

# Just tired of endless loops!

*or parallel: Stata module for parallel computing*

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# Agenda

Motivation

What is and how does it work

Benchmarks

Syntax and Usage

Concluding Remarks

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- ▶ Often our work is easily broken down into independent chunks
- ▶ But, implementing parallel computing even for these “embarrassingly parallel” problems is not easy, most of this due to lack of (user-friendly) statistical computing tools.
- ▶ `parallel` aims to make a contribution to these issues.

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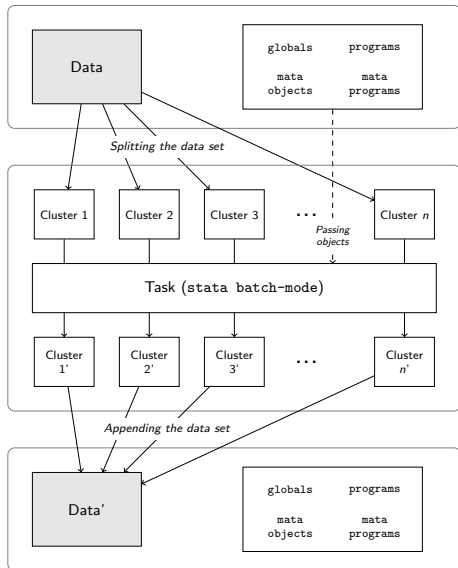
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- ▶ Thus having a quad-core computer can lead to a 400% speedup.

# What is and how does it work

How does it work?



Starting (current) stata instance loaded with data plus user defined globals, programs, mata objects and mata programs

A new stata instance (batch-mode) for every data-clusters. Programs, globals and mata objects/programs are passed to them.

The same algorithm (task) is simultaneously applied over the data-clusters.

After every instance stops, the data-clusters are appended into one.

Ending (resulting) stata instance loaded with the new data.

User defined globals, programs, mata objects and mata programs remain unchanged.



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    - ▶ List of seeds for each bootstrap resampling
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  3. Child process reads its list of tasks, loads the real dataset, and does it's own looping over tasks
- ▶ If the list of tasks is not initially definable then the “nodata” alternative mechanism allows for more flexibility.

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When the user enters

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parallel: gen x2 = x*x
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```
cap clear all
cd ~
1 set seed 34815
  set memory 16777216b
  cap set maxvar 5000
  cap set matsize 400
2 local pll_instance 1
  local pll_id efcql2tspr
  capture {
    noisily {
3 use __pllefcql2tsprdataset if _efcql2tsprcut == 1
    gen x2 = x*x
    }
  }
4 save __pllefcql2tsprdata1, replace
  local result = _rc
  cd ~
5 mata: write_diagnosis(st_local("result"),
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```
cap clear all
cd ~
1 set seed 98327
  set memory 16777216b
  cap set maxvar 5000
  cap set matsize 400
2 local pll_instance 2
  local pll_id efcql2tspr
  capture {
  noisily {
3 use __pllefcql2tsprdataset if _efcql2tsprcut == 2
  gen x2 = x*x
  }
  }
4 save __pllefcql2tsprdata2, replace
  local result = _rc
  cd ~
5 mata: write_diagnosis(st_local("result"),
  >"__pllefcql2tsprfinito2")
```

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**Benchmarks**

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# Benchmarks

## Simple example: Serial replace

### Serial fashion

```
do mydofile.do
```

### Parallel fashion

```
parallel do mydofile.do
```

Figure: mydofile.do

```
local size = _N
forval i=1/'size' {
    qui replace x = ///
        1/sqrt(2*'c(pi)')*exp(-(x^2/2)) in 'i'
}
```

Table: Serial replacing using a loop on a Linux Server (16 clusters)

	100,000	1,000,000	10,000,000
CPU	1.43	16.94	144.68
Total	0.34	3.20	12.49
Setup	0.00	0.00	0.00
Compute	0.32	3.07	11.54
Finish	0.02	0.12	0.95
Ratio (compute)	4.50	5.51	12.53
Ratio (total)	4.22 (26%)	5.30 (30%)	11.58 (72%)

Tested on a Intel Xeon X470 (hexadeca-core) machine

# Benchmarks

## Monte Carlo simulation (Windows Machine)

### Serial fashion

do myexperiment.do

### Parallel fashion

parallel do myexperiment.do, nodata

Figure: myexperiment.do

```
local num_of_intervals = 50
if length("`pllid'") == 0 {
    local start = 1
    local end = "num_of_intervals"
}
else {
    local ntot = floor("num_of_intervals"/$PLI_CLUSTERS)
    local start = ("pllidistance" - 1)*ntot + 1
    local end = ("pllidistance")*ntot
    if "pllidistance" == $PLI_CLUSTERS local end = 10
}
local reps 10000
forval i="start"/"end" {
    qui use census2, clear
    gen trunq = age
    gen x_factor = region
    sum x_factor, semeanly
    scalar sm = r(sean)
    qui {
        gen y1 = .
        gen y2 = .
        local c = 'i'
        set seed `c'
        simulate c=r(c) m1=r(sm1) sm_m1 = r(sm_m1) ///
            m2=r(sm2) sm_m2 = r(sm_m2), ///
            saving(cc`i', replace) nodata reps("reps"): ///
            m1sm_m1, c(`c')
    }
}
```

Table: Monte Carlo Experiment on a Windows Machine (4 clusters)

	2	4
CPU	111.49	114.13
Total	58.02	37.48
Setup	0.00	0.00
Compute	58.02	37.48
Finish	0.00	0.00
Ratio (compute)	1.92	3.04
Ratio (total)	1.92 (96%)	3.04 (76%)

Tested on a Intel i3 2120 (dual-core) machine

# Benchmarks

## Monte Carlo simulation (Unix Machine)

### Serial fashion

```
do myexperiment.do
```

### Parallel fashion

```
parallel do myexperiment.do, nodata
```

**Table:** Monte Carlo Experiment on a Linux Server (16 clusters)

	2	4	8	16
CPU	164.79	164.04	162.84	163.89
Total	69.85	34.28	19.00	10.78
Setup	0.00	0.00	0.00	0.00
Compute	69.85	34.28	19.00	10.78
Finish	0.00	0.00	0.00	0.00
Ratio (compute)	2.36	4.78	8.57	15.21
Ratio (total)	2.36 (118%)	4.78 (120%)	8.57 (107%)	15.21 (95%)

Tested on a Intel Xeon X470 (hexadeca-core) machine



# Benchmarks

## Reshaping Administrative Data

### Serial fashion

```
reshape wide tipsolic rutemp opta derecho ngiros, ///  
  i(id) j(time)
```

### Parallel fashion

```
parallel, by(id) :reshape wide tipsolic rutemp opta derecho ngiros, ///  
  i(id) j(time)
```

**Table:** Reshaping wide a large database on a Linux Server (8 clusters)

	100,000	1,000,000	5,000,000
CPU	5.51	72.70	392.97
Total	2.33	17.46	86.44
Setup	0.00	0.00	0.00
Compute	1.83	12.42	57.93
Finish	0.50	5.04	28.51
Ratio (compute)	3.01	5.85	6.78
Ratio (total)	2.37 (29%)	4.16 (52%)	4.55 (57%)

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## Setup

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## By syntax

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parallel [, by(varlist) programs mata seeds(string) randtype(random.org|datetime)  
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## By syntax

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parallel [, by(varlist) programs mata seeds(string) randtype(random.org|datetime)  
          processors(integer) nodata]: stata_cmd
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## Do syntax

```
parallel do filename  
          [, by(varlist) programs mata seeds(string) randtype(random.org|datetime)  
          processors(integer) nodata]
```

# Syntax and Usage

Recommendations on its usage

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parallel suits ...
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- ▶ (Currently) Tasks that already take up all of RAM.

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