

NP/NPRMPI RELATIVE PERFORMANCE

TIMING RESULTS, NUMBER OF CORES 1, . . . , 4

The run times reported in Table 1 were generated using R 4.5.2 and MPICH 4.3.2 on an Apple M2 Mac Studio (12 cores) running macOS 15.2 (current date: February 7, 2026). Each example was run in serial mode ($np=1$) using the np package then in parallel mode ($np=2, 3, 4$) using the npRmpi package.

Due to small sample sizes some demos may not show appreciable gains with respect to increasing the number of cores. Where possible we have bumped up sample sizes in the hopes that the larger sample sizes will show expected scaling benefits.

- (1) Note that the functions npconmode, npcmstest, and npqreg use actual datasets so these are restricted unless we wish to go with fully simulated data (an entry of $n = 0$ indicates the example uses a dataset)
- (2) Note that currently the function npregiv is serial only hence no speedup (in fact overhead from message passing will slow it down as the number of cores increases)
- (3) Note that currently the function npscoef and npglpreg are not fully MPI aware as the ridging occurs outside of a call to npksum() hence is processed serially and not in parallel

The table below presents Seconds with respect to the number of cores followed by the ratio (Secs(np))/Secs(1)). Note that an entry of $n = 0$ indicates the example uses a dataset hence the number of observations cannot be modified.

TABLE 1. Illustrative timed runs (seconds) with 1 processor (serial, np package) and 2, 3, and 4 processors (parallel, npRmpi package) on an Apple M2 Mac Studio.

Function	n	Secs(1)	Secs(2)	Secs(3)	Secs(4)	Ratio(2)	Ratio(3)	Ratio(4)
npcdensls	1000	460.6	236.0	166.4	126.0	0.51	0.36	0.27
npcdensml	2500	35.5	18.0	12.2	9.4	0.51	0.34	0.27
npcdistls	2000	84.1	43.2	36.7	31.2	0.51	0.44	0.37
npcmstest	616	10.0	5.8	4.4	3.8	0.58	0.44	0.38
npconmode	189	8.9	5.3	4.1	3.5	0.60	0.47	0.40
npcopula	5000	5.1	3.0	3.1	2.5	0.60	0.61	0.50
npdeneqtest	2500	33.8	17.1	11.9	9.3	0.50	0.35	0.28
npdeptest	2500	41.9	21.1	14.7	11.3	0.50	0.35	0.27
npglpreg	1500	422.6	235.7	167.7	136.3	0.56	0.40	0.32
npindexich	5000	18.6	10.2	6.8	5.2	0.55	0.37	0.28
npindexks	5000	24.6	13.4	9.0	6.9	0.54	0.37	0.28
npplreg	1000	10.1	6.0	4.3	3.4	0.59	0.42	0.34
npqreg	1008	27.1	15.1	12.2	10.2	0.56	0.45	0.38
npregiv	2500	139.1	112.2	97.5	91.5	0.81	0.70	0.66
npreglcaic	5000	160.8	82.9	55.0	40.4	0.52	0.34	0.25
npreglcls	5000	157.1	81.0	54.5	39.7	0.52	0.35	0.25
npregllaic	5000	97.0	66.1	50.5	39.3	0.68	0.52	0.40
npregllls	5000	96.7	64.1	48.9	38.4	0.66	0.51	0.40
npscoef	10000	42.7	24.6	17.9	14.7	0.58	0.42	0.34
npsdeptest	1500	70.8	37.3	26.4	20.8	0.53	0.37	0.29
npsigtest	1000	56.9	42.9	47.1	37.9	0.75	0.83	0.67
npsymtest	2500	38.9	20.4	14.5	11.1	0.52	0.37	0.28
npudensls	10000	85.1	42.0	28.2	21.2	0.49	0.33	0.25
npudensml	10000	42.5	20.9	14.0	10.7	0.49	0.33	0.25
npudistcdf	10000	119.5	62.6	89.3	78.7	0.52	0.75	0.66
npunitest	5000	155.5	76.4	52.2	39.5	0.49	0.34	0.25