

Checking the Equality of Covariance Matrices: some practical aspects

Appendix D 2 Tables of the Type I Error Rates of the Procedures for tests of Covariance Heterogeneity for fixed n_i (5,10,...,50) in Relation to different Types of Covariance Heterogeneity

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

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2. 1. Type I error rates: equal correlations of dependent variables ($r_{ij} = 0.3$)

2. 1. 1. multivariate normal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	37.55	11.70	10.00	7.70	7.25	5.65		14.90	14.00	11.40	7.75	7.50
Box M	5.15	4.85	5.20	4.90	5.55	4.65		4.85	5.50	6.10	4.65	5.90
Schott T1	0.00	2.25	2.95	3.20	3.90	3.85	0.90	2.50	4.45	5.80	4.35	5.50
Schott T2	0.25	5.00	4.55	4.70	5.25	3.90	1.40	10.25	10.90	8.65	5.85	6.70
Schott T3	0.25	9.50	6.30	5.70	4.45	3.75	1.20	22.35	22.75	13.75	8.20	5.70
Levene	2.30	4.25	3.50	4.40	4.20	3.95	3.35	3.75	3.70	4.50	4.40	4.70
R Dispersion	3.05	3.90	4.75	3.95	4.65	4.75	3.40	4.00	4.45	4.35	5.25	4.15
large design (4*6)												
LR		47.90	24.10	15.75	10.60	6.65		82.00	56.60	28.55	14.15	9.60
Box M		5.90	4.95	4.80	5.00	4.25		18.35	17.55	8.70	4.85	5.00
Schott T1	0.15	1.60	2.75	3.10	3.60	3.60	0.80	3.30	5.00	4.80	4.30	4.60
Schott T2	0.20	7.35	4.45	4.10	4.75	3.95	0.95	20.20	12.60	7.30	5.55	4.95
Schott T3	0.20	14.85	6.80	6.05	5.35	4.10	0.85	40.75	26.60	13.40	7.75	5.45
Levene	3.65	5.05	3.60	4.30	4.35	4.40	6.10	5.80	4.25	4.85	5.15	4.55
R Dispersion	3.10	4.45	4.15	4.45	5.05	5.30	3.30	3.75	4.25	5.30	4.35	4.85

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	12.85	7.50	6.45	6.15	5.60	5.40	20.80	8.30	7.70	7.65	5.50	6.40
Box M	4.15	5.20	4.40	4.80	4.75	4.95	5.35	4.95	4.60	5.25	4.65	5.70
Schott T1	0.50	2.55	3.05	3.35	4.05	4.45	1.30	2.65	4.60	4.95	3.95	4.95
Schott T2	0.85	4.30	4.10	3.85	4.65	4.40	2.00	8.20	8.15	7.20	4.70	5.20
Schott T3	0.65	7.95	4.75	4.85	3.95	4.20	1.60	16.65	16.00	10.70	7.30	5.15
large design (4*6)												
LR	90.35	27.05	15.35	11.55	8.95	6.20		43.65	26.95	16.25	10.00	7.40
Box M	13.70	4.90	5.20	5.15	5.50	4.40		6.95	7.75	5.60	4.40	5.10
Schott T1	0.60	1.80	3.25	3.20	4.05	4.20	1.30	3.55	5.05	5.25	4.10	5.20
Schott T2	0.80	5.85	4.80	3.80	4.85	3.95	1.70	17.20	10.60	6.25	5.00	5.20
Schott T3	0.75	13.85	6.65	5.40	5.50	4.20	1.45	35.30	23.15	12.05	7.25	5.75

2. 1. 2. multivariate lognormal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	45.25	19.60	19.05	20.00	19.40	18.40		24.05	21.20	20.80	20.20	20.35
Box M	8.00	9.30	12.40	14.15	15.70	16.60		10.00	10.30	12.95	15.40	17.15
Schott T1	0.55	4.50	9.30	11.55	13.55	14.80	1.60	6.70	8.40	11.85	14.25	15.75
Schott T2	1.10	5.50	5.50	5.70	5.85	5.20	2.50	9.80	9.60	7.85	7.15	6.85
Schott T3	0.90	8.60	7.50	6.40	6.05	5.70	2.00	19.45	22.65	12.85	9.85	7.50
Levene	1.85	4.45	4.25	5.00	4.80	4.05	2.65	4.85	4.20	4.60	4.55	4.85
R Dispersion	2.70	3.30	4.15	3.25	3.25	4.35	2.30	2.85	3.55	3.65	3.55	3.50
large design (4*6)												
LR		63.75	47.00	40.70	33.90	32.55		88.50	70.00	51.05	37.80	33.55
Box M		12.65	16.15	18.00	21.10	26.05		25.45	29.35	21.25	21.25	24.30
Schott T1	0.40	7.80	11.80	16.85	19.40	25.95	1.70	9.70	14.50	18.15	20.20	23.90
Schott T2	0.75	5.25	4.65	4.25	3.95	4.95	1.95	15.05	10.50	7.35	5.70	5.10
Schott T3	0.75	9.75	6.80	5.90	4.70	5.90	1.85	32.75	25.15	12.60	8.55	6.55
Levene	4.20	5.65	3.95	4.75	3.95	4.80	5.90	5.20	5.70	5.05	4.95	4.60
R Dispersion	2.95	3.00	2.95	3.05	3.65	3.20	2.65	3.95	3.45	4.10	3.60	3.30

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	18.20	12.40	12.35	13.20	13.00	12.55	25.70	13.50	13.30	14.10	13.75	12.80
Box M	7.30	7.70	9.10	10.90	11.80	11.70	7.30	9.25	8.55	11.15	11.80	11.45
Schott T1	0.80	4.75	7.50	9.25	9.65	11.10	2.70	5.60	7.50	10.75	10.40	10.85
Schott T2	1.25	4.15	4.45	5.35	4.95	5.10	3.85	7.55	7.60	7.10	5.75	5.20
Schott T3	0.90	7.85	5.80	6.00	5.00	5.90	3.30	14.50	16.00	10.35	8.20	5.80
large design (4*6)												
LR	91.85	41.30	30.35	28.15	25.00	25.25		55.65	41.95	32.95	26.75	24.70
Box M	15.45	10.65	13.25	16.95	17.20	21.75		12.85	17.10	15.35	16.45	18.15
Schott T1	1.00	7.20	10.40	13.80	15.35	19.95	3.05	9.25	12.45	15.30	16.25	17.80
Schott T2	1.45	5.55	4.50	4.25	3.80	4.75	3.35	12.15	9.05	6.75	5.80	4.45
Schott T3	1.30	9.80	6.60	6.30	4.50	5.10	3.25	30.10	21.10	11.30	8.75	5.35

2. 1. 3. multivariate uniform (discrete)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	24.05	5.20	2.90	2.30	1.10	1.05		7.10	6.20	3.85	2.00	2.00
Box M	2.35	1.85	1.30	1.55	0.95	0.75		1.80	1.50	1.90	1.35	1.55
Schott T1	0.15	0.60	0.65	0.80	0.45	0.70	0.20	0.55	0.60	1.10	0.65	1.10
Schott T2	0.20	18.40	15.25	16.55	16.35	16.45	0.35	27.70	25.20	19.40	14.80	16.55
Schott T3	0.20	33.55	29.95	30.00	36.45	42.00	0.20	47.55	47.10	36.95	35.55	40.75
Levene	1.30	3.85	2.35	2.80	3.15	3.60	1.40	4.15	2.50	3.15	3.75	4.40
R Dispersion	1.85	3.10	4.45	4.80	8.15	10.90	1.80	3.10	4.05	5.30	8.30	9.60
large design (4*6)												
LR		27.30	8.40	4.60	2.65	0.85		62.30	32.75	12.20	4.85	1.80
Box M		1.80	1.45	0.70	1.20	0.50		7.15	6.75	2.55	1.10	1.05
Schott T1	0.00	0.25	0.30	0.35	0.60	0.30	0.30	0.70	0.50	0.95	0.55	0.70
Schott T2	0.00	51.70	50.70	51.75	54.15	54.20	0.35	57.85	55.45	51.35	51.55	53.65
Schott T3	0.00	66.80	65.20	66.00	69.80	67.75	0.35	76.50	72.00	67.10	66.25	67.15
Levene	3.85	4.45	2.50	3.20	3.55	3.30	6.45	4.35	4.05	3.45	4.65	3.65
R Dispersion	2.20	2.90	5.75	6.20	9.30	14.85	1.45	3.00	5.20	6.80	9.70	14.65

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	12.35	7.30	5.15	4.60	3.50	3.35	10.80	8.20	5.85	5.65	3.95	4.15
Box M	3.90	4.00	3.90	3.70	3.20	2.95	1.20	4.20	3.35	3.60	3.35	3.90
Schott T1	0.75	1.65	1.75	2.35	2.15	2.45	0.95	2.30	2.55	3.00	2.45	2.75
Schott T2	1.35	20.10	20.30	21.55	21.00	21.85	1.95	27.35	24.65	22.80	18.95	22.55
Schott T3	1.10	35.70	40.15	39.95	46.50	53.55	1.25	46.05	47.40	44.25	44.90	51.65
large design (4*6)												
LR	66.05	24.45	11.50	9.35	5.80	3.55		40.30	22.15	13.80	7.60	3.90
Box M	3.95	4.15	3.75	3.45	3.25	2.40		5.90	5.85	4.00	3.20	2.50
Schott T1	0.25	1.25	2.00	1.50	1.90	1.65	1.00	1.65	2.65	2.45	2.10	2.30
Schott T2	0.40	53.60	55.45	57.10	58.55	60.55	1.40	58.45	56.95	54.30	56.15	59.40
Schott T3	0.45	69.45	72.40	75.00	76.20	78.75	1.25	77.75	75.10	73.80	75.25	75.60

2. 1. 4. multivariate exponential (continuous)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	73.70	65.20	67.70	68.05	71.65	71.90		66.95	68.60	68.50	69.60	71.50
Box M	27.20	48.40	58.35	61.45	68.60	70.20		45.60	52.65	59.30	63.85	68.75
Schott T1	6.15	36.10	50.40	53.35	64.10	67.70	8.70	31.65	40.35	48.75	56.30	63.60
Schott T2	9.45	5.05	5.40	4.25	5.65	5.25	11.10	7.95	10.05	7.30	7.70	7.30
Schott T3	7.40	8.45	8.15	7.40	9.90	9.75	9.30	17.30	22.55	13.35	11.90	12.00
Levene	3.05	6.25	5.00	5.75	4.70	5.25	3.85	5.80	4.80	5.95	4.75	5.95
R Dispersion	2.75	2.10	1.95	2.40	3.15	2.90	2.05	2.05	2.35	2.10	2.75	2.85
large design (4*6)												
LR		97.50	96.35	95.90	95.00	96.40		99.30	98.35	96.90	95.05	95.65
Box M		74.65	83.25	89.35	91.15	94.70		73.45	86.30	87.15	89.80	93.40
Schott T1	10.95	64.70	78.10	85.15	89.10	94.30	11.90	53.10	65.70	75.90	83.35	88.75
Schott T2	14.30	1.85	2.05	2.60	2.20	1.75	13.35	5.05	4.40	3.85	3.55	3.05
Schott T3	13.20	6.20	4.15	4.95	4.30	4.55	12.45	18.95	13.65	9.55	7.70	6.50
Levene	5.45	7.45	5.10	5.65	6.05	6.15	7.90	7.15	6.25	5.60	6.05	6.10
R Dispersion	3.30	2.35	2.15	3.05	2.40	3.05	2.40	2.70	2.25	3.35	2.40	2.50

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	42.70	42.65	46.15	46.30	49.30	51.35	45.85	42.60	45.35	45.85	46.60	50.60
Box M	22.05	34.95	41.35	43.00	47.15	49.75	18.60	33.30	37.95	40.30	43.85	48.85
Schott T1	6.90	25.70	34.40	37.50	43.65	48.00	8.15	24.10	29.05	33.40	38.75	44.15
Schott T2	8.95	3.90	4.55	3.65	4.70	3.90	10.50	6.25	7.15	5.75	5.65	5.55
Schott T3	7.25	6.90	6.15	5.50	6.95	7.50	9.00	13.15	16.55	10.50	8.60	7.55
large design (4*6)												
LR	98.95	89.60	87.05	87.35	86.95	88.00		93.00	90.80	88.75	86.55	88.00
Box M	40.50	65.95	73.55	78.00	81.30	85.65		59.10	72.30	76.70	79.45	83.70
Schott T1	11.60	55.10	66.60	74.55	77.90	85.25	13.90	46.25	56.60	66.80	73.10	79.75
Schott T2	14.75	1.80	2.15	2.15	1.70	1.45	14.80	5.30	4.15	3.50	2.70	2.65
Schott T3	13.70	6.20	4.25	5.00	3.40	3.80	14.15	17.45	12.45	8.85	5.35	5.15

2. 1. 5. mixed left and right skewed

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	31.15	6.30	3.95	3.25	1.80	1.30		8.70	6.35	4.85	2.55	2.50
Box M	4.30	1.80	1.90	2.15	1.25	0.95		2.95	2.50	2.55	1.40	2.00
Schott T1	0.10	0.60	0.75	1.15	0.80	0.75	0.30	0.90	1.15	1.55	1.15	1.00
Schott T2	0.15	13.25	12.30	13.60	13.25	12.05	0.55	22.35	21.70	16.90	13.10	13.70
Schott T3	0.10	27.65	22.80	19.70	18.50	16.20	0.45	41.85	40.80	29.85	22.15	19.50
Levene	1.95	4.50	3.35	3.75	3.70	3.45	2.60	4.90	3.75	3.95	4.35	3.65
R Dispersion	2.05	2.15	3.35	3.25	3.55	3.85	1.95	2.55	2.70	3.20	3.65	3.45
large design (4*6)												
LR		31.85	10.75	5.30	3.20	1.55		73.90	41.40	14.95	5.40	2.80
Box M		2.65	1.65	1.50	1.20	0.80		13.50	10.95	2.85	1.70	1.40
Schott T1	0.10	0.70	0.50	0.40	0.65	0.60	0.20	1.20	1.15	0.80	0.95	0.65
Schott T2	0.10	40.20	35.90	36.35	39.70	41.00	0.40	49.45	45.00	38.15	37.85	40.55
Schott T3	0.10	56.90	50.35	54.35	56.90	61.35	0.35	70.90	63.95	55.80	56.20	60.35
Levene	3.50	4.85	3.35	4.20	4.35	4.35	6.20	4.95	4.20	4.40	5.10	4.30
R Dispersion	2.50	3.35	3.10	3.75	3.10	3.75	2.20	2.25	2.45	3.30	2.70	3.25

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	14.10	6.40	5.10	4.60	3.70	3.00	20.80	7.75	6.90	6.30	4.40	4.20
Box M	4.30	4.20	4.15	3.90	3.10	2.80	5.70	4.45	3.70	4.45	3.35	3.90
Schott T1	0.70	1.95	2.35	3.15	2.50	2.60	1.05	2.55	2.95	3.40	2.55	2.85
Schott T2	1.20	16.05	14.35	16.05	16.70	16.70	1.55	21.90	20.15	19.70	15.60	17.70
Schott T3	0.90	30.25	26.35	22.80	20.45	16.85	1.20	38.85	37.05	29.35	23.50	20.20
large design (4*6)												
LR	89.75	24.00	11.90	8.75	6.55	3.30		41.30	23.95	13.60	7.80	5.05
Box M	13.45	4.85	3.75	3.35	4.25	2.55		6.50	6.90	4.35	3.35	2.90
Schott T1	0.40	1.75	2.15	1.60	2.30	2.00	1.20	2.15	2.80	2.65	2.55	2.70
Schott T2	0.50	41.85	40.30	39.85	44.65	47.30	1.50	48.85	44.70	41.15	43.55	45.60
Schott T3	0.50	57.75	56.70	60.70	65.00	70.70	1.25	71.00	67.00	60.10	62.70	67.05

2. 2. Type I error rates: unequal correlations of dependent variables ($r_{j,j+1}=0.7, 0.5, 0.4, 0.2$)

2. 2. 1. multivariate normal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	37.55	11.70	10.00	7.70	7.25	5.65		14.90	14.00	11.40	7.75	7.50
Box M	5.15	4.85	5.20	4.90	5.55	4.65		4.85	5.50	6.10	4.65	5.90
Schott T1	0.00	2.25	2.95	3.20	3.90	3.85	0.90	2.50	4.45	5.80	4.35	5.50
Schott T2	0.25	6.45	4.80	5.05	5.15	4.05	1.45	10.65	10.60	8.90	5.70	6.50
Schott T3	0.25	9.30	6.75	6.10	5.05	3.90	1.20	22.90	22.85	15.05	8.00	6.55
Levene	2.25	4.20	4.00	4.00	4.30	4.20	3.00	4.30	3.50	3.65	5.80	4.55
R Dispersion	3.10	3.70	4.60	4.45	3.90	4.80	2.80	3.60	4.65	4.85	4.90	4.40
large design (4*6)												
LR		47.90	24.10	15.75	10.60	6.65		82.00	56.60	28.55	14.15	9.60
Box M		5.90	4.95	4.80	5.00	4.25		18.35	17.55	8.70	4.85	5.00
Schott T1	0.15	1.60	2.75	3.10	3.60	3.60	0.80	3.30	5.00	4.80	4.30	4.60
Schott T2	0.25	8.65	5.85	4.80	4.40	4.10	0.85	22.45	12.80	8.05	5.75	5.60
Schott T3	0.20	15.75	8.00	7.30	5.05	3.90	0.80	42.70	28.15	14.25	8.25	5.85
Levene	3.05	5.30	3.75	3.95	4.50	4.40	4.70	5.60	3.95	4.60	4.55	5.10
R Dispersion	3.90	4.45	5.35	5.15	4.95	5.10	3.70	4.00	4.15	4.85	4.45	5.10

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	13.05	7.70	6.65	6.45	6.00	5.00	21.00	8.75	7.85	7.85	5.75	6.50
Box M	4.15	5.00	4.50	4.75	5.10	4.45	6.20	5.65	5.30	5.35	4.75	5.90
Schott T1	0.50	2.85	2.85	3.00	4.50	4.10	1.50	3.00	4.60	4.80	4.05	5.30
Schott T2	0.75	5.25	4.55	4.45	5.25	4.30	2.05	8.65	8.15	7.10	4.65	5.85
Schott T3	0.60	8.70	6.30	5.20	4.90	4.05	1.80	17.65	17.80	11.80	6.70	5.95
large design (4*6)												
LR	90.95	26.60	15.05	11.70	8.70	6.20		43.85	27.35	16.30	9.65	8.05
Box M	13.45	4.60	5.35	5.40	4.95	4.45		7.20	8.45	6.10	5.00	5.40
Schott T1	0.60	2.10	3.10	3.45	4.20	4.10	1.30	3.80	5.05	5.55	4.55	4.95
Schott T2	0.70	6.60	5.35	4.00	4.65	4.50	1.40	17.80	11.50	7.60	5.00	5.45
Schott T3	0.70	14.00	8.00	6.40	5.10	4.35	1.35	38.40	22.90	12.90	7.70	6.05

2. 2. 2. multivariate lognormal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	45.75	21.95	20.80	21.50	22.00	19.95		24.65	24.70	22.55	20.60	19.55
Box M	8.05	10.65	13.25	16.15	18.30	17.60		10.20	10.75	14.50	15.70	16.85
Schott T1	0.50	5.55	10.25	13.00	15.75	17.30	2.05	6.40	11.10	13.35	15.00	16.60
Schott T2	0.85	6.25	6.25	6.35	6.80	6.35	2.50	11.10	12.15	9.20	8.30	7.05
Schott T3	0.70	9.70	8.70	7.45	7.05	6.90	2.30	22.25	25.30	15.45	10.30	8.50
Levene	2.80	4.80	3.60	4.25	5.30	4.15	2.50	5.25	4.55	4.45	4.85	4.40
R Dispersion	2.90	3.90	4.05	4.65	3.45	3.55	2.65	3.45	3.85	3.65	3.20	3.75
large design (4*6)												
LR		66.35	50.30	46.10	37.90	36.20		88.70	72.95	54.15	41.80	39.00
Box M		14.95	18.90	21.75	24.90	28.45		25.95	31.60	23.90	24.90	28.25
Schott T1	0.70	8.60	15.35	19.85	23.45	28.40	1.65	12.10	16.05	21.95	23.90	27.75
Schott T2	1.05	6.15	5.85	5.60	5.70	6.00	2.00	16.70	12.85	9.25	7.10	6.60
Schott T3	1.05	12.25	10.50	7.95	7.00	7.60	1.75	36.70	27.15	14.95	11.10	8.25
Levene	3.60	5.40	3.95	4.35	5.05	4.75	6.20	5.30	4.45	4.20	5.05	4.65
R Dispersion	2.95	3.15	3.60	3.20	3.50	3.80	2.70	3.95	3.35	4.65	4.00	3.20

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	19.20	12.85	13.70	13.85	15.15	12.95	25.60	13.70	13.85	15.10	14.90	14.75
Box M	7.00	8.05	10.70	11.90	13.35	12.25	7.25	8.40	9.55	11.35	12.75	13.20
Schott T1	0.60	5.05	8.75	9.60	11.85	11.75	3.40	5.60	8.15	10.55	11.65	12.90
Schott T2	1.45	4.90	5.40	5.60	6.25	4.55	3.90	8.50	9.25	8.55	7.75	6.60
Schott T3	0.90	7.95	7.05	6.30	6.45	5.60	3.55	17.75	19.95	13.35	9.65	7.25
large design (4*6)												
LR	92.50	43.15	33.00	33.10	27.40	27.05		57.05	45.40	35.60	29.60	27.15
Box M	16.95	13.25	14.75	19.00	20.15	23.60		14.20	18.05	17.45	19.60	21.05
Schott T1	1.45	8.10	12.20	16.55	18.55	22.30	3.05	11.30	13.80	17.70	18.40	20.15
Schott T2	2.05	6.30	4.70	5.50	5.05	5.65	3.25	15.05	10.20	8.10	6.30	5.75
Schott T3	1.75	12.05	10.00	7.00	6.30	6.80	3.15	33.20	24.15	13.30	10.55	7.30

2. 2. 3. multivariate uniform (discrete)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	23.00	6.25	3.75	3.80	2.50	1.65		8.65	5.85	5.85	3.35	2.85
Box M	1.95	2.25	1.85	2.55	1.85	1.30		2.10	1.90	2.65	2.25	2.30
Schott T1	0.05	0.60	1.10	1.70	1.45	1.05	0.65	1.00	0.80	2.10	1.75	1.90
Schott T2	0.30	22.20	20.45	20.45	22.55	20.80	0.80	30.40	28.35	25.30	21.35	22.90
Schott T3	0.15	37.85	35.35	34.95	42.20	48.50	0.65	52.30	50.00	43.65	42.55	47.50
Levene	1.65	3.20	2.25	3.55	3.60	4.00	1.90	3.50	2.95	3.40	3.40	4.40
R Dispersion	1.60	2.65	4.15	4.50	5.35	9.50	1.65	2.75	3.80	4.85	5.70	10.05
large design (4*6)												
LR		35.35	13.15	7.90	5.70	2.50		61.20	36.55	16.60	7.70	3.65
Box M		3.65	2.45	1.70	2.35	1.45		6.00	8.10	3.85	3.10	2.10
Schott T1	0.10	1.10	1.15	0.85	1.60	1.35	0.05	1.30	1.50	1.70	1.90	1.65
Schott T2	0.15	60.15	59.45	59.20	61.40	64.75	0.25	61.90	60.55	57.35	60.15	62.10
Schott T3	0.15	73.75	72.15	73.05	76.30	77.80	0.10	79.30	76.05	72.95	73.90	76.30
Levene	3.50	4.50	2.70	2.95	3.50	3.80	5.85	4.60	3.50	3.60	3.80	4.70
R Dispersion	2.60	3.50	6.20	4.70	8.15	11.65	1.80	2.70	4.45	4.80	8.30	11.70

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	12.90	11.55	8.95	8.70	7.85	6.50	8.80	10.30	8.85	11.45	8.70	8.20
Box M	3.85	7.75	6.75	7.00	6.90	6.05	1.05	6.30	5.60	8.95	7.10	7.10
Schott T1	1.15	3.65	4.05	5.10	5.70	4.85	1.95	3.85	4.75	6.55	5.55	5.85
Schott T2	1.65	28.15	29.30	30.65	32.80	32.15	2.95	33.10	31.50	32.10	31.40	32.10
Schott T3	1.50	43.35	44.50	44.10	49.65	59.35	2.25	52.05	53.15	49.15	51.75	58.00
large design (4*6)												
LR	49.40	35.05	20.40	15.60	12.30	8.75		47.00	31.60	20.60	13.80	11.15
Box M	2.50	9.10	7.50	7.00	7.85	6.85		7.75	10.20	8.45	8.35	7.55
Schott T1	0.45	3.25	3.75	4.60	6.25	5.35	1.85	4.75	5.40	5.55	6.40	6.40
Schott T2	0.75	65.20	67.40	67.10	70.75	74.95	2.15	63.60	64.55	64.65	67.95	71.75
Schott T3	0.80	78.10	78.85	82.15	85.30	87.90	1.90	82.40	80.90	80.60	83.50	85.35

2. 2. 4. multivariate exponential (continuous)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	76.40	71.10	73.65	74.95	77.00	79.25		72.05	73.40	74.25	75.65	79.00
Box M	31.95	56.65	66.25	68.90	73.50	77.30		52.20	56.85	64.45	70.65	76.60
Schott T1	6.65	40.35	56.45	62.45	70.30	74.50	9.15	36.75	43.85	52.90	61.80	71.55
Schott T2	10.65	6.00	7.35	7.05	8.85	8.90	12.00	9.65	10.85	9.15	9.80	10.50
Schott T3	8.40	9.95	11.40	11.85	14.30	14.75	9.95	20.20	24.25	17.80	15.85	16.45
Levene	3.15	7.20	5.75	5.15	6.25	4.55	4.00	7.25	5.65	5.40	7.30	4.80
R Dispersion	3.00	2.05	2.80	3.30	3.05	2.95	2.50	2.15	1.90	2.70	2.80	3.25
large design (4*6)												
LR		99.00	97.45	98.35	98.20	98.70		99.85	99.35	98.55	97.65	97.95
Box M		82.90	90.60	94.50	95.85	97.55		80.55	91.10	93.30	94.15	96.05
Schott T1	15.65	72.50	85.95	92.00	94.70	97.15	15.45	57.85	72.60	83.10	89.20	94.60
Schott T2	20.10	3.20	3.95	4.25	3.65	4.30	17.05	6.40	6.90	7.45	5.90	6.00
Schott T3	17.80	8.95	8.30	8.70	7.30	8.80	16.30	23.00	17.90	15.70	11.95	11.40
Levene	6.05	7.55	5.45	5.10	6.45	7.20	7.45	6.85	6.05	5.70	5.90	6.20
R Dispersion	3.25	2.05	2.40	3.15	3.10	3.45	2.40	2.15	2.35	2.85	2.45	2.80

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	44.00	49.80	51.10	52.60	54.80	56.90	48.35	47.80	48.50	50.60	53.20	56.35
Box M	23.30	41.30	46.50	49.00	52.60	56.00	20.25	38.10	40.70	46.05	49.75	54.35
Schott T1	7.15	28.75	39.45	43.55	48.75	54.20	8.50	26.85	31.60	37.65	42.45	50.70
Schott T2	9.85	4.90	6.10	6.55	7.45	6.70	10.30	7.65	8.85	8.10	7.95	7.35
Schott T3	8.05	10.10	8.65	9.95	10.95	10.10	9.15	15.75	19.15	14.80	12.50	11.05
large design (4*6)												
LR	99.40	93.50	91.10	92.55	92.40	93.70		95.20	93.45	92.70	91.45	92.65
Box M	48.45	73.05	80.30	86.75	89.40	92.05		66.35	79.10	84.40	86.00	90.00
Schott T1	17.60	60.90	74.25	83.10	86.20	91.05	16.55	51.05	63.60	73.75	80.00	86.40
Schott T2	20.15	2.90	3.80	3.80	2.95	3.25	17.40	6.20	6.45	6.20	4.75	5.25
Schott T3	19.05	8.15	7.65	8.05	6.45	7.30	16.80	22.65	16.55	13.25	9.20	9.65

2. 2. 5. mixed left and right skewed

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	32.65	7.20	5.65	3.75	2.80	2.25		10.30	8.40	6.60	3.40	3.20
Box M	4.65	2.90	3.15	2.35	2.15	1.95		3.10	3.20	3.35	2.25	2.70
Schott T1	0.10	1.00	1.15	1.45	1.55	1.20	0.60	1.10	1.90	2.00	1.70	1.95
Schott T2	0.35	17.55	15.70	17.05	16.60	16.30	0.75	26.25	24.30	20.55	16.80	18.50
Schott T3	0.20	28.95	24.75	24.35	20.70	18.05	0.65	45.40	43.85	31.75	22.90	20.90
Levene	2.20	4.15	2.75	3.85	3.95	4.00	2.55	4.30	3.65	3.25	5.15	4.60
R Dispersion	2.60	3.15	3.90	3.35	3.35	3.20	2.40	3.10	3.10	3.45	2.95	3.20
large design (4*6)												
LR		36.45	15.85	8.00	5.60	2.25		76.00	46.95	18.90	8.00	3.80
Box M		4.30	2.75	2.30	2.45	1.25		14.35	12.60	3.90	3.20	2.25
Schott T1	0.15	1.05	1.10	1.05	1.65	1.30	0.60	1.10	2.20	1.95	2.05	1.80
Schott T2	0.25	45.50	43.05	44.30	45.65	50.00	0.60	54.40	47.90	45.65	43.85	48.90
Schott T3	0.15	62.50	57.70	60.80	63.90	69.60	0.60	75.05	67.30	62.90	61.30	66.20
Levene	4.50	4.85	3.15	3.60	4.05	4.45	5.80	4.55	3.90	4.45	4.35	4.00
R Dispersion	2.25	2.65	4.25	3.60	3.20	3.45	1.95	2.80	3.35	3.05	2.85	3.05

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	16.75	10.05	9.15	8.20	8.25	5.60	23.20	11.40	10.75	10.95	7.40	7.70
Box M	5.65	6.95	6.75	6.55	7.20	5.10	6.75	7.15	6.90	7.65	5.75	6.85
Schott T1	0.95	3.35	3.70	4.80	5.50	4.75	1.60	4.15	5.40	6.35	5.25	5.75
Schott T2	1.55	21.05	22.05	23.95	24.95	25.75	2.45	26.55	27.20	26.05	23.00	25.55
Schott T3	1.35	32.80	29.55	28.35	24.20	19.85	1.75	43.00	41.50	34.65	26.30	22.95
large design (4*6)												
LR	92.65	31.90	19.00	14.35	10.95	8.35		49.65	33.85	21.15	13.15	10.05
Box M	16.10	7.80	7.80	7.00	7.35	5.35		9.65	11.00	8.50	6.75	6.35
Schott T1	0.60	3.15	4.60	4.20	5.35	4.95	1.85	4.20	5.55	5.65	5.35	6.00
Schott T2	0.95	50.25	51.15	51.35	54.65	59.60	2.40	55.65	51.10	51.55	51.90	58.15
Schott T3	0.95	65.30	63.40	67.95	72.60	78.55	2.10	75.20	71.45	69.15	70.00	75.90

2. 3. Power:**group heterogeneity $\Sigma^{(i)} = c_i \Sigma^{(1)}$ with $r(c_i, n_i) \sim 0$** **2. 3. 1. multivariate normal**

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	44.75	28.50	38.35	45.90	70.05	91.90		33.95	53.50	62.95	84.10	98.40
Box M	6.55	13.55	26.50	37.65	64.90	90.75		13.85	31.45	50.30	78.40	97.90
Schott T1	0.05	7.35	19.30	30.55	58.50	88.15	0.50	4.55	18.90	35.95	71.10	96.95
Schott T2	0.65	13.60	22.85	32.70	58.35	88.10	0.70	15.35	34.90	40.50	69.30	95.85
Schott T3	0.20	19.30	19.35	24.70	46.40	82.75	0.45	27.30	35.95	33.55	58.00	93.20
Levene	3.10	11.95	22.25	35.15	61.25	90.20	4.75	13.65	32.05	46.95	76.35	97.15
R Dispersion	12.20	35.50	59.40	71.90	91.30	98.95	12.90	41.05	72.70	84.90	96.65	100.00
large design (4*6)												
LR		72.70	68.55	76.55	92.25	99.70		94.10	89.25	86.35	95.30	99.90
Box M		17.90	34.50	53.55	84.90	99.50		34.90	51.80	58.25	86.75	99.65
Schott T1	0.60	14.20	34.95	54.35	85.15	99.50	1.35	17.00	29.85	50.60	84.60	99.45
Schott T2	0.85	24.95	35.30	52.90	83.10	99.45	1.80	41.85	44.70	53.75	82.30	99.30
Schott T3	0.60	34.10	31.40	39.20	64.10	93.90	1.30	52.65	44.05	46.40	65.10	94.10
Levene	6.65	21.25	35.40	57.25	88.20	99.50	8.45	24.75	41.30	62.10	91.90	99.75
R Dispersion	35.55	74.30	90.70	97.25	99.85	100.00	38.75	80.10	95.10	98.50	100.00	100.00

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	18.80	21.05	31.25	40.15	62.15	86.75	26.65	22.35	40.65	53.05	73.90	94.75
Box M	6.65	14.55	25.35	36.00	59.00	85.90	7.30	13.65	31.85	45.90	70.05	93.75
Schott T1	1.20	9.75	18.50	29.60	51.85	82.15	1.40	5.05	20.35	36.55	64.90	92.30
Schott T2	1.85	12.95	21.10	31.40	51.90	82.40	2.05	13.40	31.65	40.05	64.65	91.75
Schott T3	1.10	18.15	19.25	25.05	43.65	78.70	1.40	22.00	33.15	34.55	57.90	89.90
large design (4*6)												
LR	92.45	52.65	58.10	69.25	88.80	99.20		71.95	72.10	77.55	92.05	99.45
Box M	17.10	18.65	35.00	53.65	82.75	98.90		21.55	40.25	56.40	85.50	99.10
Schott T1	1.50	15.65	34.35	54.80	83.25	98.90	2.75	18.00	32.35	52.45	83.25	98.95
Schott T2	2.30	22.70	35.55	53.20	82.20	98.80	3.40	39.35	42.35	53.30	81.70	98.75
Schott T3	1.65	30.65	32.50	41.15	66.60	94.40	2.70	50.15	43.20	46.60	68.30	95.30

2. 3. 2. multivariate lognormal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	51.30	40.45	48.85	60.15	75.75	92.80		43.65	60.05	69.75	85.55	97.00
Box M	10.60	22.40	37.55	53.45	72.30	91.40		21.30	41.55	57.75	81.15	96.55
Schott T1	1.15	13.55	30.40	44.70	66.05	89.45	1.70	7.55	28.15	46.40	75.10	95.45
Schott T2	1.95	12.80	19.45	29.05	44.85	72.65	2.55	13.40	26.85	33.55	54.85	84.20
Schott T3	0.95	17.40	20.00	28.05	47.25	80.20	1.55	23.85	34.95	36.80	60.00	90.85
Levene	3.05	12.25	18.35	31.95	53.05	82.55	4.20	13.05	25.10	41.45	66.65	93.05
R Dispersion	9.80	25.30	38.05	50.90	68.55	89.00	9.95	27.95	49.25	63.00	82.35	95.70
large design (4*6)												
LR		83.95	82.90	87.25	95.25	99.65		96.45	93.40	92.85	97.45	99.75
Box M		30.10	54.35	72.90	91.40	99.30		42.00	65.15	74.10	92.70	99.55
Schott T1	1.25	24.95	52.65	71.75	90.55	99.30	2.70	27.55	45.05	67.40	91.15	99.35
Schott T2	2.20	16.50	27.00	38.45	63.65	91.55	3.15	28.00	30.50	38.40	62.65	92.35
Schott T3	1.60	24.80	30.45	42.55	72.60	97.05	2.70	46.30	43.35	48.75	74.15	96.30
Levene	5.50	17.45	29.70	52.05	77.45	97.65	8.00	22.45	37.35	55.10	83.90	99.05
R Dispersion	22.70	49.85	69.60	82.65	94.15	99.55	26.25	55.50	75.15	86.45	96.90	99.50

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	24.25	29.75	38.65	48.35	66.15	86.25	30.60	29.40	46.05	57.90	76.35	92.70
Box M	10.15	20.80	32.80	44.35	64.00	85.40	9.40	19.50	37.35	52.20	73.15	92.05
Schott T1	2.25	14.45	26.45	37.60	56.95	82.95	2.35	8.30	27.35	42.55	68.00	90.70
Schott T2	3.65	11.80	18.10	26.55	40.45	67.80	2.95	12.90	24.95	32.70	51.10	80.10
Schott T3	1.95	15.60	18.90	26.40	42.45	74.15	2.40	21.20	30.80	34.95	54.55	84.55
large design (4*6)												
LR	94.70	66.35	71.10	79.75	91.75	99.40		79.05	80.20	84.20	94.95	99.55
Box M	19.05	30.60	50.20	67.30	86.85	99.10		29.90	52.70	68.70	90.40	99.45
Schott T1	2.30	25.80	48.50	66.25	86.45	98.70	3.95	28.15	43.40	64.50	88.65	99.25
Schott T2	3.80	16.65	27.25	38.05	62.75	91.00	4.80	28.40	31.00	39.05	63.05	92.30
Schott T3	2.75	24.30	30.55	41.45	69.80	95.80	4.10	43.90	42.60	47.25	72.00	95.80

2. 3. 3. multivariate uniform (discrete)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	34.05	17.95	26.15	35.90	70.90	98.75		22.60	45.80	59.80	87.85	100.00
Box M	3.65	6.50	15.40	25.95	64.10	98.05		7.35	21.35	41.45	82.00	100.00
Schott T1	0.05	2.80	8.90	19.45	51.50	95.05	0.15	1.40	10.20	24.70	73.50	99.95
Schott T2	0.40	39.70	59.60	77.25	96.35	100.00	0.35	43.35	72.40	86.95	99.30	100.00
Schott T3	0.10	54.85	49.30	51.90	48.75	54.20	0.05	55.05	47.65	43.80	38.60	40.85
Levene	2.25	14.35	29.15	52.00	83.30	99.35	3.15	20.55	45.65	70.70	95.00	99.95
R Dispersion	14.10	60.85	86.30	97.65	99.75	100.00	18.10	71.25	96.90	99.35	100.00	100.00
large design (4*6)												
LR		59.25	57.55	68.95	93.90	100.00		85.35	81.10	83.50	96.60	100.00
Box M		10.15	21.60	42.00	86.10	99.95		20.40	37.95	50.70	89.15	100.00
Schott T1	0.20	6.40	22.35	45.00	88.05	100.00	0.65	8.70	17.50	41.05	88.15	100.00
Schott T2	0.30	80.55	95.25	99.30	100.00	100.00	0.85	80.75	89.00	98.10	99.95	100.00
Schott T3	0.15	83.35	85.25	89.80	95.85	99.15	0.65	88.10	90.25	92.30	96.10	98.95
Levene	5.10	26.20	45.35	78.10	98.20	100.00	9.00	29.75	58.65	83.30	99.35	100.00
R Dispersion	51.15	96.80	99.75	100.00	100.00	100.00	58.40	98.40	99.95	100.00	100.00	100.00

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	19.00	21.00	29.80	40.50	64.10	92.45	18.90	22.40	42.30	54.35	78.20	97.45
Box M	6.15	14.45	25.20	35.90	61.60	91.70	3.40	14.45	32.70	47.80	74.95	97.10
Schott T1	1.45	8.70	17.35	28.25	52.90	88.55	1.35	4.45	21.65	37.45	68.30	96.40
Schott T2	2.45	39.55	55.05	69.35	87.90	98.80	1.90	43.75	66.55	80.20	93.00	99.55
Schott T3	1.30	51.35	46.05	49.85	47.40	53.30	1.25	52.45	48.95	45.15	39.85	41.30
large design (4*6)												
LR	76.25	52.50	58.60	70.60	91.20	99.60		71.05	72.95	79.35	94.95	99.80
Box M	8.50	17.60	34.70	56.15	86.55	99.45		21.45	39.15	59.60	89.70	99.65
Schott T1	1.20	14.40	33.15	54.95	87.80	99.40	2.55	16.25	30.45	53.65	88.95	99.65
Schott T2	1.60	79.85	92.10	97.25	99.85	100.00	3.35	80.50	88.05	97.05	99.85	100.00
Schott T3	1.20	81.65	84.95	89.30	95.85	99.15	2.55	86.85	89.70	92.05	96.00	98.95

2. 3. 4. multivariate exponential (continuous)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	77.85	74.60	81.65	82.85	89.95	95.40		75.85	85.20	85.55	91.85	97.50
Box M	31.60	59.15	75.60	78.85	88.30	95.15		56.85	73.20	79.85	89.60	97.05
Schott T1	7.20	44.80	66.90	73.90	85.60	93.95	8.20	32.90	59.25	69.90	84.70	95.90
Schott T2	11.40	7.40	11.40	12.20	20.85	35.65	10.00	8.10	14.65	14.30	23.25	42.30
Schott T3	8.05	12.70	17.80	20.90	37.30	55.85	8.15	19.20	30.70	26.50	40.00	65.40
Levene	4.60	10.60	12.85	17.05	27.20	49.35	4.50	8.15	15.00	20.20	35.05	61.80
R Dispersion	4.80	6.65	13.50	17.15	29.55	47.05	4.25	6.45	16.65	20.35	34.95	58.35
large design (4*6)												
LR		98.70	98.50	98.95	99.70	99.90		99.85	99.65	99.40	99.60	99.85
Box M		84.20	93.60	96.45	99.25	99.80		83.75	94.60	96.10	98.85	99.70
Schott T1	15.50	78.00	90.75	95.10	98.75	99.85	16.00	69.65	85.05	91.90	97.50	99.65
Schott T2	19.70	3.45	7.10	9.05	18.30	39.10	18.05	8.60	9.10	10.30	17.50	37.80
Schott T3	17.00	11.85	16.85	24.65	42.30	69.90	16.15	25.45	24.00	28.30	40.85	69.75
Levene	6.95	14.20	17.25	26.70	44.65	71.00	9.90	17.45	21.50	29.80	50.70	77.05
R Dispersion	10.20	17.55	30.95	39.30	58.30	79.90	11.45	20.75	34.95	44.45	64.20	85.55

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	48.20	55.75	65.30	67.85	78.85	87.75	51.20	56.30	69.55	71.05	83.25	92.45
Box M	27.20	46.85	61.20	65.15	77.45	87.15	22.25	46.35	62.90	67.45	81.20	91.70
Schott T1	9.35	35.95	52.80	59.25	73.60	85.45	7.55	26.85	50.60	59.75	77.20	90.95
Schott T2	12.30	6.90	10.35	12.20	19.10	32.75	9.05	6.90	12.00	13.60	21.50	41.15
Schott T3	8.75	10.90	15.25	19.05	29.65	48.05	7.85	15.10	24.85	22.75	34.05	57.60
large design (4*6)												
LR	99.15	94.85	95.35	96.50	98.25	99.70		96.30	96.60	96.20	98.35	99.70
Box M	46.35	77.30	88.15	93.55	97.40	99.65		73.85	87.55	92.45	97.00	99.55
Schott T1	17.95	69.45	83.80	92.00	96.70	99.65	18.95	65.80	79.95	87.60	95.45	99.30
Schott T2	21.30	4.50	8.25	10.50	20.15	40.55	20.75	9.25	8.70	11.20	18.00	41.25
Schott T3	18.50	12.20	17.30	24.45	40.75	66.80	18.80	24.20	23.00	27.55	39.20	66.95

2. 3. 5. mixed left and right skewed

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	37.95	17.45	23.30	31.10	60.60	95.40		22.25	39.75	51.80	80.30	99.55
Box M	5.25	6.65	14.25	23.50	53.25	94.05		7.75	19.55	37.00	73.15	99.35
Schott T1	0.15	2.80	8.10	17.55	44.10	89.70	0.20	1.60	8.70	21.35	62.85	98.60
Schott T2	0.50	32.50	50.05	67.90	90.30	99.90	0.40	37.05	62.45	76.70	96.65	100.00
Schott T3	0.25	48.00	42.50	37.05	30.50	23.60	0.25	51.80	45.00	35.35	24.05	15.35
Levene	2.95	14.55	29.15	49.75	78.20	98.05	4.10	19.70	44.75	65.75	92.10	100.00
R Dispersion	13.70	55.25	83.00	94.75	99.65	100.00	17.10	63.35	93.30	98.25	99.90	100.00
large design (4*6)												
LR		60.70	53.55	61.80	88.20	99.85		90.00	82.20	78.05	92.65	99.90
Box M		9.85	19.05	33.85	76.70	99.65		27.10	39.40	44.60	81.00	99.85
Schott T1	0.20	6.00	18.75	36.30	78.25	99.70	0.70	6.95	15.15	32.25	78.90	99.70
Schott T2	0.45	69.60	87.35	96.60	99.90	100.00	1.00	74.00	84.00	93.60	99.45	100.00
Schott T3	0.20	78.30	79.15	83.35	85.90	93.80	0.70	82.65	82.65	84.25	90.80	96.75
Levene	5.50	25.10	43.90	72.15	95.80	100.00	7.70	28.15	53.40	77.80	97.55	100.00
R Dispersion	45.05	92.95	99.25	100.00	100.00	100.00	50.40	96.05	99.70	100.00	100.00	100.00

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	19.10	19.00	27.90	38.95	58.85	88.55	27.20	20.55	39.05	50.35	74.20	95.65
Box M	7.40	13.05	23.25	35.05	55.85	87.65	7.85	13.40	29.50	44.35	70.70	95.35
Schott T1	1.70	7.95	17.15	27.30	48.75	83.75	0.90	4.65	19.10	33.15	63.90	94.15
Schott T2	2.30	35.25	48.25	62.75	81.75	97.60	1.60	38.10	59.15	72.75	89.15	99.10
Schott T3	1.55	44.05	40.85	36.50	29.75	24.25	1.05	47.70	44.60	37.50	26.95	18.00
large design (4*6)												
LR	92.65	51.75	54.85	65.90	87.75	99.50		71.95	69.00	75.75	92.05	99.55
Box M	16.90	17.10	31.60	47.70	80.65	98.95		20.45	37.75	53.45	84.30	99.25
Schott T1	1.15	12.70	29.65	49.10	81.20	99.10	3.05	15.40	25.50	46.80	82.25	99.25
Schott T2	1.70	71.05	85.25	93.95	99.35	100.00	3.55	73.45	83.30	93.05	99.15	100.00
Schott T3	1.15	76.45	79.20	83.45	85.80	94.15	2.75	82.05	82.55	84.40	90.35	96.80

2. 4. Power:

**group heterogeneity $\Sigma^{(i)} = c_i \Sigma^{(1)}$ with $r(c_i, n_i) \sim -0.7$
(negative pairing)**

2. 4. 1. multivariate normal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	47.50	40.15	58.55	69.95	90.90	99.65		41.25	54.55	62.85	82.55	97.85
Box M	7.90	23.15	44.90	61.20	88.45	99.60		19.70	34.75	51.50	76.75	96.80
Schott T1	0.25	13.75	34.85	53.75	85.05	99.30	3.75	26.05	47.05	60.40	80.65	97.55
Schott T2	1.00	21.15	38.35	53.80	83.25	99.10	6.15	37.85	53.75	61.05	80.00	97.05
Schott T3	0.35	24.20	30.00	38.95	71.55	96.35	4.00	45.65	56.25	55.55	68.35	90.15
Levene	1.75	4.05	4.05	6.80	14.35	29.05	3.40	5.00	10.40	15.45	31.50	56.50
R Dispersion	2.75	6.05	12.30	17.65	30.15	54.05	4.75	10.00	28.70	36.75	57.70	81.75
large design (4*6)												
LR		90.00	94.80	98.30	100.00	100.00		96.85	94.15	95.25	98.25	99.95
Box M		39.85	77.25	94.55	99.85	100.00		46.40	65.80	78.20	95.25	99.95
Schott T1	1.75	42.90	81.25	95.95	99.90	100.00	11.45	67.65	86.30	95.55	99.40	100.00
Schott T2	2.55	48.35	77.80	94.70	99.95	100.00	13.65	75.10	86.95	94.30	98.90	100.00
Schott T3	2.10	46.35	58.35	73.85	85.80	96.05	12.55	77.05	81.00	82.95	84.80	91.40
Levene	3.35	4.20	4.55	8.45	19.10	59.00	5.50	6.00	8.40	12.30	21.90	50.25
R Dispersion	5.25	19.20	39.15	63.40	90.20	99.65	7.40	16.90	30.45	44.35	69.20	93.80

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	21.35	31.40	47.95	59.70	84.25	98.05	29.50	30.35	42.40	52.30	73.90	93.10
Box M	8.20	23.10	41.70	55.70	82.75	97.90	8.90	20.30	33.35	46.50	70.35	92.60
Schott T1	1.75	15.75	34.10	49.15	77.70	97.70	6.40	21.75	37.55	50.75	71.80	93.25
Schott T2	2.70	21.00	36.05	49.45	78.25	96.90	7.95	31.00	43.60	51.85	71.70	92.60
Schott T3	1.65	23.45	30.00	39.55	69.15	95.70	6.30	38.20	48.65	49.20	63.05	86.90
large design (4*6)												
LR	95.40	79.20	90.75	97.25	99.90	100.00		82.75	82.85	89.30	96.90	99.85
Box M	20.30	43.60	77.40	93.50	99.60	100.00		37.35	57.35	77.25	94.20	99.75
Schott T1	2.85	44.80	81.05	94.80	99.85	100.00	17.00	63.75	80.75	91.60	98.10	99.95
Schott T2	3.95	48.45	79.20	93.95	99.95	100.00	18.70	71.35	82.70	90.60	97.75	99.90
Schott T3	3.35	46.95	61.50	76.20	89.25	97.35	17.60	74.85	78.80	81.10	85.20	92.40

2. 4. 2. multivariate lognormal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	54.80	49.60	64.70	78.00	91.65	99.05		49.35	61.05	69.40	82.85	95.90
Box M	12.00	31.50	53.35	71.95	89.70	98.85		27.45	42.80	58.05	78.35	95.35
Schott T1	1.45	20.50	44.50	64.35	86.15	98.75	6.15	30.05	51.75	64.35	81.00	95.75
Schott T2	2.55	17.65	30.30	46.40	68.50	92.35	8.40	30.00	45.55	53.10	67.85	88.70
Schott T3	1.25	22.50	28.50	43.15	70.70	95.45	6.35	40.90	53.00	55.60	68.00	89.65
Levene	1.80	3.70	4.45	7.25	12.65	24.10	2.40	4.90	9.35	14.10	23.45	48.10
R Dispersion	2.90	5.95	8.95	11.55	16.75	30.60	3.45	7.90	16.80	24.00	35.70	55.20
large design (4*6)												
LR		93.90	96.60	98.95	99.95	100.00		97.85	95.60	95.90	99.20	100.00
Box M		53.80	85.05	96.00	99.95	100.00		55.80	76.45	84.65	97.45	99.95
Schott T1	2.60	54.35	85.90	96.15	99.85	100.00	16.85	73.35	88.55	95.60	99.50	100.00
Schott T2	3.70	32.55	58.55	78.50	96.85	99.90	19.15	61.00	75.80	84.30	95.35	99.60
Schott T3	3.00	40.75	57.80	78.10	94.80	99.65	17.95	71.65	78.35	79.35	89.00	95.25
Levene	3.30	4.25	4.25	6.55	14.80	46.05	5.45	5.60	7.60	10.30	16.80	37.40
R Dispersion	4.80	11.45	21.85	31.95	54.95	87.35	4.75	11.85	19.75	22.15	40.50	68.70

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	28.90	37.70	53.95	67.80	83.55	97.30	33.30	34.90	46.75	59.20	74.75	91.15
Box M	12.25	29.50	48.15	64.25	81.80	97.10	11.80	25.50	39.35	53.40	71.75	90.35
Schott T1	3.20	20.95	39.90	56.60	77.80	96.20	8.70	24.10	41.85	55.80	72.75	90.50
Schott T2	4.45	17.35	28.30	42.20	63.55	88.70	10.85	25.05	38.50	45.80	59.95	81.75
Schott T3	2.95	20.50	27.15	40.85	66.20	92.35	8.75	35.15	46.20	48.05	59.40	84.20
large design (4*6)												
LR	95.70	85.50	92.00	97.70	99.75	100.00		88.25	87.50	91.50	97.60	99.90
Box M	23.55	54.30	82.55	94.50	99.65	100.00		46.50	68.10	81.15	95.45	99.90
Schott T1	4.70	54.85	82.80	94.70	99.65	100.00	22.15	69.60	84.20	92.30	98.40	99.95
Schott T2	6.90	34.85	59.30	78.80	96.20	99.90	23.75	60.30	72.95	80.20	93.00	99.40
Schott T3	5.65	42.05	58.95	79.55	94.85	99.70	22.90	70.10	75.95	77.35	88.00	95.85

2. 4. 3. multivariate uniform (discrete)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
	small design (3*3)											
LR	36.95	23.30	38.70	55.20	87.90	99.70		24.80	39.15	48.25	74.20	98.30
Box M	5.10	11.00	24.15	44.95	83.90	99.70		8.25	18.55	33.55	67.15	97.55
Schott T1	0.30	5.35	18.30	38.30	78.20	99.55	1.60	12.90	34.45	48.00	75.60	98.20
Schott T2	0.60	46.10	70.40	87.55	98.95	100.00	2.80	58.40	74.40	83.25	96.05	100.00
Schott T3	0.35	52.60	43.75	36.10	25.85	18.10	1.70	61.55	56.70	52.60	41.75	32.20
Levene	1.30	3.80	4.10	7.20	18.60	43.15	2.10	5.75	12.05	20.65	42.25	76.05
R Dispersion	2.50	7.75	19.20	31.40	58.85	89.90	4.80	12.10	45.05	57.75	82.65	97.95
	large design (4*6)											
LR		84.80	92.85	98.95	100.00	100.00		94.15	90.55	93.30	99.55	100.00
Box M		26.45	67.85	93.90	100.00	100.00		34.05	57.50	72.30	97.15	100.00
Schott T1	0.50	28.30	77.10	96.80	100.00	100.00	7.75	62.75	87.55	96.25	99.90	100.00
Schott T2	1.00	94.25	99.85	100.00	100.00	100.00	9.55	93.45	98.45	99.65	100.00	100.00
Schott T3	0.75	84.30	85.00	87.20	95.35	99.75	8.75	91.75	95.15	94.30	90.60	90.05
Levene	3.40	5.05	5.30	11.45	34.00	87.60	6.20	6.55	13.25	18.50	39.70	81.50
R Dispersion	6.20	39.15	79.65	97.15	100.00	100.00	7.35	29.20	59.05	82.00	97.95	100.00

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
	small design (3*3)											
LR	19.65	25.95	40.30	55.05	78.75	97.35	24.55	24.35	35.45	46.80	69.25	92.55
Box M	7.60	19.50	33.70	50.25	76.90	97.15	5.60	16.65	27.00	40.55	65.30	91.95
Schott T1	1.50	12.80	27.40	44.35	72.25	96.50	5.95	18.05	32.80	45.90	68.65	92.00
Schott T2	2.35	46.65	63.45	78.15	93.45	99.90	7.55	50.80	65.60	74.05	88.75	98.95
Schott T3	1.45	49.30	42.75	37.30	27.75	17.95	5.90	56.75	53.65	51.45	43.55	32.55
	large design (4*6)											
LR	83.75	77.75	89.85	97.25	99.95	100.00		82.80	83.40	90.85	98.10	100.00
Box M	13.50	40.95	77.40	93.60	99.85	100.00		34.25	57.35	77.10	95.65	100.00
Schott T1	2.45	42.65	80.55	94.90	99.80	100.00	16.55	62.15	81.55	92.45	99.30	100.00
Schott T2	3.55	91.70	99.20	100.00	100.00	100.00	19.45	92.05	97.45	99.30	99.95	100.00
Schott T3	3.20	84.85	85.50	87.75	95.40	99.75	18.00	91.95	94.80	94.40	91.20	90.45

2. 4. 4. multivariate exponential (continuous)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	78.80	79.10	86.00	88.20	94.50	98.40		77.35	84.45	85.20	90.90	96.65
Box M	33.95	65.75	81.25	84.85	93.55	98.00		59.30	73.25	79.35	88.95	96.10
Schott T1	8.75	52.65	73.35	79.95	91.60	97.70	16.40	51.65	68.85	77.55	88.60	95.75
Schott T2	12.40	9.75	14.55	18.20	31.70	55.00	20.25	15.95	26.05	28.60	41.10	58.60
Schott T3	8.75	16.35	24.40	31.55	50.40	75.60	16.40	28.75	41.65	40.75	54.05	73.85
Levene	2.75	4.75	4.55	5.00	7.50	13.95	3.65	4.30	7.20	8.50	13.35	24.25
R Dispersion	2.40	2.15	3.95	4.30	5.95	10.05	2.35	2.00	6.95	6.40	11.10	20.85
large design (4*6)												
LR		99.35	99.60	99.90	99.95	100.00		100.00	99.60	99.75	99.80	100.00
Box M		91.05	97.95	99.65	99.90	100.00		88.90	95.45	98.35	99.00	99.95
Schott T1	19.60	85.65	96.75	99.35	99.85	100.00	35.20	86.15	94.25	97.90	99.40	100.00
Schott T2	24.70	6.20	14.10	24.60	49.60	83.15	37.25	19.65	34.70	42.80	59.20	80.45
Schott T3	22.60	19.85	33.15	50.70	80.15	97.65	36.30	45.15	54.55	58.30	74.85	93.50
Levene	4.50	4.65	3.90	4.50	8.10	18.25	7.80	5.70	5.45	6.10	10.35	17.10
R Dispersion	2.65	4.10	5.15	8.35	16.30	34.90	2.35	4.05	5.55	9.45	13.55	24.95

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	50.70	61.75	71.30	76.55	86.85	95.20	53.25	59.25	68.80	71.25	80.80	89.95
Box M	30.45	54.70	67.70	74.65	86.25	94.70	24.60	49.10	61.20	66.80	78.90	89.30
Schott T1	10.25	43.80	59.30	69.65	83.60	94.05	16.70	41.60	56.20	66.55	78.10	90.45
Schott T2	13.15	9.50	13.55	18.55	30.70	51.95	19.20	14.70	22.10	24.55	36.00	52.75
Schott T3	9.35	14.25	21.10	27.75	45.10	67.60	16.75	25.55	35.60	33.65	46.50	65.30
large design (4*6)												
LR	99.65	97.25	98.70	99.50	99.85	100.00		97.90	97.35	98.25	99.00	99.90
Box M	50.10	86.95	96.15	98.40	99.75	100.00		81.30	90.05	95.45	98.25	99.70
Schott T1	23.15	81.50	94.05	98.00	99.70	100.00	38.00	82.55	90.60	95.45	98.55	99.70
Schott T2	27.55	7.85	16.70	29.00	53.55	84.95	39.55	21.30	35.35	43.00	57.45	78.65
Schott T3	25.05	21.95	36.60	51.90	79.45	97.00	38.40	45.40	53.75	57.50	72.40	91.55

2. 4. 5. mixed left and right skewed

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	41.50	28.65	43.40	60.75	91.95	99.95		28.90	42.55	56.00	80.85	99.35
Box M	6.45	12.45	29.70	50.75	88.60	99.90		10.80	22.20	39.80	72.85	98.95
Schott T1	0.25	6.55	21.85	43.25	82.85	99.75	1.80	16.20	39.00	55.30	81.80	99.10
Schott T2	0.55	46.65	73.70	89.75	99.20	100.00	3.20	58.75	74.95	85.60	96.50	99.95
Schott T3	0.25	51.20	44.95	39.80	30.05	23.70	1.65	63.35	60.80	56.35	45.25	34.25
Levene	2.15	4.10	4.70	8.80	19.00	46.60	2.70	6.90	14.20	23.70	43.65	76.70
R Dispersion	2.60	7.00	19.20	29.50	55.90	89.60	4.75	12.90	43.40	57.35	83.65	98.55
large design (4*6)												
LR		84.55	91.70	98.50	100.00	100.00		94.95	90.75	92.20	98.90	100.00
Box M		27.60	67.70	92.55	99.95	100.00		37.55	56.60	70.80	95.00	100.00
Schott T1	0.55	29.05	77.15	96.40	100.00	100.00	7.75	62.80	86.80	95.60	99.80	100.00
Schott T2	0.95	89.95	99.45	100.00	100.00	100.00	10.10	89.90	97.25	99.20	100.00	100.00
Schott T3	0.75	79.90	78.40	81.70	85.75	93.65	9.05	89.05	90.20	88.35	87.10	87.30
Levene	2.65	5.00	5.35	11.65	28.10	80.40	5.70	7.35	12.55	17.40	32.10	70.65
R Dispersion	5.60	30.80	69.50	91.30	99.85	100.00	5.30	20.70	42.50	65.40	93.05	99.90

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	22.70	29.35	45.15	59.75	83.10	98.75	30.45	28.05	39.75	51.35	73.95	95.00
Box M	8.85	21.55	39.35	54.70	81.55	98.50	9.00	19.25	30.00	45.55	70.45	94.45
Schott T1	2.00	14.80	31.00	48.60	77.20	98.00	6.65	20.65	36.65	50.45	72.20	94.80
Schott T2	3.10	47.30	66.60	80.85	95.10	99.90	8.40	51.20	66.15	76.60	90.85	99.50
Schott T3	1.75	49.55	43.90	41.10	32.35	25.10	6.40	57.25	58.30	54.50	45.60	36.55
large design (4*6)												
LR	94.80	77.65	90.05	96.75	99.90	100.00		81.20	82.80	89.35	97.45	99.95
Box M	20.40	42.05	76.65	92.95	99.80	100.00		35.45	55.05	75.50	93.95	99.95
Schott T1	2.60	42.75	81.50	94.95	99.90	100.00	16.00	62.20	81.55	92.25	98.35	100.00
Schott T2	3.75	87.75	98.75	99.80	100.00	100.00	18.95	89.10	95.85	98.65	99.95	100.00
Schott T3	3.25	80.70	80.00	82.75	86.40	93.80	17.45	87.70	89.90	88.85	87.70	87.90

2. 5. Power:

**group heterogeneity $\Sigma^{(i)} = c_i \Sigma^{(1)}$ with $r(c_i, n_i) \sim 0.7$
(positive pairing)**

2. 5. 1. multivariate normal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	56.95	64.05	86.80	96.45	99.80	100.00		45.00	50.35	67.70	88.90	99.55
Box M	10.45	42.55	77.30	94.35	99.75	100.00		22.15	29.90	53.95	84.35	99.35
Schott T1	0.75	26.80	61.75	86.05	99.40	100.00	0.20	7.40	8.45	21.70	51.45	93.35
Schott T2	1.80	36.05	61.80	85.15	98.75	100.00	0.30	22.05	19.25	26.95	52.15	92.50
Schott T3	1.35	33.15	44.85	64.40	89.55	98.55	0.20	32.55	39.75	34.40	39.35	79.15
Levene	4.40	12.70	13.75	19.75	28.50	45.35	4.75	9.85	11.25	16.70	25.15	47.10
R Dispersion	7.75	18.60	27.65	39.25	52.15	75.50	6.35	15.50	26.55	39.65	55.30	79.45
large design (4*6)												
LR		89.95	95.05	98.75	100.00	100.00		96.90	94.70	96.05	99.65	100.00
Box M		40.60	76.35	94.20	99.95	100.00		44.70	67.25	81.05	98.40	100.00
Schott T1	1.10	37.10	73.50	93.00	99.95	100.00	0.15	3.75	7.80	33.45	87.35	99.95
Schott T2	1.90	43.25	71.10	91.05	99.85	100.00	0.25	24.30	24.30	39.25	84.45	99.95
Schott T3	1.80	45.55	52.85	69.70	85.35	96.25	0.25	45.00	40.50	41.55	61.05	91.15
Levene	5.80	10.65	12.25	20.10	33.95	65.60	7.50	15.15	31.85	50.05	81.95	99.05
R Dispersion	13.60	38.95	59.00	72.80	89.85	99.15	32.70	72.85	90.80	97.35	99.55	100.00

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	30.65	53.45	77.80	91.00	99.15	100.00	28.85	34.80	38.90	55.80	79.30	97.70
Box M	12.20	44.35	72.50	89.50	99.00	100.00	8.10	24.30	29.80	49.05	75.90	97.25
Schott T1	3.30	28.85	56.70	81.35	97.75	100.00	0.65	12.30	12.70	25.30	50.10	88.85
Schott T2	5.30	34.25	57.40	80.10	97.60	100.00	0.95	21.50	19.85	29.80	50.95	89.15
Schott T3	4.15	32.05	45.40	65.75	91.15	99.40	1.05	30.80	35.65	34.45	43.10	79.50
large design (4*6)												
LR	95.10	79.15	90.85	97.10	99.90	100.00		82.10	85.45	90.90	98.85	100.00
Box M	20.25	42.70	78.35	93.00	99.90	100.00		32.70	57.30	78.85	97.50	100.00
Schott T1	3.30	38.85	73.50	90.95	99.60	100.00	0.35	6.15	15.20	43.40	89.30	99.95
Schott T2	4.10	43.15	71.55	89.00	99.40	100.00	0.45	26.30	30.05	46.00	86.90	99.90
Schott T3	4.00	46.00	54.20	72.00	88.60	97.55	0.35	44.40	41.65	46.40	68.35	93.45

2. 5. 2. multivariate lognormal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	62.50	72.45	87.60	94.95	99.75	100.00		56.70	59.10	73.35	91.10	99.50
Box M	16.25	53.50	80.80	92.40	99.65	100.00		30.20	39.90	60.90	86.95	99.40
Schott T1	2.00	37.35	68.25	86.05	98.55	100.00	0.20	13.95	14.25	28.95	58.65	93.45
Schott T2	3.75	29.45	48.65	69.00	91.15	99.70	0.50	18.55	17.05	19.50	38.80	75.75
Schott T3	2.95	32.90	45.70	65.65	90.70	99.65	0.40	33.80	39.95	31.25	40.20	79.60
Levene	4.55	12.55	13.90	18.80	26.65	41.60	3.90	9.95	12.05	15.75	22.95	39.80
R Dispersion	7.20	14.00	20.55	26.25	37.50	54.85	5.85	11.85	19.35	26.15	37.25	57.05
large design (4*6)												
LR		94.55	96.60	99.05	99.95	100.00		98.00	96.60	97.95	99.90	100.00
Box M		53.60	85.30	96.60	99.90	100.00		54.85	76.10	88.95	99.10	100.00
Schott T1	2.85	48.85	82.35	95.30	99.65	100.00	0.35	8.50	18.30	49.15	89.95	99.95
Schott T2	3.75	29.55	53.45	73.60	94.40	100.00	0.45	16.15	14.40	22.25	56.55	96.00
Schott T3	3.30	38.20	54.10	75.30	94.15	99.70	0.40	39.15	39.85	40.05	66.70	95.70
Levene	4.80	12.15	12.90	19.10	30.10	56.90	6.70	14.25	26.45	43.65	70.20	97.40
R Dispersion	11.05	25.10	39.70	49.30	67.30	88.05	20.55	49.15	67.90	80.60	92.90	99.60

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	36.70	61.35	79.15	89.90	98.45	100.00	33.30	41.70	45.00	59.80	83.70	97.75
Box M	16.45	51.40	74.35	88.00	98.30	100.00	11.00	30.00	35.95	53.50	81.20	97.40
Schott T1	4.35	36.35	61.15	79.60	96.30	100.00	1.10	15.00	17.70	29.00	55.10	89.05
Schott T2	6.30	29.20	46.20	64.55	88.75	99.35	2.05	18.30	16.50	21.35	41.40	72.40
Schott T3	4.75	31.10	43.15	62.30	88.45	99.70	1.50	31.15	36.70	30.85	40.60	75.75
large design (4*6)												
LR	96.15	85.00	92.60	97.40	99.80	100.00		88.05	89.05	94.70	98.95	100.00
Box M	21.65	54.25	83.70	94.25	99.65	100.00		43.25	66.10	85.85	97.75	100.00
Schott T1	5.15	48.75	79.00	93.05	99.30	100.00	0.85	11.65	24.90	54.90	89.60	99.85
Schott T2	6.25	30.80	55.10	73.65	93.65	99.95	1.10	18.35	17.55	28.90	62.30	97.00
Schott T3	5.65	38.50	55.95	75.05	94.00	99.70	0.95	38.35	41.00	42.90	69.20	96.50

2. 5. 3. multivariate uniform (discrete)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	48.15	57.40	89.55	99.00	100.00	100.00		35.10	37.25	57.15	90.25	99.95
Box M	7.20	33.50	79.40	98.05	100.00	100.00		13.40	18.05	40.00	84.30	99.90
Schott T1	0.40	18.35	56.30	89.75	99.95	100.00	0.00	3.35	2.95	10.50	42.35	96.90
Schott T2	1.10	74.85	96.10	99.95	100.00	100.00	0.25	48.85	47.70	66.50	95.20	100.00
Schott T3	0.80	63.60	55.75	51.15	51.30	56.15	0.00	63.45	55.20	54.85	49.60	48.45
Levene	4.15	12.55	12.60	20.15	31.15	55.10	3.90	8.85	11.15	17.35	31.00	59.30
R Dispersion	7.15	22.50	38.00	55.20	75.80	94.90	5.55	19.70	42.45	63.25	84.15	98.05
large design (4*6)												
LR		84.40	93.70	99.00	100.00	100.00		89.20	87.15	93.65	99.70	100.00
Box M		26.55	67.60	94.75	100.00	100.00		30.00	47.30	70.40	98.55	100.00
Schott T1	0.45	24.40	65.15	92.00	99.95	100.00	0.00	1.40	2.35	15.75	84.70	99.95
Schott T2	0.90	91.80	99.65	99.95	100.00	100.00	0.00	66.85	78.35	95.40	100.00	100.00
Schott T3	0.65	85.80	87.65	90.05	96.70	99.50	0.00	84.50	88.55	92.55	95.65	98.00
Levene	4.05	10.10	10.30	19.20	37.30	74.70	7.65	16.45	39.20	65.05	93.10	99.90
R Dispersion	14.00	51.50	79.00	92.35	99.45	100.00	42.10	92.10	99.35	99.90	100.00	100.00

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	31.80	53.50	80.05	93.30	99.50	100.00	15.70	34.20	37.55	55.20	80.90	98.70
Box M	12.25	42.60	74.20	91.85	99.30	100.00	2.45	22.75	28.90	48.35	77.25	98.50
Schott T1	2.80	26.95	57.00	83.15	98.55	100.00	0.75	10.05	9.50	22.75	49.35	91.35
Schott T2	4.10	69.25	90.90	98.05	100.00	100.00	1.05	47.70	47.85	64.05	88.20	99.75
Schott T3	3.15	62.15	56.55	51.10	51.60	55.95	0.80	60.85	53.70	54.25	49.20	48.85
large design (4*6)												
LR	85.75	77.50	91.65	97.50	99.95	100.00		78.95	81.80	89.65	99.35	100.00
Box M	13.15	39.80	76.55	94.55	99.90	100.00		31.80	51.20	75.60	97.85	100.00
Schott T1	2.60	35.45	72.85	91.95	99.80	100.00	0.25	4.10	10.45	37.35	88.30	99.90
Schott T2	3.70	90.70	99.05	99.95	100.00	100.00	0.25	69.35	81.10	94.15	99.90	100.00
Schott T3	3.35	86.60	87.80	90.40	96.70	99.50	0.25	84.35	88.35	93.25	96.00	98.10

2. 5. 4. multivariate exponential (continuous)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	82.40	88.25	93.60	96.75	99.10	99.90		82.60	86.10	90.70	94.90	98.85
Box M	39.05	77.30	90.25	95.45	98.80	99.90		65.30	72.90	85.05	93.05	98.65
Schott T1	10.20	61.90	82.85	92.45	98.20	99.80	3.25	38.70	43.65	59.15	76.10	94.70
Schott T2	15.75	12.55	20.90	30.60	49.55	79.70	5.70	9.40	6.95	8.55	14.70	30.70
Schott T3	12.80	20.60	33.40	50.30	71.80	93.05	3.95	21.85	25.95	21.90	26.75	56.40
Levene	6.25	14.05	14.40	17.10	19.85	28.30	5.10	11.45	10.15	13.40	16.15	25.20
R Dispersion	4.75	7.00	10.00	13.10	16.90	28.05	4.00	6.05	6.95	11.10	15.85	25.30
large design (4*6)												
LR		99.55	99.75	99.90	100.00	100.00		99.85	99.70	99.80	100.00	100.00
Box M		91.55	98.15	99.60	100.00	100.00		88.05	97.20	98.45	99.75	100.00
Schott T1	21.30	86.45	95.75	99.00	100.00	100.00	4.30	44.65	67.70	85.95	97.50	100.00
Schott T2	25.30	5.75	12.20	21.85	42.70	76.90	5.00	3.30	2.45	3.55	9.05	34.95
Schott T3	23.85	16.25	31.05	48.45	75.95	95.65	4.60	19.60	17.55	18.05	34.95	77.30
Levene	6.35	13.85	13.40	16.85	23.80	37.30	8.50	13.30	17.50	23.40	41.10	70.15
R Dispersion	5.90	11.60	14.50	22.75	32.85	49.80	6.25	17.00	26.35	36.35	57.40	80.05

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	50.70	61.75	71.30	76.55	86.85	95.20	53.25	59.25	68.80	71.25	80.80	89.95
Box M	30.45	54.70	67.70	74.65	86.25	94.70	24.60	49.10	61.20	66.80	78.90	89.30
Schott T1	10.25	43.80	59.30	69.65	83.60	94.05	16.70	41.60	56.20	66.55	78.10	90.45
Schott T2	13.15	9.50	13.55	18.55	30.70	51.95	19.20	14.70	22.10	24.55	36.00	52.75
Schott T3	9.35	14.25	21.10	27.75	45.10	67.60	16.75	25.55	35.60	33.65	46.50	65.30
large design (4*6)												
LR	99.65	97.25	98.70	99.50	99.85	100.00		97.90	97.35	98.25	99.00	99.90
Box M	50.10	86.95	96.15	98.40	99.75	100.00		81.30	90.05	95.45	98.25	99.70
Schott T1	23.15	81.50	94.05	98.00	99.70	100.00	38.00	82.55	90.60	95.45	98.55	99.70
Schott T2	27.55	7.85	16.70	29.00	53.55	84.95	39.55	21.30	35.35	43.00	57.45	78.65
Schott T3	25.05	21.95	36.60	51.90	79.45	97.00	38.40	45.40	53.75	57.50	72.40	91.55

2. 5. 5. mixed left and right skewed

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	51.30	54.25	84.75	98.00	100.00	100.00		35.40	37.95	55.00	87.55	99.80
Box M	8.30	32.25	73.55	96.40	100.00	100.00		14.65	18.60	39.95	80.15	99.75
Schott T1	0.50	18.15	53.80	87.00	99.85	100.00	0.10	3.45	3.40	11.25	42.55	95.45
Schott T2	1.00	65.70	92.80	99.50	100.00	100.00	0.20	44.85	44.15	60.30	91.75	99.95
Schott T3	0.70	59.00	50.70	41.65	31.15	23.70	0.05	59.60	52.90	49.20	40.50	31.80
Levene	4.70	13.30	14.20	22.25	32.50	57.25	4.30	9.05	12.45	19.55	32.70	61.65
R Dispersion	8.75	21.20	37.75	54.50	76.45	96.00	5.90	19.30	43.65	63.00	84.00	98.05
large design (4*6)												
LR		84.30	92.50	98.40	100.00	100.00		94.75	91.65	93.75	99.75	100.00
Box M		27.65	66.10	93.25	99.95	100.00		36.65	54.45	70.80	98.15	100.00
Schott T1	0.40	24.25	64.20	91.05	99.95	100.00	0.00	1.45	2.95	17.15	83.85	100.00
Schott T2	1.05	86.55	98.85	100.00	100.00	100.00	0.05	61.30	75.20	91.95	99.85	100.00
Schott T3	1.00	80.70	80.30	81.95	86.60	93.75	0.00	79.75	82.15	83.50	89.45	94.20
Levene	4.85	10.75	14.10	23.35	40.80	79.15	7.15	17.55	41.50	66.20	92.90	99.85
R Dispersion	14.70	53.80	80.15	92.30	99.30	100.00	43.05	91.40	99.10	99.80	100.00	100.00

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	30.60	51.90	77.85	92.10	99.60	100.0	28.40	33.65	37.70	54.60	79.75	98.35
Box M	12.70	42.75	72.50	90.35	99.15	100.0	8.25	21.85	27.60	47.45	76.80	98.10
Schott T1	3.00	26.80	55.70	81.95	98.30	100.0	0.70	10.55	10.80	22.75	50.05	90.50
Schott T2	4.70	62.85	86.60	96.65	99.90	100.0	1.00	43.15	44.45	60.90	85.60	99.55
Schott T3	3.55	57.40	52.00	44.95	34.05	25.6	0.95	58.60	51.95	49.55	41.65	33.80
large design (4*6)												
LR	95.15	78.20	90.80	96.85	99.95	100.0		80.85	83.30	90.55	99.00	100.00
Box M	20.40	40.10	76.45	93.45	99.85	100.0		31.85	54.50	76.70	97.60	100.00
Schott T1	2.90	36.25	72.45	90.85	99.75	100.0	0.35	4.65	12.20	38.65	88.55	100.00
Schott T2	4.50	85.60	98.30	99.80	100.00	100.0	0.40	63.75	78.85	92.50	99.60	100.00
Schott T3	3.85	81.30	81.05	83.15	87.20	93.9	0.40	79.65	82.95	83.80	90.00	94.50

2. 6. Power:

**group heterogeneity: $r^{(i)}=(0.2, 0.3, 0.4, 0.5)$ with
 $r(r^{(i)}, n_i) \sim 0.1$**

2. 6. 1. multivariate normal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	41.60	17.45	17.30	19.95	23.20	35.50		20.40	22.75	24.40	29.95	48.20
Box M	6.50	7.35	10.65	14.45	18.90	32.45		7.90	9.50	16.70	23.55	43.85
Schott T1	0.10	3.05	7.15	11.25	16.80	30.90	1.00	3.30	6.80	11.00	18.00	38.75
Schott T2	0.50	9.40	9.40	12.45	18.95	31.45	1.50	11.80	16.25	15.75	19.85	39.60
Schott T3	0.45	12.70	10.40	11.80	17.05	30.20	1.30	22.75	26.75	20.00	20.85	37.65
Levene	2.65	7.55	9.95	13.60	19.80	34.90	2.35	6.10	9.45	15.40	23.65	45.25
large design (4*6)												
LR		53.60	37.25	32.95	35.80	49.80		84.30	60.10	38.25	30.00	35.90
Box M		7.45	10.60	12.95	21.35	41.35		18.85	19.80	12.30	14.55	24.90
Schott T1	0.40	3.15	6.35	9.80	18.45	38.55	0.30	2.15	3.40	4.80	7.40	14.65
Schott T2	0.65	9.45	10.70	13.65	20.00	39.15	0.30	16.35	12.15	7.60	9.45	15.80
Schott T3	0.65	17.35	13.10	14.75	18.60	35.60	0.25	34.70	25.10	13.55	12.55	15.65
Levene	5.05	8.70	7.60	9.15	11.30	14.10	6.60	7.75	6.20	6.30	8.60	9.20

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	15.95	11.80	12.70	16.65	22.70	36.05	22.15	11.75	16.00	20.05	28.35	47.50
Box M	6.30	8.00	9.80	14.75	20.50	34.60	6.80	7.30	11.20	16.35	24.95	45.15
Schott T1	0.90	4.80	8.25	12.30	20.10	34.95	1.25	2.15	5.80	10.25	18.60	40.00
Schott T2	1.50	8.50	10.20	13.05	20.65	34.30	1.75	7.60	12.60	14.10	19.90	40.45
Schott T3	0.95	11.50	10.90	11.70	16.60	31.25	1.30	15.95	19.25	15.30	17.70	36.25
large design (4*6)												
LR	90.25	31.65	25.35	24.20	29.45	43.95		45.85	31.70	21.75	20.65	27.45
Box M	13.80	7.50	10.00	12.25	21.50	37.75		8.60	9.80	7.90	11.55	21.20
Schott T1	0.70	3.80	7.40	10.60	19.20	35.65	0.50	1.30	1.30	1.70	3.50	8.70
Schott T2	0.85	9.20	10.25	12.55	18.65	36.05	0.50	10.70	6.15	3.85	5.65	9.95
Schott T3	0.80	16.95	12.85	14.30	16.85	30.65	0.50	26.15	17.45	8.45	9.35	8.85

2. 6. 2. multivariate lognormal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	48.40	27.50	28.95	33.55	38.90	52.15		31.35	33.20	35.90	42.35	62.20
Box M	8.75	13.55	19.60	25.50	33.85	49.20		13.80	17.00	25.50	35.40	58.55
Schott T1	0.60	7.10	14.75	21.95	30.80	47.15	1.55	6.85	11.25	19.75	30.60	53.65
Schott T2	1.05	7.55	9.45	11.35	16.10	25.15	2.30	11.15	13.35	13.85	17.50	30.20
Schott T3	0.85	11.25	10.85	12.05	17.05	26.90	1.80	21.90	25.55	19.55	19.10	32.75
Levene	3.15	7.45	10.05	13.80	20.15	35.30	2.35	6.25	9.40	15.90	23.95	45.25
large design (4*6)												
LR		71.50	59.15	57.05	61.50	75.35		90.40	75.30	60.20	56.80	62.85
Box M		16.55	27.25	34.40	47.20	68.15		26.85	34.00	31.45	35.55	51.25
Schott T1	0.50	10.85	22.15	30.50	44.55	66.00	0.90	6.70	11.80	17.65	24.00	37.80
Schott T2	1.05	8.65	8.70	10.80	13.80	24.25	1.05	13.35	9.90	7.60	6.95	9.50
Schott T3	1.00	13.70	10.95	12.90	14.70	29.35	0.90	30.35	23.75	12.85	11.40	12.30
Levene	4.95	8.85	8.40	9.75	11.80	14.70	7.30	8.15	7.00	7.35	8.95	9.20

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	20.45	18.70	21.35	25.90	31.80	45.55	26.65	19.10	22.75	27.70	35.05	53.80
Box M	8.45	13.45	17.30	22.60	29.85	44.45	7.70	11.65	16.30	22.95	31.25	51.75
Schott T1	1.80	8.55	13.45	19.05	27.20	43.55	1.70	4.75	10.30	16.50	25.70	47.80
Schott T2	2.10	7.20	9.45	12.20	17.65	27.30	2.35	8.30	11.10	11.65	15.10	30.85
Schott T3	1.60	11.35	10.45	13.15	17.55	31.85	1.85	16.20	19.80	15.30	17.65	35.45
large design (4*6)												
LR	93.90	47.35	42.70	44.05	48.00	61.95		59.30	47.15	40.15	40.55	48.70
Box M	17.80	15.25	23.80	27.80	38.75	56.25		14.30	19.50	20.40	27.85	40.15
Schott T1	1.15	11.45	19.00	26.35	36.10	54.80	1.35	4.10	6.40	8.65	14.00	23.55
Schott T2	1.60	7.60	8.30	10.55	13.90	23.30	1.60	9.10	4.90	3.65	3.95	6.05
Schott T3	1.50	14.00	12.15	12.55	15.80	30.50	1.55	23.55	16.25	9.45	8.95	8.45

2. 6. 3. multivariate uniform (discrete)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	26.45	8.85	7.65	7.90	8.35	15.80		12.15	11.00	12.10	13.60	23.85
Box M	2.20	3.00	3.70	5.30	6.30	14.20		4.10	5.20	7.05	10.30	20.75
Schott T1	0.00	0.65	1.95	3.60	5.00	12.45	0.20	0.70	1.85	3.45	6.70	16.75
Schott T2	0.15	26.90	27.30	31.25	41.40	56.90	0.50	30.40	36.15	39.15	42.55	65.25
Schott T3	0.10	42.65	38.70	44.80	53.75	67.05	0.35	51.45	53.60	49.70	54.25	72.80
Levene	2.15	5.95	6.10	9.90	14.05	25.50	1.85	6.50	7.70	11.90	17.75	34.25
large design (4*6)												
LR		35.05	17.90	13.15	12.45	20.60		61.30	37.00	19.40	11.95	12.90
Box M		3.05	3.80	4.05	6.70	15.35		7.30	9.30	5.50	4.80	7.85
Schott T1	0.10	0.45	1.40	1.85	4.05	12.55	0.15	0.40	0.40	0.35	1.10	2.70
Schott T2	0.15	58.25	65.05	72.00	78.20	89.10	0.20	53.70	54.40	51.00	60.25	74.30
Schott T3	0.20	72.30	79.00	83.35	89.75	96.35	0.15	75.60	72.95	69.95	75.55	87.45
Levene	3.45	6.20	4.80	6.05	7.65	9.75	6.35	6.10	4.00	4.70	7.05	6.35

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	14.15	12.25	11.15	12.75	15.55	26.15	10.35	12.65	13.25	16.85	20.85	33.80
Box M	4.30	8.45	8.60	9.95	13.55	24.75	1.35	7.60	8.95	13.50	17.95	31.90
Schott T1	0.85	4.15	5.95	7.95	12.55	23.05	0.95	1.45	5.30	7.80	13.15	26.85
Schott T2	1.45	29.90	34.35	39.15	48.55	63.30	1.40	29.85	35.95	41.00	47.60	69.15
Schott T3	0.90	47.00	46.20	50.65	59.10	71.65	1.05	50.20	53.25	53.30	60.60	77.75
large design (4*6)												
LR	59.35	31.15	20.50	18.35	20.80	27.85		42.15	27.60	20.05	16.00	18.75
Box M	3.80	7.15	7.95	9.30	13.55	23.05		8.05	8.45	8.55	9.25	13.65
Schott T1	0.70	2.55	4.60	6.20	10.15	20.50	0.15	0.85	1.35	1.40	1.90	3.65
Schott T2	1.15	61.10	70.15	74.70	80.25	89.95	0.40	51.25	52.35	50.50	59.50	73.00
Schott T3	1.15	74.85	83.30	88.90	93.80	98.80	0.15	77.25	77.10	78.15	84.45	92.75

2. 6. 4. multivariate exponential (continuous)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	75.20	71.40	75.05	78.50	81.40	86.10		74.10	76.00	74.95	80.20	89.25
Box M	29.80	55.60	65.85	72.65	78.60	84.95		52.70	60.80	66.95	75.80	87.50
Schott T1	7.10	42.10	57.50	65.25	74.55	83.00	7.40	33.10	45.45	55.35	68.30	84.40
Schott T2	10.70	5.55	7.45	7.20	9.90	12.20	10.30	7.50	7.95	8.50	10.65	13.30
Schott T3	8.80	10.65	10.75	11.05	16.30	19.85	8.50	16.65	19.90	16.85	16.40	19.00
Levene	4.65	9.20	10.75	14.35	19.40	33.75	3.70	8.30	11.30	17.10	22.90	42.95
large design (4*6)												
LR		98.65	97.60	97.85	98.40	99.10		99.35	98.95	97.75	98.25	98.25
Box M		80.25	89.40	93.55	96.90	98.75		76.15	87.85	91.35	95.10	96.65
Schott T1	13.80	68.60	84.05	90.70	96.40	98.30	9.60	49.40	64.50	76.75	87.40	93.15
Schott T2	17.05	2.10	2.75	3.60	4.45	7.10	10.65	4.55	3.50	4.15	3.40	5.30
Schott T3	15.65	6.50	6.05	7.50	9.25	14.15	10.00	17.30	13.75	8.65	8.00	9.10
Levene	6.60	10.10	9.90	10.95	12.45	16.35	9.15	9.35	8.65	8.70	9.65	10.65

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	44.85	48.25	52.50	54.70	59.55	67.25	48.15	51.45	51.20	53.55	61.55	69.80
Box M	24.35	39.85	47.25	51.80	57.40	65.80	20.40	39.95	43.55	48.75	58.30	68.50
Schott T1	7.55	30.90	40.05	46.65	54.35	64.00	6.85	23.05	31.10	40.65	50.90	64.05
Schott T2	9.50	5.15	6.25	7.35	9.60	12.10	8.60	6.35	6.65	6.50	8.05	12.25
Schott T3	7.65	9.05	10.20	11.60	14.50	20.95	7.05	14.05	16.15	12.75	14.70	20.15
large design (4*6)												
LR	98.75	92.05	90.05	91.15	92.95	95.25		94.20	92.30	91.65	92.30	93.05
Box M	44.85	70.85	80.45	83.80	90.55	93.95		61.30	76.85	82.40	86.75	91.00
Schott T1	15.90	59.25	74.70	79.85	88.30	92.85	9.00	38.55	50.45	62.70	72.15	81.65
Schott T2	18.55	2.45	2.60	3.60	5.05	7.00	9.75	3.10	2.10	2.70	1.70	2.55
Schott T3	17.70	6.80	6.75	7.95	10.10	15.40	9.30	13.25	10.40	6.55	4.85	5.55

2. 6. 5. mixed left and right skewed

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	33.90	9.35	8.55	10.85	11.55	21.50		13.10	14.70	15.05	17.35	31.75
Box M	4.65	4.05	5.05	6.55	9.25	19.30		4.95	6.55	9.35	13.15	27.85
Schott T1	0.15	0.70	2.60	5.05	7.20	16.95	0.35	1.15	2.45	4.65	9.10	23.45
Schott T2	0.25	22.90	24.15	29.40	38.20	56.40	0.55	26.50	33.95	33.95	41.50	63.95
Schott T3	0.20	34.20	30.75	31.40	29.50	28.60	0.45	45.70	47.30	37.30	35.40	33.15
Levene	3.15	7.25	9.00	12.45	16.70	30.35	2.15	6.65	9.15	13.45	21.05	39.20
large design (4*6)												
LR		38.50	20.90	16.70	17.70	27.75		75.50	46.90	22.65	14.25	18.50
Box M		3.20	4.05	5.40	9.15	21.15		14.70	14.05	4.95	6.50	11.90
Schott T1	0.15	0.70	1.95	2.70	6.40	18.20	0.1	0.45	0.35	0.85	1.80	4.75
Schott T2	0.20	45.85	53.60	60.85	70.75	87.05	0.1	45.25	45.00	41.40	48.10	66.65
Schott T3	0.20	63.35	67.65	71.75	80.75	92.30	0.1	70.10	66.45	61.50	65.05	81.50
Levene	5.15	7.55	6.10	7.65	10.15	13.05	6.9	7.70	6.40	5.70	8.60	8.45

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	16.25	11.60	12.30	14.30	17.45	30.80	22.10	11.65	15.45	17.95	23.95	40.20
Box M	6.00	7.25	9.55	12.30	15.95	29.15	6.45	6.95	10.55	14.80	20.95	38.00
Schott T1	0.95	3.70	7.00	9.40	13.80	28.40	1.05	1.70	5.05	8.75	15.40	33.05
Schott T2	1.50	24.95	28.40	33.75	45.30	63.35	1.45	22.90	33.30	35.65	46.00	69.05
Schott T3	0.90	37.65	32.55	31.10	25.45	21.05	1.10	41.45	41.50	32.30	26.90	18.85
large design (4*6)												
LR	90.60	31.15	21.25	20.35	23.60	35.30		45.55	29.30	19.95	18.35	22.45
Box M	15.10	6.75	8.40	10.95	16.85	30.40		8.50	8.75	7.60	10.40	16.80
Schott T1	0.80	2.60	4.50	6.95	12.00	27.80	0.45	1.20	0.80	1.00	2.30	5.45
Schott T2	1.00	47.80	56.05	62.60	73.55	87.90	0.45	41.30	39.85	36.10	44.50	63.00
Schott T3	0.95	65.45	72.00	76.75	83.10	93.25	0.45	69.30	68.10	67.25	71.95	86.10

2. 7. Power:

**group heterogeneity $r^{(i)} = (0.6, 0.15, 0.15, 0.6)$ with
 $r(r^{(i)}, n_i) \sim 0.9$**

2. 7. 1. multivariate normal

	equal cell counts						unequal cell counts					
method	5	10	15	20	30	50	5	10	15	20	30	50
	small design (3*3)											
LR	45.10	25.90	31.85	40.00	56.15	84.50		28.15	29.60	32.05	40.65	59.70
Box M	8.65	13.00	22.00	32.70	50.75	82.35		12.20	14.50	20.80	34.65	55.45
Schott T1	0.60	7.20	17.45	29.60	49.35	81.85	2.95	14.15	23.05	31.55	43.55	64.65
Schott T2	1.00	13.50	20.60	31.20	49.40	81.10	4.75	25.80	32.90	35.70	44.50	64.25
Schott T3	0.75	17.65	20.65	28.70	45.70	79.45	3.55	36.65	43.90	37.75	40.30	61.70
Levene	1.50	2.30	2.55	2.65	3.40	2.95	2.55	3.75	3.85	4.10	5.90	6.95
	large design (4*6)											
LR		77.20	77.50	85.85	95.50	99.85		94.10	89.60	88.15	95.85	99.90
Box M		21.95	43.80	65.70	91.80	99.75		34.80	53.85	62.65	88.25	99.55
Schott T1	0.45	15.45	37.05	61.80	89.40	99.75	8.00	44.25	63.65	79.10	95.05	99.80
Schott T2	0.80	25.30	41.60	59.30	87.50	99.65	9.10	58.90	69.40	77.75	93.40	99.70
Schott T3	0.50	33.65	38.85	54.00	80.75	97.30	8.25	71.20	71.60	72.35	85.90	96.55
Levene	2.35	0.90	0.45	0.85	0.40	0.65	4.30	1.80	1.55	1.80	1.30	1.10

with orthonormal transformation

	equal cell counts						unequal cell counts					
method	5	10	15	20	30	50	5	10	15	20	30	50
	small design (3*3)											
LR	19.45	21.40	27.90	38.85	57.40	83.20	27.50	21.85	25.80	32.50	43.20	63.80
Box M	7.05	13.65	22.70	35.80	54.50	81.80	9.25	15.15	19.30	27.95	39.30	61.60
Schott T1	0.80	9.35	21.75	33.80	54.65	82.40	7.65	19.95	30.25	39.70	50.55	70.50
Schott T2	1.65	13.25	22.75	35.25	54.80	82.80	9.00	27.40	34.95	41.45	51.00	70.15
Schott T3	0.85	18.00	19.70	28.45	46.95	79.45	7.90	36.55	44.45	40.35	42.90	64.60
	large design (4*6)											
LR	92.40	57.50	63.70	77.50	92.80	99.80		73.65	76.40	80.45	93.75	99.65
Box M	17.10	20.45	40.65	62.45	89.20	99.50		25.45	46.65	62.50	87.80	99.15
Schott T1	1.40	17.40	38.55	59.80	86.85	99.45	17.90	54.45	71.05	84.10	95.95	99.80
Schott T2	1.90	24.55	41.30	58.80	86.00	99.30	19.55	63.95	75.35	82.65	95.15	99.80
Schott T3	1.45	33.45	35.35	48.00	68.95	92.75	18.35	72.55	73.15	73.30	82.00	93.75

2. 7. 2. multivariate lognormal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	52.20	37.25	43.35	54.00	68.75	88.65		38.20	41.85	44.00	53.95	70.15
Box M	10.80	20.05	33.05	45.20	64.00	86.85		18.85	23.20	33.55	47.30	66.70
Schott T1	1.00	13.20	27.05	41.60	60.45	86.30	5.00	21.00	30.85	39.95	52.75	70.45
Schott T2	1.80	12.40	18.00	26.30	39.40	65.60	6.90	22.85	29.20	30.10	38.50	54.65
Schott T3	1.35	15.80	18.65	26.00	39.95	69.60	5.90	34.25	41.15	35.65	38.90	57.35
Levene	1.70	2.35	2.15	3.05	3.55	3.05	2.75	3.75	4.65	4.50	6.10	7.30
large design (4*6)												
LR		87.25	87.30	93.65	98.25	100.00		96.05	93.85	94.15	97.65	99.90
Box M		37.15	62.85	80.65	95.95	99.95		46.55	68.35	76.80	92.85	99.80
Schott T1	1.40	28.50	56.75	76.60	94.25	99.90	11.55	55.75	74.45	85.50	96.20	99.85
Schott T2	2.05	18.50	28.40	42.35	69.30	96.35	13.10	48.05	55.40	62.85	82.70	96.50
Schott T3	1.70	27.10	33.65	47.05	74.35	97.85	12.25	63.35	65.15	66.00	84.35	97.85
Levene	2.90	1.00	0.50	1.10	0.50	0.40	4.90	2.20	1.90	1.50	1.50	1.45

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	24.55	27.05	35.25	45.80	61.30	82.15	32.55	29.00	32.75	39.25	50.15	65.95
Box M	10.50	19.40	29.95	42.55	59.20	81.40	11.25	20.15	26.85	34.55	46.85	63.90
Schott T1	1.85	14.00	26.75	39.60	57.60	80.95	9.85	24.30	33.10	43.40	55.00	71.25
Schott T2	3.00	12.60	18.45	28.60	42.00	67.00	11.55	24.90	31.40	36.30	45.00	59.75
Schott T3	2.15	16.65	18.85	29.10	42.60	72.50	10.15	34.30	42.05	39.55	43.95	62.60
large design (4*6)												
LR	94.45	70.65	75.25	85.20	94.70	99.45		80.25	82.40	85.20	93.15	99.50
Box M	19.80	33.50	56.50	73.60	91.00	99.25		34.65	58.40	70.95	89.40	99.05
Schott T1	2.35	28.05	52.15	69.35	89.05	99.20	22.65	62.80	76.60	85.95	95.25	99.80
Schott T2	3.70	19.15	29.60	41.90	67.15	92.55	25.30	54.40	62.30	68.30	85.20	96.65
Schott T3	2.65	28.60	33.95	46.15	72.00	96.90	23.50	67.40	69.20	70.20	85.30	96.70

2. 7. 3. multivariate uniform (discrete)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	29.40	14.60	15.35	20.60	31.40	57.65		15.85	16.35	15.95	20.20	32.35
Box M	3.30	7.20	9.35	15.80	27.05	54.95		5.30	7.35	9.40	15.55	28.60
Schott T1	0.30	2.60	6.50	12.50	25.45	54.45	1.90	5.60	12.30	15.20	24.45	39.20
Schott T2	0.45	35.95	45.25	57.00	71.30	90.90	3.20	46.45	52.15	53.75	63.10	79.80
Schott T3	0.30	45.50	50.10	54.80	63.80	74.00	2.75	58.65	61.65	60.40	64.75	73.45
Levene	0.90	2.25	1.05	2.60	3.05	2.90	1.95	3.15	2.20	3.90	4.00	6.60
large design (4*6)												
LR		60.75	53.15	59.40	78.10	97.65		80.70	71.05	65.55	79.15	95.30
Box M		13.65	22.65	36.45	67.25	96.15		20.20	31.00	36.20	61.60	91.45
Schott T1	0.15	5.35	14.40	27.80	59.05	94.95	5.10	24.00	37.95	53.55	79.50	96.30
Schott T2	0.30	77.05	89.65	95.95	99.25	100.00	6.30	82.20	89.20	95.90	99.80	99.95
Schott T3	0.15	84.20	91.10	95.30	98.50	100.00	5.60	88.45	92.20	96.25	98.35	99.40
Levene	2.20	1.25	0.70	1.10	0.80	0.85	5.15	2.25	1.30	1.45	2.10	2.10

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	18.60	19.45	24.65	31.20	43.15	70.95	18.30	20.15	23.40	24.95	33.75	49.20
Box M	5.60	13.55	20.40	27.75	40.45	69.35	4.05	12.25	17.60	20.10	29.95	46.65
Schott T1	1.00	8.45	16.15	24.50	40.15	69.65	6.70	16.00	25.25	30.70	40.95	57.65
Schott T2	1.50	40.40	52.80	63.40	78.35	92.95	8.55	51.45	57.35	62.80	72.65	85.10
Schott T3	1.00	51.80	53.50	55.80	65.05	74.20	7.05	61.00	63.55	65.00	67.45	71.00
large design (4*6)												
LR	57.00	54.85	55.75	64.25	82.55	97.85		70.65	68.15	70.70	85.10	97.15
Box M	3.25	20.65	34.25	47.90	74.95	96.95		20.20	36.35	48.40	75.60	95.55
Schott T1	1.30	13.00	25.95	38.25	70.10	96.50	18.05	44.95	59.30	72.60	90.30	98.50
Schott T2	1.65	77.90	90.95	95.40	99.30	99.95	20.55	85.30	91.45	97.30	99.85	99.95
Schott T3	1.50	86.50	91.25	95.10	98.50	100.00	18.85	90.70	92.85	95.45	97.95	99.05

2. 7. 4. multivariate exponential (continuous)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	80.00	77.90	82.30	85.30	91.10	96.75		76.85	77.55	78.80	83.95	91.90
Box M	33.70	63.95	75.05	81.65	89.40	96.40		56.90	63.35	70.95	79.30	90.50
Schott T1	7.40	47.90	65.90	75.70	86.35	95.50	15.85	47.80	56.75	66.40	75.45	87.75
Schott T2	11.25	7.30	8.30	12.60	16.25	26.75	19.55	13.00	16.80	17.20	22.60	29.05
Schott T3	8.75	12.25	13.70	18.00	25.00	37.05	17.20	25.85	29.95	26.55	29.95	39.90
Levene	1.95	4.25	3.30	4.90	4.70	3.90	4.25	5.55	5.80	5.10	7.30	7.90
large design (4*6)												
LR		99.30	99.40	99.90	99.95	100.00		99.70	99.65	99.90	99.85	100.00
Box M		88.75	96.50	98.90	99.85	100.00		86.35	95.10	98.30	99.70	99.95
Schott T1	18.15	80.85	93.30	97.90	99.65	100.00	33.75	83.25	92.10	97.05	99.35	99.90
Schott T2	22.10	4.15	6.40	9.60	15.65	38.80	35.20	14.00	18.45	22.35	33.80	54.70
Schott T3	20.00	10.80	12.65	18.80	31.10	58.15	34.40	35.30	36.35	37.70	50.95	70.55
Levene	3.50	2.20	1.30	1.55	0.85	0.50	6.80	3.40	2.75	2.30	2.20	2.00

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	49.00	55.75	60.60	65.05	75.00	83.90	52.75	53.05	55.45	60.35	67.65	75.55
Box M	28.65	47.55	56.35	62.45	73.10	83.05	25.00	44.35	48.55	56.15	64.75	74.45
Schott T1	9.00	36.25	49.20	57.30	69.40	81.90	18.70	40.35	49.05	57.55	66.20	76.35
Schott T2	12.60	6.25	9.55	13.30	18.00	28.45	21.70	13.75	18.45	20.25	25.70	33.65
Schott T3	9.65	11.55	15.40	19.15	27.25	42.20	18.95	24.55	29.65	26.85	33.25	43.85
large design (4*6)												
LR	99.25	95.35	95.95	97.40	98.90	99.45		97.45	96.15	96.85	98.40	99.45
Box M	49.95	81.25	89.85	94.65	97.85	99.45		75.95	87.75	92.70	96.25	99.25
Schott T1	20.40	70.85	84.80	92.05	96.70	99.20	41.10	81.90	88.75	93.75	97.75	99.50
Schott T2	24.00	4.65	7.45	10.40	16.60	37.75	42.75	18.00	24.35	30.05	42.20	59.40
Schott T3	21.05	11.30	15.85	23.20	38.10	63.00	41.65	40.50	42.50	46.50	60.10	78.35

2. 7. 5. mixed left and right skewed

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	39.15	17.00	20.30	26.05	40.00	69.30		19.05	20.80	19.75	27.35	43.25
Box M	6.35	8.10	13.65	20.45	34.35	66.85		7.10	9.20	13.20	21.65	38.60
Schott T1	0.25	3.45	9.55	17.30	32.70	67.80	2.40	7.70	16.25	20.40	30.55	50.35
Schott T2	0.55	31.85	43.05	54.90	73.00	92.60	3.60	43.35	50.55	53.45	64.20	81.15
Schott T3	0.45	40.65	41.30	41.25	43.55	38.70	3.00	55.15	56.00	50.90	46.75	44.80
Levene	1.15	2.80	1.90	2.25	3.20	2.95	2.65	4.40	3.95	3.65	5.55	6.10
large design (4*6)												
LR		66.00	61.25	69.35	88.65	99.15		89.55	80.35	76.20	88.30	98.45
Box M		15.50	30.40	47.15	79.20	98.75		28.20	40.55	47.35	75.65	97.45
Schott T1	0.30	7.70	21.35	38.35	74.00	98.40	6.45	31.55	49.45	65.60	88.75	98.90
Schott T2	0.45	68.55	86.55	94.50	99.30	100.00	7.90	80.65	89.10	95.30	99.60	99.95
Schott T3	0.30	76.95	84.85	84.70	88.65	94.45	6.75	87.05	88.60	87.80	89.65	94.50
Levene	2.70	0.95	0.40	1.05	0.60	0.65	4.40	2.15	1.50	1.35	2.05	1.90

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	21.05	19.85	27.80	36.05	52.65	79.45	29.15	21.75	26.85	29.40	39.35	58.25
Box M	7.95	14.60	22.90	32.60	49.35	78.25	9.80	14.25	19.00	24.15	36.00	56.40
Schott T1	0.75	9.45	19.75	30.05	48.30	78.95	7.50	17.90	29.20	35.90	47.30	66.80
Schott T2	1.45	36.20	49.25	62.15	79.55	94.85	9.30	47.60	56.80	61.70	72.35	86.15
Schott T3	0.90	42.90	40.80	36.65	31.40	21.20	8.05	56.75	55.75	53.00	45.55	37.85
large design (4*6)												
LR	93.60	58.30	61.90	72.90	91.05	99.35		74.30	74.30	78.50	92.45	98.95
Box M	18.95	22.70	38.95	56.35	85.75	99.15		24.70	44.55	58.70	84.85	98.35
Schott T1	1.85	14.60	32.05	49.10	80.75	99.05	19.55	52.40	67.90	80.90	95.15	99.55
Schott T2	2.60	69.85	87.35	94.10	99.35	100.00	21.65	86.00	92.35	97.25	99.75	99.95
Schott T3	1.95	77.25	84.45	82.85	86.95	94.00	19.70	88.45	88.15	86.75	88.30	92.85

2. 8. Power:

**group heterogeneity $r^{(i)} = (0.15, 0.6, 0.6, 0.15)$ with
 $r(r^{(i)}, n_i) \sim -0.9$**

2. 8. 1. multivariate normal

	equal cell counts						unequal cell counts					
method	5	10	15	20	30	50	5	10	15	20	30	50
	small design (3*3)											
LR	46.35	29.65	36.05	45.40	65.75	91.75		24.55	22.15	24.85	31.70	55.95
Box M	8.15	12.85	24.85	35.70	61.25	90.20		10.75	9.60	15.60	24.35	51.45
Schott T1	0.35	7.00	16.60	27.95	50.65	85.60	1.15	4.45	6.50	10.45	15.65	34.20
Schott T2	0.80	13.25	20.40	28.35	51.15	84.50	1.55	14.50	13.20	14.10	17.00	34.75
Schott T3	0.55	18.05	20.40	27.55	48.70	83.55	1.35	25.20	28.65	21.25	20.55	34.95
Levene	2.80	6.35	5.70	6.55	7.80	6.35	2.25	5.40	5.15	5.60	5.25	5.70
	large design (4*6)											
LR		77.35	76.80	86.25	96.40	99.90		91.65	84.30	79.65	88.55	99.50
Box M		21.15	44.95	66.05	91.75	99.85		27.70	44.90	49.30	76.45	98.90
Schott T1	0.60	13.65	37.40	61.50	89.50	99.80	0.10	2.60	11.15	21.55	50.65	94.70
Schott T2	1.00	23.50	40.45	59.70	86.95	99.75	0.10	20.40	24.45	28.00	51.20	93.65
Schott T3	0.95	31.40	38.65	54.05	79.35	97.95	0.05	39.85	37.80	35.30	49.05	87.20
Levene	6.40	13.30	11.20	14.20	15.45	16.45	7.70	8.55	8.55	9.70	10.00	10.90

with orthonormal transformation

	equal cell counts						unequal cell counts					
method	5	10	15	20	30	50	5	10	15	20	30	50
	small design (3*3)											
LR	19.95	23.35	33.95	43.10	66.75	91.60	22.70	14.30	12.40	17.20	26.40	51.20
Box M	8.40	16.80	27.80	39.05	64.20	90.70	6.95	8.20	8.25	13.20	23.30	48.60
Schott T1	1.15	9.10	17.50	27.40	52.55	86.35	0.40	2.25	1.35	3.55	6.10	20.15
Schott T2	1.80	14.25	20.70	28.40	51.75	85.45	0.60	7.15	4.55	5.50	8.20	21.10
Schott T3	1.55	18.25	20.25	23.50	42.80	81.85	0.50	18.15	18.50	16.60	12.40	16.10
	large design (4*6)											
LR	92.75	55.65	65.60	76.65	92.70	99.50		58.65	57.80	61.15	80.10	98.25
Box M	16.80	20.05	43.50	62.75	89.25	99.40		13.70	26.80	37.65	68.55	97.35
Schott T1	1.80	16.20	39.05	59.55	86.65	99.40	0.10	0.35	2.00	7.10	27.55	85.55
Schott T2	2.50	24.35	39.85	58.55	85.65	99.20	0.10	10.05	10.20	11.55	30.10	83.35
Schott T3	2.35	32.10	36.15	45.80	68.20	93.70	0.10	25.40	26.00	23.75	28.15	62.10

2. 8. 2. multivariate lognormal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	52.35	38.90	48.10	58.05	75.25	93.70		33.95	33.10	37.35	45.95	66.85
Box M	10.75	21.20	35.90	49.65	70.40	92.65		15.05	17.10	25.50	38.65	63.00
Schott T1	0.70	12.15	26.40	39.75	63.50	89.95	1.95	8.00	11.15	17.80	25.10	44.95
Schott T2	1.60	11.75	16.25	23.30	39.65	69.90	2.85	12.80	11.75	12.90	14.30	25.30
Schott T3	1.20	15.20	16.80	23.55	41.25	73.35	2.25	24.35	27.25	22.05	19.15	28.65
Levene	2.85	6.75	5.80	6.55	8.20	6.65	2.65	5.20	5.15	5.65	4.90	5.55
large design (4*6)												
LR		87.30	87.30	92.70	98.40	99.95		95.40	91.10	90.10	95.45	99.75
Box M		35.55	63.20	80.20	96.30	99.90		38.75	58.50	67.00	88.95	99.60
Schott T1	1.65	26.20	56.55	76.35	94.70	99.90	0.45	8.85	23.45	38.15	68.45	97.30
Schott T2	2.70	17.35	26.65	42.75	67.15	95.75	0.55	14.80	16.90	19.30	33.85	73.85
Schott T3	2.70	24.35	32.65	46.25	73.30	98.10	0.50	33.50	33.80	29.25	39.75	78.45
Levene	5.75	13.90	13.00	14.45	14.70	16.00	7.25	8.60	9.80	9.80	10.15	11.05

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	24.50	29.90	41.10	49.15	67.75	88.45	27.20	21.15	17.50	25.00	36.20	58.40
Box M	10.65	21.35	34.80	45.20	65.85	87.80	8.10	13.30	12.70	20.15	32.45	55.30
Schott T1	1.85	14.65	25.20	35.10	57.00	83.40	0.70	3.75	3.10	6.35	11.95	27.45
Schott T2	2.95	12.75	16.80	23.25	39.75	66.70	1.05	7.65	4.50	5.05	7.30	13.85
Schott T3	2.55	16.55	18.30	23.25	41.90	73.75	1.00	18.40	19.40	16.65	10.95	15.15
large design (4*6)												
LR	94.90	69.45	74.85	83.70	94.10	99.70		70.30	70.45	74.65	88.20	98.25
Box M	20.35	31.40	56.55	72.70	90.30	99.55		21.55	40.65	53.10	79.10	97.55
Schott T1	3.55	26.80	52.80	69.45	88.55	99.35	0.25	1.65	7.65	16.50	43.15	87.75
Schott T2	4.80	17.85	27.90	42.45	63.75	92.35	0.30	7.35	7.25	8.15	17.15	52.50
Schott T3	4.80	26.25	34.80	44.75	71.45	97.25	0.25	23.10	23.40	21.00	25.80	65.05

2. 8. 3. multivariate uniform (discrete)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	28.55	15.55	17.45	23.10	37.60	67.90		13.85	11.80	11.50	14.75	28.90
Box M	2.55	6.35	11.70	17.35	33.50	65.45		4.10	3.90	7.25	11.10	25.55
Schott T1	0.25	2.25	6.00	11.50	26.20	58.70	0.10	0.85	1.35	2.55	4.80	14.95
Schott T2	0.40	34.60	46.10	58.25	76.60	94.25	0.40	32.20	29.60	30.35	37.95	61.00
Schott T3	0.50	48.00	52.75	58.45	69.00	80.20	0.30	54.10	52.05	46.10	51.20	64.00
Levene	2.05	5.05	3.85	5.65	5.65	5.55	2.20	4.45	3.45	3.70	3.90	4.40
large design (4*6)												
LR		58.70	52.90	59.90	78.25	98.10		63.70	59.00	56.30	66.95	91.25
Box M		11.35	22.95	36.30	66.10	96.45		9.30	21.30	28.05	48.00	86.80
Schott T1	0.25	4.40	13.95	28.60	60.05	94.55	0.10	0.25	2.30	5.55	21.55	70.40
Schott T2	0.50	74.75	90.20	95.55	99.35	100.00	0.15	58.10	67.40	78.55	93.65	99.65
Schott T3	0.60	84.85	89.95	94.85	98.25	99.90	0.10	80.85	84.25	89.70	95.80	98.25
Levene	5.00	10.15	8.10	9.70	9.70	11.30	7.50	7.95	6.90	7.60	7.70	9.25

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	16.35	18.60	24.30	30.65	49.50	76.75	5.40	12.30	10.85	13.80	19.80	36.45
Box M	5.10	11.90	19.95	27.15	46.65	75.45	0.60	7.10	7.10	10.35	16.70	34.05
Schott T1	1.05	5.80	11.40	17.50	34.35	67.80	0.30	1.05	0.80	1.50	2.90	9.85
Schott T2	2.10	36.30	49.25	61.25	78.95	95.05	0.45	26.00	20.25	20.85	29.55	57.20
Schott T3	1.90	52.70	55.80	58.00	65.60	76.25	0.30	50.85	52.80	52.80	59.30	65.80
large design (4*6)												
LR	56.20	53.55	56.65	64.60	82.50	98.00		54.05	49.15	53.35	66.55	91.25
Box M	3.35	17.60	33.15	49.35	74.40	97.45		10.10	23.05	32.20	54.25	87.85
Schott T1	2.00	10.60	23.65	41.40	68.85	96.50	0.00	0.15	1.40	3.10	14.05	58.80
Schott T2	2.65	76.90	90.55	95.30	99.30	100.00	0.00	49.85	58.80	70.95	90.05	99.60
Schott T3	2.60	85.55	91.00	94.55	98.30	99.90	0.00	82.10	85.80	91.70	96.00	98.15

2. 8. 4. multivariate exponential (continuous)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	78.90	75.25	83.40	86.00	92.45	97.50		72.30	73.85	76.55	83.75	90.40
Box M	31.25	60.20	75.45	81.70	90.90	97.00		53.10	57.35	67.90	80.10	89.15
Schott T1	7.20	44.75	64.30	75.20	88.00	95.85	7.40	30.15	37.00	49.65	64.00	77.15
Schott T2	10.30	6.90	7.90	11.05	15.70	28.65	10.10	6.85	7.20	7.90	8.75	12.25
Schott T3	9.00	11.40	12.45	16.30	22.95	36.85	8.45	19.40	20.90	16.70	15.55	19.10
Levene	3.75	8.30	7.00	7.85	9.05	8.60	3.30	6.45	6.40	6.20	5.70	6.00
large design (4*6)												
LR		99.50	99.25	99.75	99.95	99.95		99.85	99.45	99.50	99.70	100.00
Box M		88.75	96.60	99.05	99.90	99.95		84.00	94.40	98.15	99.25	100.00
Schott T1	18.55	81.10	93.30	97.65	99.60	99.95	6.50	48.85	71.35	86.45	96.50	99.85
Schott T2	22.70	3.80	5.60	8.85	17.20	37.90	7.15	4.80	4.90	5.15	7.15	16.35
Schott T3	21.15	10.10	11.70	18.75	31.60	58.30	6.75	18.60	17.00	12.70	15.85	28.70
Levene	7.65	15.50	15.10	16.90	17.45	18.60	7.95	10.35	11.20	10.25	10.35	12.60
R Dispersion	3.40	3.00	2.70	2.95	2.60	3.10	2.00	2.70	2.65	3.60	2.95	3.15

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	48.00	54.15	63.95	66.60	76.35	85.95	46.30	48.55	50.10	55.45	64.75	75.50
Box M	26.95	45.90	58.70	63.35	75.00	85.35	18.50	38.15	42.35	49.50	62.85	73.65
Schott T1	7.65	34.05	50.50	56.45	70.30	83.90	4.55	18.30	21.40	28.40	40.20	55.05
Schott T2	10.30	5.95	7.85	11.00	17.35	25.25	6.05	5.25	3.05	3.25	3.60	4.35
Schott T3	8.70	11.75	13.30	16.75	26.95	39.95	5.35	15.65	14.45	10.85	8.15	11.05
large design (4*6)												
LR	99.20	96.45	96.15	96.90	98.60	99.80		96.95	95.90	96.75	97.65	99.20
Box M	49.70	82.05	89.70	94.35	97.55	99.70		70.90	85.65	91.70	95.90	99.00
Schott T1	20.45	70.35	85.15	91.75	96.05	99.50	4.45	28.10	47.55	65.15	83.85	95.65
Schott T2	24.15	4.15	6.45	10.45	18.25	34.95	4.85	2.55	2.20	1.80	2.40	6.15
Schott T3	22.35	11.50	15.35	22.65	38.60	62.45	4.75	12.80	10.95	7.80	9.95	23.75

2. 8. 5. mixed left and right skewed

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	38.60	17.90	23.65	29.80	48.00	79.00		17.30	13.75	14.95	18.45	38.80
Box M	6.00	8.15	16.10	23.45	42.50	76.65		6.85	5.95	9.15	14.35	34.10
Schott T1	0.35	3.40	9.45	15.70	33.30	70.05	0.45	1.65	2.15	3.85	7.15	20.40
Schott T2	0.65	31.25	42.65	55.75	76.35	95.75	1.00	28.05	25.40	26.65	35.10	60.05
Schott T3	0.70	42.75	42.80	44.45	47.50	48.65	0.80	47.15	47.40	39.70	40.00	44.60
Levene	2.60	5.85	4.65	6.20	6.85	5.95	2.55	5.10	4.40	5.40	4.80	5.05
large design (4*6)												
LR		65.55	62.80	70.55	88.45	99.50		86.15	73.75	64.30	76.30	96.90
Box M		14.00	29.50	46.05	78.70	99.15		22.80	33.80	34.55	59.25	94.25
Schott T1	0.30	5.90	19.75	39.25	73.05	98.55	0.05	0.55	3.25	8.60	29.10	81.80
Schott T2	0.70	66.85	85.80	94.35	99.55	100.00	0.05	51.20	59.75	72.60	90.85	99.65
Schott T3	0.70	76.35	82.10	87.65	89.30	95.40	0.05	75.00	79.95	81.75	87.50	92.60
Levene	5.95	12.65	9.85	12.15	13.15	14.35	7.00	9.00	8.80	9.15	9.50	9.40
R Dispersion	1.80	2.40	3.10	2.30	2.80	1.85	1.10	2.10	2.25	2.50	2.60	3.45

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	21.30	20.50	29.90	38.05	58.80	87.15	20.95	14.50	12.15	15.80	22.35	44.05
Box M	7.85	14.05	25.15	34.15	55.60	86.00	5.75	8.10	7.90	12.45	19.10	41.45
Schott T1	1.00	6.25	14.25	22.05	43.10	79.10	0.35	1.45	0.70	1.80	3.65	12.85
Schott T2	1.60	33.05	44.90	59.10	80.15	96.40	0.60	21.35	16.05	17.25	26.25	54.10
Schott T3	1.50	45.60	41.60	35.90	33.50	26.45	0.55	42.75	43.95	39.60	38.35	34.70
large design (4*6)												
LR	93.25	57.90	64.40	73.00	91.15	99.75		60.75	57.75	59.05	76.00	96.85
Box M	18.95	21.30	41.00	56.95	86.15	99.30		15.15	28.85	37.65	64.90	95.25
Schott T1	1.85	12.75	30.95	50.30	81.65	98.80	0.00	0.15	1.50	4.30	19.50	74.90
Schott T2	3.00	69.70	87.15	94.85	99.35	100.00	0.00	41.20	50.25	62.75	86.65	99.65
Schott T3	2.60	77.20	81.20	85.60	87.30	94.10	0.00	73.15	79.75	82.10	85.00	91.30

2. 9. Power:

group heterogeneity: varying correlations $r_{j_1 j_2}^{(i)}$ for variables j_1, j_2 ($j_1, j_2 = 1, \dots, J$) within each $\Sigma^{(i)}$

2. 9. 1. multivariate normal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	42.00	16.85	17.30	19.60	24.70	37.60		19.45	18.50	17.65	19.70	23.40
Box M	6.20	8.15	10.35	14.75	20.35	34.65		7.90	7.45	10.35	14.60	20.05
Schott T1	0.35	3.35	7.65	12.60	18.90	34.75	1.60	6.40	9.30	13.00	18.80	24.70
Schott T2	0.60	8.40	10.10	13.55	19.60	34.80	2.25	14.55	17.50	16.05	19.15	25.40
Schott T3	0.35	10.90	12.75	13.75	18.65	33.75	1.75	25.90	29.45	20.05	19.40	24.45
Levene	2.00	3.65	3.90	4.10	4.10	4.00	2.55	4.40	4.05	4.60	4.55	5.25
large design (4*6)												
LR		60.85	48.70	51.00	60.60	84.20		88.10	74.00	60.10	64.60	82.70
Box M		11.40	17.95	25.15	44.55	78.10		23.05	31.75	29.05	43.00	75.10
Schott T1	0.15	5.60	11.80	21.60	38.60	74.65	0.90	7.75	13.35	21.80	40.50	71.75
Schott T2	0.40	13.50	16.05	23.80	40.15	73.45	1.15	28.25	28.05	27.30	40.20	70.70
Schott T3	0.30	20.05	19.35	25.75	39.60	73.40	0.95	45.85	39.95	31.60	41.95	70.45
Levene	4.00	6.75	7.15	10.65	17.85	34.25	6.35	8.80	9.90	13.40	22.75	45.95

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	17.15	12.75	15.40	18.00	25.00	41.15	23.10	12.90	14.60	14.55	20.60	26.80
Box M	7.05	7.85	11.70	15.55	23.30	39.55	6.60	8.10	9.75	11.80	17.55	25.20
Schott T1	0.60	5.20	9.75	14.35	21.95	39.65	3.05	7.45	12.35	14.05	21.40	29.30
Schott T2	1.10	8.15	11.30	15.55	22.45	40.35	4.10	14.50	16.50	16.00	21.80	30.45
Schott T3	0.70	11.05	12.90	15.00	21.70	39.30	3.25	23.05	25.95	19.45	21.15	28.75
large design (4*6)												
LR	90.80	41.40	39.30	45.10	58.95	84.45		56.95	52.15	49.70	61.85	82.80
Box M	14.80	11.50	19.15	30.10	48.80	80.65		13.20	22.50	27.50	47.25	78.20
Schott T1	0.95	7.15	14.90	24.55	43.80	78.10	2.10	9.60	15.75	24.55	45.30	75.75
Schott T2	1.30	13.15	17.70	25.80	43.55	77.80	2.30	26.95	26.80	27.60	44.90	74.75
Schott T3	1.25	18.55	20.30	27.80	42.85	76.75	2.05	43.65	38.95	32.75	44.75	73.25

2. 9. 2. lognormal

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	48.75	27.55	29.55	33.05	40.25	53.10		28.80	29.00	27.55	31.25	38.80
Box M	8.90	13.30	20.40	25.25	35.60	50.10		13.25	14.75	18.95	25.35	33.95
Schott T1	0.60	8.15	14.90	21.75	31.70	49.35	2.40	11.20	15.55	19.55	26.65	36.55
Schott T2	1.15	8.70	9.75	11.80	15.50	26.65	3.30	14.15	15.65	13.15	18.40	20.45
Schott T3	0.85	12.55	10.60	12.15	16.75	28.60	2.85	23.20	27.40	19.00	20.55	22.95
Levene	2.00	4.00	4.20	4.70	4.30	4.00	3.10	4.35	4.70	4.60	5.15	5.70
large design (4*6)												
LR		76.05	69.45	71.60	80.40	93.15		92.60	85.20	77.60	80.70	91.70
Box M		21.15	36.00	48.85	67.45	90.10		31.85	45.35	47.45	63.10	86.40
Schott T1	0.50	15.55	29.05	43.85	62.65	87.80	2.05	17.40	27.60	41.70	60.45	83.65
Schott T2	1.05	9.50	11.35	17.10	25.35	50.95	2.40	21.10	19.75	20.00	27.65	48.40
Schott T3	0.95	16.80	15.30	19.45	28.15	55.15	2.10	40.70	32.90	26.25	31.80	51.75
Levene	3.75	6.85	7.10	10.45	17.50	34.30	6.30	8.55	10.90	13.70	23.20	45.90

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	22.15	19.80	23.15	26.35	31.95	47.25	26.65	20.00	20.70	20.85	26.70	34.15
Box M	9.10	14.00	19.05	22.60	30.25	46.25	8.60	13.20	15.40	16.65	23.75	32.45
Schott T1	1.25	9.75	15.55	20.55	28.85	46.25	3.75	11.55	16.05	19.10	25.70	35.30
Schott T2	2.10	9.10	9.75	12.30	17.20	29.95	4.90	13.70	14.75	13.50	18.50	23.35
Schott T3	1.50	12.00	11.40	13.25	18.60	31.60	4.25	20.45	24.80	18.20	20.50	25.45
large design (4*6)												
LR	94.25	56.20	57.15	61.55	73.05	90.90		68.25	65.60	64.65	74.00	89.70
Box M	18.80	20.45	34.55	46.70	64.10	88.40		19.75	34.65	42.60	61.85	85.80
Schott T1	1.80	15.50	28.90	41.10	59.85	85.95	3.50	17.45	26.30	39.65	59.05	83.70
Schott T2	2.55	9.50	12.70	17.65	28.75	55.70	4.00	20.80	19.45	21.15	30.05	52.95
Schott T3	2.35	17.30	16.50	20.30	31.70	59.15	3.65	37.90	32.00	26.45	33.55	56.15

2. 9. 3. uniform (discrete)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	26.20	7.50	6.75	7.05	9.35	14.85		10.80	8.90	7.70	6.15	9.00
Box M	2.05	2.95	3.60	4.20	7.65	12.80		3.25	3.30	4.10	4.80	7.30
Schott T1	0.10	1.05	1.75	3.00	6.30	13.25	0.50	2.50	4.25	4.50	6.60	10.50
Schott T2	0.20	24.45	28.50	31.85	41.35	57.35	1.05	32.00	35.10	31.30	34.75	43.85
Schott T3	0.15	38.35	39.45	42.50	50.90	64.30	0.75	51.00	53.60	46.05	48.85	60.60
Levene	1.20	3.90	2.55	2.85	3.40	3.60	1.85	3.30	3.25	3.30	3.55	5.45
large design (4*6)												
LR		39.60	22.00	20.35	24.95	47.50		69.50	50.40	32.85	29.75	47.55
Box M		4.35	4.70	7.10	15.05	39.20		9.00	14.00	10.90	15.10	35.60
Schott T1	0.10	1.55	1.45	4.75	11.15	34.85	0.20	2.40	3.50	5.25	12.55	32.00
Schott T2	0.15	64.50	73.90	81.80	90.30	98.65	0.50	63.75	71.45	77.15	87.05	97.20
Schott T3	0.15	75.20	82.40	87.00	93.65	99.15	0.35	80.75	82.30	85.80	92.20	98.10
Levene	2.70	4.80	4.10	6.85	11.10	23.90	7.25	6.95	8.10	9.90	16.80	32.95

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	14.85	11.70	12.45	13.75	17.85	26.85	12.45	11.90	11.85	11.85	12.95	16.90
Box M	4.90	7.50	9.65	10.95	16.10	25.35	2.40	7.00	8.00	9.25	11.20	15.45
Schott T1	1.00	3.75	7.10	9.30	14.35	25.45	2.95	5.75	9.90	10.55	13.35	19.90
Schott T2	1.50	28.70	35.85	38.85	48.95	65.30	3.75	33.90	36.95	36.20	41.90	53.30
Schott T3	1.20	42.40	45.85	49.70	57.35	69.20	3.05	51.70	54.40	51.90	55.25	67.00
large design (4*6)												
LR	68.15	36.40	28.15	30.65	38.50	63.25		51.35	40.80	36.60	41.55	62.25
Box M	4.85	9.60	11.75	17.05	28.40	58.45		10.60	16.30	17.50	27.70	54.10
Schott T1	0.85	4.10	7.05	12.45	24.05	54.80	1.55	5.70	9.60	14.45	25.75	51.35
Schott T2	1.05	66.85	76.10	85.90	92.60	99.10	2.05	65.10	73.05	80.80	91.05	98.25
Schott T3	1.05	78.45	85.15	90.60	95.80	99.55	1.65	82.25	85.10	88.90	95.30	98.95

2. 9. 4. exponential (continuous)

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	75.85	70.10	74.25	77.45	80.40	86.60		71.30	71.30	69.60	76.00	81.10
Box M	29.70	54.75	65.60	71.15	77.65	84.75		51.20	55.35	61.40	71.45	78.60
Schott T1	6.70	42.30	56.75	65.60	73.05	83.00	9.95	36.60	44.15	50.75	63.40	73.95
Schott T2	9.60	6.15	6.70	7.80	9.55	12.60	12.65	9.75	10.75	8.75	11.70	12.90
Schott T3	7.75	10.25	10.25	11.55	14.40	20.00	11.00	20.85	21.50	16.95	17.05	18.85
Levene	2.85	6.10	5.05	5.05	6.60	4.75	3.35	5.95	6.00	5.35	5.45	6.15
large design (4*6)												
LR		98.60	97.80	98.85	99.05	99.80		99.55	99.15	98.75	98.95	99.55
Box M		81.80	91.15	95.65	98.00	99.50		79.05	92.20	93.95	97.00	99.35
Schott T1	13.65	69.85	86.55	92.20	96.95	99.55	13.45	58.95	74.75	86.30	93.95	98.75
Schott T2	16.85	1.90	2.65	3.80	5.10	10.70	14.35	5.60	6.50	6.65	8.70	11.60
Schott T3	15.35	6.55	6.75	7.35	10.20	16.90	13.75	20.35	18.00	13.90	15.45	18.95
Levene	4.60	8.35	8.10	11.80	17.50	34.30	7.35	9.85	11.65	14.95	23.00	42.60

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	45.45	50.00	54.25	57.15	62.60	69.70	48.35	47.80	49.20	49.90	56.60	61.45
Box M	26.50	41.40	49.35	53.60	60.35	68.70	20.40	37.35	40.85	45.00	54.20	59.90
Schott T1	8.85	31.40	42.20	48.05	55.60	67.10	10.60	28.40	34.75	40.00	48.15	57.20
Schott T2	11.05	6.00	5.70	7.45	8.80	13.75	12.35	8.25	10.25	8.85	12.00	12.00
Schott T3	9.85	9.60	9.00	10.75	12.40	19.20	11.20	17.25	18.15	13.55	16.70	16.65
large design (4*6)												
LR	99.30	93.45	93.15	94.70	97.10	98.90		95.15	95.25	95.10	96.55	98.50
Box M	45.90	74.05	84.90	90.15	95.45	98.75		66.80	82.55	87.30	94.15	97.75
Schott T1	16.55	62.40	79.25	85.80	93.85	98.20	17.45	54.25	70.10	79.40	90.70	96.75
Schott T2	19.75	2.15	2.95	3.90	5.95	11.10	18.70	5.55	6.30	6.80	8.75	12.15
Schott T3	18.95	7.00	6.40	8.30	11.35	17.75	17.85	20.00	17.15	13.70	15.65	18.95

2. 9. 5. mixed left and right skewed

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	36.35	9.85	8.45	9.30	12.70	20.20		12.90	9.90	10.05	8.80	12.45
Box M	4.60	3.75	4.30	5.90	10.25	18.15		4.20	4.05	5.35	6.25	10.30
Schott T1	0.30	1.10	2.55	4.80	9.40	18.55	0.60	3.30	4.90	6.15	9.30	14.20
Schott T2	0.45	20.30	24.90	29.45	40.10	57.80	1.25	27.40	30.70	29.30	33.50	43.90
Schott T3	0.45	31.05	32.00	31.15	33.95	38.85	1.00	44.05	47.00	36.35	34.10	34.60
Levene	2.15	3.95	3.55	4.50	4.45	3.75	2.60	4.40	3.55	4.10	4.40	5.35
large design (4*6)												
LR		46.55	29.50	27.65	35.00	62.70		80.00	58.80	39.90	40.85	61.40
Box M		5.15	7.65	10.95	22.40	54.35		15.90	20.80	14.00	21.80	51.30
Schott T1	0.05	1.90	3.35	7.50	17.60	50.30	0.30	3.35	5.30	8.70	19.60	47.85
Schott T2	0.10	51.35	63.95	74.40	86.95	97.90	0.35	59.15	65.25	70.45	84.65	96.65
Schott T3	0.05	64.20	71.40	77.75	86.35	96.25	0.30	78.25	75.65	77.80	88.55	95.70
Levene	3.05	6.60	6.25	8.85	15.00	29.45	7.10	7.85	9.20	12.50	19.90	39.30

with orthonormal transformation

method	equal cell counts						unequal cell counts					
	5	10	15	20	30	50	5	10	15	20	30	50
small design (3*3)												
LR	17.80	11.85	13.85	15.30	20.35	33.20	22.00	11.85	12.25	13.35	14.85	21.00
Box M	6.75	8.05	11.10	11.95	18.30	31.90	7.10	6.85	7.85	10.30	13.20	19.20
Schott T1	0.85	3.90	8.90	11.05	17.95	32.60	3.10	6.20	9.80	11.70	16.80	24.45
Schott T2	1.25	23.50	31.45	36.10	47.15	65.95	3.85	29.70	31.65	32.35	40.10	51.75
Schott T3	1.00	33.25	35.45	33.00	33.10	37.35	3.20	43.15	46.25	37.10	35.45	34.10
large design (4*6)												
LR	92.00	39.10	32.60	36.70	47.25	75.25		54.60	46.55	41.05	50.35	73.45
Box M	16.15	10.60	14.95	21.10	36.55	69.35		12.05	18.85	21.15	36.05	67.00
Schott T1	0.70	5.25	9.30	15.90	30.85	65.35	1.40	6.75	11.70	16.65	33.10	63.50
Schott T2	1.35	53.85	67.15	78.40	89.80	98.55	1.95	59.95	67.45	74.70	88.00	97.80
Schott T3	1.20	66.55	74.50	81.60	88.25	96.90	1.55	77.85	78.00	81.60	89.80	96.40