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Computation time in total

Total	0.5503757317860921min.
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Tolerance of physicality constraint violation

		True	False
Tolerance at physicality violation test	equality constraint	1.00e-13	1.00e-05
	inequality constraint	1.00e-05	1.00e-05

Experimental condition

Type of tomography	StandardQst
Nrep	10
N	[10, 100]
RNG seed	777

True object

Type	State
Dim	2
Vec	[0.70710678 0.01900582 -0.10294554 0.65537864]

Tester objects

0	Type	Povm
	Dim	2
	Number of outcomes	2
	Vecs	[[0.72718114 0.63323685 -0.06643122 -0.05867981] [0.68703242 -0.63323685 0.06643122 0.05867981]]
1	Type	Povm
	Dim	2
	Number of outcomes	2
	Vecs	[[0.69794903 -0.04457267 0.63539095 0.0786084] [0.71626453 0.04457267 -0.63539095 -0.0786084]]
2	Type	Povm
	Dim	2
	Number of outcomes	2
	Vecs	[[0.72807441 -0.09343513 -0.04036465 0.63004429] [0.68613915 0.09343513 0.04036465 -0.63004429]]

Cases

	Name	Param	Tomography	Estimator
0	Linear (True)	True	StandardQst	Linear
1	Linear (False)	False	StandardQst	Linear
2	ProjectedLinear (True)	True	StandardQst	ProjectedLinear
3	ProjectedLinear (False)	False	StandardQst	ProjectedLinear
4	Maximum-Likelihood (True)	True	StandardQst	LossMinimization
5	Maximum-Likelihood (False)	False	StandardQst	LossMinimization

6	Least Squares (True)	True	StandardQst	LossMinimization
7	Least Squares (False)	False	StandardQst	LossMinimization

Computation time of estimators

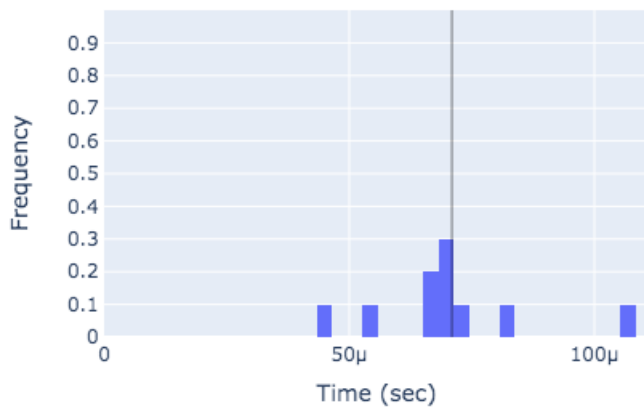
Table

	Name	N	Nrep	Mean (sec)	Std (sec)
0	Linear (True)	10	10	0.000071	0.000016
1	"	100	10	0.000061	0.000010
2	Linear (False)	10	10	0.000064	0.000013
3	"	100	10	0.000054	0.000014
4	ProjectedLinear (True)	10	10	0.009921	0.006278
5	"	100	10	0.004590	0.004766
6	ProjectedLinear (False)	10	10	0.009209	0.005524
7	"	100	10	0.003897	0.004519
8	Maximum-Likelihood (True)	10	10	0.481922	0.138619
9	"	100	10	0.511826	0.119586
10	Maximum-Likelihood (False)	10	10	0.689375	0.270307
11	"	100	10	0.701542	0.419390
12	Least Squares (True)	10	10	0.234638	0.103964
13	"	100	10	0.144703	0.117185
14	Least Squares (False)	10	10	0.282629	0.098945
15	"	100	10	0.227753	0.143212

Histogram

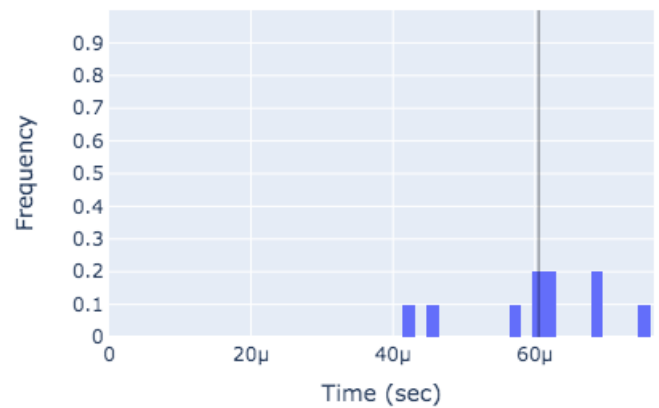
Case 0: Linear (True)

N=10, Nrep=10
Mean = 7.092952728271484e-05(sec)



Min: 4.601478576660156e-05
Max: 0.00010800361633300781
|Max-Min|: 6.198883056640625e-05

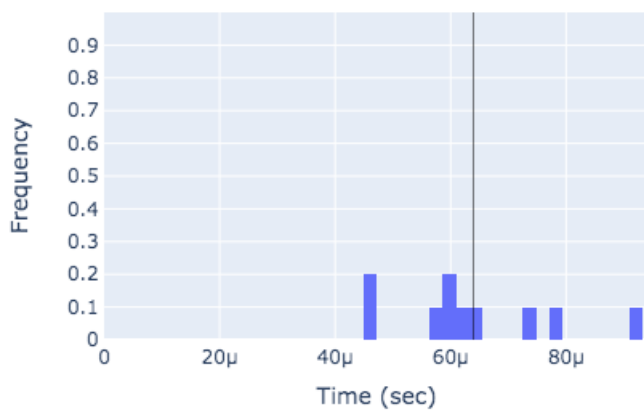
N=100, Nrep=10
Mean = 6.053447723388672e-05(sec)



Min: 4.1961669921875e-05
Max: 7.510185241699219e-05
|Max-Min|: 3.314018249511719e-05

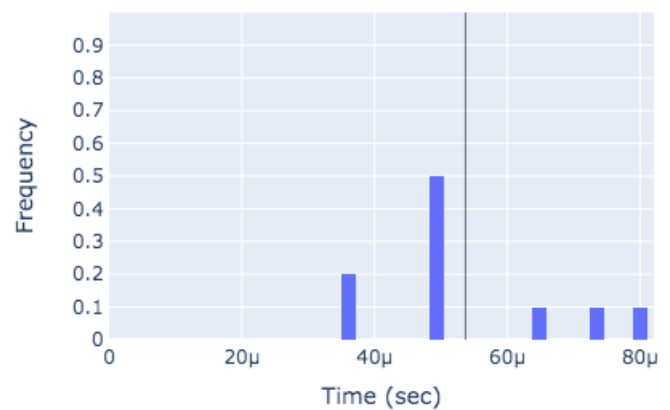
Case 1: Linear (False)

N=10, Nrep=10
Mean = 6.394386291503906e-05(sec)



Min: 4.601478576660156e-05
Max: 9.202957153320312e-05
|Max-Min|: 4.601478576660156e-05

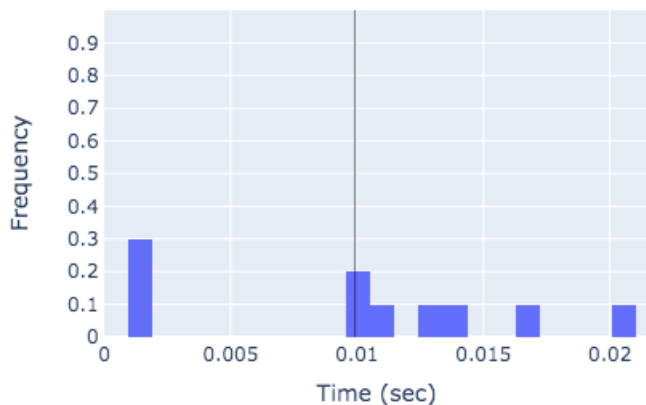
N=100, Nrep=10
Mean = 5.369186401367187e-05(sec)



Min: 3.600120544433594e-05
Max: 7.987022399902344e-05
|Max-Min|: 4.38690185546875e-05

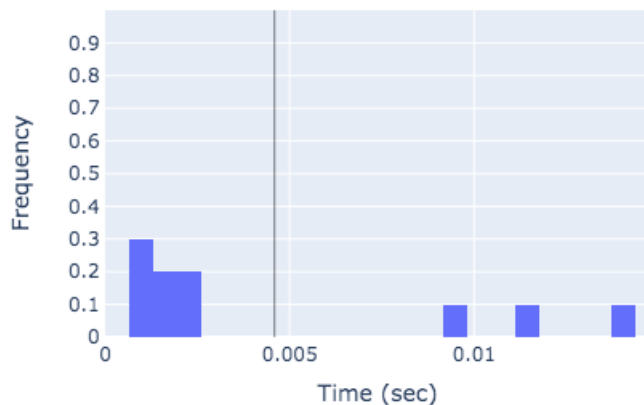
Case 2: ProjectedLinear (True)

N=10, Nrep=10
Mean = 0.00992147922515869(sec)



Min: 0.0014493465423583984
Max: 0.020581960678100586
|Max-Min|: 0.019132614135742188

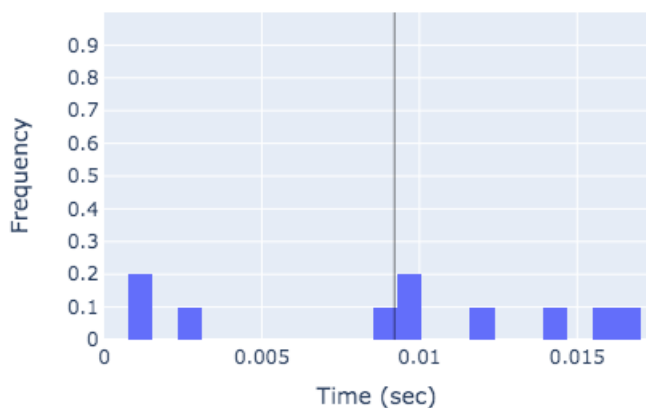
N=100, Nrep=10
Mean = 0.004590249061584473(sec)



Min: 0.0010421276092529297
Max: 0.014111042022705078
|Max-Min|: 0.013068914413452148

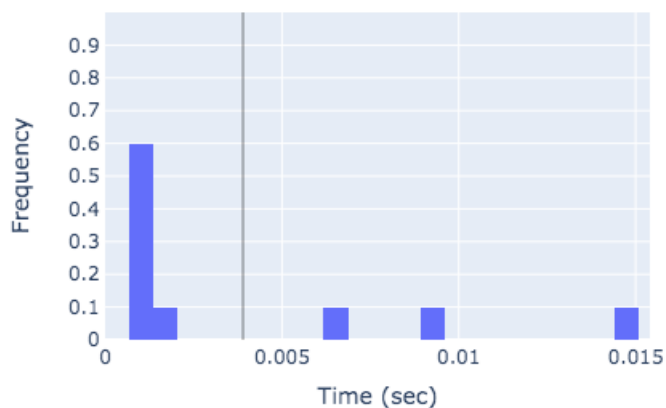
Case 3: ProjectedLinear (False)

N=10, Nrep=10
Mean = 0.009208750724792481(sec)



Min: 0.0010271072387695312
Max: 0.016499996185302734
|Max-Min|: 0.015472888946533203

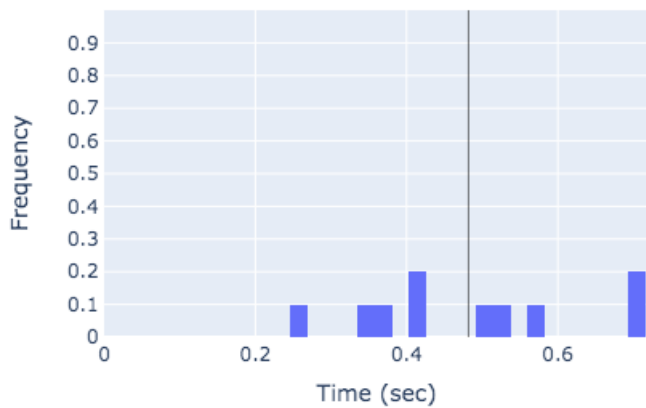
N=100, Nrep=10
Mean = 0.003896641731262207(sec)



Min: 0.0009860992431640625
Max: 0.014715909957885742
|Max-Min|: 0.01372981071472168

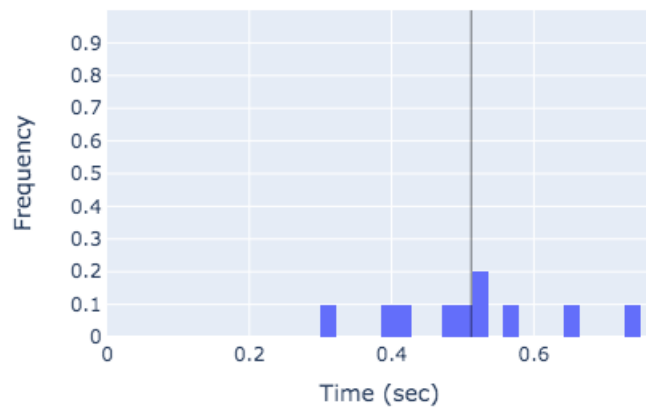
Case 4: Maximum-Likelihood (True)

N=10, Nrep=10
Mean = 0.4819220542907715(sec)



Min: 0.25034189224243164
Max: 0.698004961013794
|Max-Min|: 0.4476630687713623

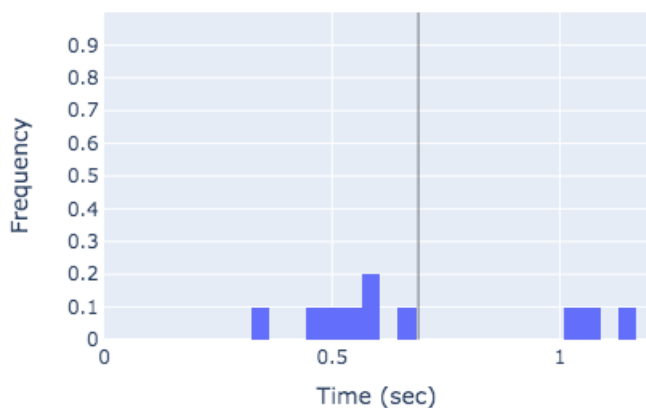
N=100, Nrep=10
Mean = 0.5118257522583007(sec)



Min: 0.3158562183380127
Max: 0.7444441318511963
|Max-Min|: 0.4285879135131836

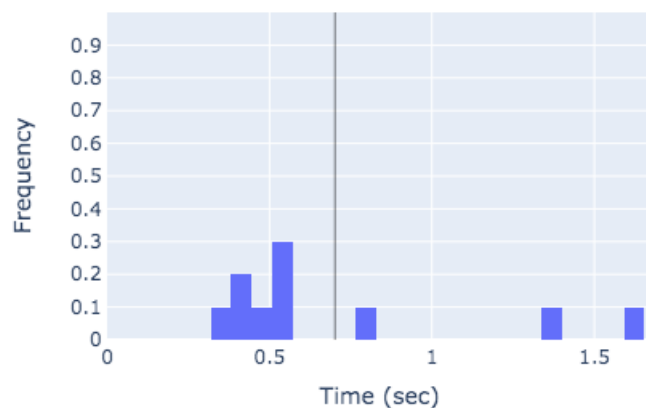
Case 5: Maximum-Likelihood (False)

N=10, Nrep=10
Mean = 0.6893749475479126(sec)



Min: 0.3487892150878906
Max: 1.1547038555145264
|Max-Min|: 0.8059146404266357

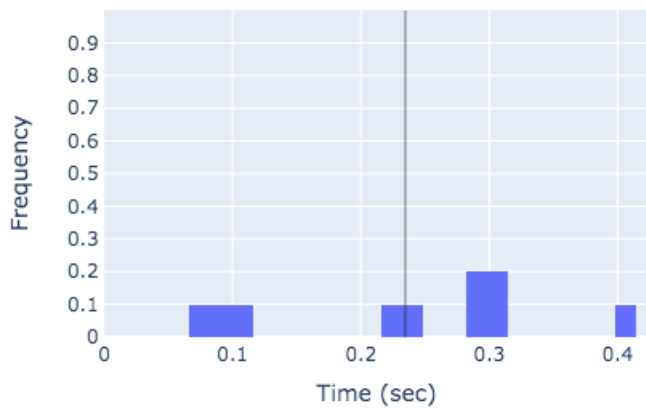
N=100, Nrep=10
Mean = 0.7015421390533447(sec)



Min: 0.34050464630126953
Max: 1.613386869430542
|Max-Min|: 1.2728822231292725

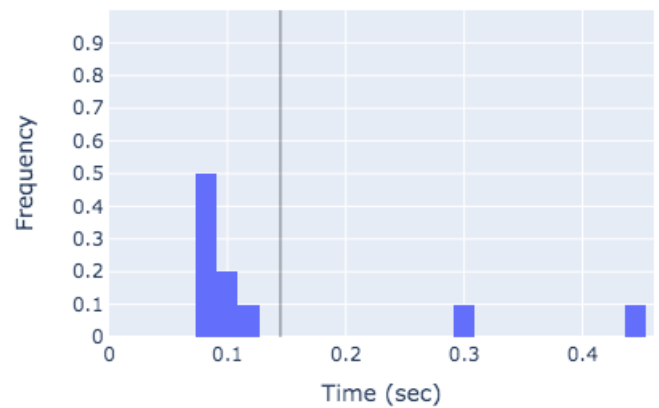
Case 6: Least Squares (True)

N=10, Nrep=10
Mean = 0.23463819026947022(sec)



Min: 0.07610726356506348
Max: 0.40777134895324707
|Max-Min|: 0.3316640853881836

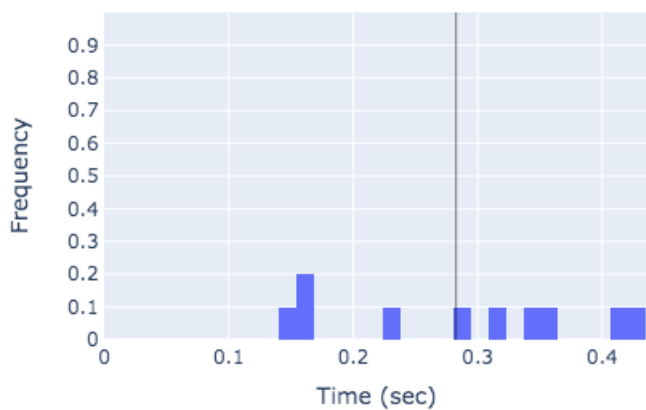
N=100, Nrep=10
Mean = 0.14470269680023193(sec)



Min: 0.07891273498535156
Max: 0.44204115867614746
|Max-Min|: 0.3631284236907959

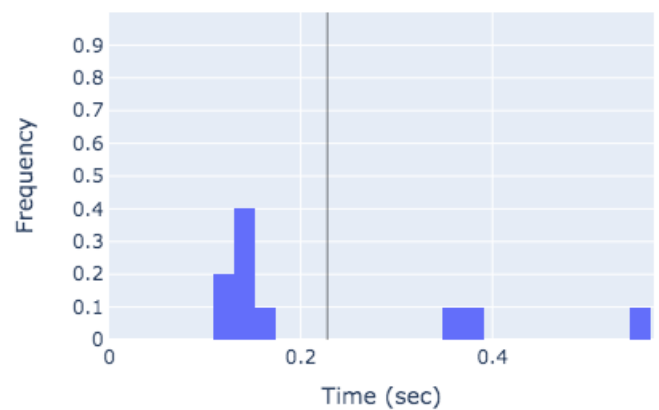
Case 7: Least Squares (False)

N=10, Nrep=10
Mean = 0.28262927532196047(sec)



Min: 0.14296388626098633
Max: 0.42344021797180176
|Max-Min|: 0.28047633171081543

N=100, Nrep=10
Mean = 0.2277531147003174(sec)



Min: 0.11190080642700195
Max: 0.5467355251312256
|Max-Min|: 0.43483471870422363

MSE of empirical distributions

Mean squared error



Consistency test

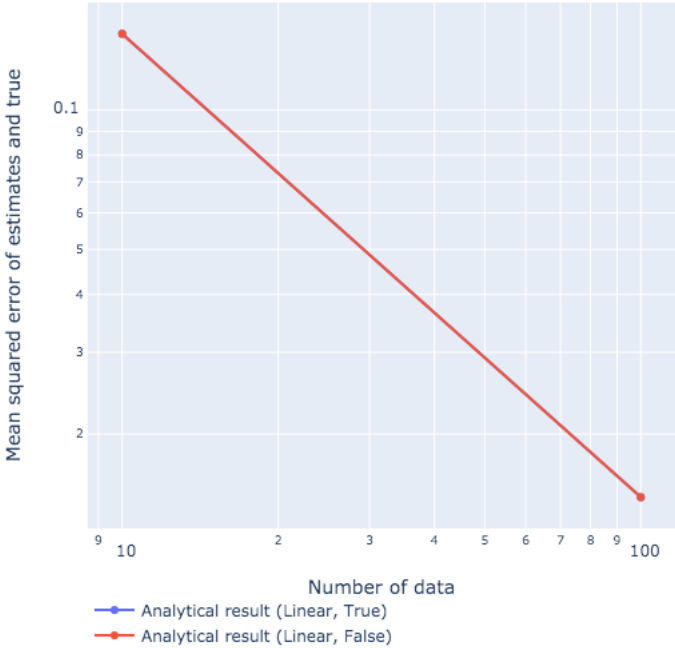
	Name	Type of tomography	Param	Estimator	Loss	Algo	Squared Error to True	Possibly OK	To be checked
0	Linear (True)	Standard Qst	True	Linear	None	None	1.00e-32	OK	not need debug
1	Linear (False)	Standard Qst	False	Linear	None	None	2.59e-32	OK	not need debug
2	ProjectedLinear (True)	Standard Qst	True	Projected Linear	None	None	1.66e-32	OK	not need debug
3	ProjectedLinear (False)	Standard Qst	False	Projected Linear	None	None	3.06e-32	OK	not need debug
4	Maximum-Likelihood (True)	Standard Qst	True	Loss Minimization	Weighted Relative Entropy	Projected Gradient Descent Backtracking	4.61e-18	OK	not need debug
5	Maximum-Likelihood (False)	Standard Qst	False	Loss Minimization	Weighted Relative Entropy	Projected Gradient Descent Backtracking	1.08e-08	NG	not need debug
6	Least Squares (True)	Standard Qst	True	Loss Minimization	Weighted Probability Based Squared Error	Projected Gradient Descent Backtracking	1.30e-29	OK	not need debug

7	Least Squares (False)	Standard Qst	False	Loss Minimization	Weighted Probability Based Squared Error	Projected Gradient Descent Backtracking	1.11e-29	OK	not need debug
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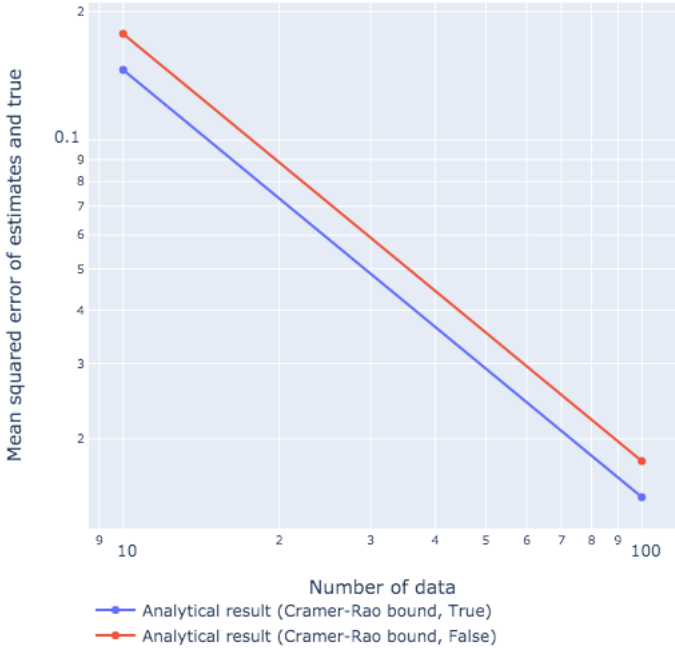
MSE of estimators

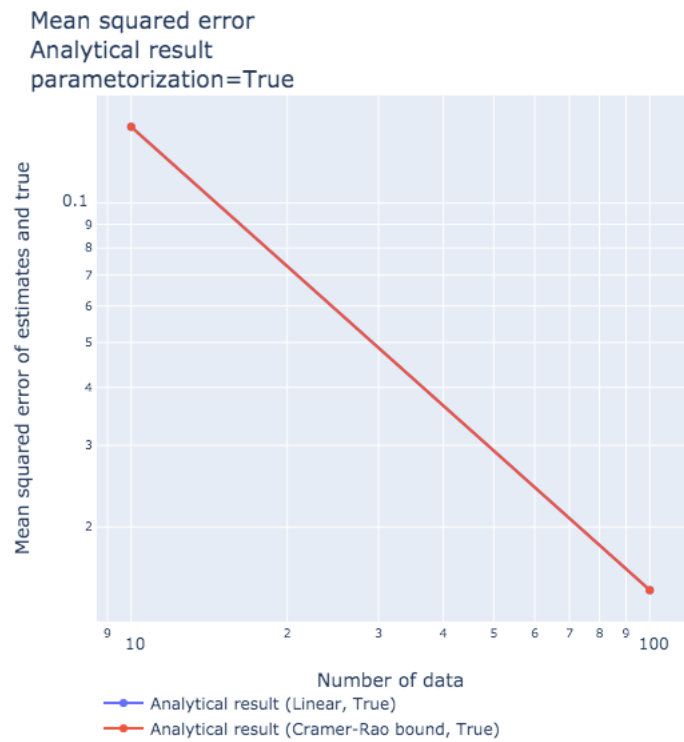
Comparison of analytical results

Mean squared error
Analytical result
estimator=Linear

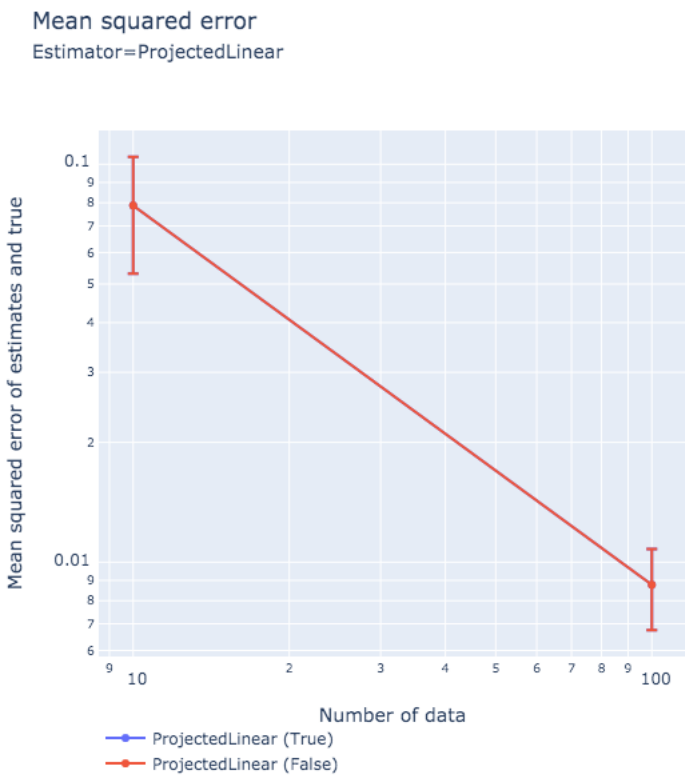
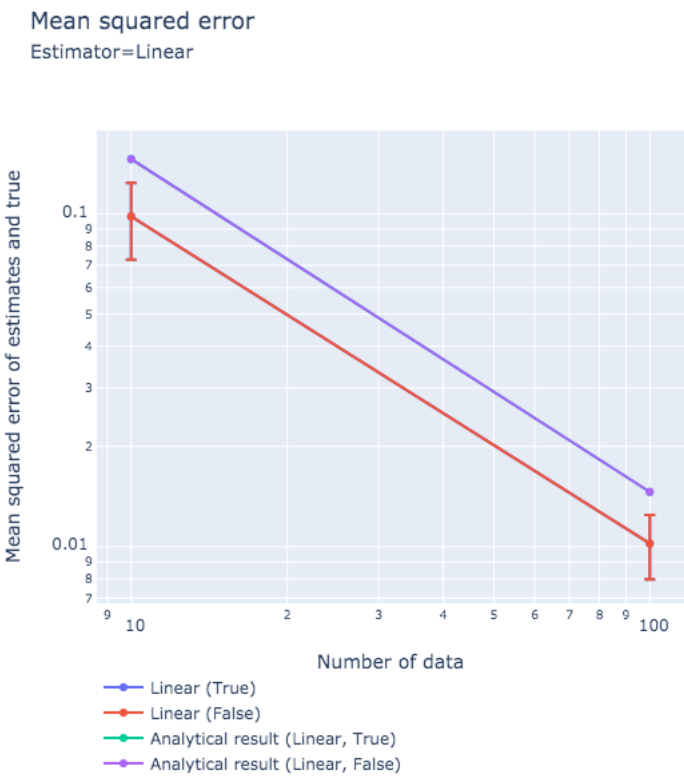


Mean squared error
Analytical result
Cramer-Rao bound





Comparison of parametrization

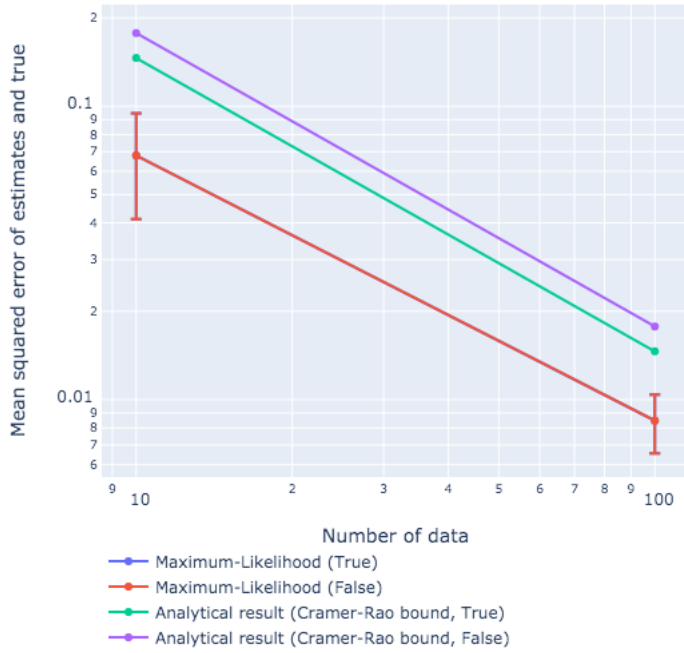


Mean squared error

Estimator=LossMinimization

Loss=WeightedRelativeEntropy

Algo=ProjectedGradientDescentBacktracking

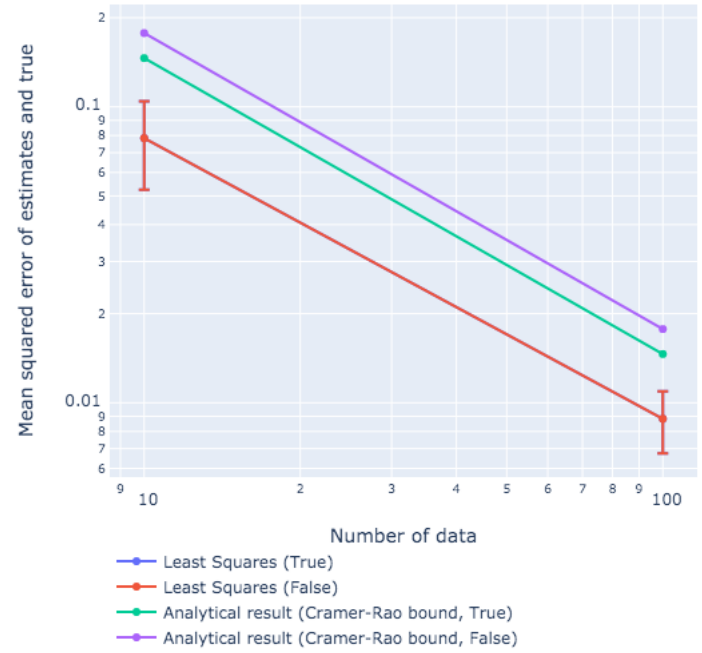


Mean squared error

Estimator=LossMinimization

Loss=WeightedProbabilityBasedSquaredError

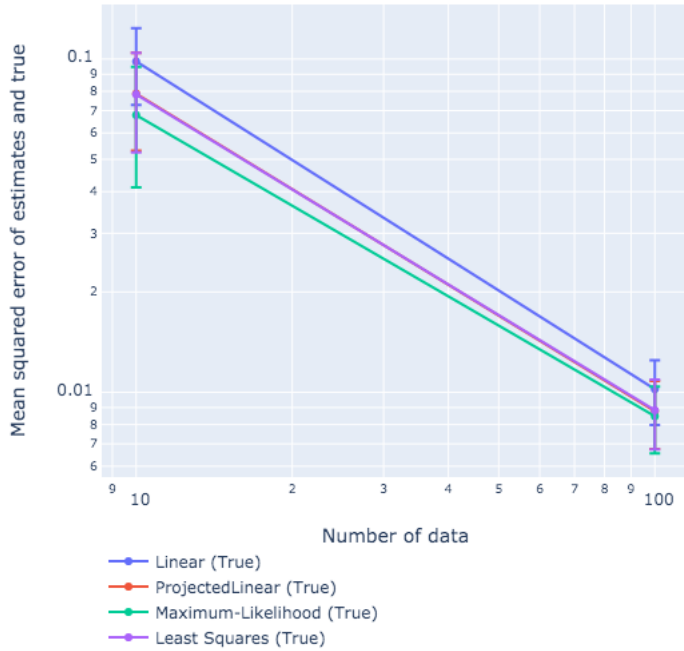
Algo=ProjectedGradientDescentBacktracking



Comparison of estimators

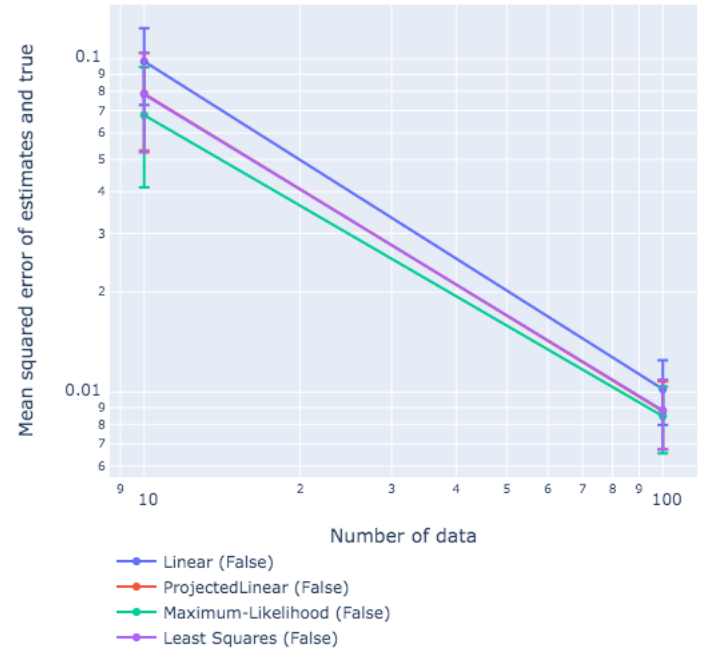
Mean squared error

parametrization=True



Mean squared error

parametrization=False

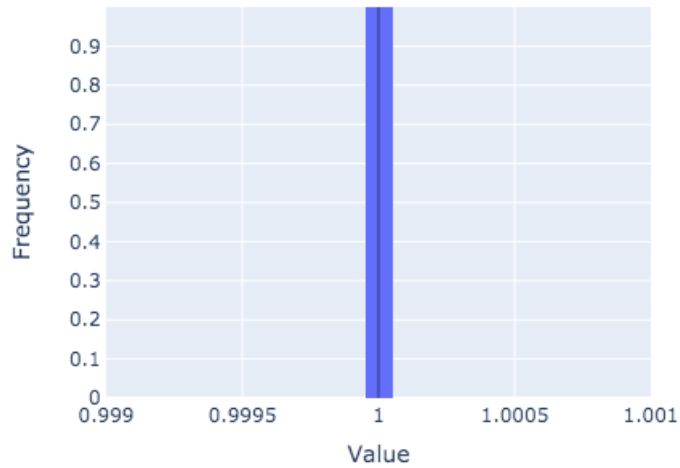


Physicality violation test

Test of equality constraint violation

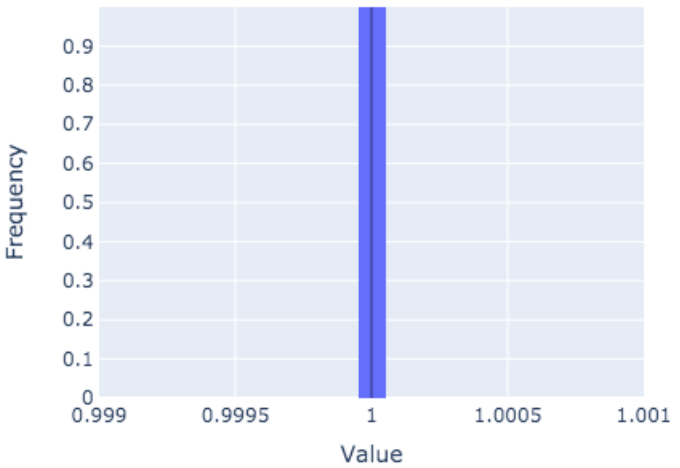
Case 0: Linear (True)

N=10, Nrep=10



Min: 0.9999999999999997
Max: 0.9999999999999998
|Max-Min|: 1.1102230246251565e-16

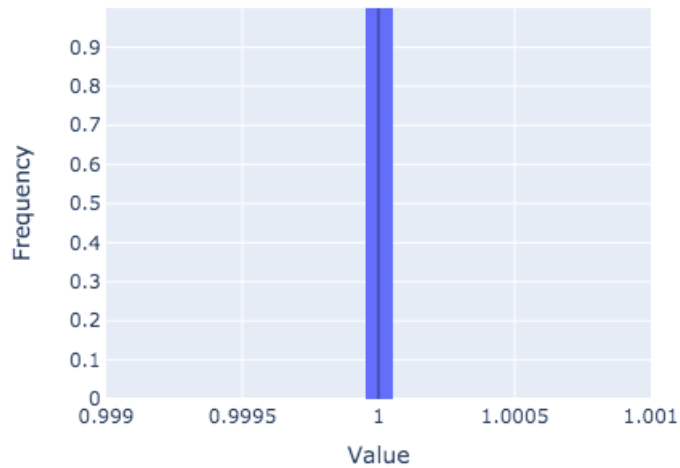
N=100, Nrep=10



Min: 0.9999999999999998
Max: 0.9999999999999998
|Max-Min|: 0.0

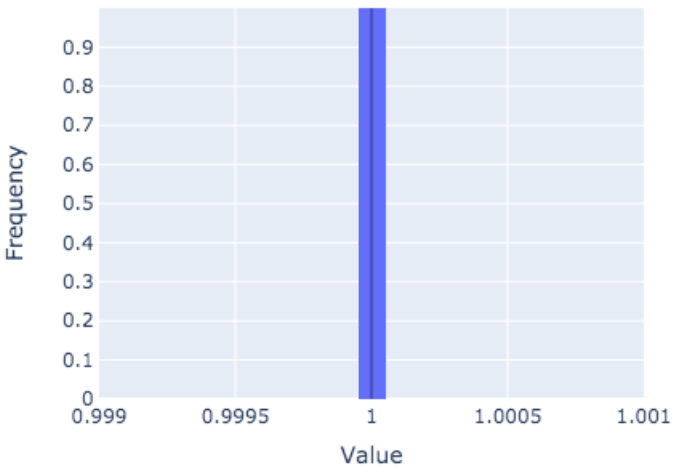
Case 1: Linear (False)

N=10, Nrep=10



Min: 1.0
Max: 1.0000000000000004
|Max-Min|: 4.440892098500626e-16

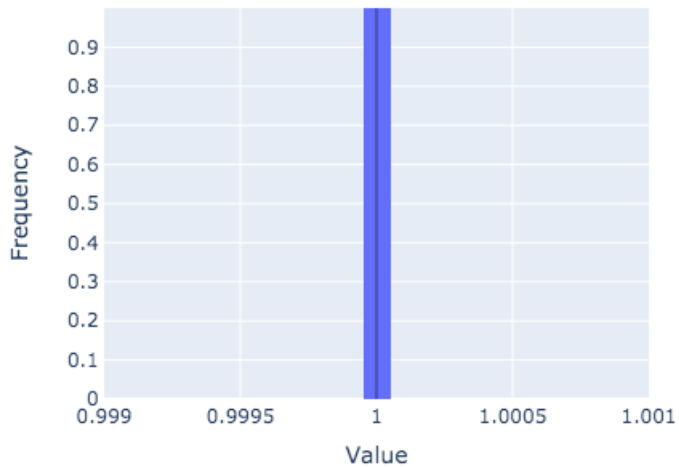
N=100, Nrep=10



Min: 1.0000000000000002
Max: 1.0000000000000002
|Max-Min|: 0.0

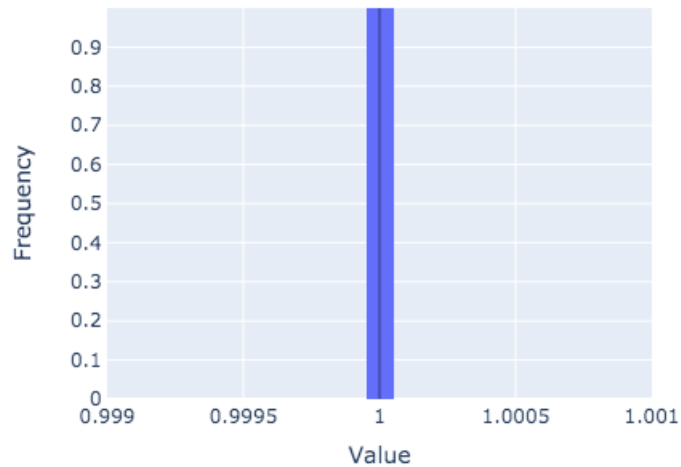
Case 2: ProjectedLinear (True)

N=10, Nrep=10



Min: 0.9999999999999998
Max: 0.9999999999999998
|Max-Min|: 0.0

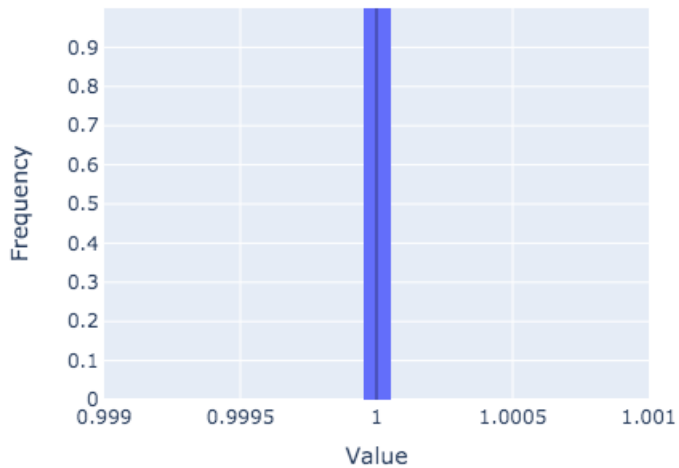
N=100, Nrep=10



Min: 0.9999999999999998
Max: 0.9999999999999998
|Max-Min|: 0.0

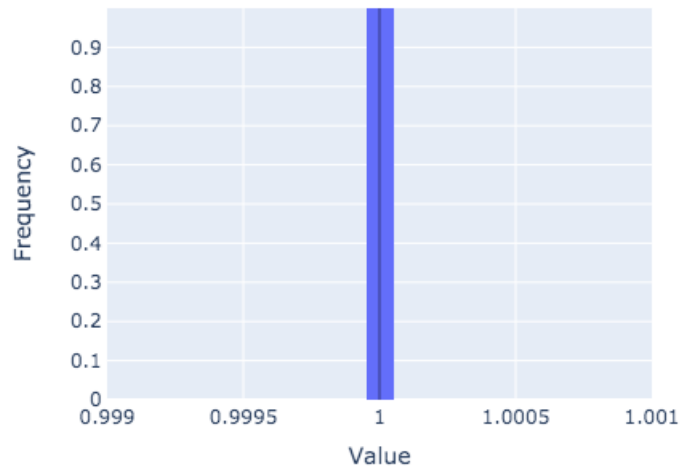
Case 3: ProjectedLinear (False)

N=10, Nrep=10



Min: 0.9999999999999998
Max: 1.0000001807827894
|Max-Min|: 1.807827896271874e-07

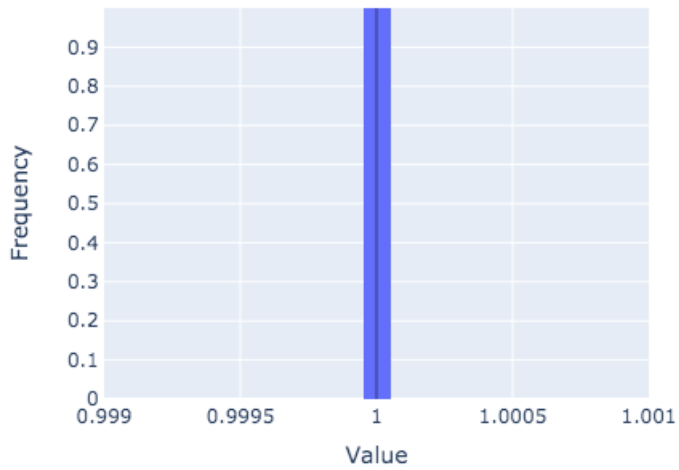
N=100, Nrep=10



Min: 0.9999999999999998
Max: 1.0000001551111417
|Max-Min|: 1.55111141930675e-07

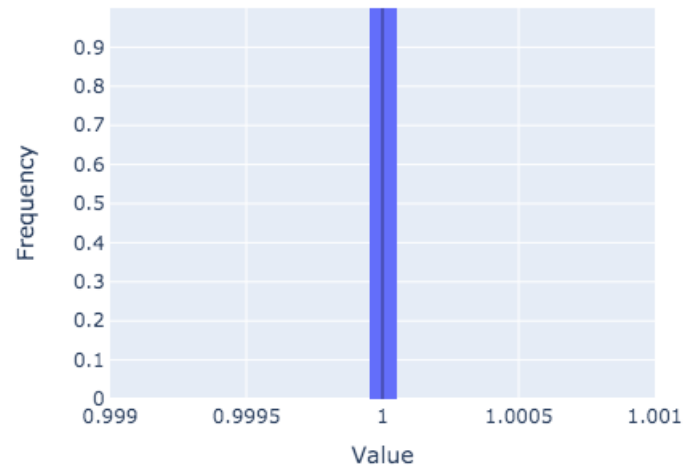
Case 4: Maximum-Likelihood (True)

N=10, Nrep=10



Min: 0.9999999999999998
Max: 0.9999999999999998
|Max-Min|: 0.0

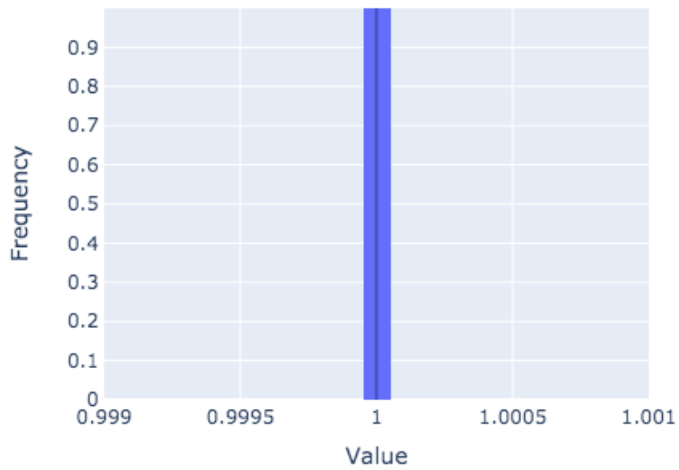
N=100, Nrep=10



Min: 0.9999999999999998
Max: 0.9999999999999998
|Max-Min|: 0.0

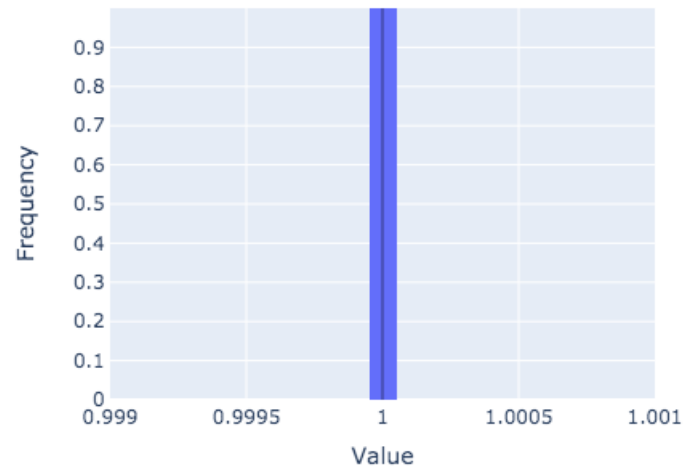
Case 5: Maximum-Likelihood (False)

N=10, Nrep=10



Min: 1.000000002701252
Max: 1.00000015572761
|Max-Min|: 1.530263578075619e-07

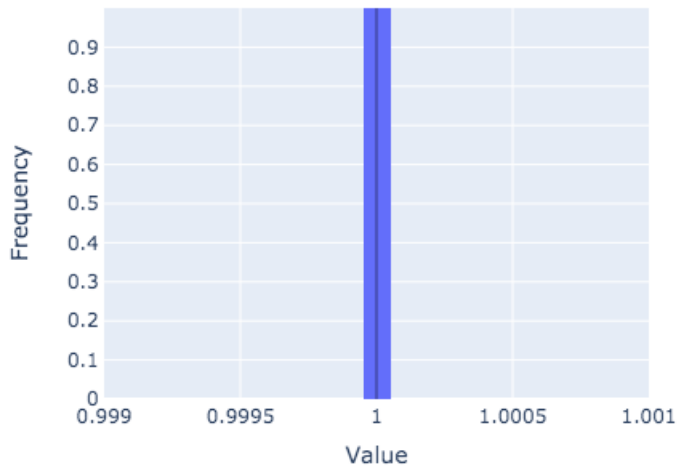
N=100, Nrep=10



Min: 1.000000007540976
Max: 1.0000001541710055
|Max-Min|: 1.4663002945169978e-07

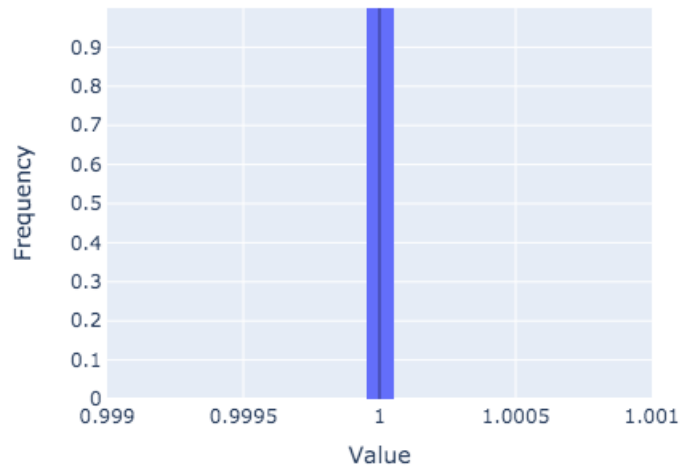
Case 6: Least Squares (True)

N=10, Nrep=10



Min: 0.9999999999999998
Max: 0.9999999999999998
|Max-Min|: 0.0

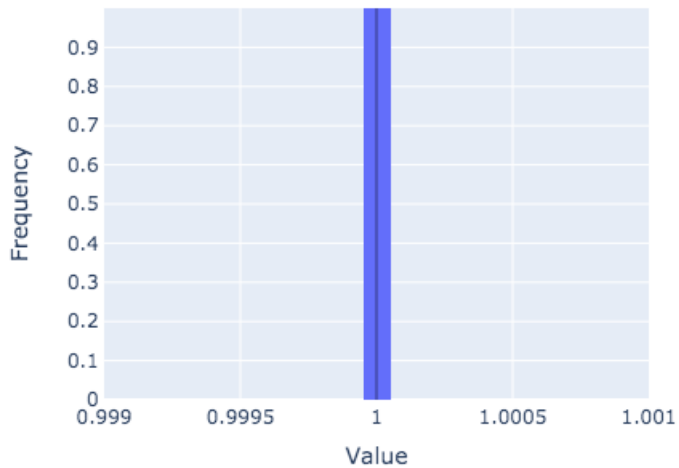
N=100, Nrep=10



Min: 0.9999999999999998
Max: 0.9999999999999998
|Max-Min|: 0.0

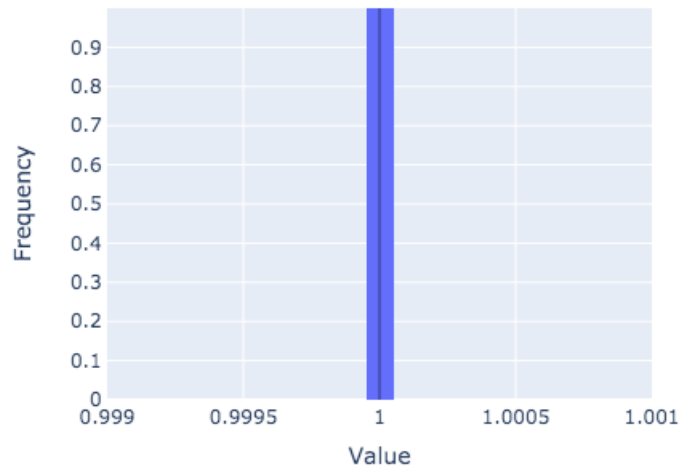
Case 7: Least Squares (False)

N=10, Nrep=10



Min: 1.00000000000000013
Max: 1.0000001660502706
|Max-Min|: 1.6605026931237887e-07

N=100, Nrep=10



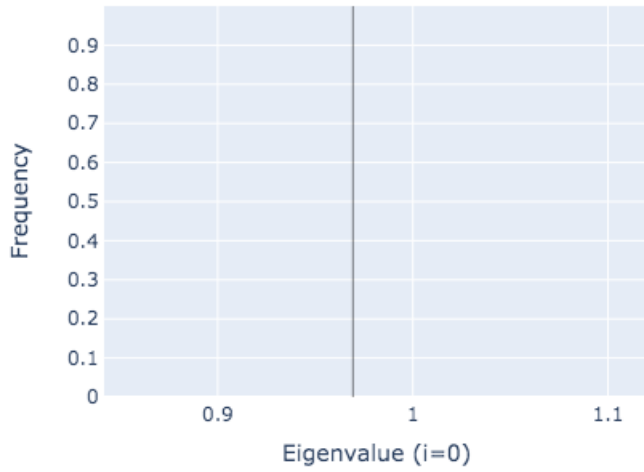
Min: 1.00000000000000013
Max: 1.0000001531930411
|Max-Min|: 1.5319303980909638e-07

Test of inequality constraint violation

Eigenvalue

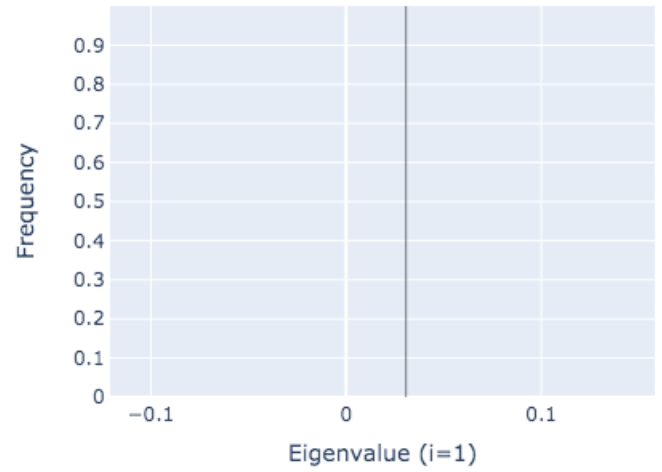
Case 0: Linear (True)

N=10, Nrep=10



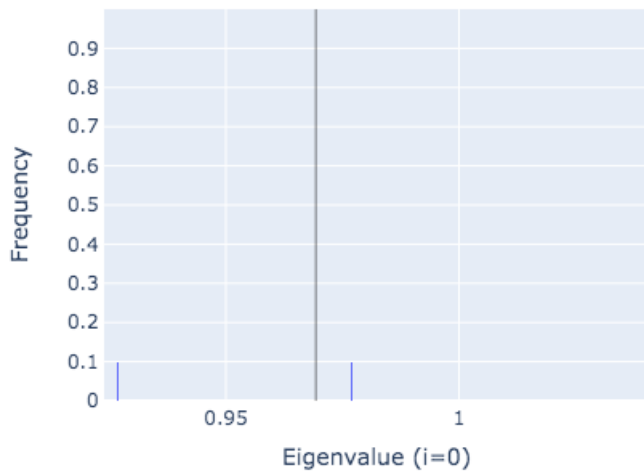
Min: 0.8418102069718651
 Max: 1.1208478114533518
 |Max-Min|: 0.2790376044814866

N=10, Nrep=10



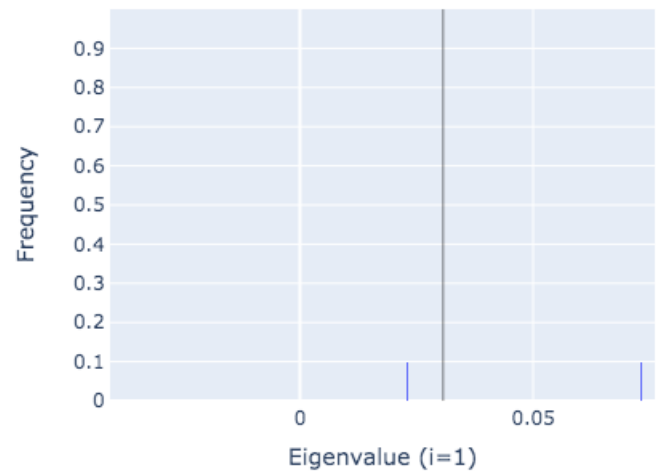
Min: -0.12084781145335197
 Max: 0.15818979302813466
 |Max-Min|: 0.2790376044814866

N=100, Nrep=10



Min: 0.9239932464088522
 Max: 1.0406614551236344
 |Max-Min|: 0.11666820871478223

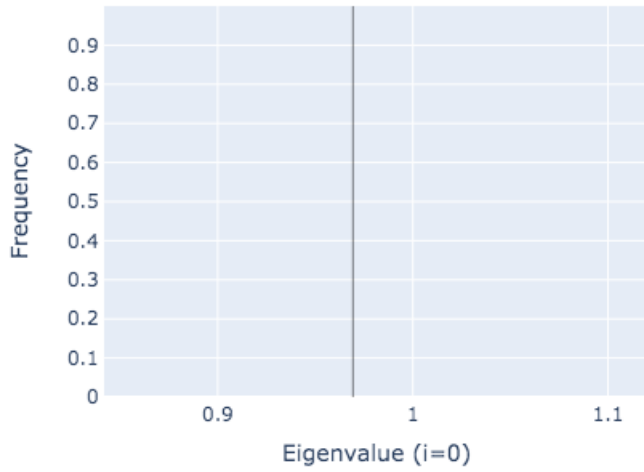
N=100, Nrep=10



Min: -0.04066145512363449
 Max: 0.07600675359114764
 |Max-Min|: 0.11666820871478213

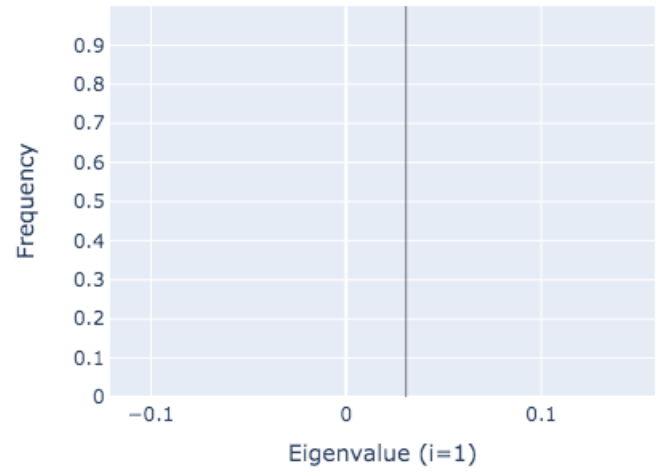
Case 1: Linear (False)

N=10, Nrep=10



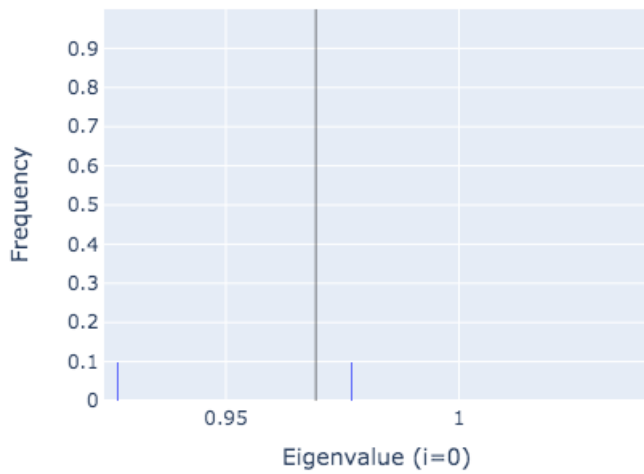
Min: 0.8418102069718654
 Max: 1.120847811453352
 |Max-Min|: 0.2790376044814866

N=10, Nrep=10



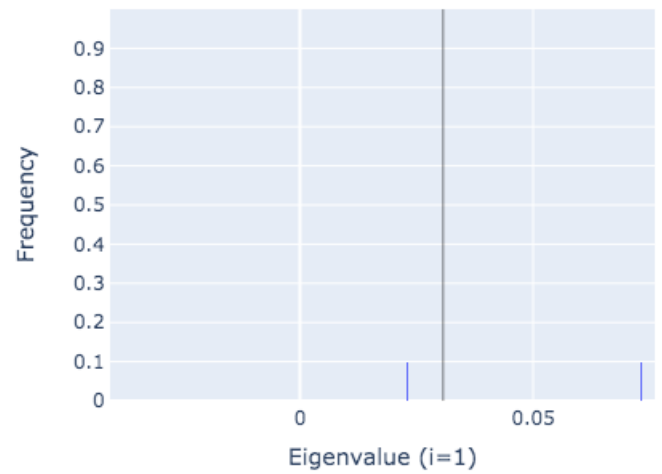
Min: -0.12084781145335197
 Max: 0.15818979302813474
 |Max-Min|: 0.27903760448148673

N=100, Nrep=10



Min: 0.9239932464088524
 Max: 1.0406614551236344
 |Max-Min|: 0.116668208714782

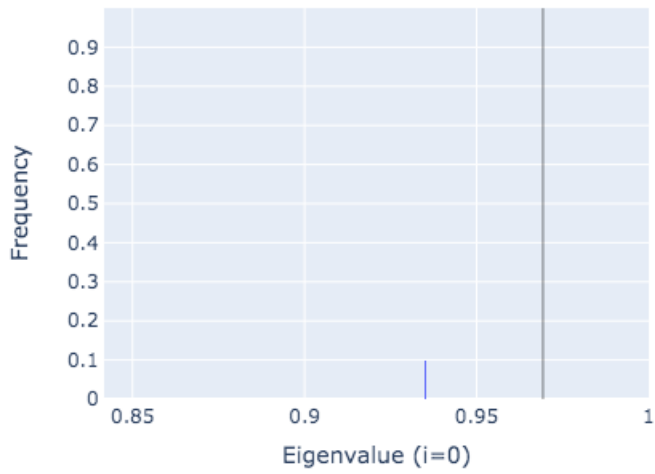
N=100, Nrep=10



Min: -0.040661455123634296
 Max: 0.07600675359114792
 |Max-Min|: 0.11666820871478221

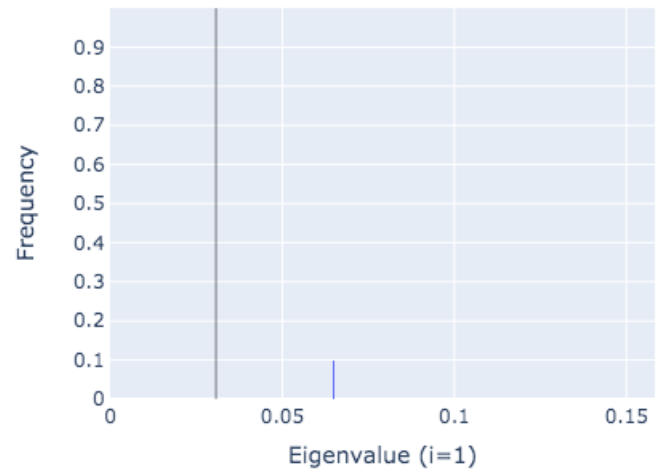
Case 2: ProjectedLinear (True)

N=10, Nrep=10



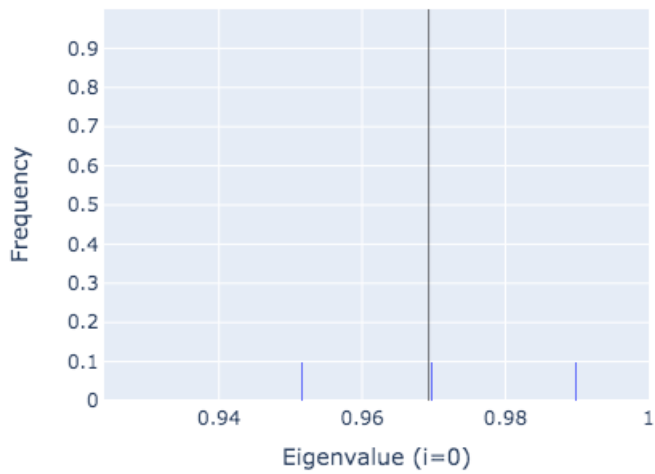
Min: 0.8418102069718649
 Max: 1.0000000903913944
 |Max-Min|: 0.15818988341952944

N=10, Nrep=10



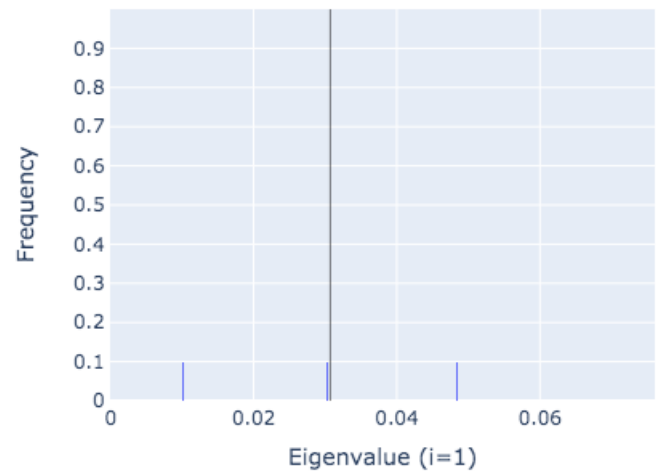
Min: -9.039139473032698e-08
 Max: 0.15818979302813482
 |Max-Min|: 0.15818988341952955

N=100, Nrep=10



Min: 0.923993246408852
 Max: 1.0000000775555709
 |Max-Min|: 0.0760068311467188

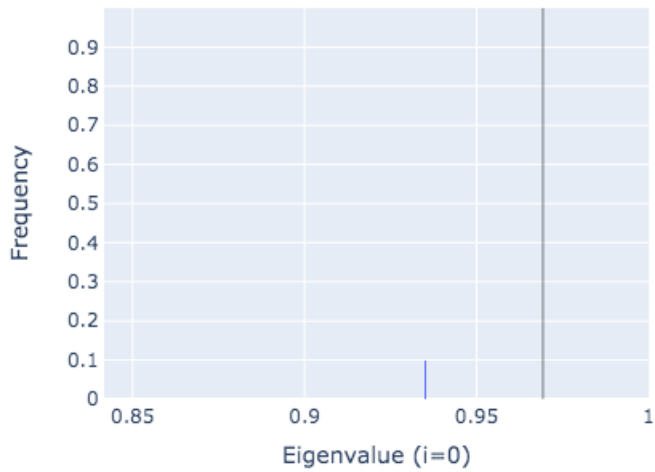
N=100, Nrep=10



Min: -7.755557092283677e-08
 Max: 0.07600675359114771
 |Max-Min|: 0.07600683114671863

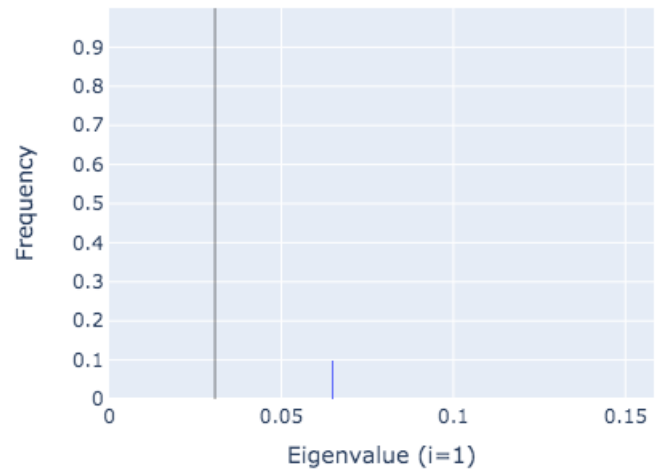
Case 3: ProjectedLinear (False)

N=10, Nrep=10



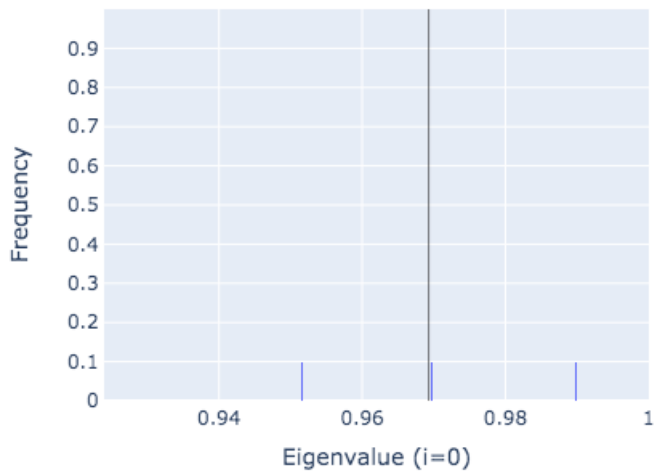
Min: 0.8418102069718654
 Max: 1.0000001807827896
 |Max-Min|: 0.15818997381092426

N=10, Nrep=10



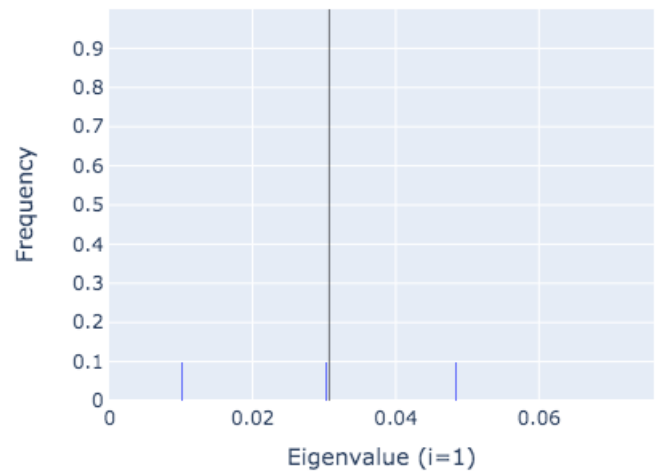
Min: -8.326672684688674e-17
 Max: 0.15818979302813488
 |Max-Min|: 0.15818979302813496

N=100, Nrep=10



Min: 0.9239932464088519
 Max: 1.0000001551111417
 |Max-Min|: 0.07600690870228977

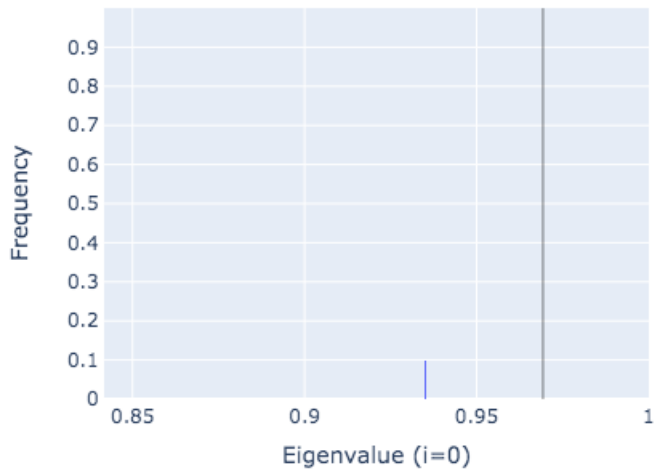
N=100, Nrep=10



Min: 2.935477382004503e-17
 Max: 0.07600675359114775
 |Max-Min|: 0.07600675359114772

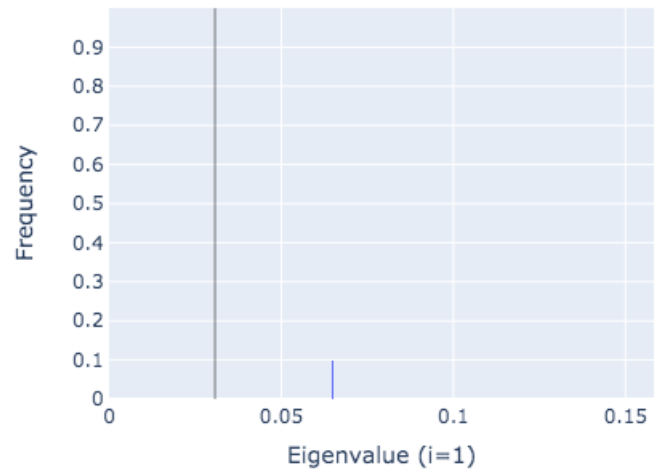
Case 4: Maximum-Likelihood (True)

N=10, Nrep=10



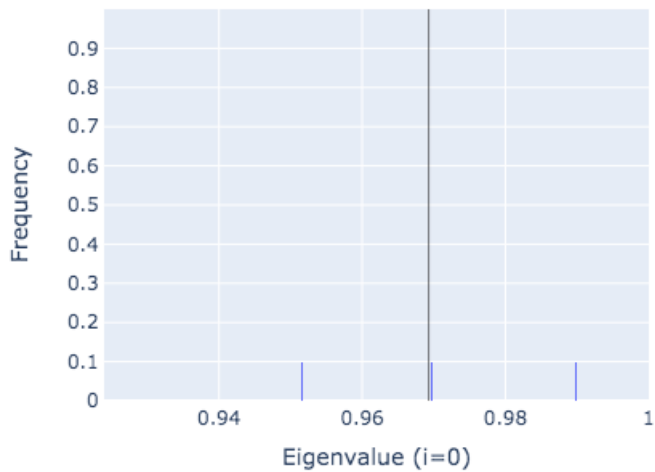
Min: 0.841810205970211
 Max: 1.0000000674320337
 |Max-Min|: 0.1581898614618228

N=10, Nrep=10



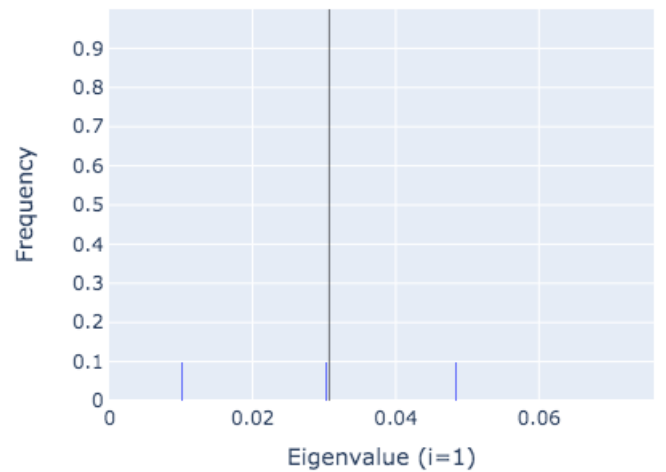
Min: -6.743203388032137e-08
 Max: 0.15818979402978878
 |Max-Min|: 0.15818986146182265

N=100, Nrep=10



Min: 0.9239932443919643
 Max: 1.0000000667579059
 |Max-Min|: 0.07600682236594158

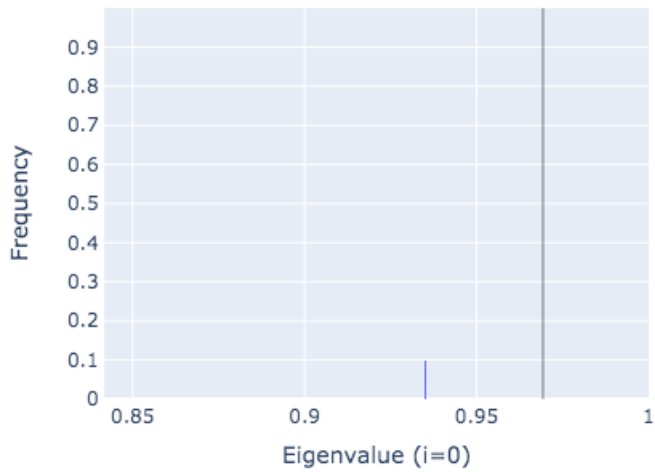
N=100, Nrep=10



Min: -6.675790605037424e-08
 Max: 0.07600675560803535
 |Max-Min|: 0.0760068223659414

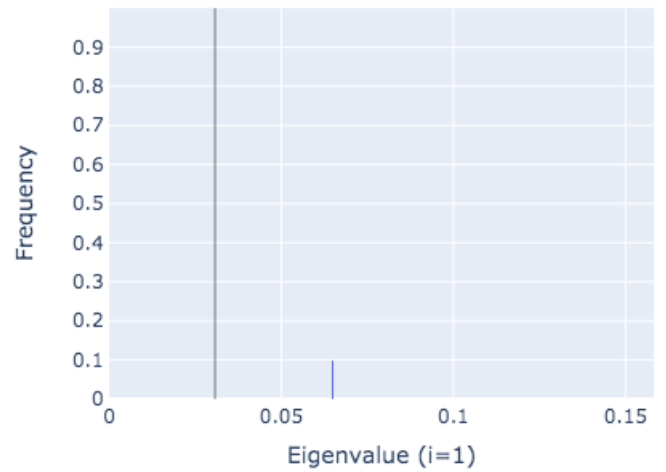
Case 5: Maximum-Likelihood (False)

N=10, Nrep=10



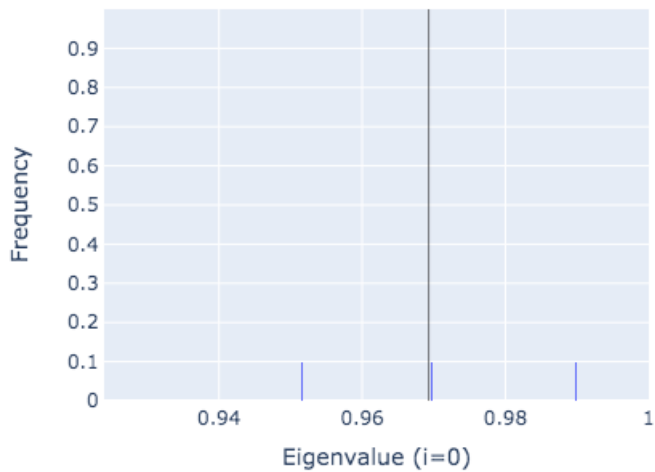
Min: 0.8418193521194106
 Max: 1.00000015572761
 |Max-Min|: 0.1581808036081993

N=10, Nrep=10



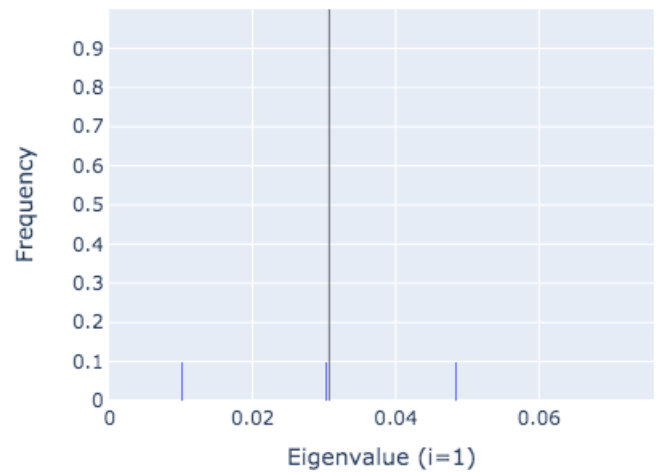
Min: 9.71445146547012e-17
 Max: 0.15818065058184155
 |Max-Min|: 0.15818065058184144

N=100, Nrep=10



Min: 0.9239674033539598
 Max: 1.0000001541709906
 |Max-Min|: 0.07603275081703087

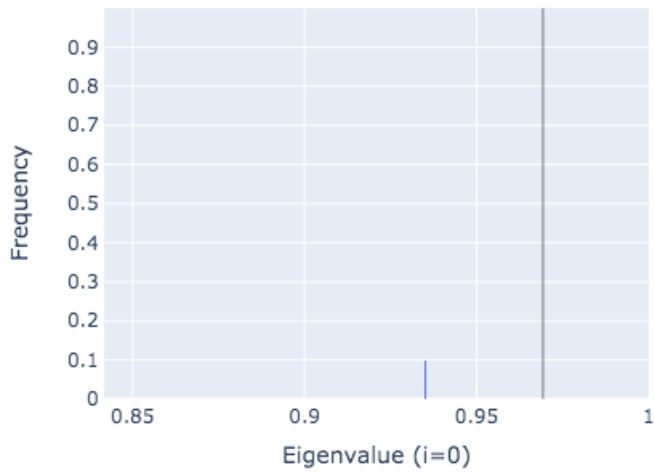
N=100, Nrep=10



Min: 1.1796119636642288e-16
 Max: 0.07603260922147073
 |Max-Min|: 0.07603260922147062

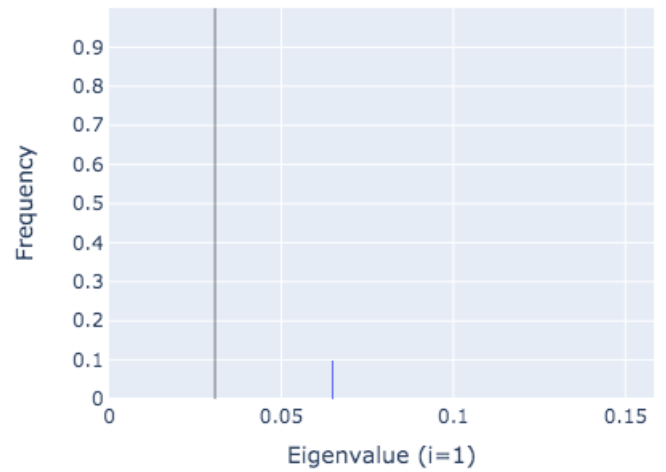
Case 6: Least Squares (True)

N=10, Nrep=10



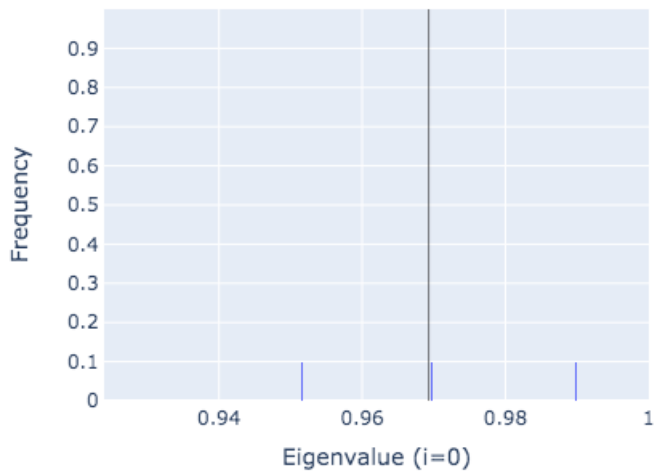
Min: 0.8418102069718657
 Max: 1.0000000805599834
 |Max-Min|: 0.15818987358811765

N=10, Nrep=10



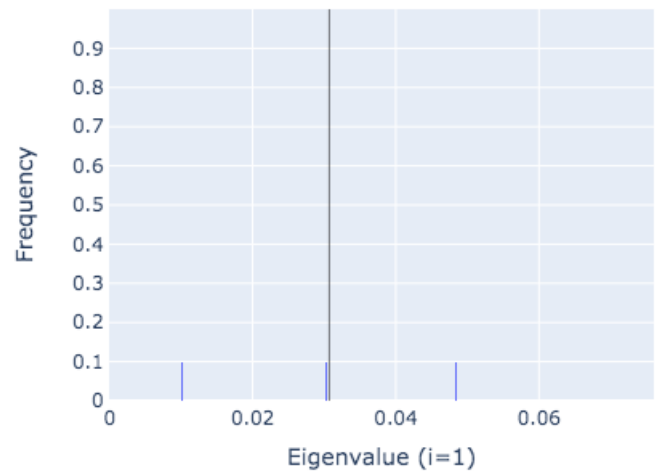
Min: -8.055998357292538e-08
 Max: 0.158189793028134
 |Max-Min|: 0.15818987358811756

N=100, Nrep=10



Min: 0.9239932464088507
 Max: 1.0000000896591925
 |Max-Min|: 0.0760068432503418

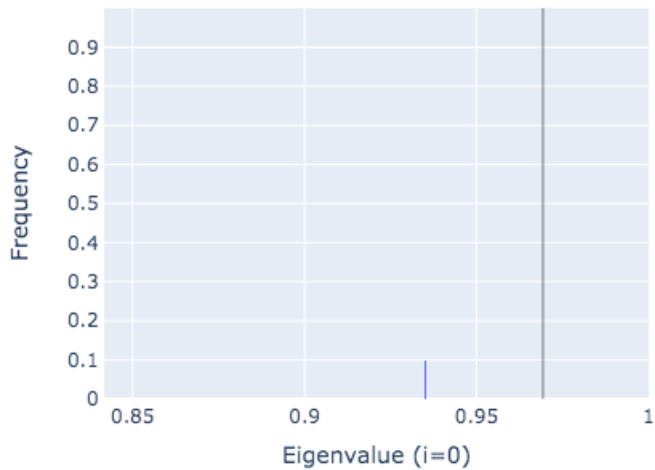
N=100, Nrep=10



Min: -8.965919272847073e-08
 Max: 0.0760067535911491
 |Max-Min|: 0.07600684325034182

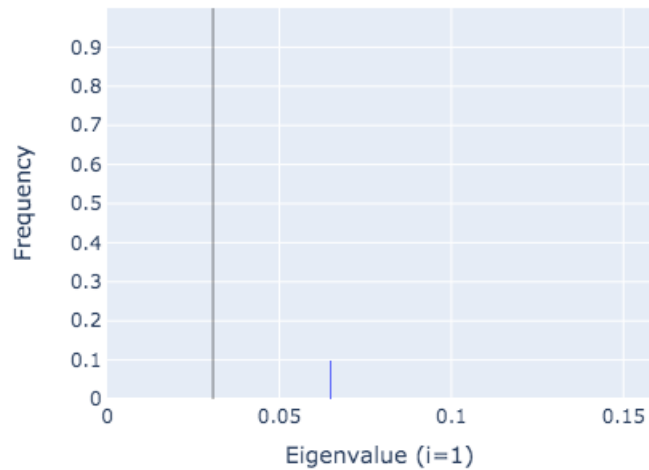
Case 7: Least Squares (False)

N=10, Nrep=10



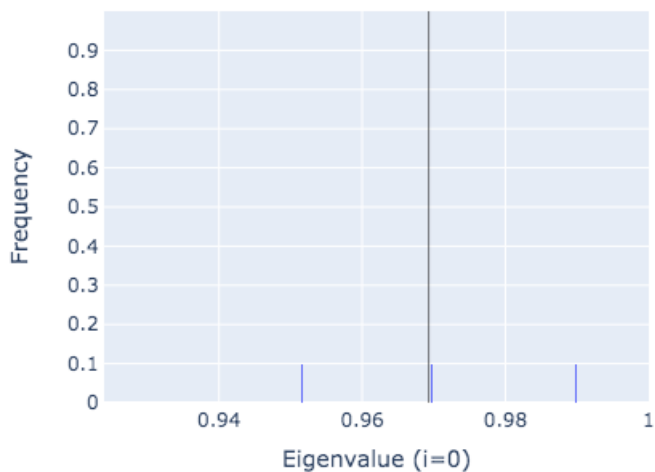
Min: 0.8418102069718676
 Max: 1.00000016605027
 |Max-Min|: 0.1581899590784024

N=10, Nrep=10



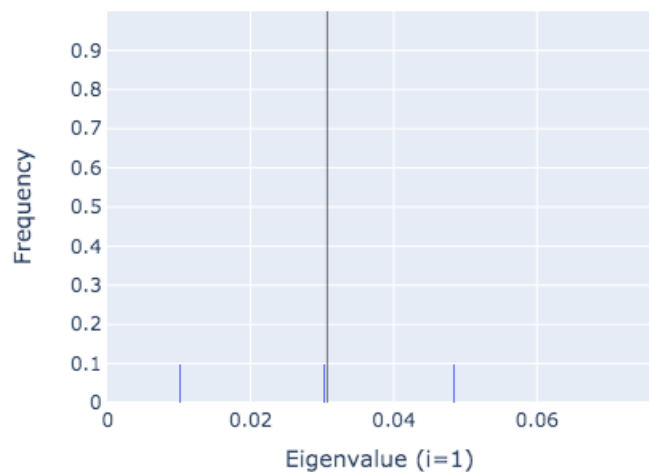
Min: -1.2836953722228372e-16
 Max: 0.15818979302813618
 |Max-Min|: 0.15818979302813632

N=100, Nrep=10



Min: 0.9239932464088527
 Max: 1.0000001531930411
 |Max-Min|: 0.07600690678418842

N=100, Nrep=10



Min: -6.938893903907228e-18
 Max: 0.07600675359114963
 |Max-Min|: 0.07600675359114964

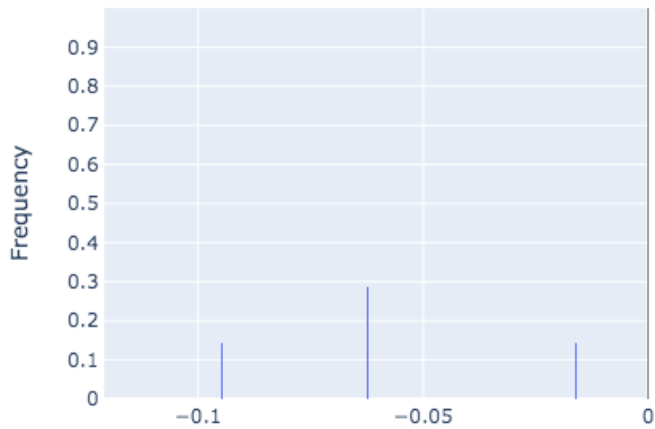
Sum of unphysical eigenvalues

Case 0: Linear (True)

N=10

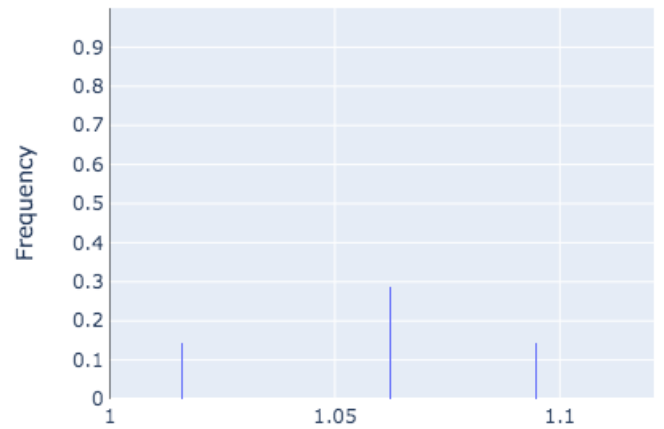
Number of unphysical estimates=7

N=10, Nrep=10



Min: -0.12084781145335197
Max: -0.016008803355067935
|Max-Min|: 0.10483900809828403

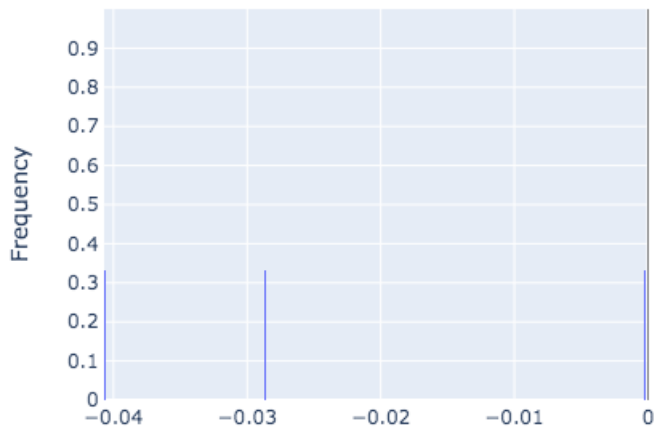
N=10, Nrep=10



Min: 1.0160088033550676
Max: 1.1208478114533518
|Max-Min|: 0.10483900809828417

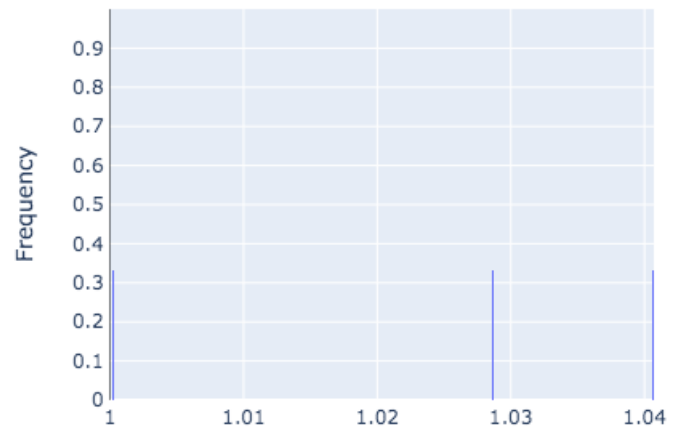
N=100
Number of unphysical estimates=3

N=100, Nrep=10



Min: -0.04066145512363449
Max: -0.00020965699256968076
|Max-Min|: 0.04045179813106481

N=100, Nrep=10

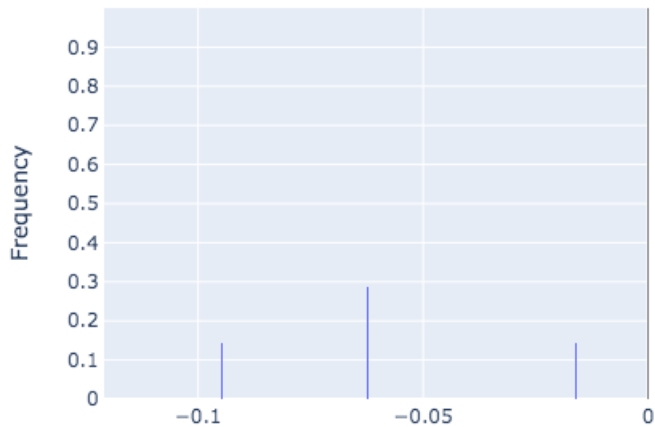


Min: 1.0002096569925696
Max: 1.0406614551236344
|Max-Min|: 0.04045179813106481

Case 1: Linear (False)

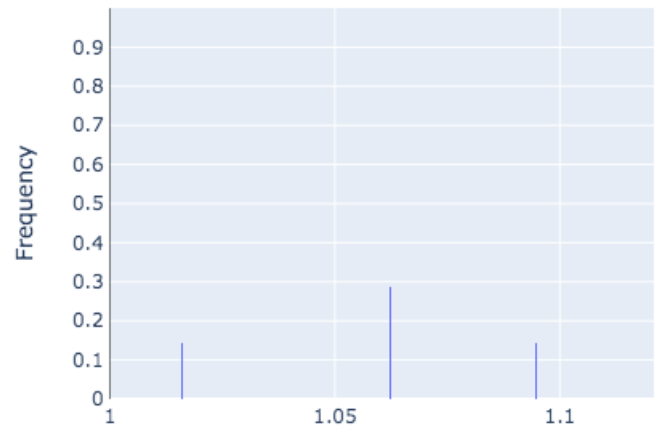
N=10
Number of unphysical estimates=7

N=10, Nrep=10



Min: -0.12084781145335197
Max: -0.01600880335506777
|Max-Min|: 0.1048390080982842

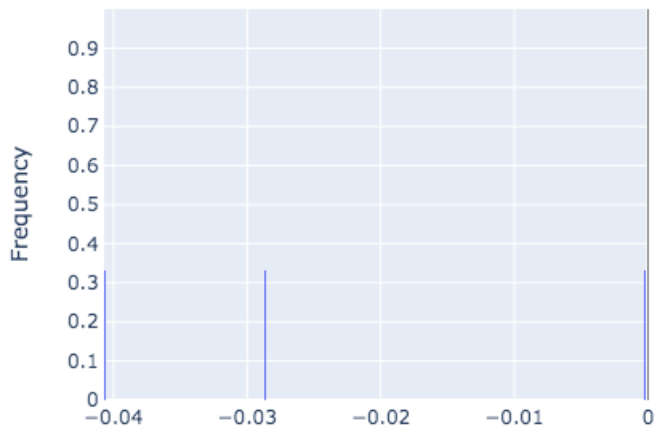
N=10, Nrep=10



Min: 1.016008803355068
Max: 1.120847811453352
|Max-Min|: 0.10483900809828395

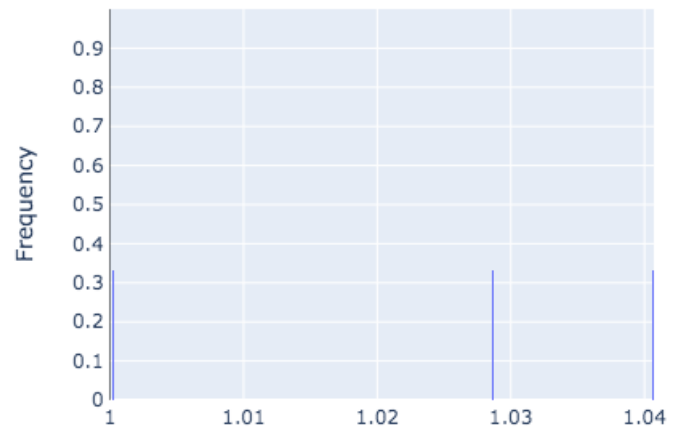
N=100
Number of unphysical estimates=3

N=100, Nrep=10



Min: -0.040661455123634296
Max: -0.0002096569925694593
|Max-Min|: 0.04045179813106484

N=100, Nrep=10

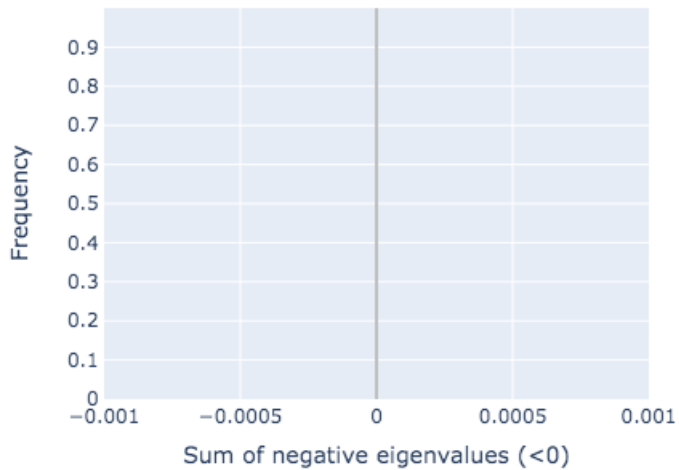


Min: 1.0002096569925696
Max: 1.0406614551236344
|Max-Min|: 0.04045179813106481

Case 2: ProjectedLinear (True)

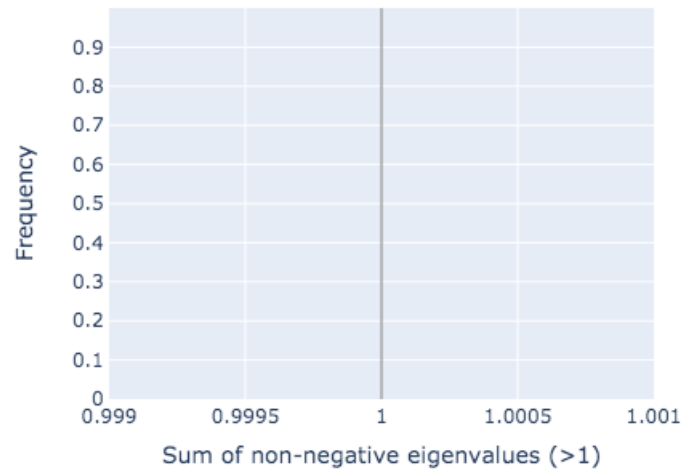
N=10
Number of unphysical estimates=0

N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

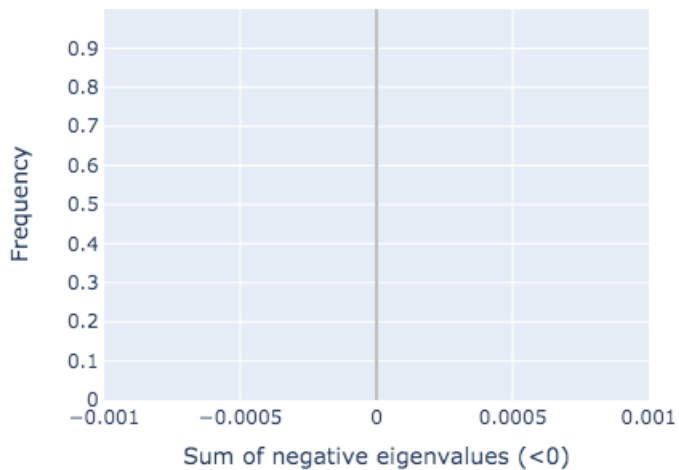
N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

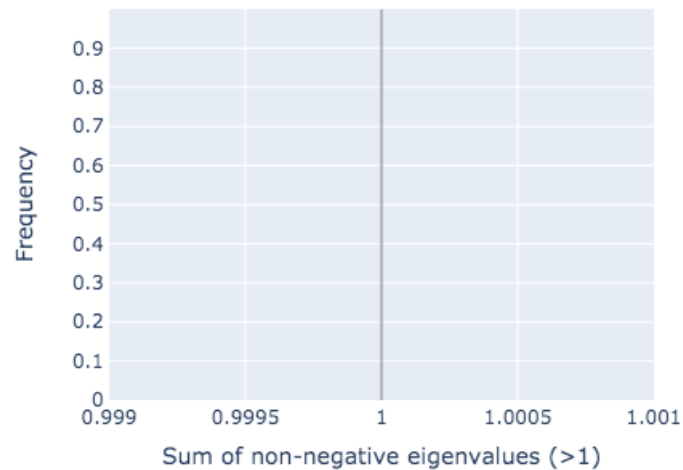
N=100
Number of unphysical estimates=0

N=100, Nrep=10



Min: -
Max: -
|Max-Min|: -

N=100, Nrep=10

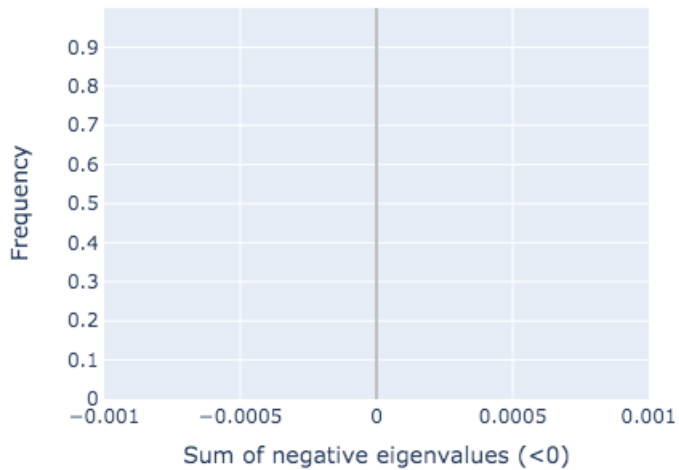


Min: -
Max: -
|Max-Min|: -

Case 3: ProjectedLinear (False)

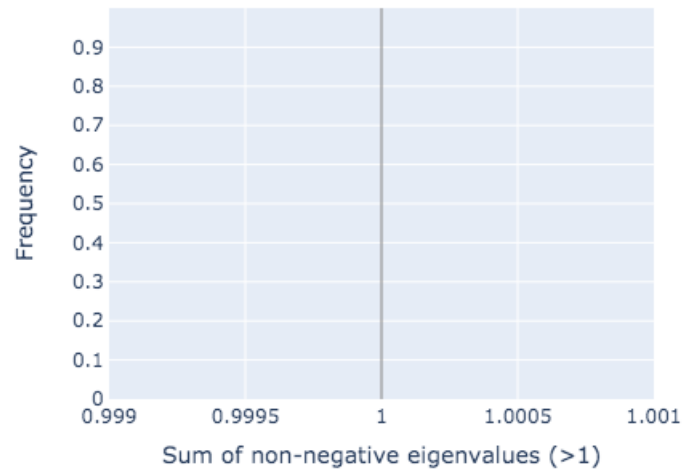
N=10
Number of unphysical estimates=0

N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

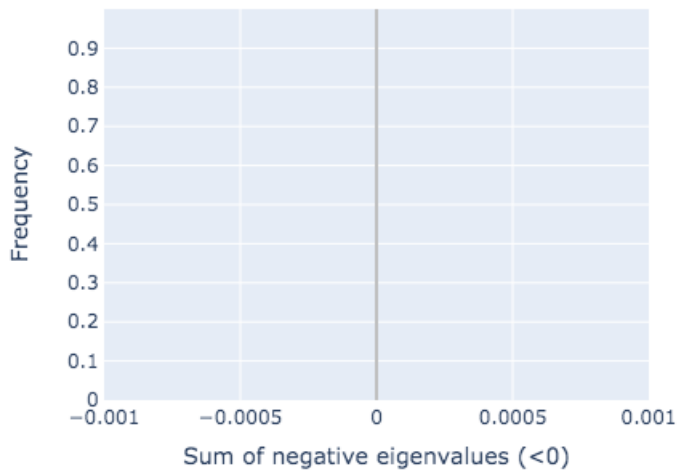
N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

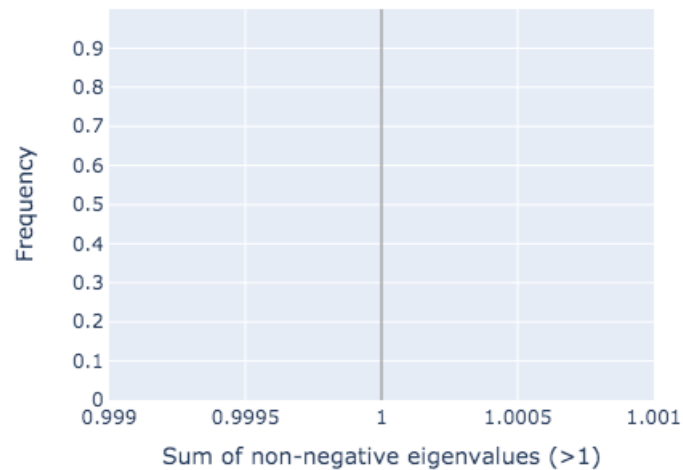
N=100
Number of unphysical estimates=0

N=100, Nrep=10



Min: -
Max: -
|Max-Min|: -

N=100, Nrep=10

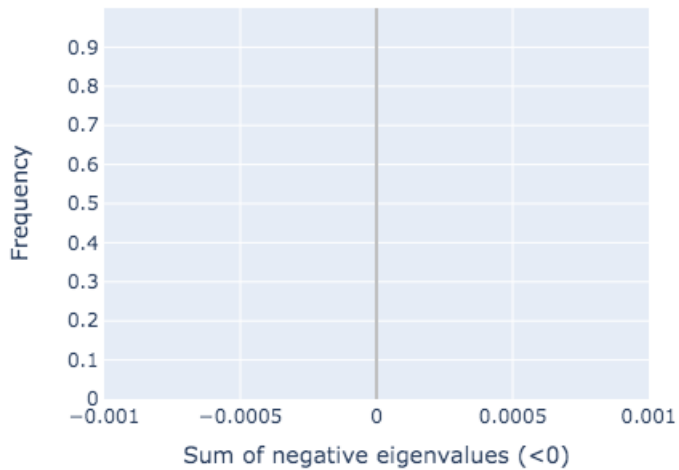


Min: -
Max: -
|Max-Min|: -

Case 4: Maximum-Likelihood (True)

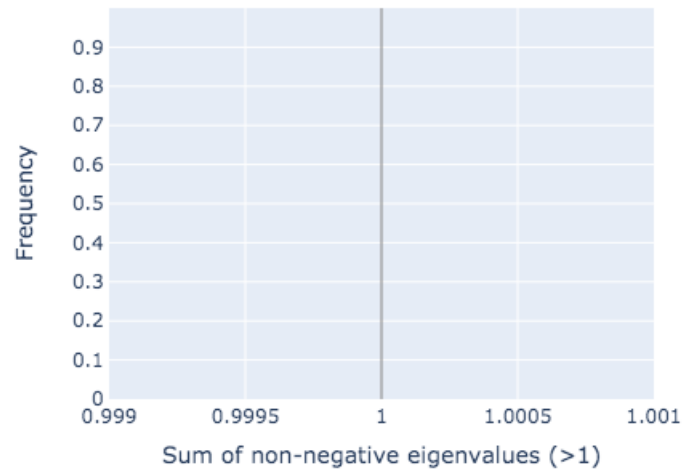
N=10
Number of unphysical estimates=0

N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

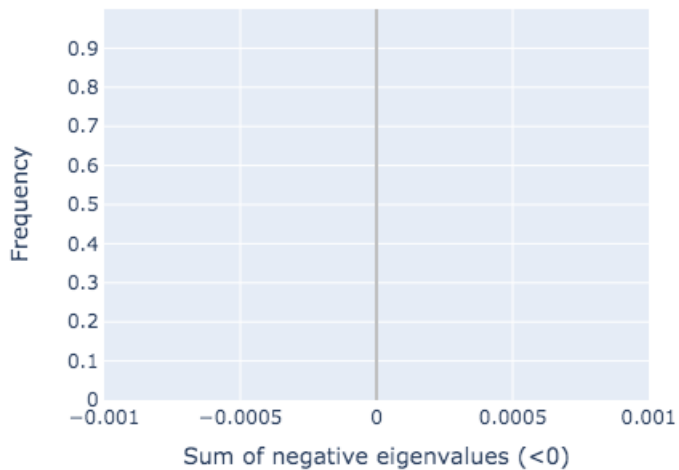
N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

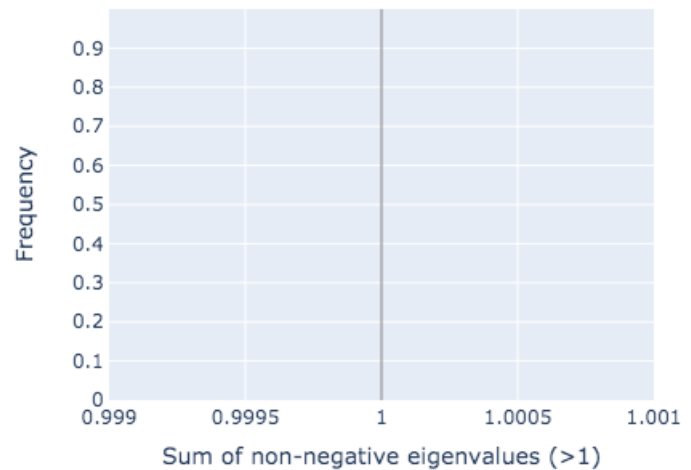
N=100
Number of unphysical estimates=0

N=100, Nrep=10



Min: -
Max: -
|Max-Min|: -

N=100, Nrep=10

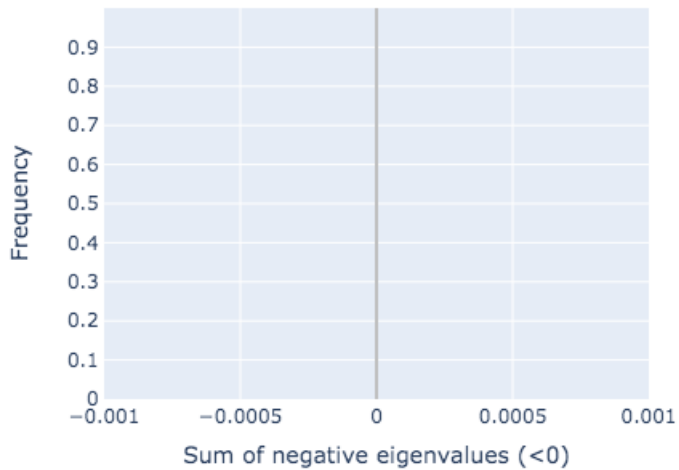


Min: -
Max: -
|Max-Min|: -

Case 5: Maximum-Likelihood (False)

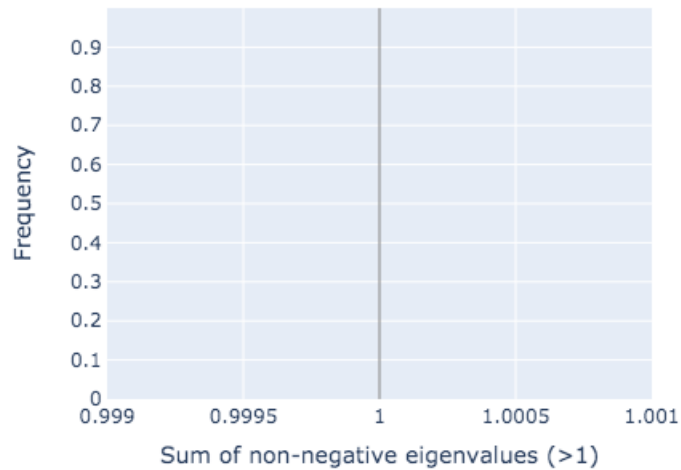
N=10
Number of unphysical estimates=0

N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

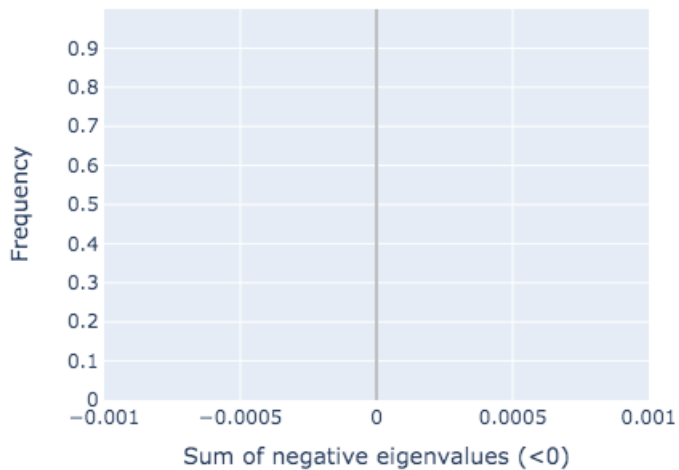
N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

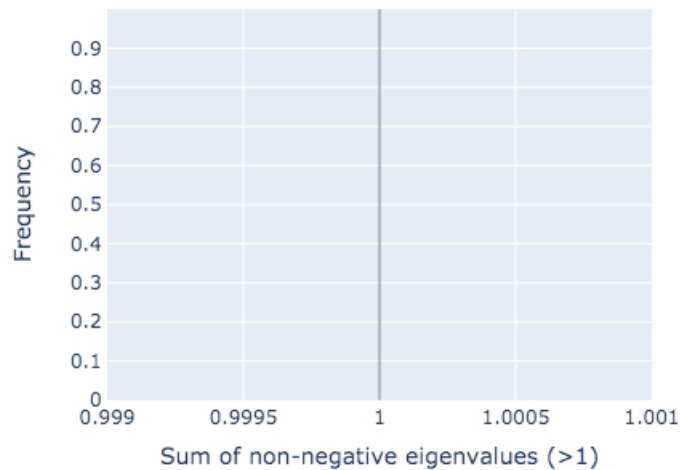
N=100
Number of unphysical estimates=0

N=100, Nrep=10



Min: -
Max: -
|Max-Min|: -

N=100, Nrep=10

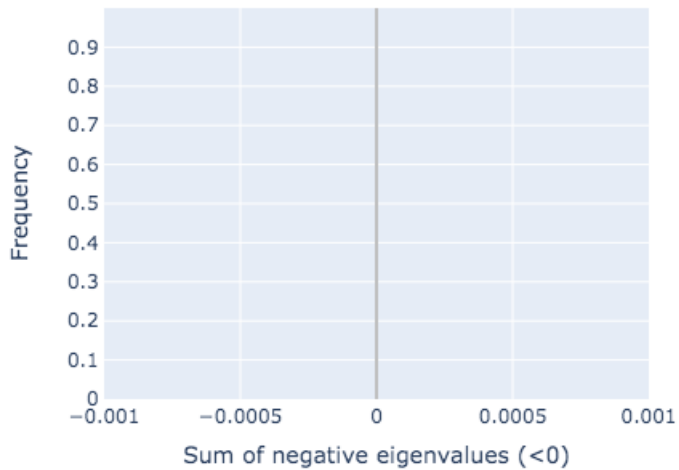


Min: -
Max: -
|Max-Min|: -

Case 6: Least Squares (True)

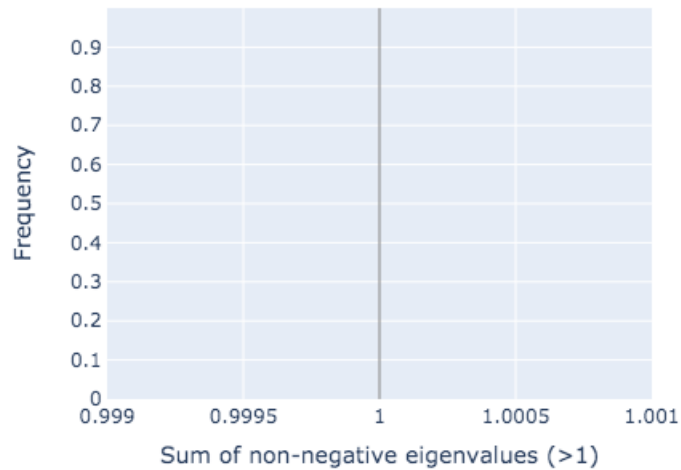
N=10
Number of unphysical estimates=0

N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

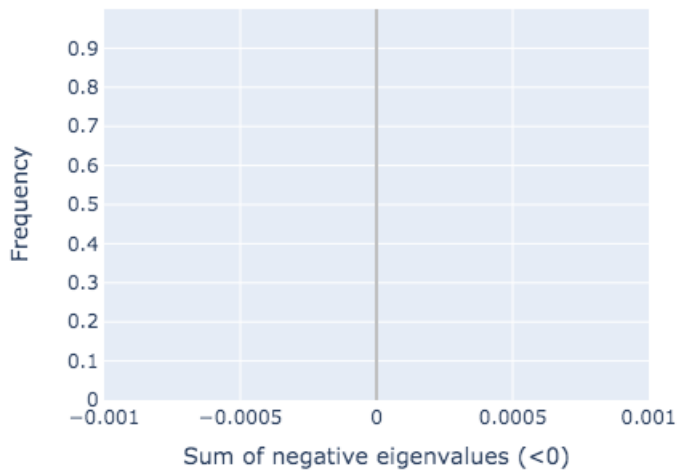
N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

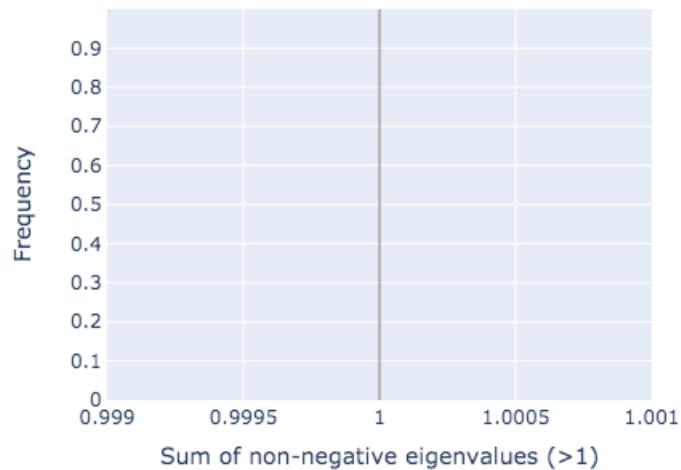
N=100
Number of unphysical estimates=0

N=100, Nrep=10



Min: -
Max: -
|Max-Min|: -

N=100, Nrep=10

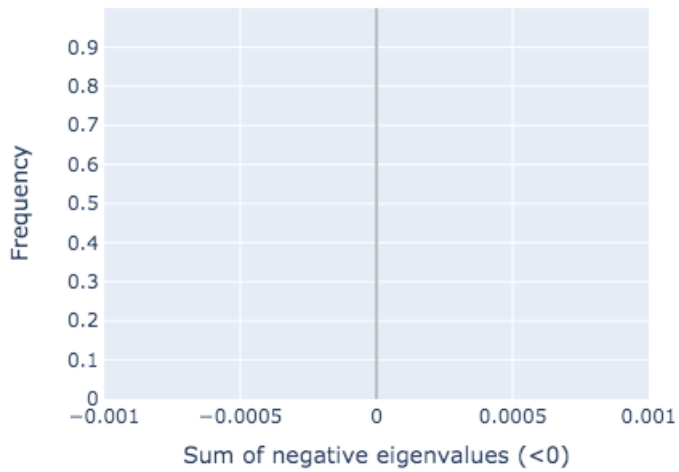


Min: -
Max: -
|Max-Min|: -

Case 7: Least Squares (False)

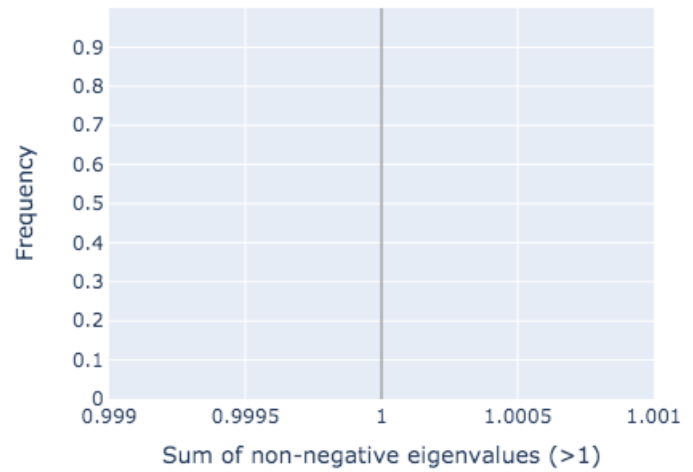
N=10
Number of unphysical estimates=0

N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

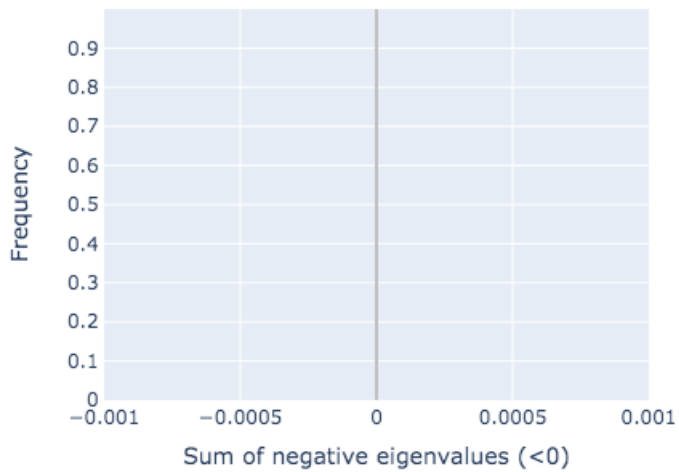
N=10, Nrep=10



Min: -
Max: -
|Max-Min|: -

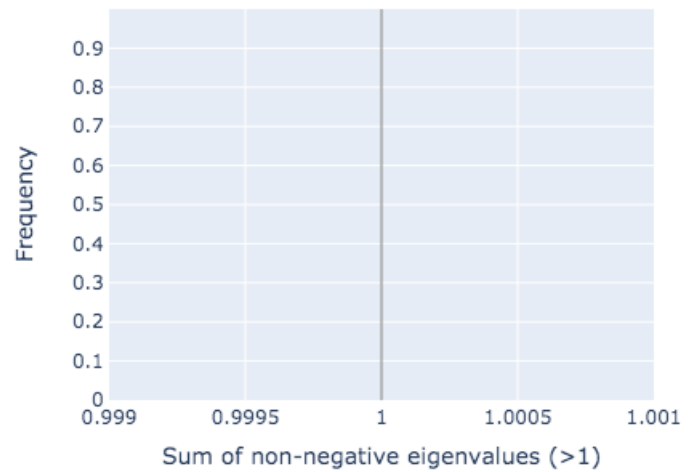
N=100
Number of unphysical estimates=0

N=100, Nrep=10



Min: -
Max: -
|Max-Min|: -

N=100, Nrep=10



Min: -
Max: -
|Max-Min|: -