表 6 不同方法识别出的重要基因数

	MD-CARDS	融合惩罚	融合惩罚 1	成对惩罚	独立 AdaLasso	合并 AdaLasso
MD-CARDS	13/14/14	1/1/0	0/1/1	4/3/1	0/0/0	3/3/4
融合惩罚		2/32/28	0/5/6	1/1/0	0/0/0	1/2/0
融合惩罚 1			35/41/43	3/0/0	0/0/0	3/6/4
成对惩罚				17/52/56	0/0/0	5/6/9
独立 AdaLasso					0/0/0	0/0/0
合并 AdaLasso						97/97/97

注：单元格内数值为 5 种方法在 I 期/ II 期/III-IV 期中识别出的相同基因数。

附表 7 融合惩罚方法得出的重要基因系数估计值

基因	I 期	II 期	III 期-IV 期
LOC348021	0.94		
FILIP1			-1.93

CLIC5		-0.51	-0.51
GNAT3		0.65	0.65
ANGPTL1		-0.63	-0.63
CT45A6		0.093	0.22
CGB		0.55	
C1orf54		-0.77	-0.77
RBP5		-0.19	
LOC100240735			-0.06
MGC14436		0.23	0.31
LHX5			2.96
NUDT16		-1.65	1.60
S1PR1		-0.10	
ZNF366		-0.16	
FABP5		0.33	
SPRR2D		0.33	
CCDC102B		0.27	
TCEAL7			-1.34
ZNF197		-0.45	-0.45
GIMAP4		1.45	
TMED3		0.50	0.61
UBA7	-0.01		-0.01
TNFRSF4		-0.82	-0.82
CPNE6			1.41
AOC3			2.48
SYNPO2		0.21	
PAX1			1.56
ZNF606		-0.03	0.67
MEST			0.47
SULT2B1		-0.23	
SIGLEC6			-0.19
TRAT1		2.30	
ZNF211		-0.16	
DMRT3		0.49	0.49
PILRA			-1.44

KCNE3		-0.16	
OR11H12		0.59	
LOC401093		-0.39	
SSH2		1.73	
PEAR1			-1.37
GFI1			0.97
TNFRSF13B		0.61	
KCNQ1			-0.84
SPATC1			0.99
AGAP2		0.24	
CD200R1		-0.86	-0.34
ATOH8		-0.34	

附表 8

融合惩罚 1 方法得出的重要基因系数估计值

基因	I 期	II 期	III 期-IV 期
LOC348012	-2.76	-2.76	5.52
C7	-0.32	-0.32	-0.87
FILIP1		-0.77	-0.59
CLIC5	-0.29	-0.32	-0.32
CGB2	0.04	0.04	0.04
CT45A6	0.15	0.15	0.15
CGB	0.52	0.93	0.52
SNX3	-0.65	-0.65	-0.65
ZNF197		-0.55	-0.74
C17orf87	0.01	0.01	0.01
CYSLTR1	0.45	0.45	0.45
TMED3		-0.37	
IL3RA		-0.52	0.26
ABCD2		0.03	
CPNE6	-0.12	-0.12	0.88
AOC3	-0.37	-0.37	1.27
DTX3L	0.25	0.25	-0.49
ARMC2	0.22	0.48	0.66
MS4A1	0.17	0.17	0.18
PKDCC	-0.84	-0.84	0.17
LILRA1	-0.26	-0.43	0.7
TMEM200A	-0.12	-0.12	0.24
KCNA3	-0.49	-0.49	-0.49
GRIN3A	-0.58	1.16	-0.58
ZNF439	-0.18	-0.2	
FCN1	0.08	0.08	
CELA3A		2.58	
IPCEFE	0.29	0.29	0.29
BTN3A1	0.60	0.60	1.30
MMP10	0.18	0.18	0.18
OR4F21	1.25	1.25	1.25
GPR183		-0.08	
SIGLEC5	-0.16	0.31	0.31
LGALS9	0.38	-1.00	-1.00
FIL1		-0.19	0.39
FAM26F	0.23	0.23	0.57
OR10A6	-0.11	-0.11	0.23
RARRES1	0.36	0.36	0.36
GLIPR2	-0.16	0.33	-0.16
PNOC	0.10	0.10	

LGI2	0.27	0.27	0.27
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附表 9 成对惩罚方法得出的重要基因系数估计值

基因	I 期	II 期	III期-IV 期
KMO	0.11	0.11	0.11
CCDC102B	0.08	0.08	0.08
GPIHBP1	-0.24	-0.24	-0.24
CXCL10	-0.70	-0.70	-0.70
RASGRF2	0.13	0.13	0.13
UBA7	0.58	0.58	0.58
ITGA8	-0.18	-0.18	-0.18
RGS5	0.45	0.45	0.45
ZNF366	0.22	0.22	0.22
GIMAP4	-0.49	-0.49	-0.49
PSMB8	0.53	0.53	0.53
CGB5	0.39	0.39	
PSMB8	-0.92	-0.92	
PRAMEF1	0.61	0.61	
FLT3	0.34	0.34	
LRMP	0.18	0.18	
FCN1	-0.52		
ADAMTSL3	-0.23	-0.23	
INPP5D		0.16	0.16
NCKAP1L		0.54	0.54
NRK		-1.40	-1.40
CXCR2P1		1.20	1.20
KIAA0125		0.23	0.23
PRKCB		0.38	0.38
ABI3		0.17	0.17
FLI1		0.30	0.30
SP140		0.32	0.32
CP		-0.71	-0.71
CKMT1A		0.94	0.94
WDFY4		0.36	0.36
CD84		-0.99	-0.99
GPR116		-0.45	-0.45
SELL		0.48	0.48
MYO7B		0.66	0.66
CCRL2		-0.27	-0.27
CYTIP		-0.80	-0.80
OR10A3		-0.07	-0.07
DDX60		-0.25	-0.25
NLRP5		0.28	0.28

FAM111A		0.05	0.05
ARHGAP15	-0.33	-0.33	
LOC145820	0.21	0.21	
ARHGDIB		1.60	1.60
LOC339524	0.42	0.42	
PRAMEF2		-0.57	-0.57
ZNF80		-0.03	-0.03
KIAA1432		0.54	0.54
SLIT2		-0.13	-0.13
FCER2		1.46	1.46
SOBP		0.35	0.35
MEOX2		-0.66	-0.66
SLC12A3		0.31	-0.04
TFEC		0.70	
LAX1			0.14
SAMHD1			0.27
ADH1B			0.44
CYYR1			-0.19
CAMK4			-0.11
IQGAP2			0.81
CDKN1A			0.49
TCF4			0.33
KRT6B			0.09
AEN			-0.86