ANOVA with binary variables -
The F-test and some Alternatives

Appendix B 10
Tables and Graphs of the Power for selected GEE methods in relation to n_i (5,10,..,50) in mixed designs

All tables and graphs refer to $\alpha=0.05$. Reported are the proportions of rejections of the corresponding null hypothesis.

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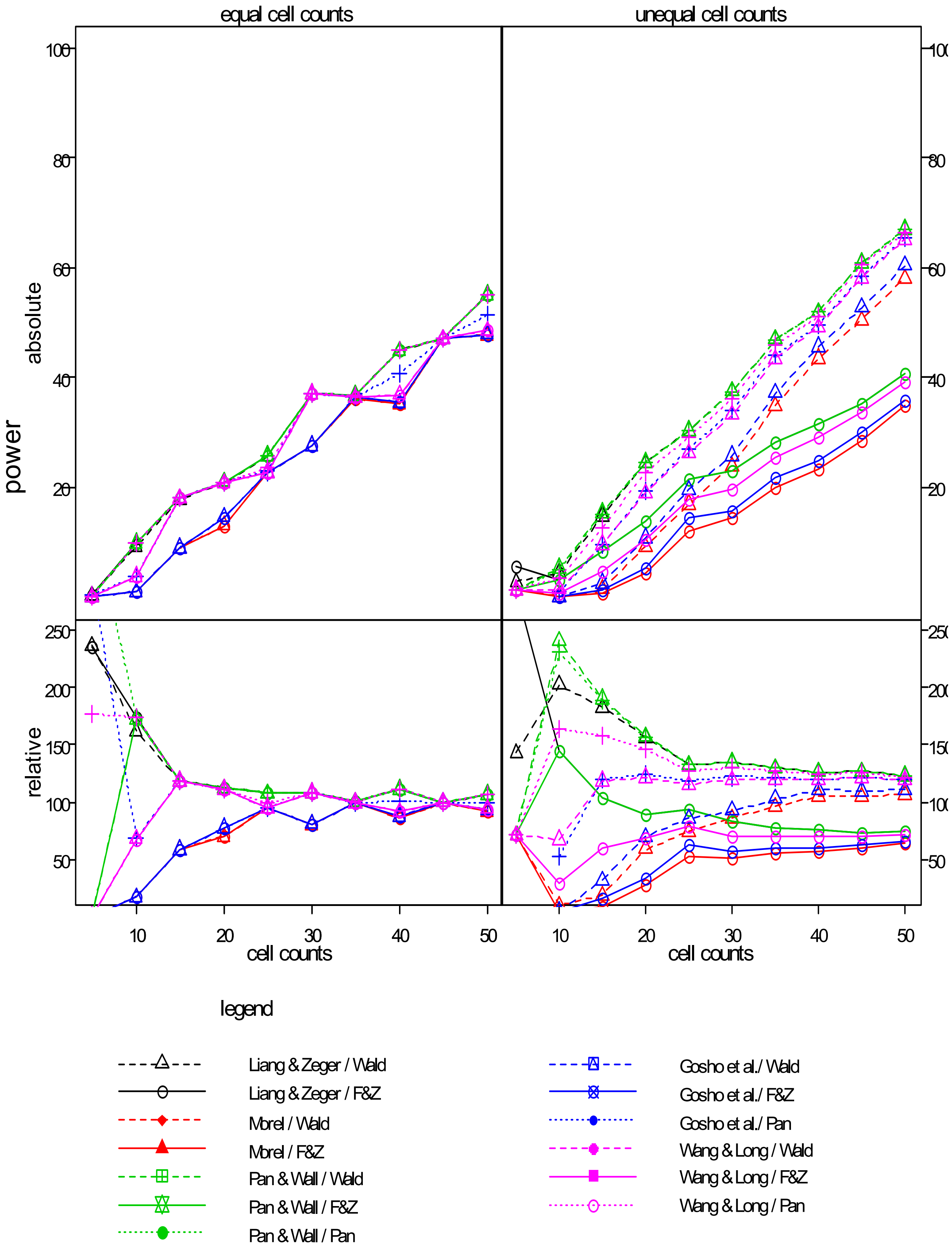
10. 1. Main effect A (effects $a_i = 0.4*s$)

10. 1. 1. equal correlations on B (r=0.3)

10. 1. 1. 1 p = 0.5

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	0.4	9.3	17.9	21.0	37.1	44.9	55.1	2.8	4.5	14.8	24.4	37.5	51.9	67.1
	Fan & Zhang	0.4	10.0	18.0	21.0	37.1	44.9	55.1	5.6	3.2	8.4	13.9	23.1	31.5	40.8
Morel et al.	Wald	0.0	1.0	9.0	13.1	27.6	35.1	47.7	1.4	0.2	1.5	9.2	23.8	43.5	58.1
	Fan & Zhang	0.0	1.0	9.0	13.1	27.6	35.1	47.7	1.4	0.1	0.8	4.3	14.3	23.4	34.8
Pan & Wall	Wald	0.0	9.9	18.0	21.0	37.1	44.9	55.1	1.4	5.3	15.4	24.5	37.5	51.9	67.1
	Fan & Zhang	0.0	9.9	18.0	21.0	37.1	44.9	55.1	1.4	3.2	8.4	13.9	23.1	31.5	40.8
	Pan	0.6	10.0	18.0	21.0	37.1	44.9	55.1	1.4	5.1	15.2	24.5	37.5	51.9	67.1
Gosho et al.	Wald	0.0	1.0	9.0	14.6	27.7	35.4	47.9		0.1	2.6	10.9	25.8	45.6	60.4
	Fan & Zhang	0.0	1.0	9.0	14.6	27.7	35.4	47.9		0.1	1.3	5.3	15.7	24.7	35.8
	Pan	0.5	3.9	18.0	20.9	37.1	40.7	51.3		1.2	9.7	19.5	33.9	49.5	65.6
Wang & Long	Wald	0.0	3.9	18.0	20.8	37.1	36.9	48.6	1.4	1.5	9.6	19.0	33.2	49.2	65.2
	Fan & Zhang	0.0	3.9	18.0	20.8	37.1	36.9	48.6	1.4	0.6	4.8	10.7	19.6	29.2	39.2
	Pan	0.3	10.0	18.0	20.9	37.1	44.9	55.1	1.4	3.6	12.8	22.8	36.3	51.2	66.3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Liang & Zeger / Wald
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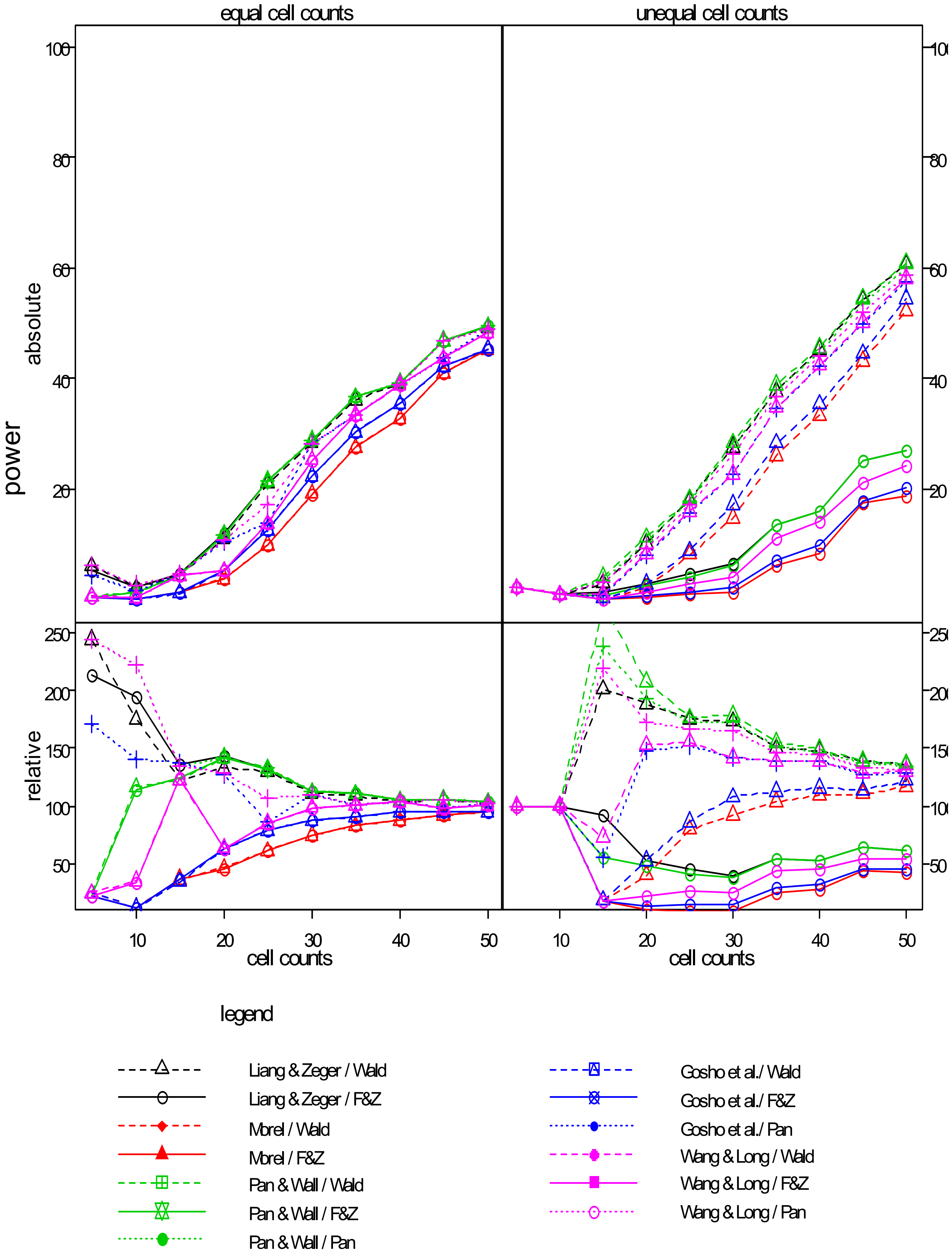
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 1. 1. 2 p = 0.8

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	6.2	2.1	4.3	11.1	28.6	39.1	49.3		1	3.0	10.2	27.7	45.3	60.8
	Fan & Zhang	5.4	2.4	4.8	12.0	28.8	39.4	49.5	2.2	1	1.4	2.9	6.4	16.1	27.1
Morel et al.	Wald	0.6	0.1	1.3	3.9	19.2	32.9	45.3	2.2	1	0.3	2.2	14.8	33.4	52.2
	Fan & Zhang	0.5	0.1	1.3	3.8	19.2	32.9	45.3	2.2	1	0.3	0.5	1.5	8.5	18.9
Pan & Wall	Wald	0.6	1.4	4.3	11.8	28.8	39.4	49.5	2.2	1	4.1	11.3	28.5	45.6	61.0
	Fan & Zhang	0.5	1.4	4.3	11.8	28.8	39.4	49.5	2.2	1	0.8	2.6	6.2	16.1	27.1
	Pan	6.2	2.7	4.7	11.8	28.9	39.4	49.5	2.2	1	3.6	10.5	27.7	44.6	60.0
Gosho et al.	Wald	0.6	0.1	1.2	5.2	22.5	35.5	45.4		1	0.3	2.9	17.3	35.4	54.5
	Fan & Zhang	0.5	0.1	1.3	5.2	22.5	35.5	45.4		1	0.3	0.7	2.3	9.8	20.4
	Pan	4.3	1.7	4.8	10.6	28.3	38.9	48.8		1	0.8	8.1	22.6	42.4	57.4
Wang & Long	Wald	0.6	0.4	4.3	5.3	25.3	38.9	48.2	2.2	1	1.1	8.3	22.7	42.4	58.1
	Fan & Zhang	0.5	0.4	4.3	5.3	25.3	38.9	48.2	2.2	1	0.3	1.2	4.0	14.1	24.1
	Pan	6.2	2.7	4.7	10.7	28.3	38.9	48.8	2.2	1	3.3	9.4	26.3	44.1	58.8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Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
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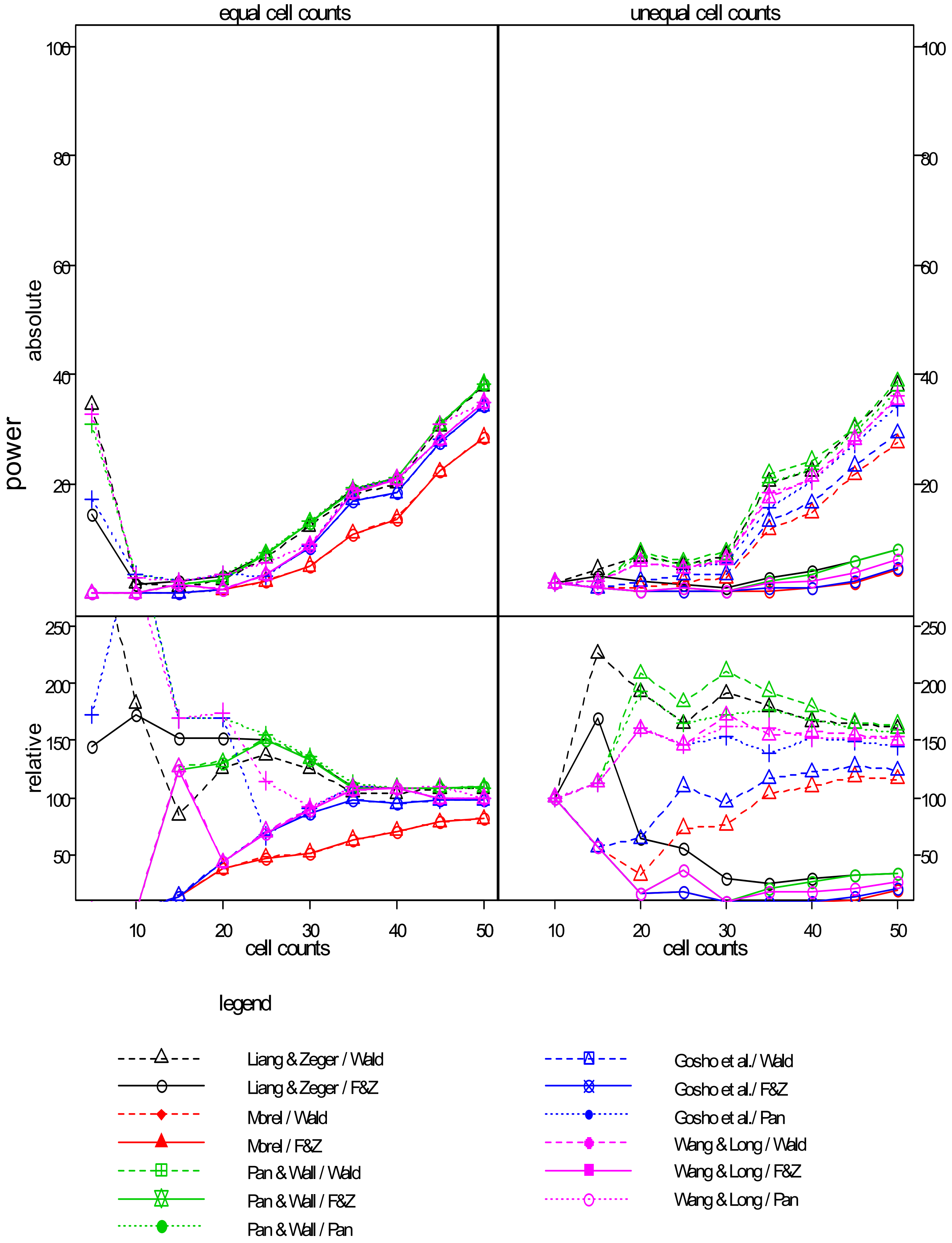
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 1. 1. 3 p = 0.9

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	34.5	1.9	1.2	2.6	12.2	20.1	38.0		2	4.4	6.9	7.0	22.5	38.0
	Fan & Zhang	14.4	1.8	2.1	3.1	13.1	21.1	38.3		2	3.3	2.3	1.0	4.0	8.1
Morel et al.	Wald	0.0	0.0	0.2	0.8	5.1	13.7	28.5		2	1.1	1.2	2.8	14.8	27.5
	Fan & Zhang	0.0	0.0	0.2	0.8	5.0	13.7	28.5		2	1.1	0.6	0.3	1.2	4.4
Pan & Wall	Wald	0.0	0.0	1.8	2.7	13.1	21.1	38.3		2	2.2	7.5	7.7	24.2	38.8
	Fan & Zhang	0.0	0.0	1.8	2.7	13.1	21.1	38.3		2	1.1	0.6	0.3	3.7	8.1
	Pan	31.0	3.4	2.4	3.5	13.3	21.1	38.2		2	2.2	6.9	6.3	22.7	37.0
Gosho et al.	Wald	0.0	0.0	0.2	0.9	8.5	18.4	34.3		2	1.1	2.3	3.5	16.5	29.4
	Fan & Zhang	0.0	0.0	0.2	0.9	8.5	18.4	34.3		2	1.1	0.6	0.3	1.2	4.8
	Pan	17.2	3.4	2.4	3.5	8.8	21.0	35.0		2	2.2	5.8	5.6	20.6	34.2
Wang & Long	Wald	0.0	0.0	1.8	0.9	8.8	21.0	35.0		2	2.2	5.8	6.3	21.3	35.6
	Fan & Zhang	0.0	0.0	1.8	0.9	8.8	20.9	35.0		2	1.1	0.6	0.3	2.3	6.2
	Pan	32.8	3.0	2.4	3.6	8.9	21.0	35.0		2	2.2	5.8	5.9	20.6	36.3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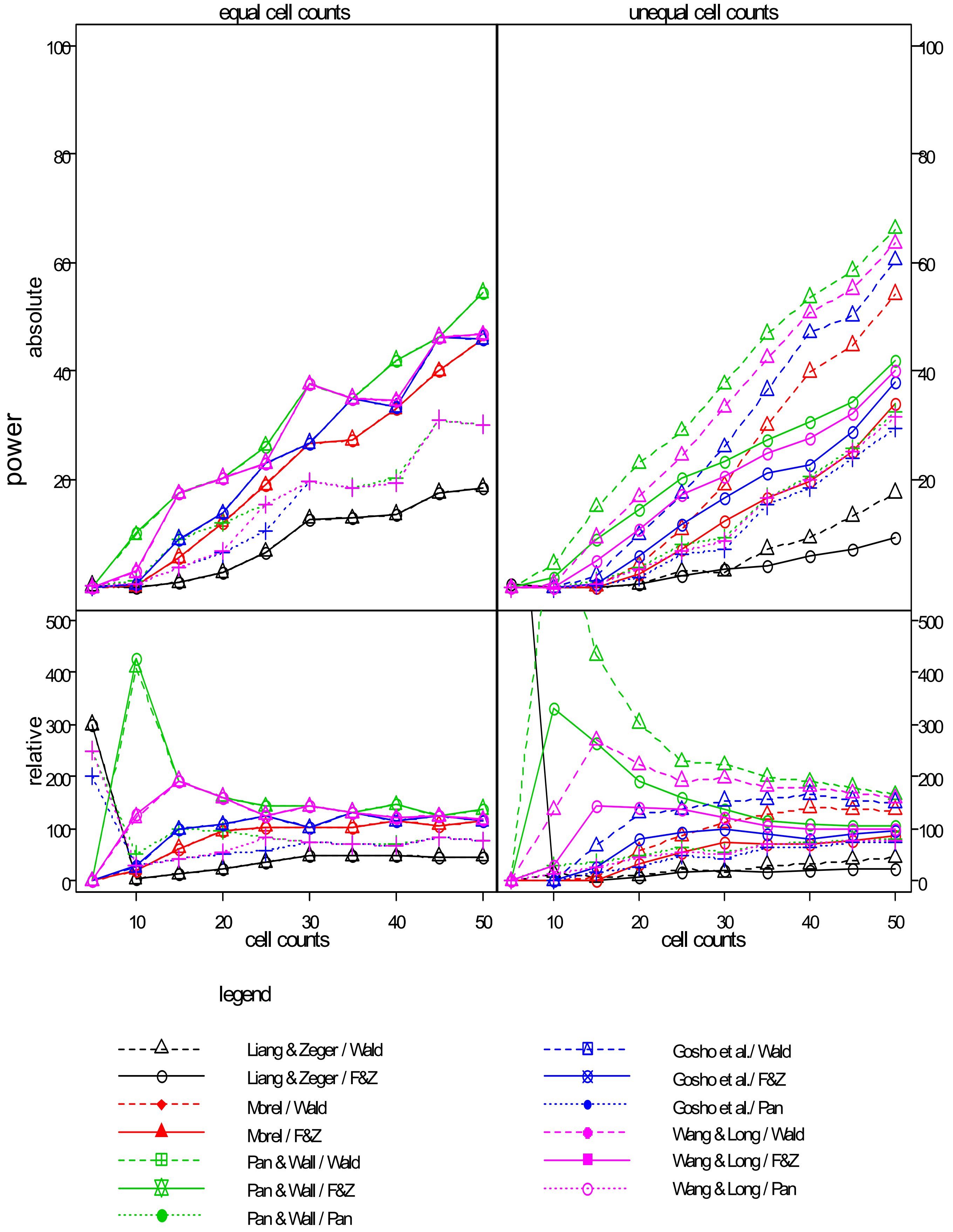
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 1. 2. unequal correlations on B (r = 0.7, 0.5, 0.4, 0.2) ar1-structure assumed

10. 1. 2. 1 p = 0.5

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	0.5	0.1	1.2	3.0	12.8	13.6	18.6	0.0	0.1	0.2	0.8	3.0	9.2	17.6
	Fan & Zhang	0.5	0.1	1.2	3.0	12.8	13.6	18.6	0.9	0.0	0.0	0.6	3.4	6.0	9.2
Morel et al.	Wald	0.0	0.5	5.7	12.2	26.7	33.1	45.9	0.0	0.0	0.3	4.3	19.0	39.8	54.2
	Fan & Zhang	0.0	0.5	5.7	12.2	26.7	33.1	45.9	0.0	0.0	0.0	2.6	12.4	19.6	34.1
Pan & Wall	Wald	0.0	9.8	17.5	20.4	37.6	42.0	54.5	0.0	4.4	14.9	22.9	37.6	53.6	66.2
	Fan & Zhang	0.0	10.2	17.5	20.4	37.6	42.0	54.5	0.0	2.0	9.1	14.5	23.2	30.7	42.1
	Pan	0.4	1.2	9.0	12.2	19.7	20.3	30.2	0.0	0.2	1.3	3.8	9.3	20.5	32.6
Gosho et al.	Wald	0.0	0.6	9.0	13.8	26.7	33.3	45.9		0.0	2.3	9.8	26.0	47.1	60.4
	Fan & Zhang	0.0	0.7	9.1	13.8	26.7	33.3	45.9		0.0	0.9	6.0	16.6	22.8	38.1
	Pan	0.3	0.7	3.8	6.4	19.7	19.3	30.2		0.0	0.5	2.1	7.2	18.4	29.5
Wang & Long	Wald	0.0	2.9	17.5	20.3	37.6	34.5	46.7	0.0	0.8	9.3	16.8	33.3	50.7	63.5
	Fan & Zhang	0.0	3.1	17.5	20.3	37.6	34.5	46.7	0.0	0.2	5.0	10.8	20.6	27.7	40.2
	Pan	0.4	0.7	3.9	7.0	19.7	19.4	30.2	0.0	0.1	0.9	3.5	8.7	20.1	31.5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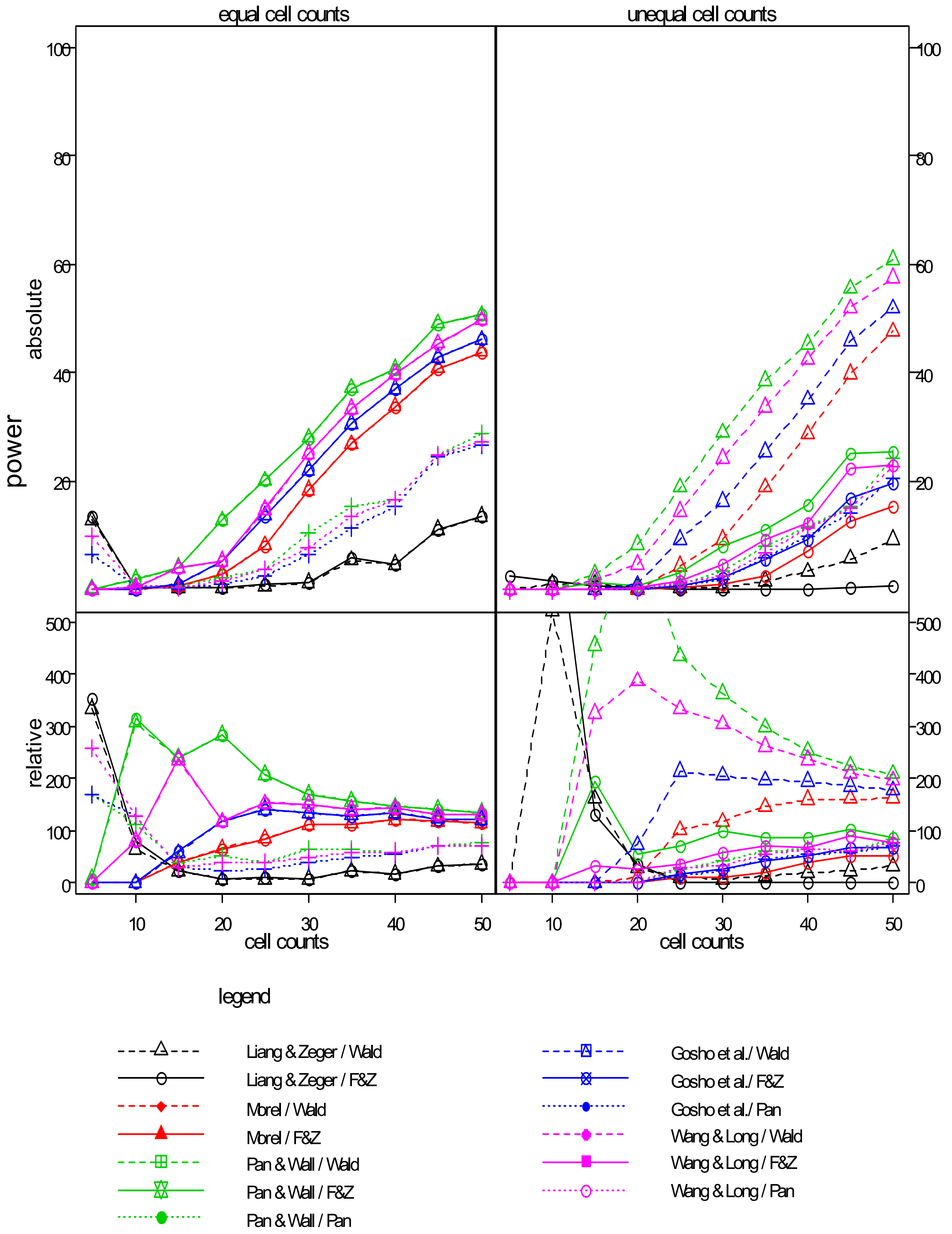
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 1. 2. 2 p = 0.8

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	12.8	0.4	0.4	0.3	1.4	4.8	13.6	0.0	1.1	1.0	0.3	0.5	3.4	9.4
	Fan & Zhang	13.5	0.5	0.4	0.3	1.4	4.9	13.7	2.5	1.6	0.8	0.5	0.1	0.2	0.6
Morel et al.	Wald	0.0	0.0	0.7	3.0	18.5	33.8	43.9	0.0	0.0	0.0	0.1	9.4	28.8	47.7
	Fan & Zhang	0.0	0.0	0.7	3.0	18.5	33.8	43.9	0.0	0.0	0.0	0.0	0.9	7.0	15.3
Pan & Wall	Wald	0.3	2.1	4.1	12.9	28.1	40.7	50.8	0.0	0.0	2.9	8.4	29.0	45.4	60.9
	Fan & Zhang	0.2	2.1	4.1	12.8	28.1	40.7	50.8	0.0	0.0	1.2	0.7	8.0	15.8	25.3
	Pan	6.6	0.8	0.7	2.4	10.5	16.6	28.9	0.0	0.0	0.0	0.0	3.5	11.8	24.2
Gosho et al.	Wald	0.0	0.0	1.0	5.4	22.2	37.2	46.1		0.0	0.0	0.9	16.4	35.1	51.9
	Fan & Zhang	0.0	0.0	1.1	5.3	22.2	37.2	46.1		0.0	0.0	0.0	2.1	9.5	19.7
	Pan	6.6	0.9	0.5	1.1	6.5	15.5	26.7		0.0	0.0	0.0	1.9	10.0	20.5
Wang & Long	Wald	0.0	0.5	4.0	5.4	25.2	39.9	49.8	0.0	0.0	2.1	4.8	24.3	42.4	57.6
	Fan & Zhang	0.0	0.5	4.1	5.3	25.2	39.9	49.8	0.0	0.0	0.2	0.3	4.7	12.4	23.0
	Pan	10.0	0.9	0.5	1.8	7.9	16.6	27.3	0.0	0.0	0.0	0.0	2.7	11.3	22.8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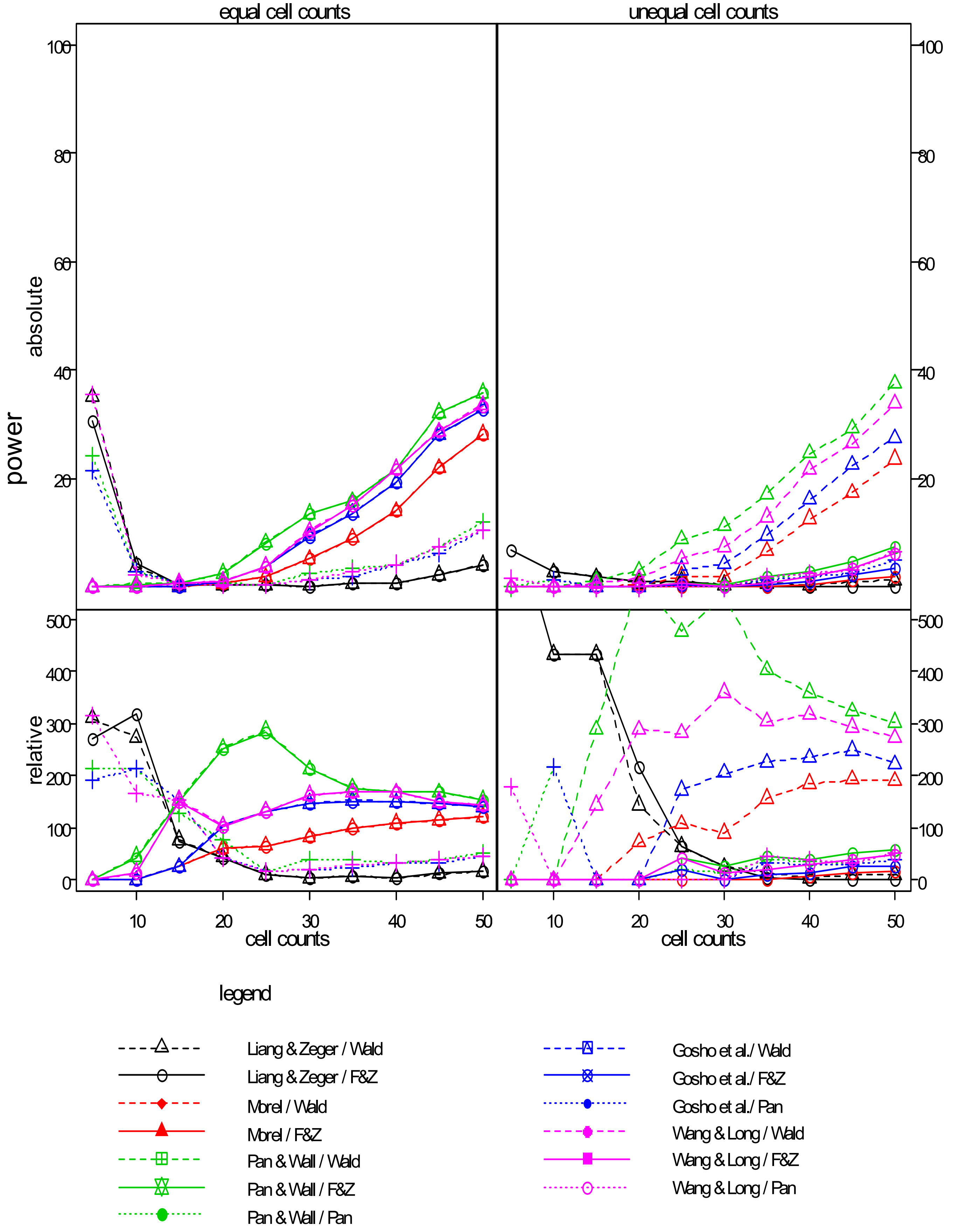
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 1. 2. 3 p = 0.9

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	35.2	3.8	0.4	0.5	0.3	0.7	4.1		2.9	1.9	0.8	0.5	0.3	1.3
	Fan & Zhang	30.7	4.5	0.4	0.5	0.3	0.7	4.1	6.9	2.9	1.9	1.1	0.5	0.2	0.0
Morel et al.	Wald	0.0	0.0	0.1	0.6	5.3	14.2	28.3	0.0	0.0	0.0	0.4	1.9	12.7	23.7
	Fan & Zhang	0.0	0.0	0.1	0.6	5.2	14.2	28.3	0.0	0.0	0.0	0.0	0.0	0.5	2.1
Pan & Wall	Wald	0.0	0.6	0.8	2.6	13.6	21.8	35.8	0.0	0.0	1.3	3.1	11.2	24.7	37.6
	Fan & Zhang	0.0	0.6	0.8	2.6	13.6	21.8	35.8	0.0	0.0	0.0	0.0	0.5	2.8	7.4
	Pan	24.2	3.0	0.7	0.8	2.6	4.2	12.1	0.0	1.4	0.0	0.0	0.3	2.5	6.5
Gosho et al.	Wald	0.0	0.0	0.1	1.1	9.5	19.3	32.9		0.0	0.0	0.0	4.3	16.1	27.5
	Fan & Zhang	0.0	0.0	0.1	1.1	9.4	19.3	32.9		0.0	0.0	0.0	0.0	1.0	3.4
	Pan	21.6	3.0	0.8	0.5	1.2	4.2	10.5		1.4	0.0	0.0	0.0	2.0	4.9
Wang & Long	Wald	0.0	0.2	0.8	1.1	10.4	21.8	33.6	0.0	0.0	0.6	1.5	7.5	21.7	33.9
	Fan & Zhang	0.0	0.2	0.8	1.1	10.4	21.8	33.5	0.0	0.0	0.0	0.0	0.3	2.0	6.2
	Pan	35.6	2.3	0.8	0.5	1.4	4.2	10.5	1.7	0.0	0.0	0.0	0.0	2.6	6.5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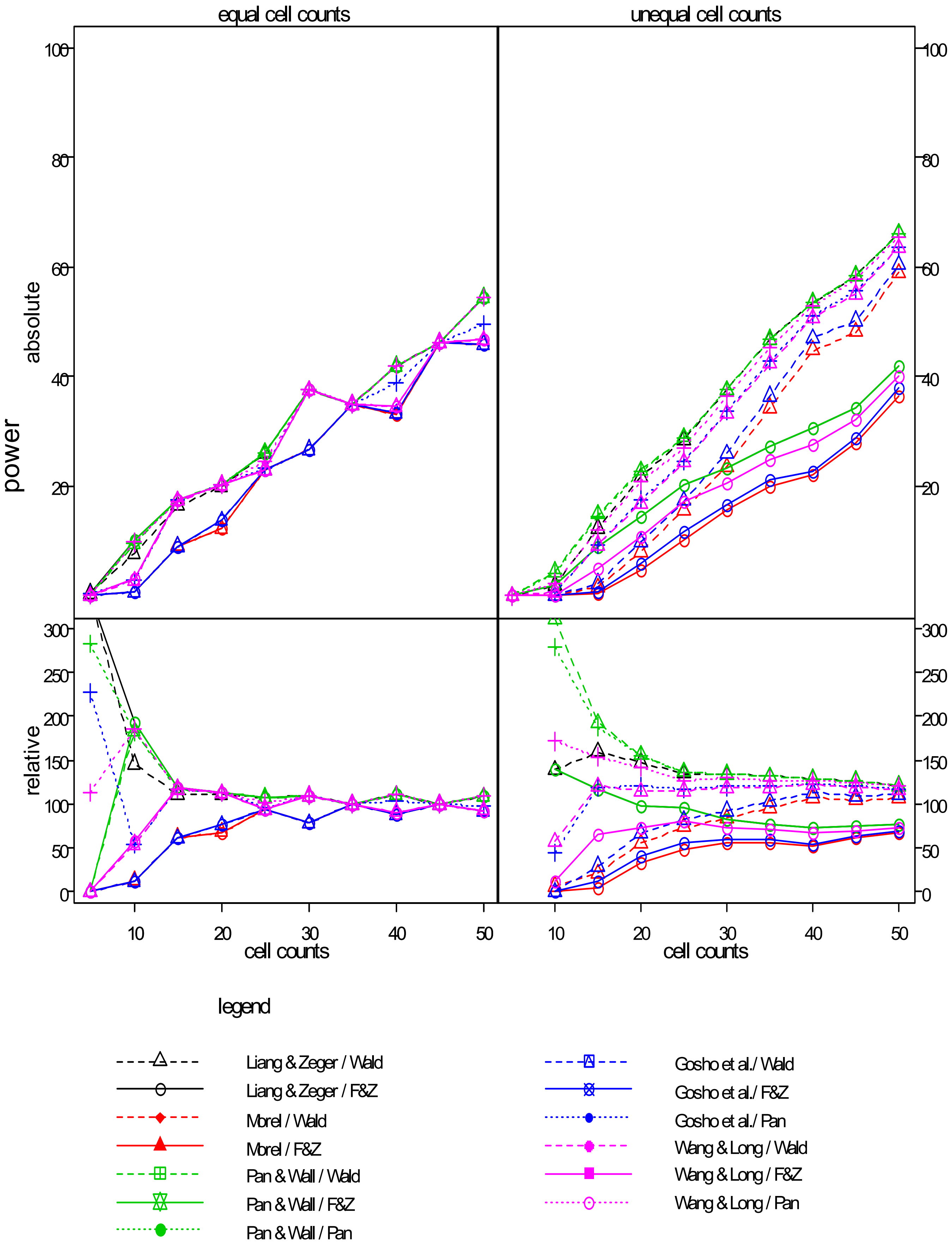
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 1. 3. unequal correlations on B (r = 0.7, 0.5, 0.4, 0.2) exchangeable structure assumed

10. 1. 3. 1 p = 0.5

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	0.5	7.7	16.5	20.1	37.6	41.9	54.5	0.0	2.0	12.4	21.7	37.5	53.6	66.2
	Fan & Zhang	0.5	10.2	17.5	20.4	37.6	42.0	54.5	0.0	2.0	9.1	14.5	23.2	30.7	42.1
Morel et al.	Wald	0.0	0.7	9.1	12.3	26.7	33.2	45.9	0.0	0.1	1.6	8.1	23.5	44.8	58.9
	Fan & Zhang	0.0	0.7	9.1	12.3	26.7	33.2	45.9	0.0	0.0	0.4	4.8	15.8	22.1	36.5
Pan & Wall	Wald	0.0	9.7	17.4	20.4	37.6	42.0	54.5	0.0	4.4	14.9	22.9	37.6	53.6	66.2
	Fan & Zhang	0.0	10.2	17.5	20.4	37.6	42.0	54.5	0.0	2.0	9.1	14.5	23.2	30.7	42.1
	Pan	0.4	9.6	17.4	20.4	37.6	42.0	54.5	0.0	4.0	14.6	22.8	37.6	53.6	66.2
Gosho et al.	Wald	0.0	0.6	9.1	13.8	26.7	33.3	45.9		0.0	2.3	9.8	26.0	47.1	60.4
	Fan & Zhang	0.0	0.7	9.1	13.8	26.7	33.3	45.9		0.0	0.9	6.0	16.6	22.8	38.1
	Pan	0.3	2.9	17.4	20.3	37.6	39.0	49.6		0.6	9.2	17.7	33.7	51.1	63.7
Wang & Long	Wald	0.0	2.9	17.4	20.3	37.6	34.5	46.7	0.0	0.8	9.3	16.8	33.3	50.7	63.5
	Fan & Zhang	0.0	3.1	17.5	20.3	37.6	34.5	46.7	0.0	0.2	5.0	10.8	20.6	27.7	40.2
	Pan	0.2	9.8	17.4	20.3	37.6	42.0	54.5	0.0	2.4	12.0	20.9	36.5	52.9	65.5


equal cell counts
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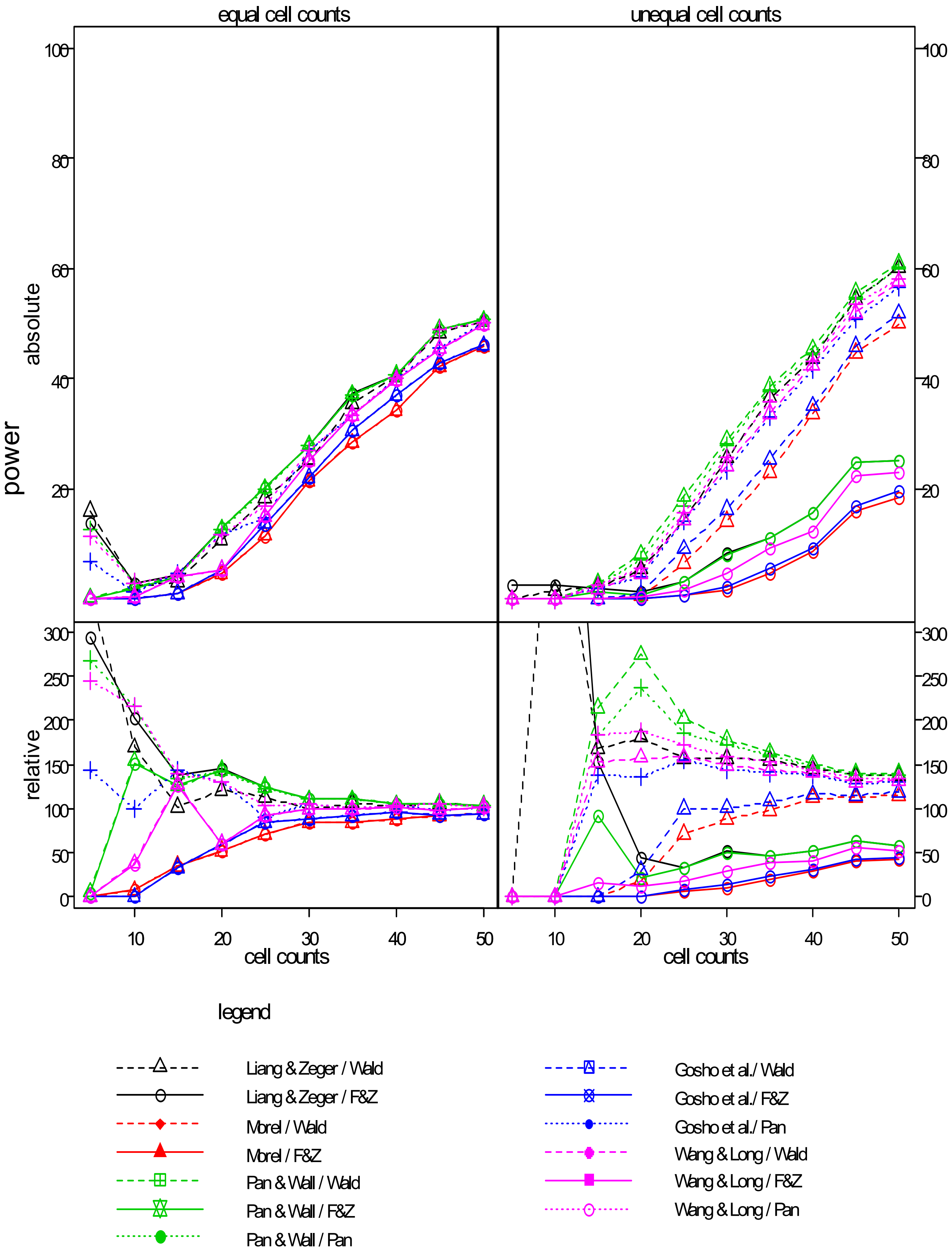
cell counts
legend
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 1. 3. 2 p = 0.8

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	16.1	2.4	3.3	10.8	25.3	40.3	50.4	0.0	1.6	2.3	5.5	25.6	43.7	60.2
	Fan & Zhang	13.9	2.9	4.5	13.0	28.1	40.7	50.8	2.5	2.6	2.1	1.4	8.4	15.8	25.3
Morel et al.	Wald	0.0	0.1	1.1	4.7	21.5	34.2	45.9	0.0	0.0	0.0	0.6	14.2	33.7	50.0
	Fan & Zhang	0.0	0.1	1.1	4.7	21.5	34.2	45.9	0.0	0.0	0.0	0.0	1.6	8.8	18.6
Pan & Wall	Wald	0.3	2.2	4.0	12.9	28.1	40.7	50.8	0.0	0.0	2.9	8.3	29.0	45.5	60.9
	Fan & Zhang	0.2	2.1	4.1	12.8	28.1	40.7	50.8	0.0	0.0	1.2	0.7	8.0	15.8	25.3
	Pan	12.7	3.0	4.4	12.7	28.0	40.8	50.8	0.0	0.0	2.5	7.2	27.9	44.4	60.4
Gosho et al.	Wald	0.0	0.0	1.1	5.4	22.2	37.2	46.1		0.0	0.0	0.9	16.4	35.1	51.9
	Fan & Zhang	0.0	0.0	1.1	5.3	22.2	37.2	46.1		0.0	0.0	0.0	2.1	9.5	19.6
	Pan	6.8	1.4	4.7	11.6	26.9	40.0	50.3		0.0	1.9	4.1	23.3	41.8	56.6
Wang & Long	Wald	0.0	0.5	4.1	5.4	25.2	39.9	49.8	0.0	0.0	2.1	4.8	24.3	42.4	57.6
	Fan & Zhang	0.0	0.5	4.1	5.3	25.2	39.9	49.8	0.0	0.0	0.2	0.3	4.7	12.4	22.9
	Pan	11.5	3.0	4.5	11.7	26.9	40.0	50.3	0.0	0.0	2.5	5.7	25.9	43.3	58.1


equal cell counts
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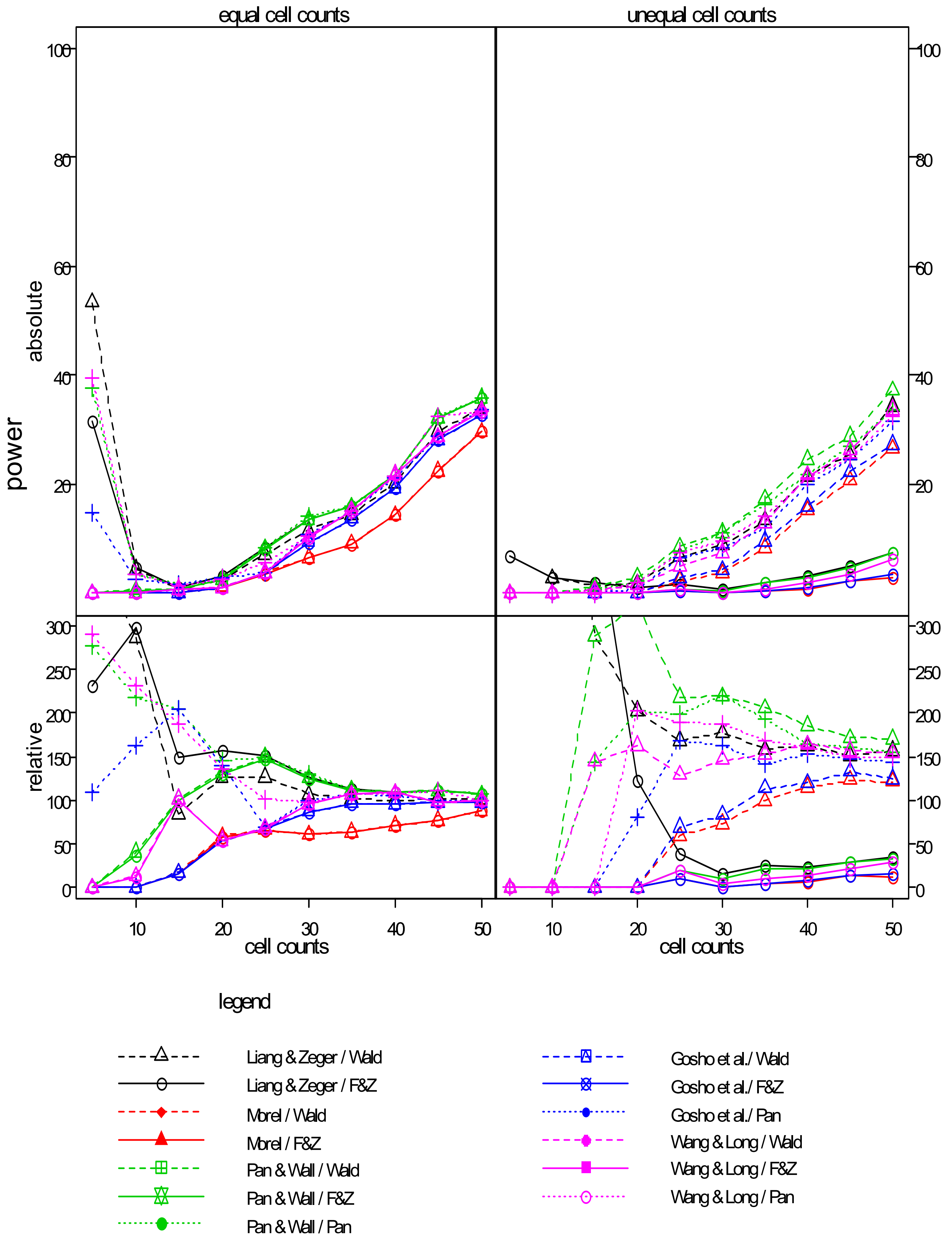
cell counts
legend
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 1. 3. 3 p = 0.9

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	53.4	4.4	0.7	2.6	11.6	20.2	33.9		2.9	1.3	1.9	9.1	21.4	34.3
	Fan & Zhang	31.4	4.6	1.2	3.2	13.7	21.8	35.9	6.8	2.9	1.9	1.1	0.8	3.1	7.5
Morel et al.	Wald	0.0	0.0	0.1	1.2	6.6	14.4	29.7	0.0	0.0	0.0	0.0	3.7	15.2	26.6
	Fan & Zhang	0.0	0.0	0.1	1.2	6.6	14.4	29.7	0.0	0.0	0.0	0.0	0.0	0.8	2.8
Pan & Wall	Wald	0.0	0.6	0.8	2.6	13.6	21.8	35.8	0.0	0.0	1.3	3.0	11.2	24.5	37.3
	Fan & Zhang	0.0	0.6	0.8	2.6	13.6	21.8	35.8	0.0	0.0	0.0	0.0	0.5	2.9	7.4
	Pan	37.7	3.4	1.6	2.9	14.0	21.6	35.8	0.0	0.0	0.6	1.9	11.2	21.8	33.8
Gosho et al.	Wald	0.0	0.0	0.1	1.1	9.4	19.3	32.9		0.0	0.0	0.0	4.3	15.9	27.3
	Fan & Zhang	0.0	0.0	0.1	1.1	9.4	19.3	32.9		0.0	0.0	0.0	0.0	1.0	3.4
	Pan	14.8	2.5	1.6	2.8	10.8	21.3	33.6		0.0	0.0	0.8	8.3	20.1	31.6
Wang & Long	Wald	0.0	0.2	0.8	1.1	10.4	21.8	33.6	0.0	0.0	0.6	1.5	7.5	21.6	33.7
	Fan & Zhang	0.0	0.2	0.8	1.1	10.3	21.8	33.5	0.0	0.0	0.0	0.0	0.3	2.0	6.2
	Pan	39.4	3.6	1.5	2.7	10.7	21.5	33.4	0.0	0.0	0.0	1.9	9.6	21.3	32.5


equal cell counts
unequal cell counts
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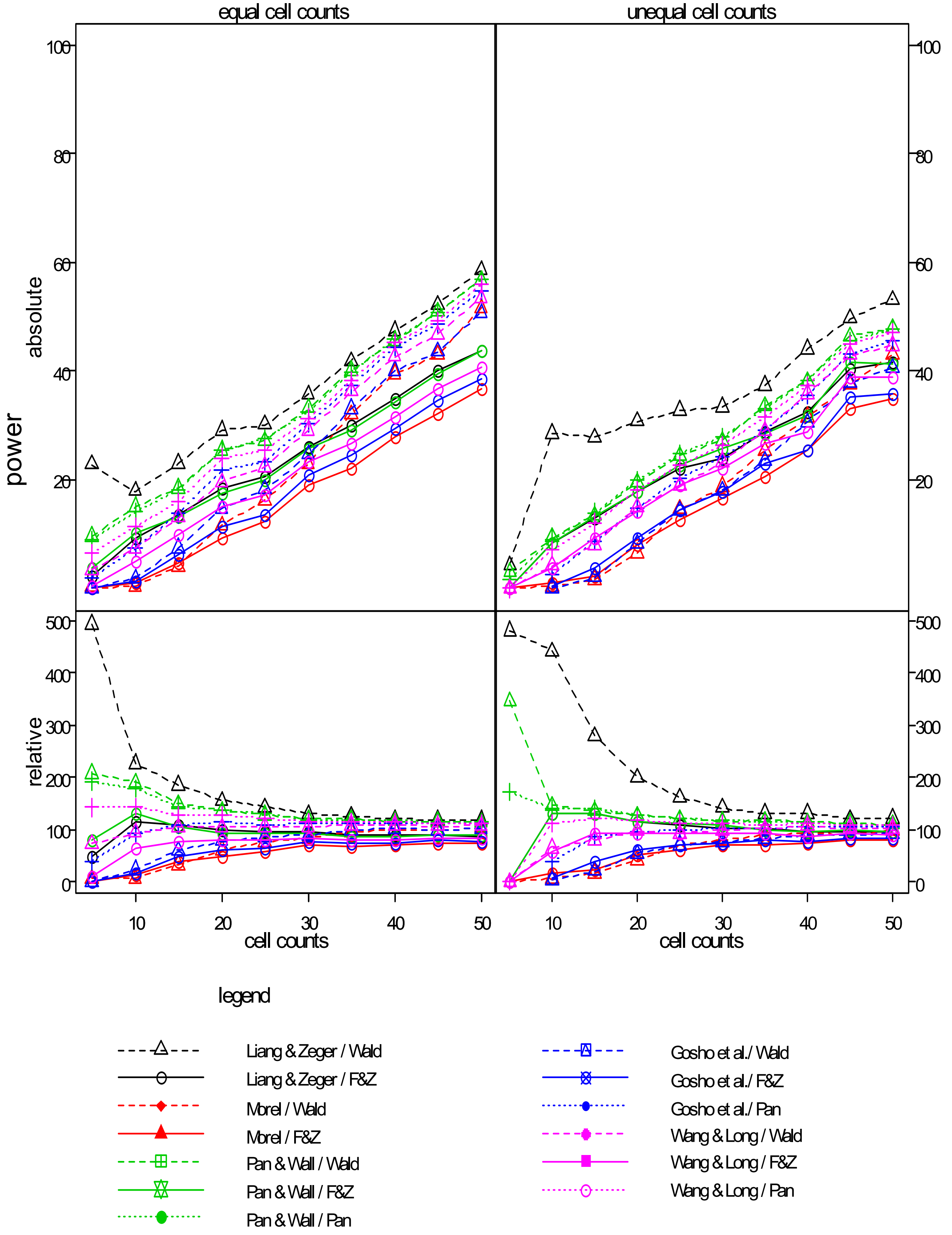
cell counts
legend
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 2. Main effect B (effects $b_i = 0.3*s$)

10. 2. 1. equal correlations on B (r=0.3)

10. 2. 1. 1 p = 0.5

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	22.8	18.0	23.1	29.1	35.7	47.5	58.6	4.3	28.5	27.8	30.8	33.4	44.1	53.1
	Fan & Zhang	2.3	9.2	13.6	18.6	26.2	34.8	43.7	0.0	8.5	13.0	17.7	24.0	32.6	41.8
Morel et al.	Wald	0.3	0.5	4.1	11.7	22.9	39.6	51.6	0.0	0.5	1.7	6.5	18.8	31.6	43.1
	Fan & Zhang	0.0	1.0	4.9	9.2	19.1	27.9	36.9	0.0	1.0	2.2	8.2	16.7	25.3	35.0
Pan & Wall	Wald	9.6	15.2	18.5	25.6	33.2	45.7	56.8	3.1	9.4	13.5	19.5	27.2	38.2	47.9
	Fan & Zhang	3.8	10.4	13.2	17.6	25.9	34.4	43.9	0.0	8.4	13.2	17.9	25.7	32.0	41.3
	Pan	8.9	14.2	18.1	25.6	32.6	46.0	56.8	1.6	9.1	14.0	19.9	27.8	38.2	47.7
Gosho et al.	Wald	0.0	1.9	7.5	14.7	24.7	40.2	50.7		0.2	2.1	8.3	18.0	30.5	40.7
	Fan & Zhang	0.0	1.3	6.1	11.3	21.0	29.4	38.7		0.5	3.9	9.5	17.7	25.6	35.8
	Pan	1.8	7.4	13.7	21.9	30.3	44.3	54.9		2.6	8.7	14.8	24.3	35.5	45.5
Wang & Long	Wald	3.4	7.5	13.1	19.6	29.2	42.7	53.5	0.0	4.2	8.1	15.0	23.3	35.9	44.7
	Fan & Zhang	0.6	5.1	9.8	15.0	23.3	31.5	40.7	0.0	3.7	9.2	14.3	22.2	28.9	38.9
	Pan	6.6	11.4	16.1	24.1	31.4	45.4	56.1	0.0	7.2	12.2	18.1	26.5	37.3	47.2


equal cell counts
unequal cell counts
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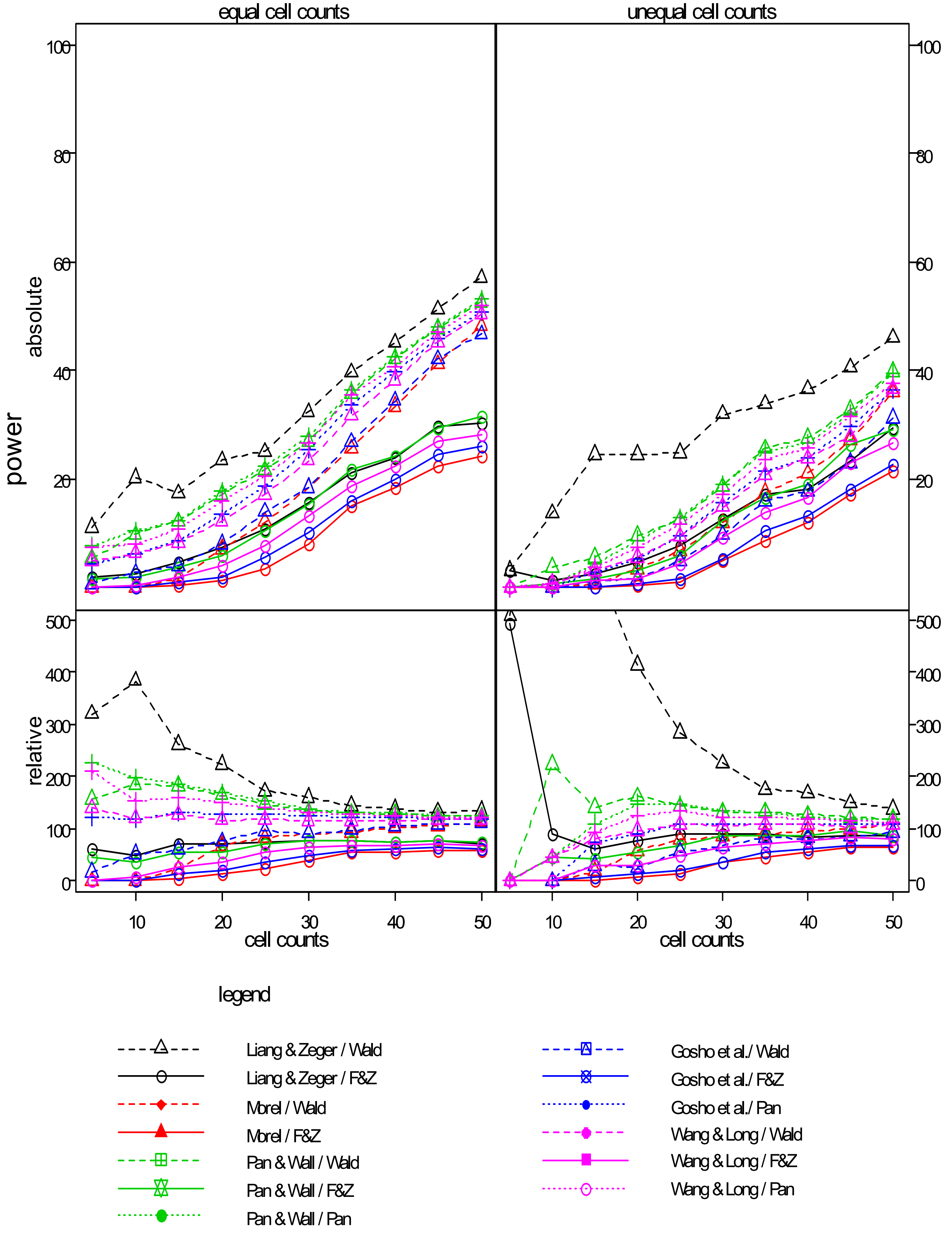
cell counts
legend
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al. / Wald
Gosho et al. / F&Z
Gosho et al. / Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 2. 1. 2 p = 0.8

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	11.1	20.3	17.5	23.6	32.4	45.2	57.1	3.2	13.7	24.6	24.6	32.0	36.6	46.2
	Fan & Zhang	2.1	2.6	4.7	7.5	15.6	24.0	30.5	3.1	1.5	2.5	4.7	12.8	18.1	29.4
Morel et al.	Wald	0.0	0.0	1.5	7.2	18.4	33.5	48.2	0.0	0.0	0.7	3.4	12.0	21.1	36.1
	Fan & Zhang	0.0	0.0	0.4	1.5	8.2	18.3	24.3	0.0	0.0	0.0	0.4	5.0	12.1	21.4
Pan & Wall	Wald	5.5	9.8	12.2	17.3	27.1	42.2	52.7	0.0	3.8	5.7	9.6	18.7	27.7	39.8
	Fan & Zhang	1.6	1.8	3.7	5.9	15.4	24.4	31.7	0.0	0.8	1.7	3.2	12.3	19.0	29.1
	Pan	7.9	10.5	12.3	17.9	28.0	42.5	53.2	0.0	0.8	4.4	8.8	19.0	26.8	39.5
Gosho et al.	Wald	0.6	2.8	4.0	8.1	18.4	34.5	46.7		0.0	1.2	1.6	9.7	17.7	31.3
	Fan & Zhang	0.0	0.0	0.9	2.1	10.1	20.0	26.1		0.0	0.2	0.8	5.3	13.3	22.7
	Pan	4.3	6.2	8.8	13.6	25.5	39.9	51.0		0.0	3.0	5.3	15.7	23.9	36.6
Wang & Long	Wald	4.9	6.3	8.5	12.3	23.4	38.3	50.5	0.0	0.8	3.2	5.7	14.9	23.9	36.6
	Fan & Zhang	0.0	0.4	1.8	4.0	13.1	22.3	28.3	0.0	0.0	1.2	1.7	9.3	16.6	26.6
	Pan	7.3	8.2	10.7	15.9	26.7	40.8	52.0	0.0	0.8	3.7	7.4	17.3	25.7	37.7


equal cell counts
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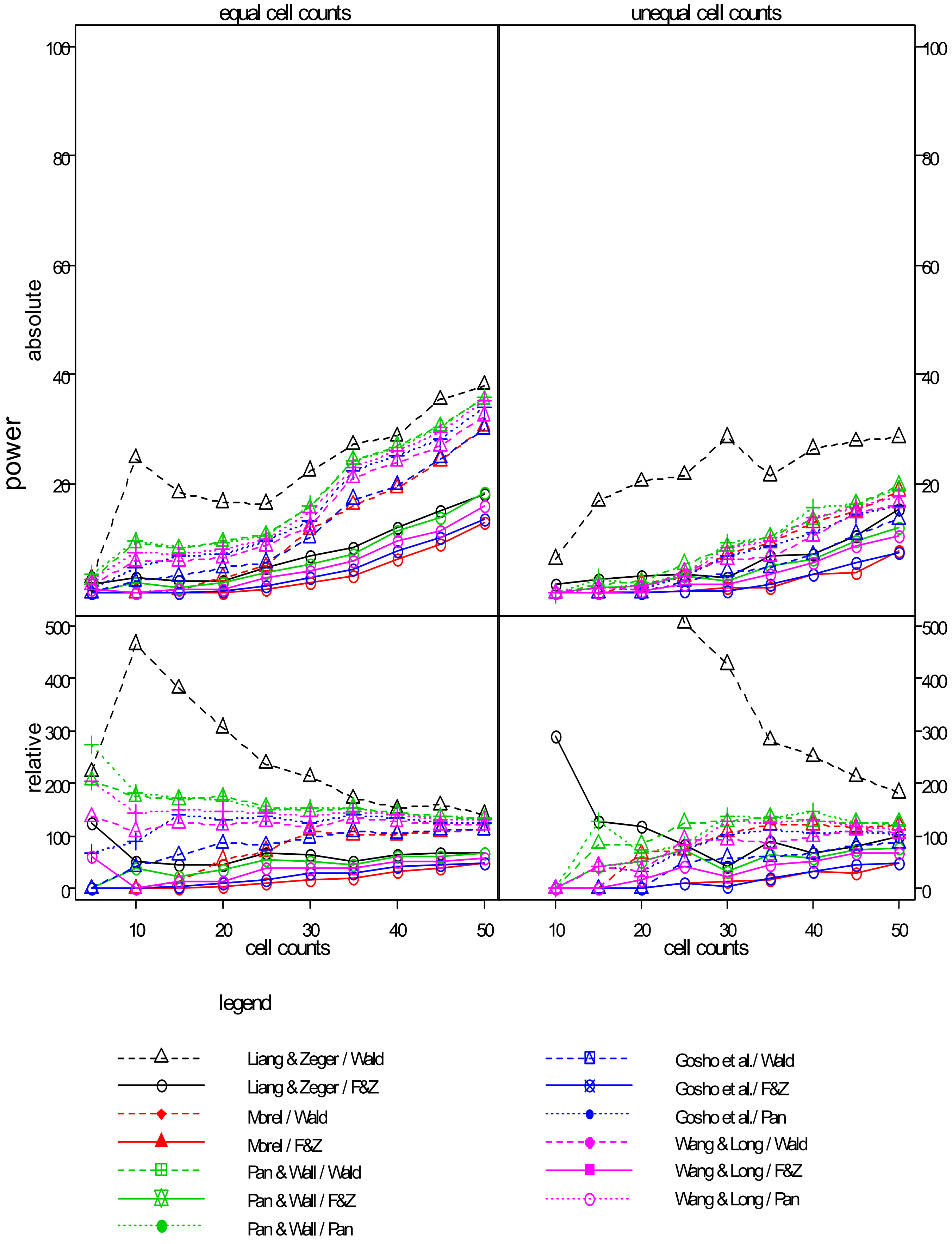
cell counts
legend
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al. / Wald
Gosho et al. / F&Z
Gosho et al. / Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 2. 1. 3 p = 0.9

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	2.7	24.7	18.4	16.6	22.5	28.7	38.1		6.2	16.8	20.5	28.6	26.4	28.6
	Fan & Zhang	1.5	2.7	2.1	2.4	6.8	12.0	18.2		1.8	2.7	3.1	2.9	7.2	15.4
Morel et al.	Wald	0.0	0.0	0.6	3.0	11.7	19.3	30.5		0.0	0.0	1.8	7.2	12.9	18.8
	Fan & Zhang	0.0	0.0	0.0	0.2	2.0	6.4	13.0		0.0	0.0	0.0	1.0	3.4	7.8
Pan & Wall	Wald	2.5	9.4	8.2	9.5	15.6	27.0	35.4		0.0	1.8	2.2	8.5	13.5	19.7
	Fan & Zhang	0.0	2.1	1.1	1.9	5.3	11.5	18.5		0.0	0.9	1.3	2.3	6.3	12.1
	Pan	3.4	9.7	8.3	9.2	16.1	26.6	35.9		0.0	2.7	1.8	9.2	15.6	19.0
Gosho et al.	Wald	0.0	2.2	3.1	4.7	10.3	19.8	30.0		0.0	0.0	0.0	3.9	7.0	13.5
	Fan & Zhang	0.0	0.0	0.2	0.6	3.0	7.7	13.6		0.0	0.0	0.0	0.3	3.4	7.5
	Pan	0.8	4.7	6.8	7.1	13.3	25.3	34.0		0.0	0.9	0.9	6.9	11.2	16.0
Wang & Long	Wald	1.7	5.8	6.0	6.6	12.2	24.1	32.6		0.0	0.9	0.9	6.2	10.4	16.4
	Fan & Zhang	0.8	0.0	0.6	0.8	4.0	9.6	15.9		0.0	0.0	0.4	1.6	5.5	10.6
	Pan	2.5	7.6	7.2	8.1	14.7	26.2	35.2		0.0	0.9	1.3	8.5	13.9	17.8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cell counts
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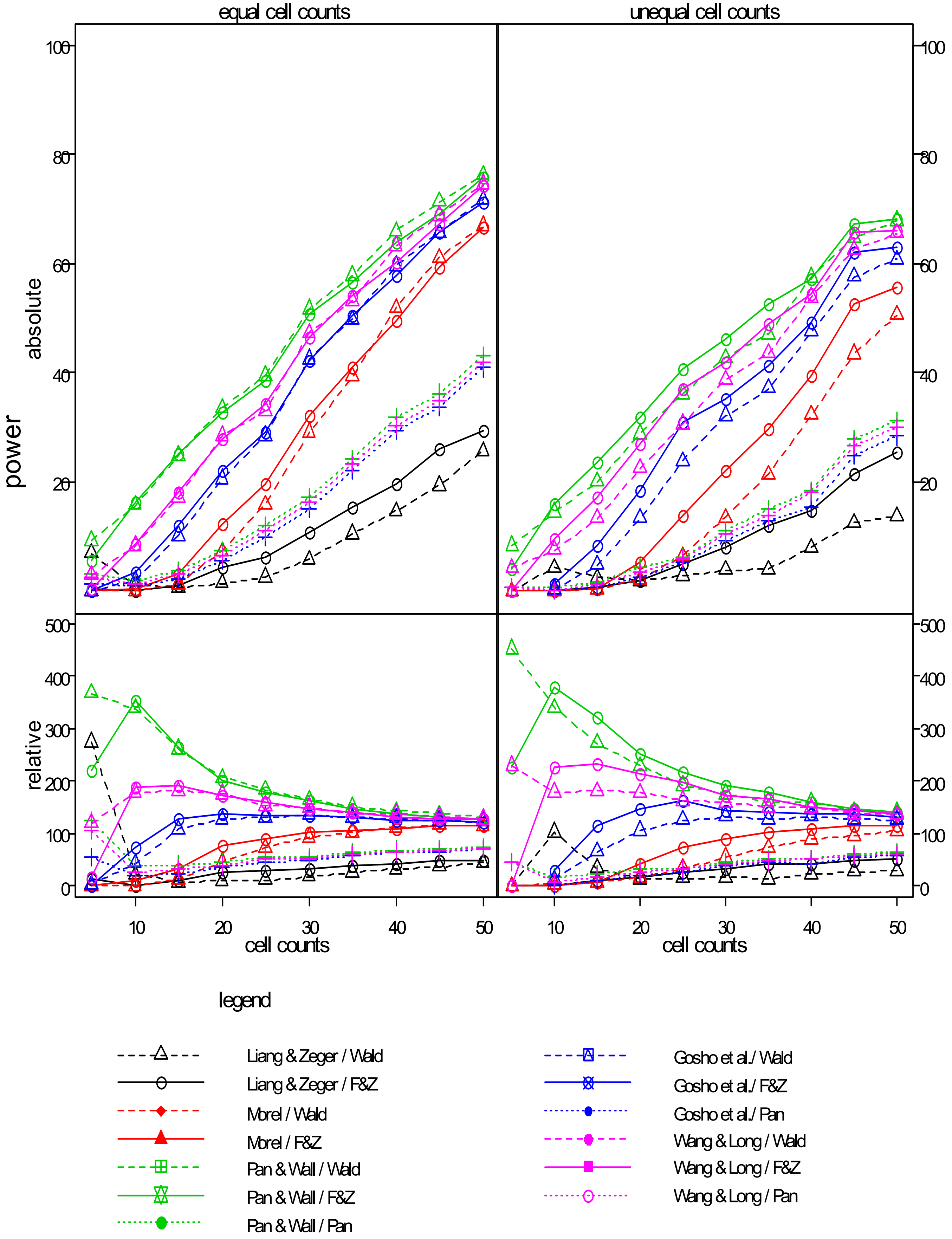
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 2. 2. unequal correlations on B (r = 0.7, 0.5, 0.4, 0.2), ar1-structure

10. 2. 2. 1 p = 0.5

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	7.0	1.1	0.7	1.5	5.8	14.7	25.7	0.0	4.4	2.5	1.9	3.9	8.0	13.8
	Fan & Zhang	0.3	0.1	1.1	4.3	10.7	19.7	29.3	0.0	0.0	0.7	2.0	8.1	14.8	25.5
Morel et al.	Wald	0.0	0.0	1.4	7.4	29.2	51.9	67.0	0.0	0.2	0.5	2.2	13.5	32.3	50.6
	Fan & Zhang	0.0	0.6	3.1	12.4	32.3	49.6	66.8	0.0	0.0	0.6	5.4	22.1	39.6	55.6
Pan & Wall	Wald	9.3	15.8	24.8	33.6	51.7	66.0	76.3	8.4	14.5	20.1	28.9	42.8	57.6	67.9
	Fan & Zhang	5.6	16.5	25.2	32.8	50.9	63.9	75.7	4.2	16.2	23.7	32.0	46.3	57.3	68.1
	Pan	3.2	1.8	3.9	7.5	17.2	31.9	43.1	0.8	0.7	1.8	4.3	11.0	18.4	31.2
Gosho et al.	Wald	0.1	2.0	10.3	20.7	42.6	59.7	71.8		0.5	4.8	13.4	32.2	47.6	60.8
	Fan & Zhang	0.0	3.4	12.0	22.2	42.4	57.8	71.2		1.2	8.5	18.5	35.3	49.3	63.0
	Pan	1.4	0.9	2.2	5.7	15.0	29.5	40.9		0.1	0.8	2.7	9.4	15.5	28.4
Wang & Long	Wald	3.0	8.4	17.2	28.5	47.3	63.4	74.7	4.3	7.6	13.4	22.6	38.8	53.9	65.6
	Fan & Zhang	0.4	8.8	18.3	27.9	46.6	60.4	74.2	0.0	9.6	17.1	26.9	41.9	54.5	66.0
	Pan	2.7	1.3	3.2	6.5	16.4	30.5	41.9	0.9	0.3	1.4	3.5	10.5	18.2	30.0


equal cell counts
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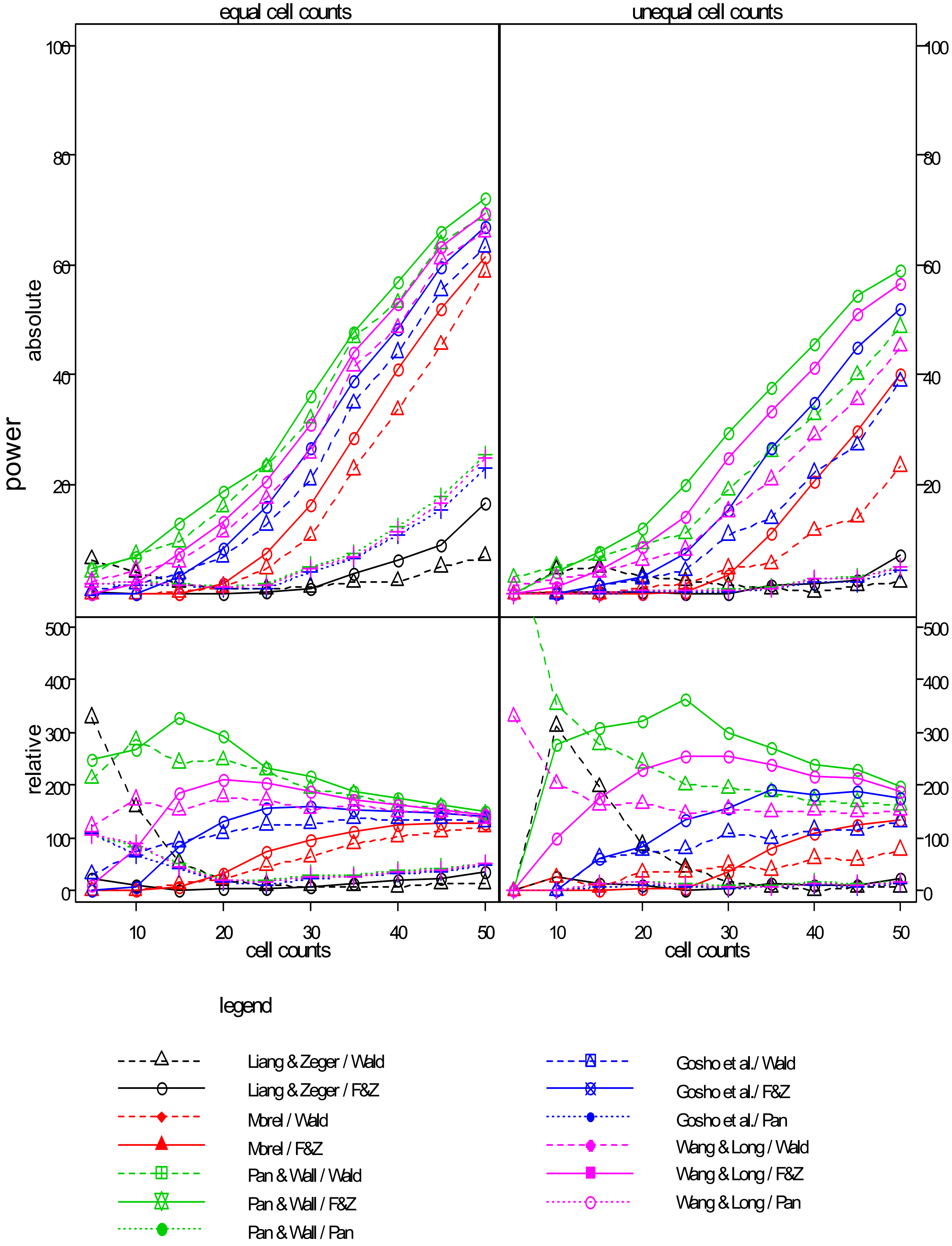
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 2. 2. 2 p = 0.8

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	6.4	4.0	2.1	1.2	1.4	2.4	7.0	0.0	4.5	5.0	3.3	1.5	0.4	2.2
	Fan & Zhang	0.5	0.3	0.0	0.2	1.1	6.1	16.7	0.0	0.4	0.3	0.4	0.3	1.9	7.0
Morel et al.	Wald	0.0	0.0	0.5	1.5	10.6	33.6	58.8	0.0	0.4	0.2	1.3	4.8	11.7	23.3
	Fan & Zhang	0.0	0.0	0.3	2.0	16.2	40.9	61.5	0.0	0.0	0.0	0.2	3.7	20.6	40.1
Pan & Wall	Wald	4.1	7.3	9.6	15.8	32.0	53.1	69.0	3.1	5.1	7.0	9.2	19.0	32.6	48.7
	Fan & Zhang	4.8	6.8	12.9	18.6	36.1	56.8	72.2	0.0	4.0	7.8	12.1	29.4	45.6	59.2
	Pan	2.1	2.2	2.0	1.3	5.2	12.5	25.4	0.0	0.0	0.3	0.6	1.1	3.0	5.1
Gosho et al.	Wald	0.6	1.9	3.7	6.9	20.9	44.1	63.4		0.0	1.6	2.9	10.8	22.1	38.8
	Fan & Zhang	0.0	0.2	3.3	8.4	26.6	48.5	66.9		0.0	1.6	3.2	15.3	34.9	51.9
	Pan	2.1	1.8	1.7	1.0	4.1	10.8	22.9		0.0	0.2	0.4	0.6	2.2	4.4
Wang & Long	Wald	2.4	4.4	6.0	11.3	25.7	48.6	66.0	1.5	3.0	4.1	6.2	15.2	29.0	45.1
	Fan & Zhang	0.2	2.1	7.3	13.3	31.1	53.0	69.4	0.0	1.5	4.5	8.7	24.9	41.3	56.5
	Pan	2.1	2.3	1.8	1.3	4.6	11.6	24.9	0.0	0.0	0.3	0.6	0.8	2.8	5.1


equal cell counts
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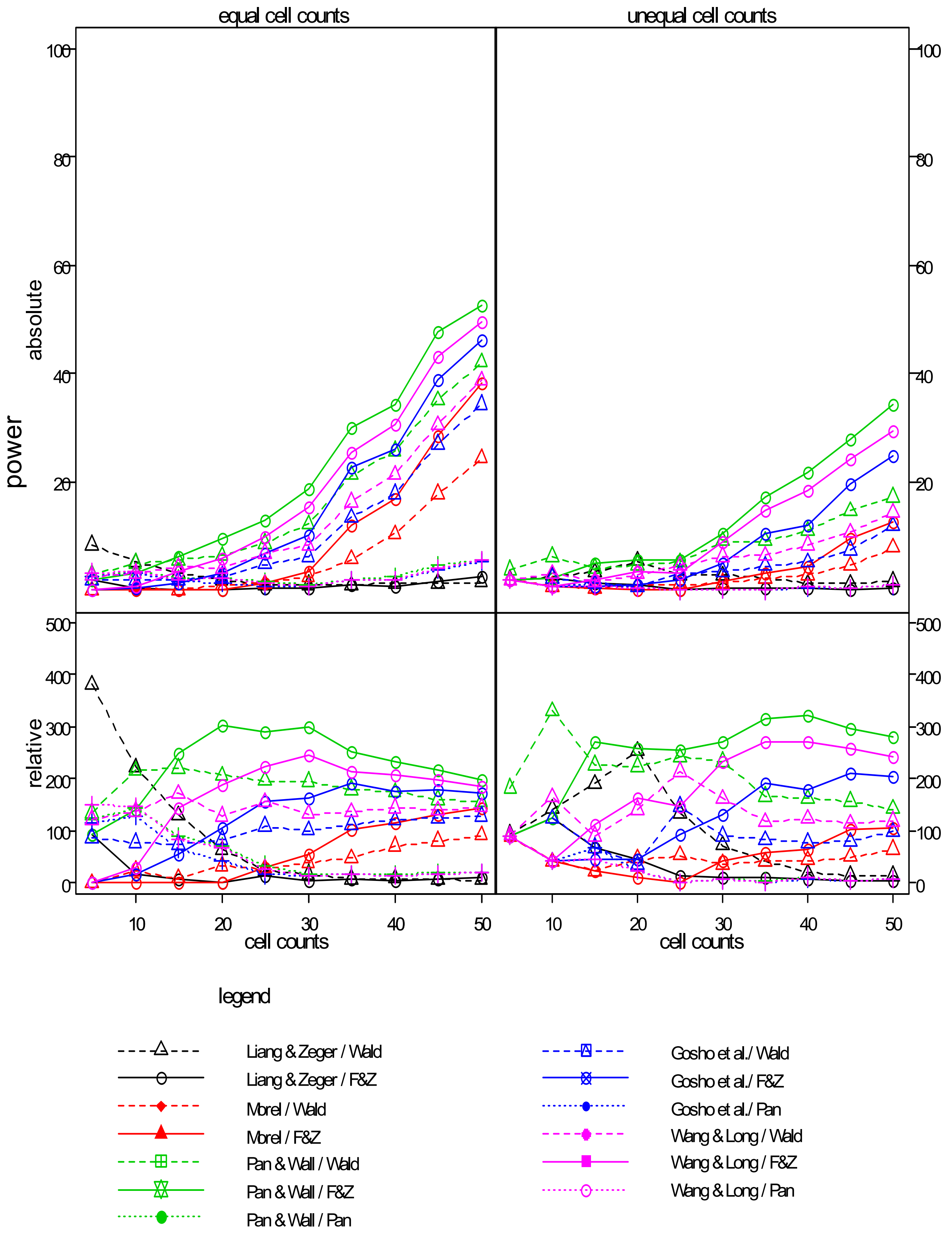
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 2. 2. 3 p = 0.9

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	8.4	5.3	3.3	2.0	1.1	1.3	1.5	2.0	2.7	3.5	5.5	2.8	1.3	1.7
	Fan & Zhang	2.1	0.4	0.2	0.1	0.4	0.7	2.7	1.9	2.3	1.2	1.0	0.5	0.5	0.4
Morel et al.	Wald	0.0	0.6	0.2	1.1	2.5	10.5	24.4	1.9	0.8	0.4	1.0	1.4	3.0	7.9
	Fan & Zhang	0.0	0.0	0.0	0.1	3.5	16.9	38.4	1.9	0.8	0.4	0.3	1.6	4.4	12.7
Pan & Wall	Wald	3.0	5.1	5.5	6.5	12.2	25.8	42.1	3.8	6.2	4.1	4.8	9.1	11.0	17.2
	Fan & Zhang	2.1	3.3	6.2	9.5	18.6	34.5	52.7	1.9	2.3	4.9	5.6	10.5	21.8	34.2
	Pan	2.7	3.4	2.2	2.2	1.1	2.6	5.7	1.9	0.8	1.2	0.5	0.2	0.8	1.1
Gosho et al.	Wald	1.9	1.8	1.9	2.6	6.3	17.9	34.4		2.3	1.2	0.8	3.5	5.2	12.0
	Fan & Zhang	0.0	0.4	1.4	3.3	10.2	26.1	46.1		0.8	0.8	1.0	5.2	12.1	24.8
	Pan	2.6	3.1	1.6	1.3	0.9	2.0	5.4		0.8	1.2	0.5	0.2	0.5	0.9
Wang & Long	Wald	2.7	3.3	4.3	4.0	8.3	21.4	38.9	1.9	3.1	1.6	3.0	6.3	8.4	14.4
	Fan & Zhang	0.0	0.7	3.6	5.9	15.3	30.5	49.5	1.9	0.8	2.1	3.5	9.1	18.4	29.4
	Pan	3.3	3.5	2.1	2.1	0.9	2.1	5.5	1.9	0.8	0.8	0.5	0.2	0.8	1.1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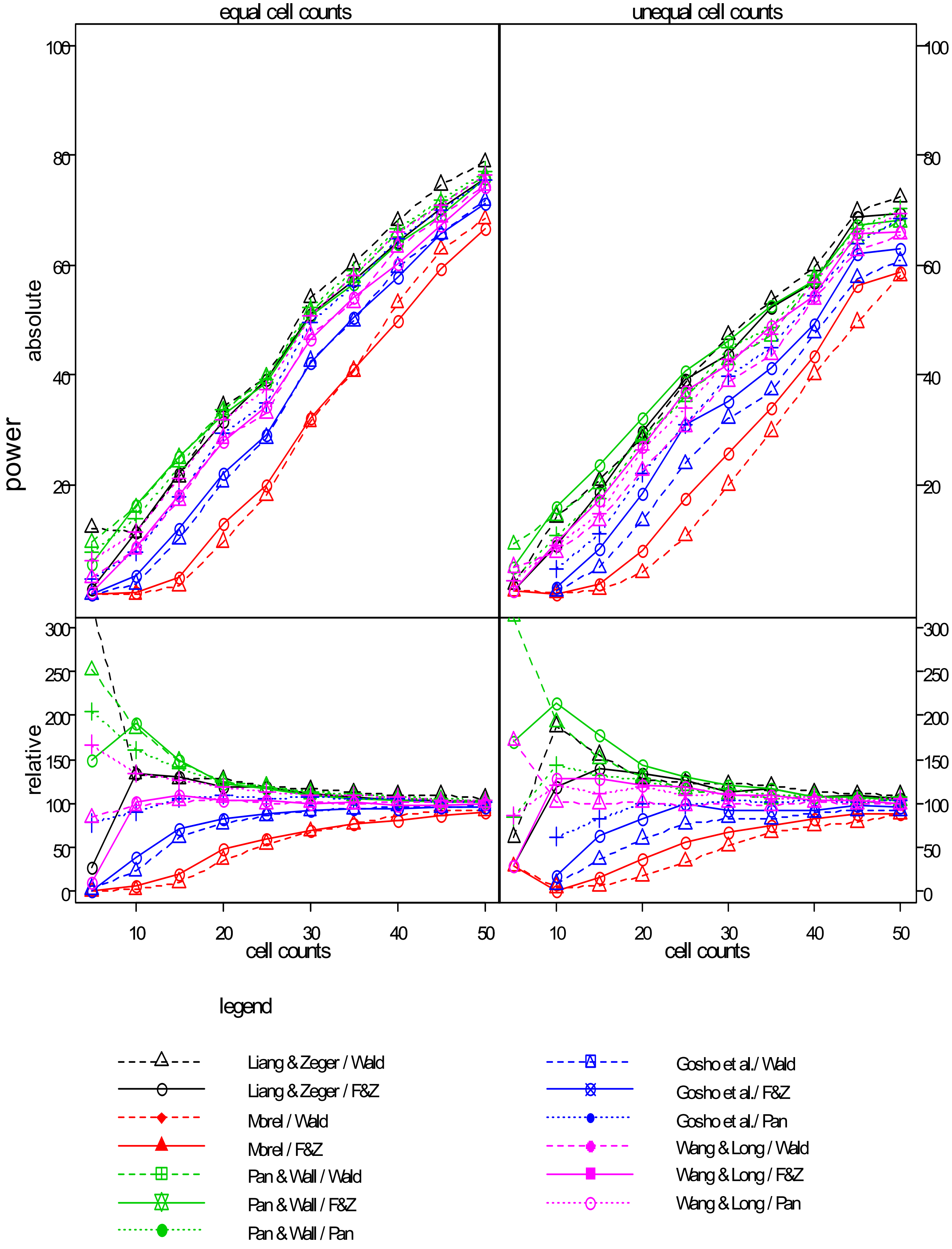
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 2. 3. unequal correlations on B (r = 0.7, 0.5, 0.4, 0.2) exchangeable-structure assumed

10. 2. 3. 1 p = 0.5

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	12.2	11.4	21.4	34.3	54.1	68.1	78.8	1.8	14.2	20.7	28.5	47.2	59.8	72.4
	Fan & Zhang	1.1	11.5	22.0	31.7	51.2	64.1	75.7	0.8	9.0	18.8	29.9	43.9	56.9	69.5
Morel et al.	Wald	0.0	0.2	1.8	9.7	31.6	53.1	68.4	0.8	0.4	0.9	4.1	20.0	40.1	58.0
	Fan & Zhang	0.0	0.5	3.3	12.9	32.2	49.9	66.6	0.8	0.1	2.1	8.2	25.7	43.5	58.7
Pan & Wall	Wald	9.5	15.9	24.9	33.6	51.7	66.0	76.3	9.2	14.6	20.2	29.0	42.8	57.6	67.9
	Fan & Zhang	5.6	16.5	25.2	32.8	50.9	63.9	75.7	5.0	16.2	23.8	32.1	46.3	57.3	68.1
	Pan	7.7	13.8	23.4	33.6	52.2	66.7	77.2	2.5	10.8	17.6	28.1	45.1	58.2	70.3
Gosho et al.	Wald	0.1	2.0	10.3	20.7	42.6	59.7	71.8		0.6	4.9	13.4	32.2	47.6	60.8
	Fan & Zhang	0.0	3.4	12.0	22.2	42.4	57.8	71.2		1.3	8.5	18.6	35.3	49.3	63.0
	Pan	2.9	7.8	17.9	29.6	49.7	64.7	75.5		4.7	11.1	22.3	39.9	54.6	68.4
Wang & Long	Wald	3.1	8.3	17.3	28.5	47.3	63.4	74.7	5.0	7.7	13.4	22.6	38.8	53.9	65.6
	Fan & Zhang	0.4	8.8	18.3	27.9	46.6	60.4	74.2	0.8	9.7	17.2	27.0	41.9	54.5	66.0
	Pan	6.3	11.5	21.2	31.8	50.8	66.0	76.5	2.5	9.1	14.9	26.4	42.8	56.8	69.3


equal cell counts
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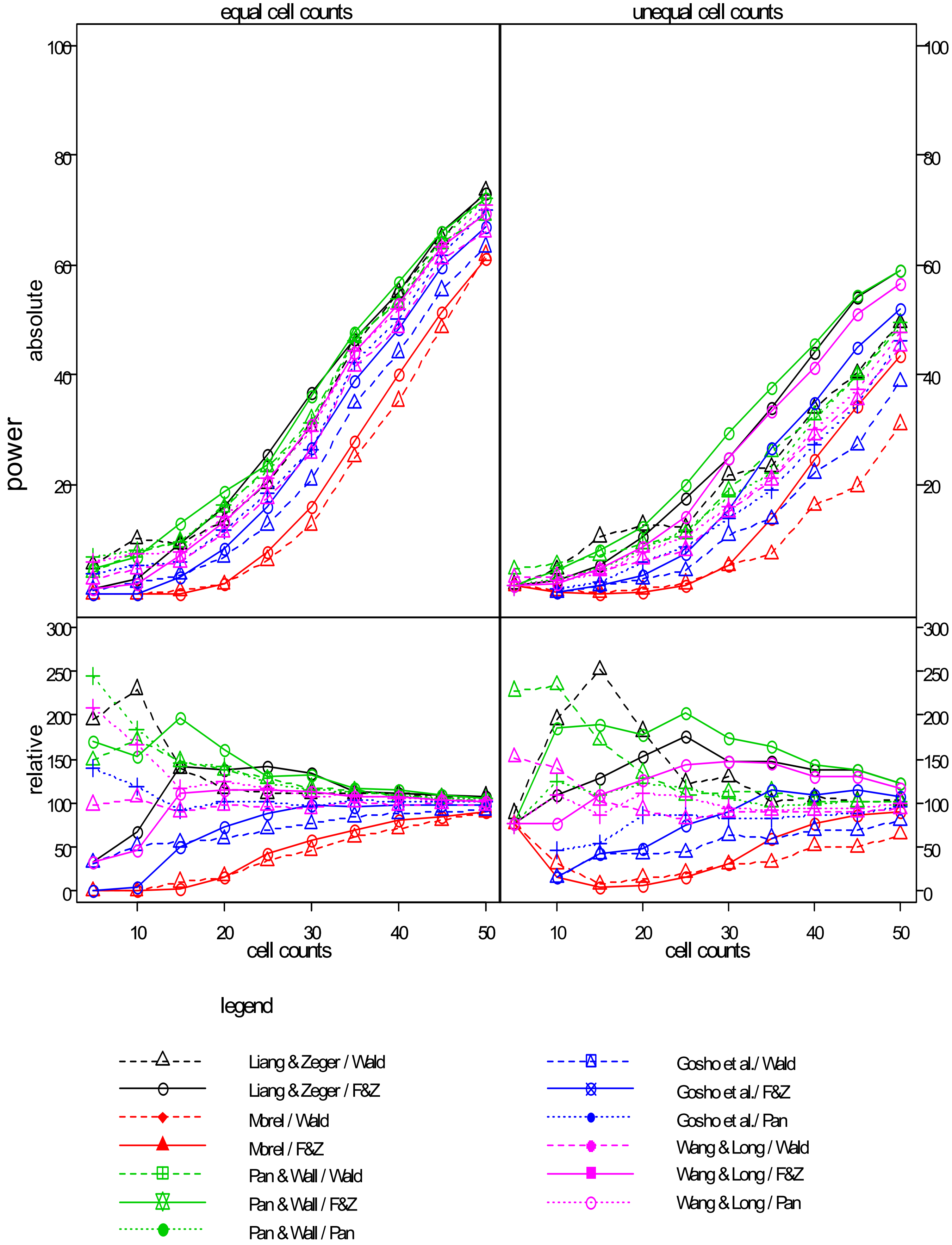
legend
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 2. 3. 2 $p = 0.8$

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	5.5	10.2	9.2	13.5	30.5	55.1	73.5	1.8	4.6	10.5	12.6	21.8	34.0	49.5
	Fan & Zhang	0.9	3.0	9.3	16.0	36.7	55.1	73.0	1.5	2.6	5.4	10.7	24.7	44.0	59.2
Morel et al.	Wald	0.0	0.0	0.7	1.9	12.7	35.2	61.8	1.5	0.7	0.3	1.0	5.2	16.2	31.0
	Fan & Zhang	0.0	0.0	0.2	1.9	16.0	40.2	61.3	1.5	0.4	0.2	0.5	5.3	24.7	43.5
Pan & Wall	Wald	4.2	7.6	9.7	15.8	32.0	53.1	69.0	4.6	5.5	7.2	9.3	19.0	32.6	48.7
	Fan & Zhang	4.8	6.8	12.9	18.6	36.1	56.8	72.2	1.5	4.4	7.9	12.3	29.4	45.6	59.2
	Pan	6.9	8.2	9.5	16.3	31.4	53.8	72.1	1.5	2.9	4.6	8.5	17.8	31.8	49.5
Gosho et al.	Wald	0.9	2.3	3.6	6.9	20.9	44.1	63.4		0.4	1.7	2.9	10.8	22.1	38.8
	Fan & Zhang	0.0	0.2	3.3	8.3	26.6	48.5	66.9		0.4	1.7	3.4	15.3	34.9	51.9
	Pan	3.9	5.3	6.1	11.8	26.5	50.1	70.0		1.1	2.2	6.0	13.9	27.3	46.2
Wang & Long	Wald	2.8	4.7	5.9	11.3	25.7	48.6	66.1	3.1	3.3	4.3	6.4	15.2	29.0	45.1
	Fan & Zhang	0.9	2.1	7.3	13.3	31.1	53.0	69.4	1.5	1.8	4.6	8.8	24.9	41.3	56.5
	Pan	5.8	7.4	7.7	14.3	29.6	51.9	71.1	1.5	2.6	3.7	7.7	16.0	30.1	47.8


equal cell counts
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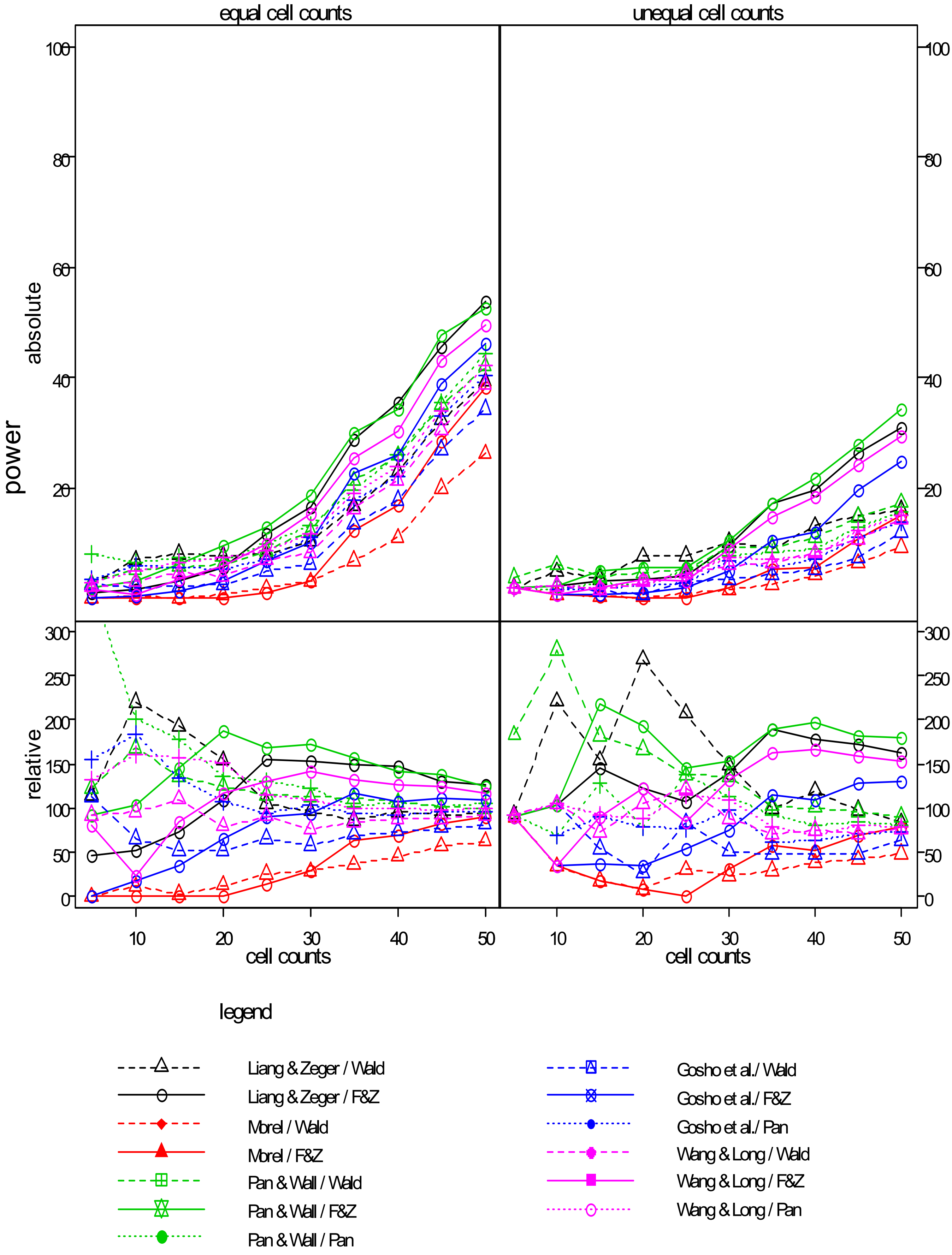
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 2. 3. 3 p = 0.9

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	2.6	7.1	8.2	7.8	10.5	23.1	39.3	2.0	4.9	3.5	7.7	10.2	13.2	16.0
	Fan & Zhang	1.0	1.7	3.1	5.5	16.5	35.5	53.8	1.9	2.3	3.3	3.5	9.6	19.6	30.9
Morel et al.	Wald	0.0	0.4	0.1	0.6	3.1	11.0	26.4	1.9	0.8	0.4	0.3	1.6	4.3	9.3
	Fan & Zhang	0.0	0.0	0.0	0.1	3.2	16.9	38.4	1.9	0.8	0.4	0.3	2.1	5.7	15.1
Pan & Wall	Wald	2.8	5.4	5.8	6.3	12.2	25.9	42.1	3.8	6.2	4.1	4.8	9.4	11.1	17.3
	Fan & Zhang	2.1	3.3	6.2	9.5	18.6	34.4	52.7	1.9	2.3	4.9	5.5	10.5	21.8	34.3
	Pan	8.0	6.4	7.5	6.8	13.3	26.2	44.4	1.9	1.6	2.9	2.3	7.7	9.0	15.6
Gosho et al.	Wald	2.5	2.1	2.2	2.6	6.3	17.9	34.4		2.3	1.2	0.8	3.5	5.4	12.1
	Fan & Zhang	0.0	0.6	1.5	3.3	10.2	26.0	46.1		0.8	0.8	1.0	5.2	12.1	24.9
	Pan	3.5	5.9	5.7	5.4	11.2	22.1	40.5		1.6	2.0	2.3	6.8	7.0	14.0
Wang & Long	Wald	2.1	3.1	4.7	4.0	8.3	21.4	38.9	1.9	2.3	1.6	3.0	6.1	8.3	14.5
	Fan & Zhang	1.8	0.7	3.6	5.9	15.3	30.5	49.5	1.9	0.8	2.0	3.5	9.1	18.3	29.5
	Pan	3.0	5.1	6.7	7.6	11.9	24.1	42.4	1.9	2.3	2.1	2.5	7.5	7.7	15.1

10. 2. 3.Main effect B (effects $b_i = 0.3*s$)

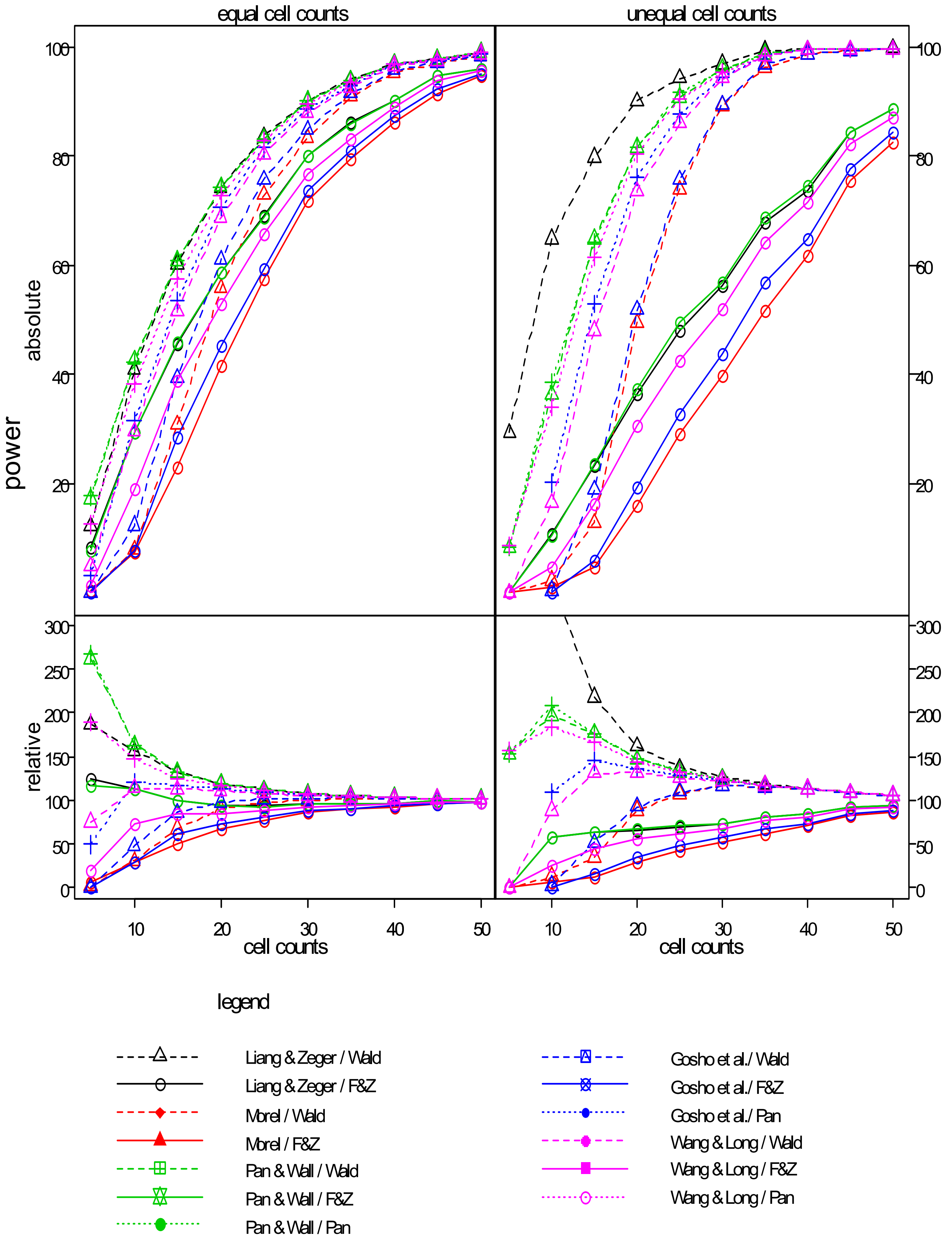


10. 3. Interaction effect A (effects ab_{ij} = 0.4*s)

10. 3. 1. equal correlations on B (r=0.3)

10. 3. 1. 1 p = 0.5

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	12.3	40.9	60.3	74.3	90.2	97.0	99.0	29.4	64.9	79.9	90.1	96.9	99.6	99.8
	Fan & Zhang	8.3	29.5	45.5	58.6	80.0	90.3	96.0	0.0	10.7	23.3	36.4	56.4	73.6	88.7
Morel et al.	Wald	0.1	8.0	30.9	56.0	83.4	95.4	98.3	0.0	2.4	12.8	49.5	89.3	98.7	99.5
	Fan & Zhang	0.4	7.4	23.0	41.6	71.9	86.2	94.9	0.0	1.1	4.7	16.1	39.8	61.8	82.5
Pan & Wall	Wald	17.3	42.7	60.9	74.5	90.2	97.0	99.0	8.3	36.4	64.8	81.7	96.1	99.6	99.6
	Fan & Zhang	7.8	29.6	45.8	58.8	80.1	90.3	96.0	0.0	10.6	23.6	37.4	56.9	74.7	88.5
	Pan	17.7	42.3	60.8	74.4	90.2	97.0	99.0	8.3	38.6	64.2	81.6	95.6	99.6	99.6
Gosho et al.	Wald	0.0	12.4	39.4	61.1	84.9	95.8	98.5		0.5	18.9	51.9	89.4	98.7	99.6
	Fan & Zhang	0.0	7.9	28.4	45.3	73.8	87.4	95.2		0.2	5.9	19.3	43.9	64.9	84.3
	Pan	3.3	31.5	53.5	70.8	88.7	96.8	98.8		20.2	53.1	76.2	94.6	99.6	99.6
Wang & Long	Wald	4.9	29.7	51.7	68.8	87.9	96.6	98.7	0.0	16.4	48.1	73.6	94.3	99.6	99.6
	Fan & Zhang	1.3	19.1	38.8	52.8	76.8	89.1	95.7	0.0	4.8	16.2	30.7	51.9	71.5	87.1
	Pan	12.5	38.3	57.5	72.7	89.6	96.8	99.0	8.6	34.0	61.4	80.3	95.3	99.6	99.6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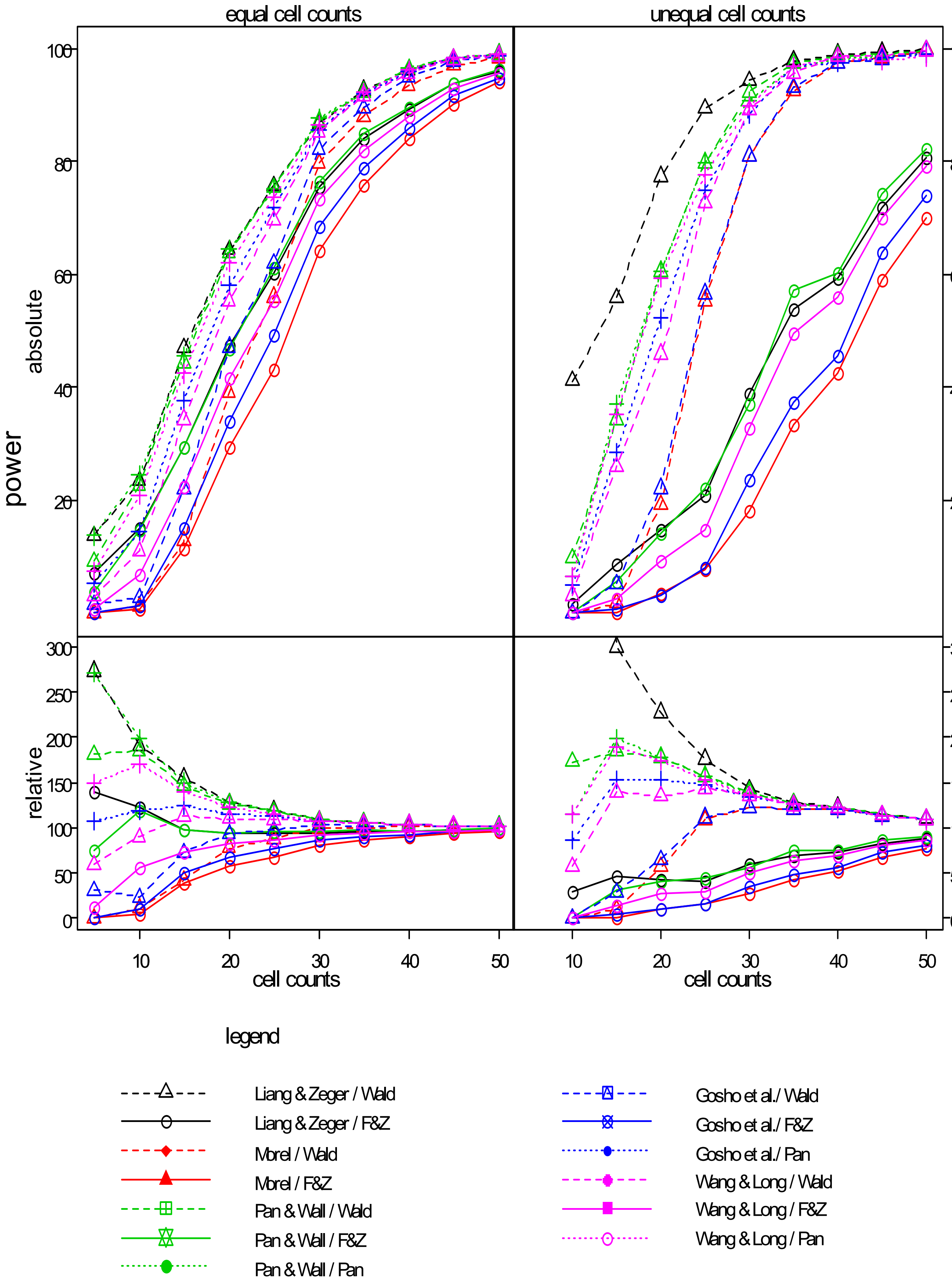
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 3. 1. 2 p = 0.8

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	13.8	23.5	47.0	64.4	86.9	96.2	99.1		41.2	55.8	77.4	94.4	99.1	99.9
	Fan & Zhang	7.1	15.1	29.5	47.5	75.4	89.2	96.1		1.6	8.8	14.7	39.0	59.3	80.7
Morel et al.	Wald	0.0	1.3	12.8	39.1	79.7	93.4	98.5		0.0	1.8	19.3	81.0	97.4	99.8
	Fan & Zhang	0.0	0.7	11.5	29.4	64.1	84.2	94.1		0.0	0.0	3.6	18.2	42.7	69.9
Pan & Wall	Wald	9.2	22.8	44.4	63.8	87.2	96.5	99.1		9.8	34.4	60.6	92.2	98.8	99.6
	Fan & Zhang	3.8	14.6	29.5	46.9	76.5	89.5	96.4		0.0	5.7	14.1	37.2	60.3	82.2
	Pan	13.7	24.5	45.5	64.6	87.7	96.4	99.0		6.6	37.0	60.6	90.9	98.2	99.1
Gosho et al.	Wald	1.6	2.8	22.1	47.1	82.1	94.9	98.6		0.0	5.3	22.2	81.0	97.4	99.6
	Fan & Zhang	0.0	1.3	15.1	33.9	68.6	85.8	94.7		0.0	0.9	3.2	23.6	45.5	74.1
	Pan	5.5	14.5	37.7	58.2	85.7	96.0	98.8		4.9	28.6	52.2	88.4	97.6	99.2
Wang & Long	Wald	3.0	11.1	34.4	55.3	85.2	95.7	98.8		3.3	26.0	45.9	89.1	98.6	99.6
	Fan & Zhang	0.6	6.8	22.3	41.6	73.5	88.1	95.8		0.0	2.6	9.2	32.8	56.0	79.2
	Pan	7.5	20.9	42.4	62.1	86.5	96.2	99.0		6.6	35.2	59.3	89.9	98.4	98.6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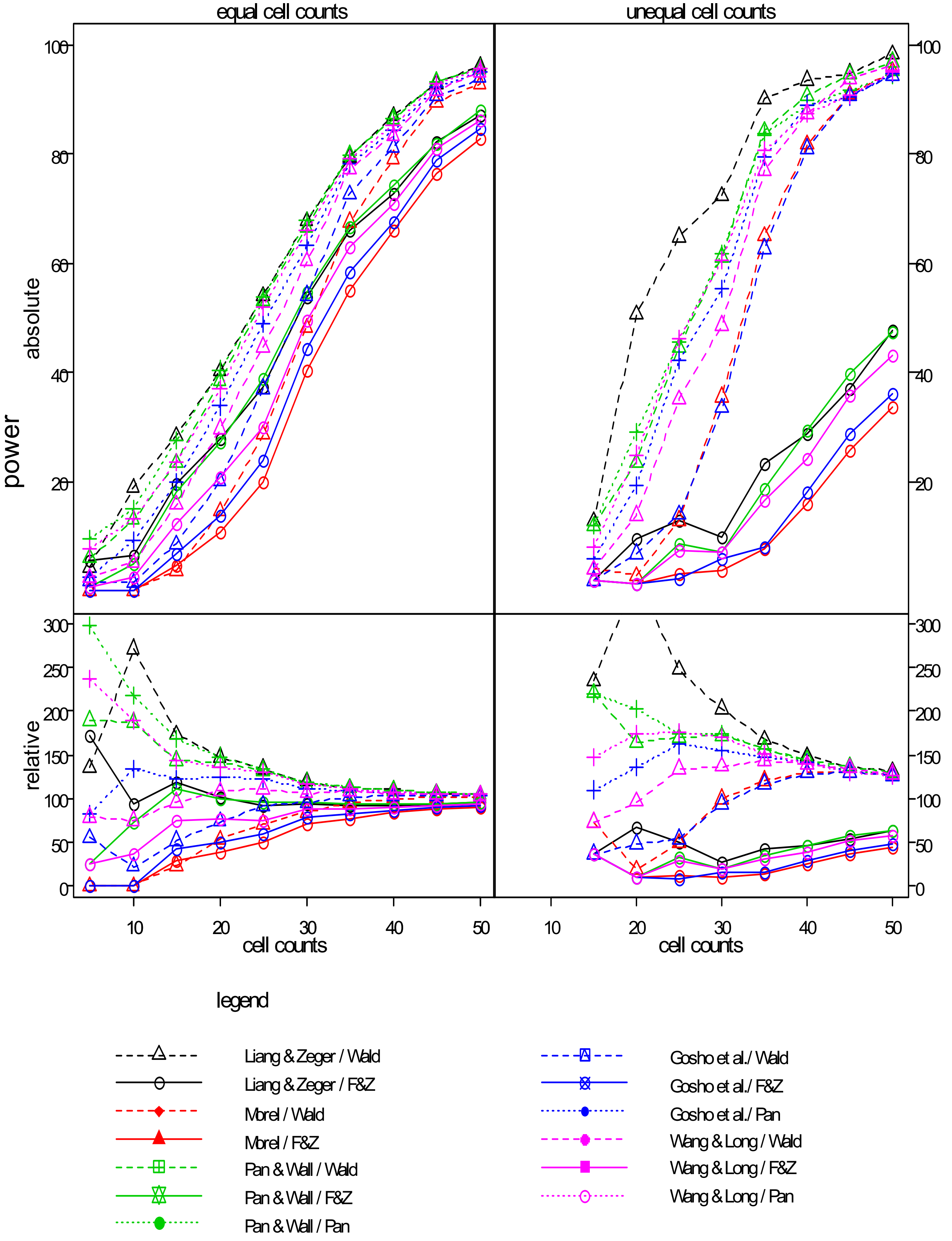
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al. / Wald
Gosho et al. / F&Z
Gosho et al. / Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 3. 1. 3 p = 0.9

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	4.3	18.9	28.4	40.3	67.8	87.0	96.1			12.8	50.7	72.4	93.6	98.3
	Fan & Zhang	5.6	6.6	19.5	28.0	53.9	72.9	87.1			2.0	9.7	9.9	28.8	47.7
Morel et al.	Wald	0.0	0.0	3.9	14.6	48.3	79.1	92.8			4.0	2.8	35.5	81.7	95.2
	Fan & Zhang	0.0	0.0	4.7	10.7	40.5	65.9	82.8			2.0	1.4	3.9	16.0	33.8
Pan & Wall	Wald	6.1	13.1	23.6	38.5	66.6	86.5	95.6			12.0	23.6	61.2	90.7	96.9
	Fan & Zhang	0.8	5.1	18.2	27.2	54.9	74.2	88.1			2.0	1.4	7.2	29.5	47.5
	Pan	9.6	15.2	27.7	40.6	67.9	86.4	95.8			12.0	29.2	61.8	89.1	94.6
Gosho et al.	Wald	1.8	1.6	8.6	20.2	54.2	81.3	93.9			2.0	6.9	33.6	81.1	94.4
	Fan & Zhang	0.0	0.0	6.9	13.9	44.3	67.5	84.7			2.0	1.4	5.9	18.3	36.2
	Pan	2.7	9.4	20.1	33.9	63.4	84.3	95.0			6.0	19.4	55.3	89.1	94.8
Wang & Long	Wald	2.5	5.3	15.8	29.7	60.4	83.3	95.0			4.0	13.9	48.7	87.5	96.2
	Fan & Zhang	0.8	2.5	12.2	20.9	49.6	70.9	86.1			2.0	1.4	7.2	24.4	43.1
	Pan	7.6	13.2	23.6	37.2	66.0	85.2	95.6			8.0	25.0	60.5	87.5	95.0


equal cell counts
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cell counts
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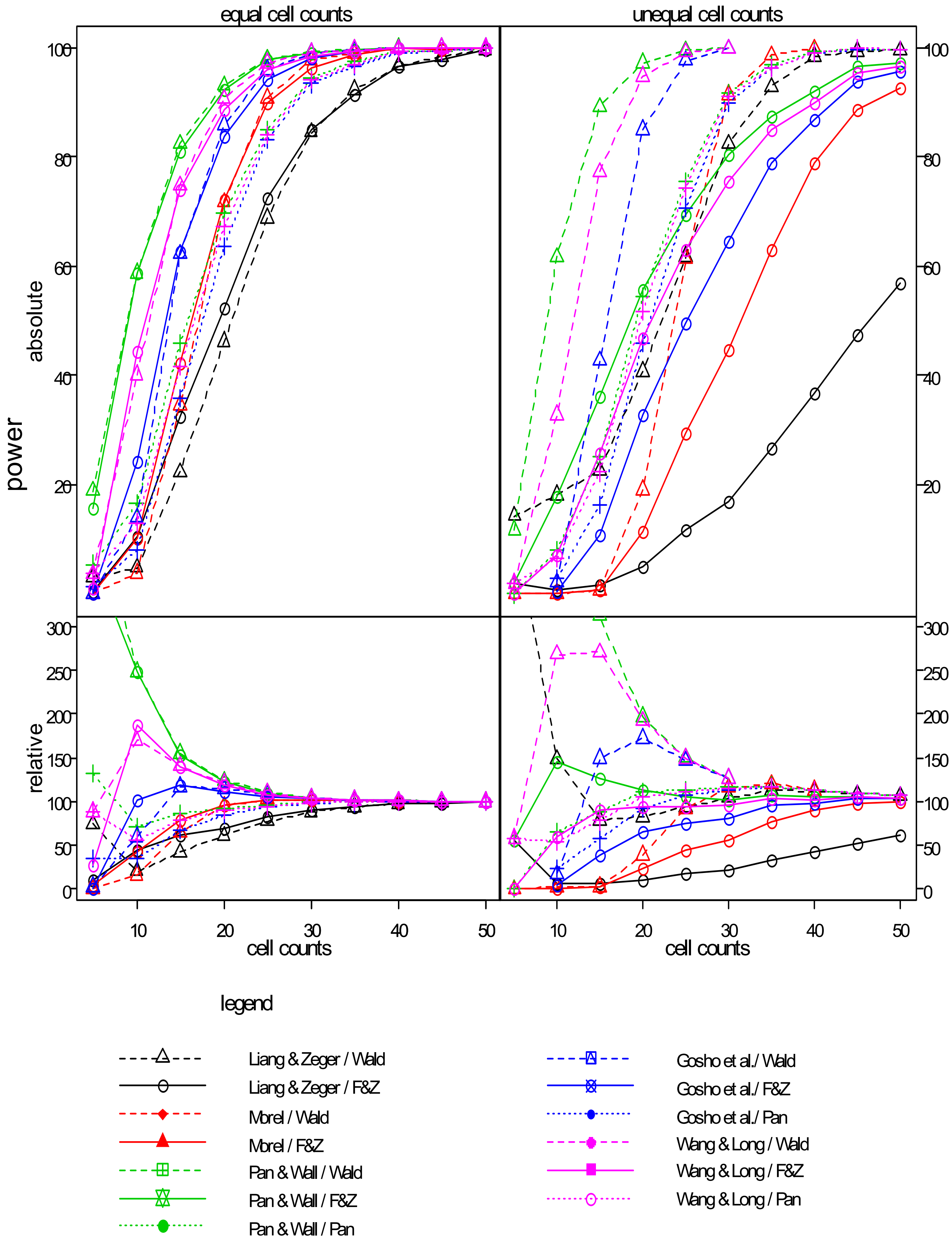
legend
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 3. 2. unequal correlations on B (r = 0.7, 0.5, 0.4, 0.2) ar1-structure assumed

10. 3. 2. 1 p = 0.5

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	3.1	4.8	22.3	46.2	84.5	96.7	99.7	14.3	18.1	22.6	40.7	82.4	98.4	99.6
	Fan & Zhang	0.4	10.6	32.4	52.4	85.1	96.6	99.6	1.9	0.8	1.7	5.1	16.8	36.9	57.0
Morel et al.	Wald	0.0	3.9	34.6	71.7	97.7	99.8	100.0	0.0	0.2	0.7	19.1	91.4	99.8	100.0
	Fan & Zhang	0.2	10.1	42.1	72.1	96.2	99.9	100.0	0.0	0.0	0.9	11.4	44.6	78.7	92.5
Pan & Wall	Wald	18.9	58.8	82.5	93.1	99.3	100.0	100.0	11.8	61.7	89.2	97.3	99.8	100.0	100.0
	Fan & Zhang	15.6	58.8	81.1	92.2	98.9	100.0	100.0	1.9	17.7	36.0	55.8	80.3	92.0	97.2
	Pan	5.5	16.6	45.9	69.8	94.5	99.2	100.0	0.0	8.1	25.3	54.4	91.7	99.2	99.7
Gosho et al.	Wald	0.1	14.1	62.2	85.9	99.0	99.8	100.0		2.2	42.7	85.1	99.8	100.0	100.0
	Fan & Zhang	0.0	24.2	62.8	83.9	98.2	100.0	100.0		0.5	10.9	32.7	64.4	86.9	95.7
	Pan	1.4	8.1	35.7	63.7	93.4	99.1	100.0		3.0	16.3	45.8	90.0	99.0	99.6
Wang & Long	Wald	3.7	40.1	74.9	90.7	99.1	99.9	100.0	2.0	32.8	77.3	94.8	99.8	100.0	100.0
	Fan & Zhang	1.2	44.5	74.1	88.7	98.5	100.0	100.0	0.0	7.3	25.7	46.8	75.5	90.0	96.5
	Pan	3.7	13.1	41.7	67.3	94.2	99.2	100.0	2.0	6.7	22.3	51.9	91.1	99.0	99.6


equal cell counts
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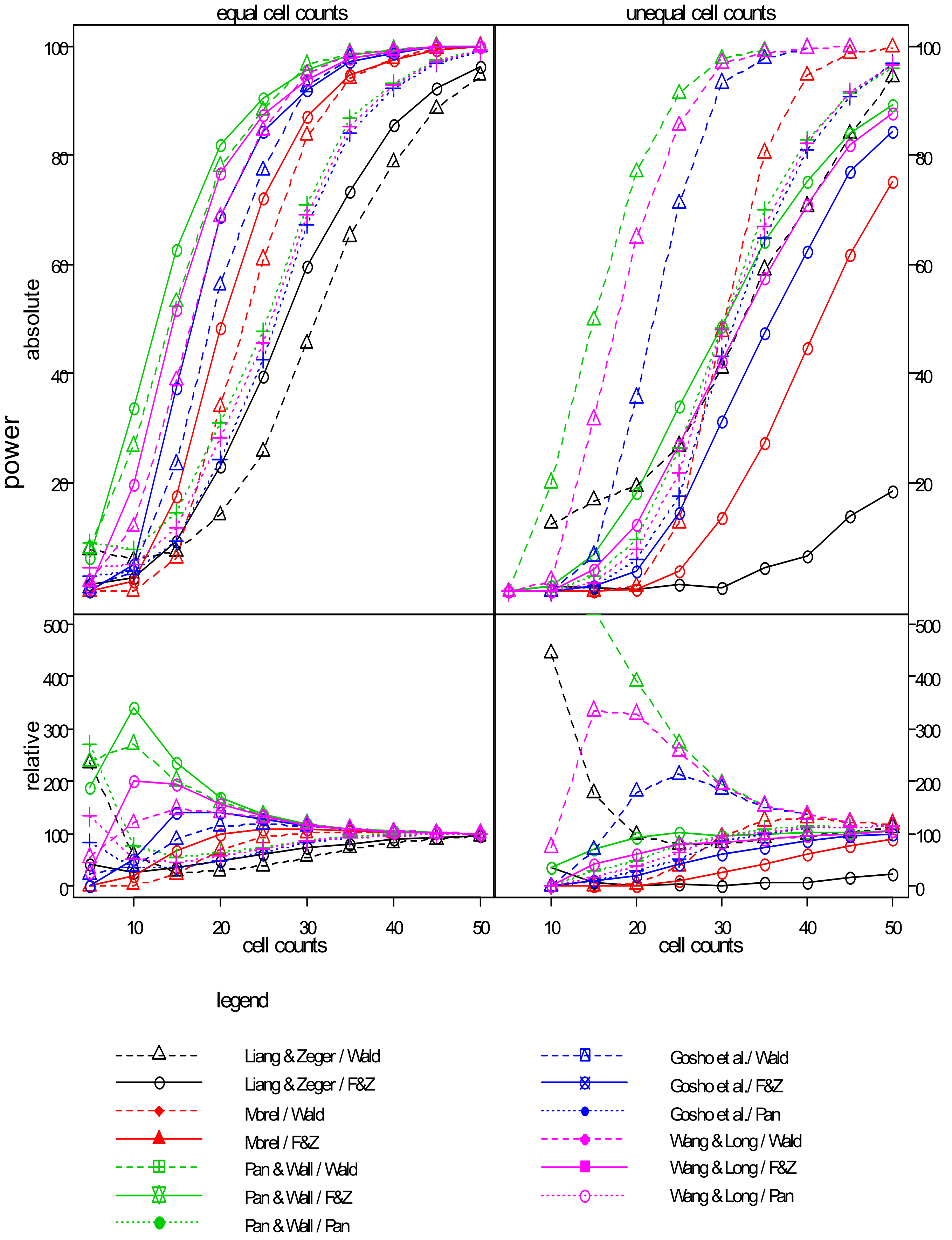
cell counts
legend
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 3. 2. 2 p = 0.8

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	7.9	5.9	7.3	14.1	45.5	78.7	94.6		12.5	16.7	19.3	41.1	70.6	94.3
	Fan & Zhang	1.4	2.6	9.4	23.2	59.7	85.6	96.4	0.0	1.0	0.7	0.3	0.9	6.6	18.3
Morel et al.	Wald	0.0	0.2	6.1	34.0	83.6	97.7	100.0	0.0	0.0	0.0	1.0	47.8	94.6	99.8
	Fan & Zhang	0.0	1.9	17.5	48.3	87.1	97.5	99.8	0.0	0.0	0.0	0.5	13.6	44.7	75.3
Pan & Wall	Wald	7.9	26.8	53.1	78.1	96.6	99.4	99.9	0.0	20.0	49.8	77.0	97.8	100.0	100.0
	Fan & Zhang	6.3	33.7	62.7	81.8	95.8	99.2	99.9	0.0	1.0	6.8	18.3	48.6	75.1	89.4
	Pan	9.0	7.7	14.5	30.9	70.9	93.3	99.2	0.0	0.0	2.7	9.6	48.4	82.8	96.0
Gosho et al.	Wald	0.8	3.9	23.4	56.2	92.6	99.0	99.9		0.0	6.5	35.6	93.3	99.6	100.0
	Fan & Zhang	0.0	5.0	37.4	68.7	92.1	98.7	99.9		0.0	1.0	3.9	31.4	62.5	84.4
	Pan	2.8	3.7	9.4	24.2	67.3	92.3	99.1		0.0	1.0	6.0	43.1	81.1	96.9
Wang & Long	Wald	1.9	12.0	38.8	68.7	94.9	99.3	99.9	0.0	2.1	31.6	64.9	96.9	99.6	100.0
	Fan & Zhang	0.9	19.7	51.6	76.7	94.0	98.9	99.9	0.0	0.0	4.1	12.4	42.2	70.9	87.6
	Pan	4.4	5.1	11.7	28.3	69.0	92.8	99.2	0.0	0.0	1.7	7.7	47.9	82.2	96.6


equal cell counts
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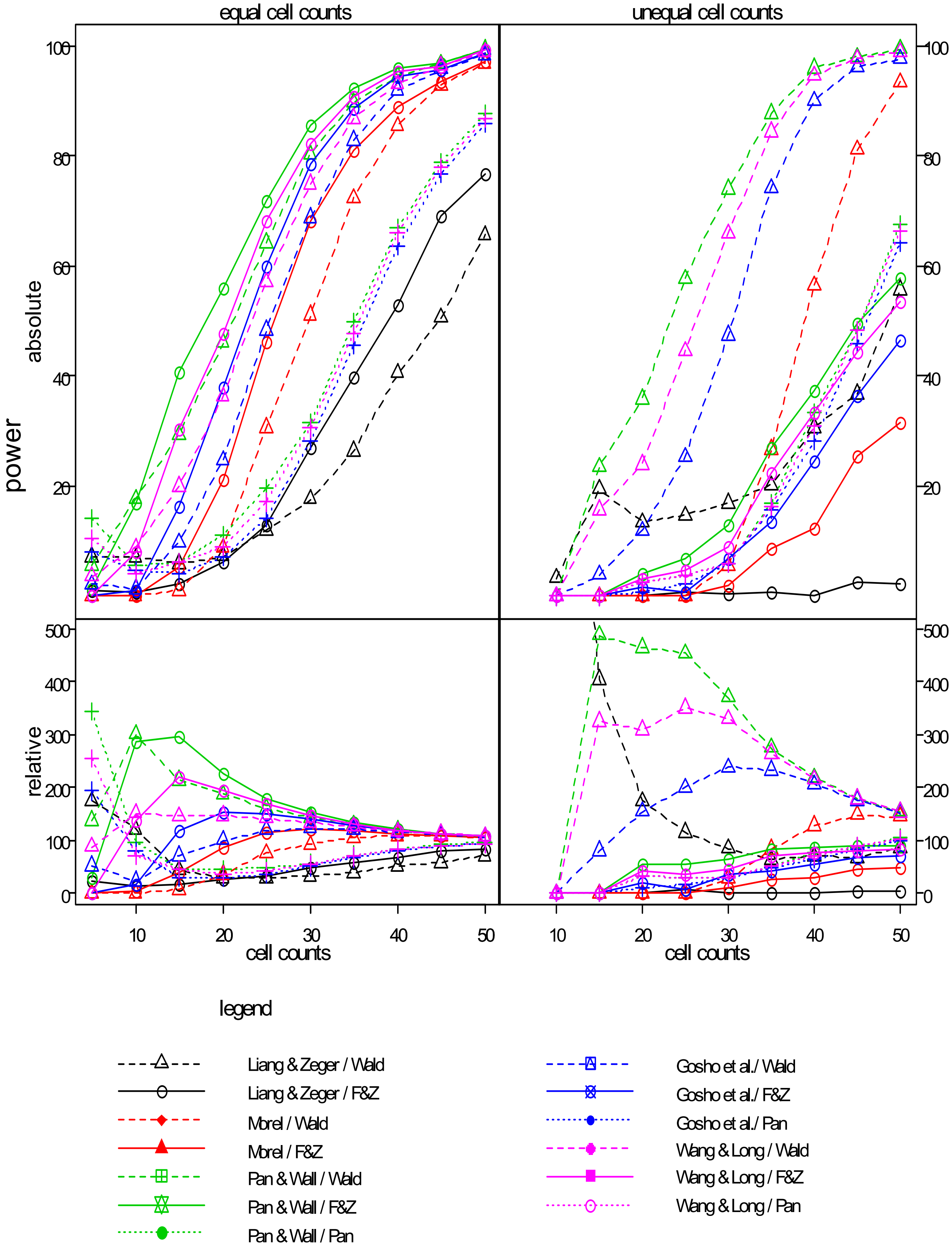
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 3. 2. 3 p = 0.9

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	7.2	7.1	6.0	7.3	17.7	40.6	65.7		3.3	19.5	13.5	16.9	30.7	55.7
	Fan & Zhang	0.9	0.8	2.2	6.3	27.1	53.0	76.8		0.0	0.0	0.0	0.5	0.3	2.4
Morel et al.	Wald	0.0	0.0	1.0	8.9	51.1	85.5	96.9		0.0	0.0	0.0	5.5	56.5	93.4
	Fan & Zhang	0.0	0.3	5.2	21.3	68.1	88.8	97.1		0.0	0.0	0.0	2.0	12.4	31.7
Pan & Wall	Wald	5.7	17.7	29.4	46.1	80.3	94.5	99.4		0.0	23.5	35.9	74.0	95.9	99.5
	Fan & Zhang	1.2	16.9	40.7	56.1	85.5	95.9	99.5		0.0	0.0	4.2	13.0	37.5	57.7
	Pan	14.2	5.6	6.3	11.1	31.6	67.1	87.8		0.0	0.0	2.6	6.0	33.4	67.6
Gosho et al.	Wald	2.2	1.4	9.8	24.8	68.8	92.0	98.5		0.0	3.9	12.0	47.5	90.1	97.6
	Fan & Zhang	0.0	1.0	16.3	38.1	78.7	94.5	98.7		0.0	0.0	1.7	7.0	24.6	46.6
	Pan	8.0	4.8	4.0	7.1	28.2	63.6	86.0		0.0	0.0	0.9	6.0	28.4	64.3
Wang & Long	Wald	3.6	8.9	20.0	36.4	75.0	93.1	98.8		0.0	15.7	23.9	66.0	94.7	98.9
	Fan & Zhang	0.0	8.1	30.3	47.6	82.2	95.2	99.3		0.0	0.0	3.3	9.0	33.4	53.6
	Pan	10.6	4.2	6.4	9.0	30.5	65.9	86.7		0.0	0.0	2.6	6.0	30.9	66.3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unequal cell counts
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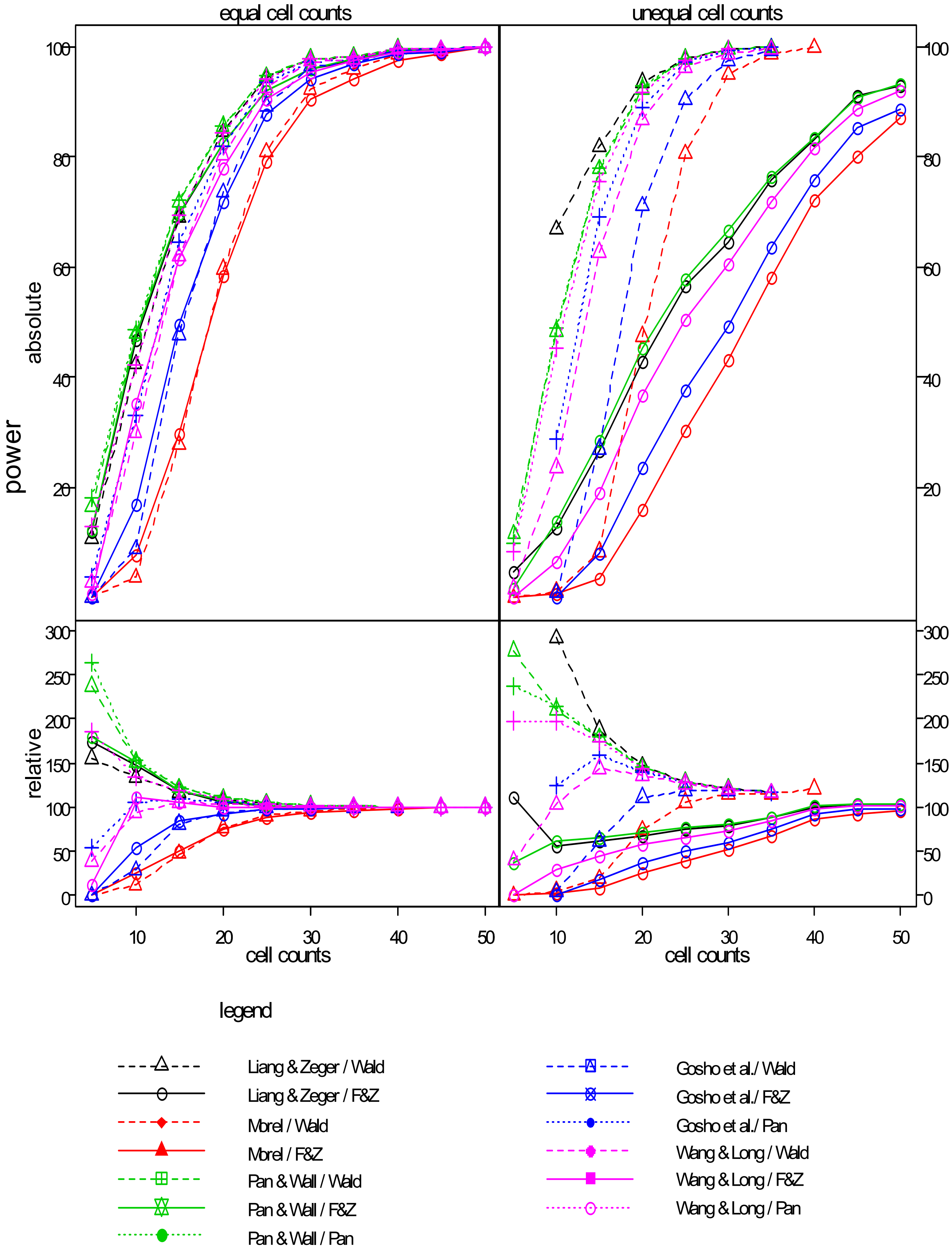
cell counts
legend
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 3. 3. unequal correlations on B (r = 0.7, 0.5, 0.4, 0.2) exchangeable structure assumed

10. 3. 3. 1 p = 0.5

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	10.8	42.4	69.1	84.5	97.9	99.7	99.9		66.9	81.8	93.5	99.5	100.0	100.0
	Fan & Zhang	12.1	46.7	69.5	82.6	96.1	99.3	100.0	4.7	12.7	26.8	43.0	64.6	83.3	93.0
Morel et al.	Wald	0.0	3.7	27.8	59.7	92.4	98.7	99.9	0.0	1.2	8.4	47.5	94.9	99.9	100.0
	Fan & Zhang	0.0	7.8	29.8	58.3	90.4	97.5	99.8	0.0	0.7	3.6	15.9	43.2	72.2	87.0
Pan & Wall	Wald	16.5	47.9	71.8	85.7	97.9	99.7	99.9	11.7	48.4	77.8	92.4	99.6	100.0	100.0
	Fan & Zhang	12.4	47.8	69.7	82.7	96.1	99.4	100.0	1.6	14.0	28.4	45.4	66.5	83.6	93.3
	Pan	18.3	48.6	72.1	85.7	97.9	99.7	99.9	10.0	49.1	78.1	92.9	99.6	100.0	100.0
Gosho et al.	Wald	0.0	9.0	47.8	73.6	96.4	99.3	99.9		0.9	27.0	71.1	97.5	100.0	100.0
	Fan & Zhang	0.0	16.8	49.6	71.7	94.1	98.7	99.8		0.3	8.1	23.7	49.3	75.8	88.6
	Pan	3.7	33.2	64.6	82.0	97.3	99.6	99.9		28.7	69.1	89.1	99.2	100.0	100.0
Wang & Long	Wald	2.7	29.8	61.9	80.5	97.3	99.6	99.9	1.7	23.6	62.7	86.7	98.6	100.0	100.0
	Fan & Zhang	0.9	35.1	61.5	78.0	95.3	99.0	99.9	0.0	6.6	19.0	36.9	60.7	81.6	92.1
	Pan	12.9	42.4	69.4	84.4	97.7	99.7	99.9	8.3	45.4	75.6	91.7	99.6	100.0	100.0


equal cell counts
unequal cell counts
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cell counts
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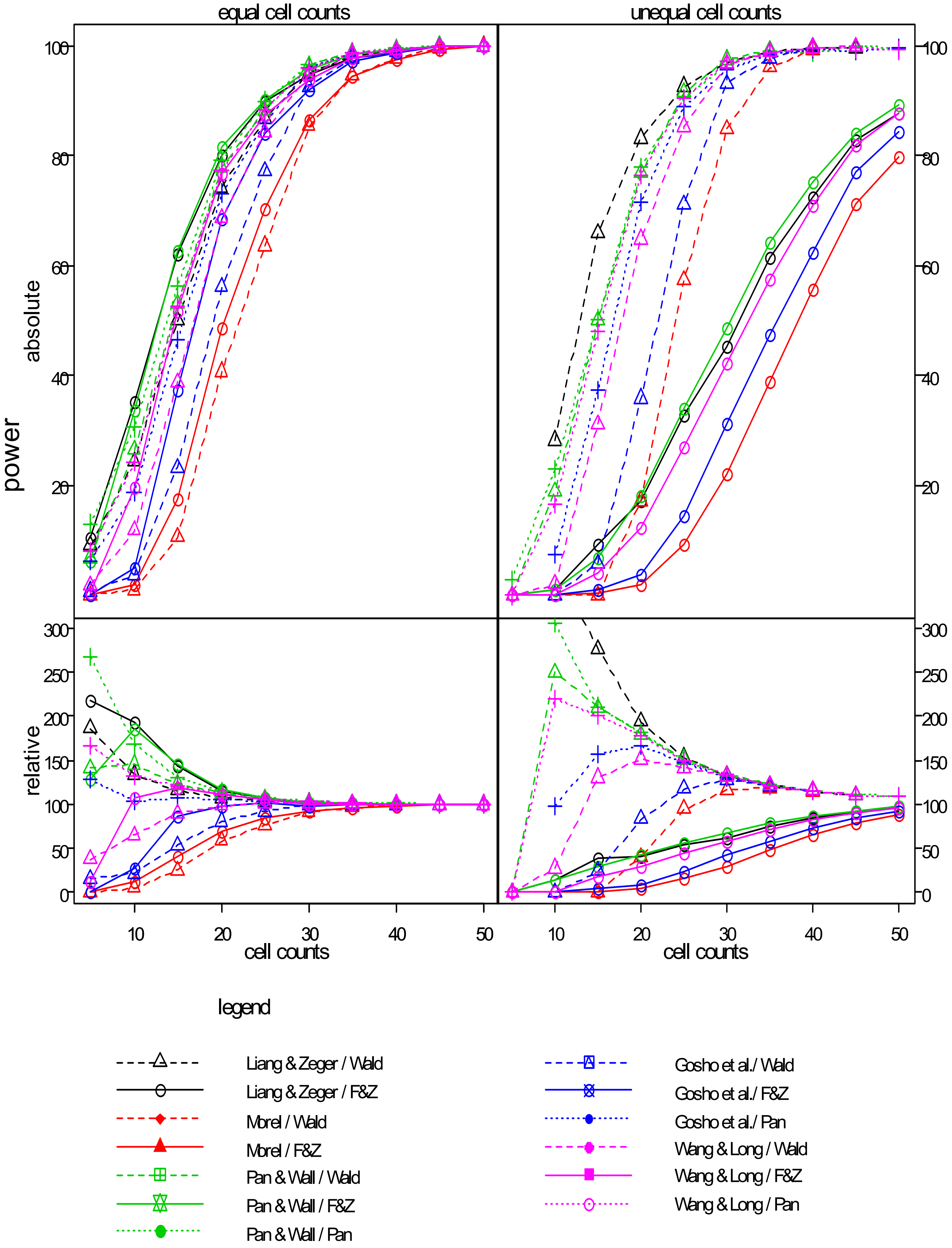
legend
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan

10. 3. 3. 2 p = 0.8

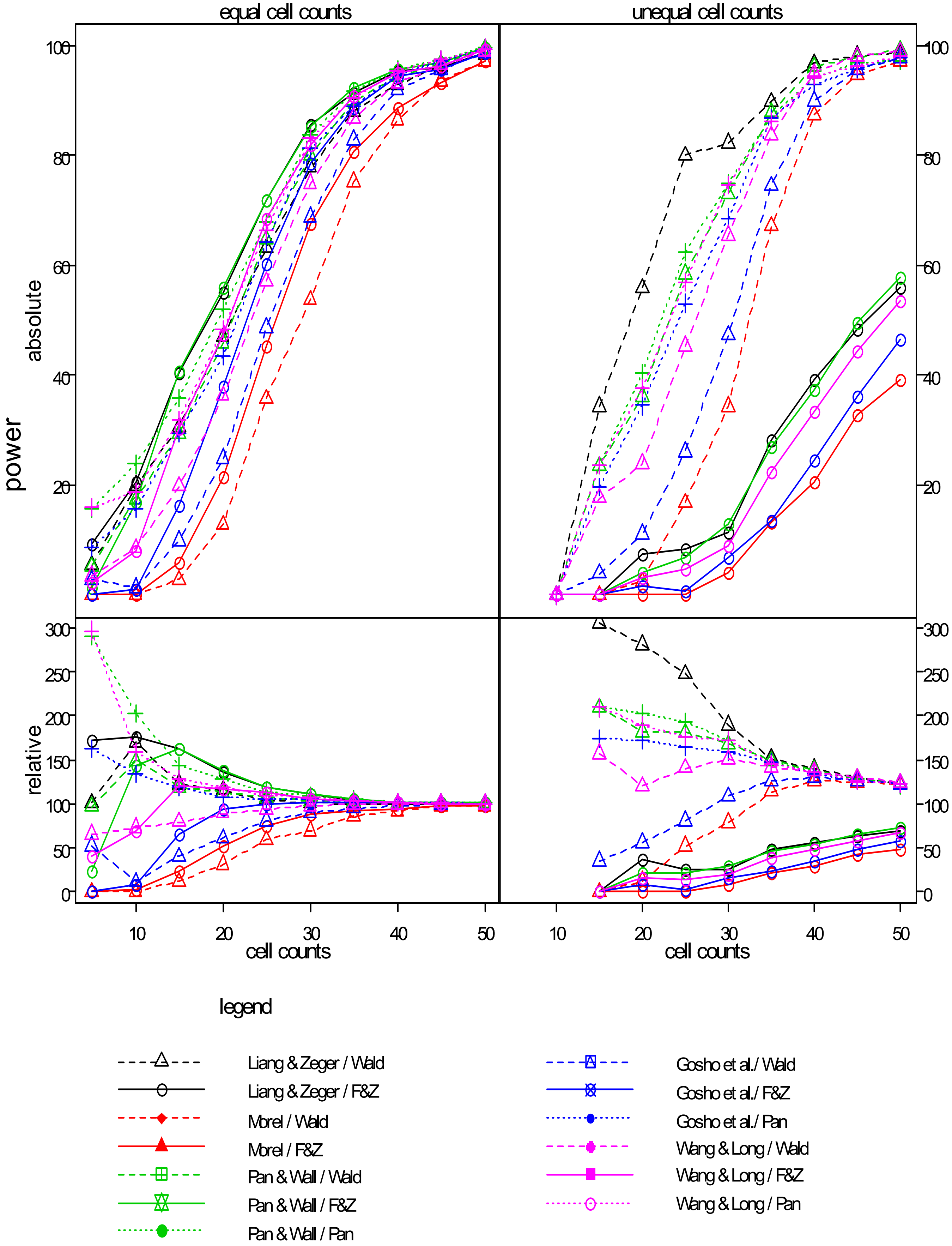
		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	9.1	24.5	50.0	74.2	95.0	99.3	100.0		28.3	65.9	83.2	96.8	99.7	100.0
	Fan & Zhang	10.6	35.2	61.9	80.2	94.7	98.8	99.9	0.0	1.0	9.2	17.3	45.4	72.6	87.9
Morel et al.	Wald	0.0	0.9	10.6	40.7	85.4	97.9	100.0	0.0	0.0	0.0	17.3	84.9	99.3	100.0
	Fan & Zhang	0.0	2.1	17.5	48.7	86.6	97.5	99.8	0.0	0.0	0.3	2.0	22.0	55.8	79.9
Pan & Wall	Wald	6.9	26.5	53.1	77.9	96.5	99.4	99.9	0.0	18.9	50.0	76.8	97.6	100.0	100.0
	Fan & Zhang	6.3	33.6	62.7	81.7	95.7	99.2	99.9	0.0	1.0	6.8	18.3	48.5	75.1	89.4
	Pan	13.1	30.5	56.3	79.3	96.5	99.7	99.9	2.9	23.2	50.3	78.0	96.7	98.8	99.7
Gosho et al.	Wald	0.7	3.9	23.2	56.1	92.5	99.0	99.9		0.0	5.8	35.8	93.1	99.6	100.0
	Fan & Zhang	0.0	5.0	37.3	68.6	92.0	98.7	99.9		0.0	1.0	3.9	31.3	62.5	84.4
	Pan	6.2	18.8	46.6	73.2	96.0	99.4	100.0		7.4	37.3	71.5	95.5	99.3	99.5
Wang & Long	Wald	1.8	11.8	38.8	68.6	94.8	99.3	99.9	0.0	2.1	31.2	64.9	96.7	99.6	100.0
	Fan & Zhang	0.6	19.7	51.6	76.7	93.9	98.9	99.9	0.0	0.0	4.1	12.4	42.2	70.9	87.6
	Pan	8.1	24.2	52.6	77.2	96.0	99.4	99.9	0.0	16.7	47.9	76.5	97.1	99.6	99.2

10. 3. 3.Interaction effect A (effects $ab_{ij} = 0.4*s$)



10. 3. 3. 3 p = 0.9

		equal cell counts							unequal cell counts						
method	Anova-type	5	10	15	20	30	40	50	5	10	15	20	30	40	50
Liang & Zeger	Wald	5.5	20.0	30.6	47.1	77.8	92.9	98.5		0	34.4	56.0	82.2	96.9	98.7
	Fan & Zhang	9.3	20.6	40.5	55.2	85.5	95.5	98.7		0	0.0	7.5	11.4	39.2	55.9
Morel et al.	Wald	0.0	0.0	2.8	12.9	53.8	86.5	97.2		0	0.0	2.5	34.3	87.3	97.3
	Fan & Zhang	0.0	0.3	5.8	21.5	67.4	88.5	97.2		0	0.0	0.0	4.0	20.5	39.2
Pan & Wall	Wald	5.2	17.5	29.3	46.0	80.1	94.4	99.5		0	23.5	36.2	73.0	96.2	99.3
	Fan & Zhang	1.2	16.8	40.6	56.0	85.4	95.8	99.6		0	0.0	4.2	12.9	37.5	57.7
	Pan	15.7	23.8	35.8	52.0	83.9	95.6	99.6		0	23.5	40.5	75.0	94.2	97.3
Gosho et al.	Wald	2.8	1.4	9.9	24.9	68.9	92.0	98.6		0	3.9	11.2	47.3	89.9	97.8
	Fan & Zhang	0.0	1.0	16.2	38.0	78.6	94.4	98.8		0	0.0	1.7	7.0	24.6	46.6
	Pan	8.8	15.8	29.5	43.5	81.5	94.8	99.5		0	19.6	34.5	68.7	92.9	97.8
Wang & Long	Wald	3.6	8.6	19.8	36.3	74.9	93.1	98.9		0	17.6	23.9	65.5	94.9	98.9
	Fan & Zhang	2.2	8.0	30.2	47.5	82.1	95.1	99.4		0	0.0	3.3	9.0	33.4	53.6
	Pan	16.1	18.7	31.9	48.5	83.0	95.2	99.5		0	23.5	37.6	74.5	94.4	98.2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cell counts
legend
Liang & Zeger / Wald
Liang & Zeger / F&Z
Morel / Wald
Morel / F&Z
Pan & Wall / Wald
Pan & Wall / F&Z
Pan & Wall / Pan
Gosho et al./ Wald
Gosho et al./ F&Z
Gosho et al./ Pan
Wang & Long / Wald
Wang & Long / F&Z
Wang & Long / Pan