

# 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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- ▶ But, implementing parallel computing for the social scientist 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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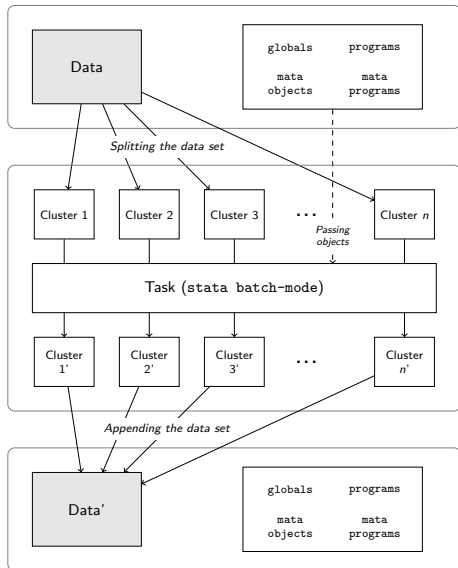
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- ▶ Thus having a quad-core computer can lead to a 400% speedup.

# 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.



# What is and how does it work

Sounds “pretty” but...

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Sounds “pretty” but...is this for real!?

# What is and how does it work

## Parallel's backend

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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 n = _N
    }
  }
4 save __pllefcql2tsprdata1, replace
  local result = _rc
  cd ~
5 mata: write_diagnosis(st_local("result"),
  >"__pllefcql2tsprfinito1")
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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 n = _N
  }
  }
4 save __pllefcql2tsprdata2, replace
  local result = _rc
  cd ~
5 mata: write_diagnosis(st_local("result"),
  >"__pllefcql2tsprfinito2")
```

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Ok, it works but...

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Ok, it works but...

it must be really hard to use!

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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("`pl1,id'") == 0 {
    local start = 1
    local end = "num_of_intervals"
}
else {
    local stot = floor("num_of_intervals"/$PL1_CLUSTERS)
    local start = ("pl1_instance" - 1)*stot + 1
    local end = ("pl1_instance")*stot
    if "pl1_instance" == $PL1_CLUSTERS local end = 10
}

local reps 10000
forval i="start"/"end" {
    qui use cnumm2, clear
    gen true_y = age
    gen x_factor = region
    sum x_factor, meanonly
    scalar xmu = r(mean)
    qui {
        gen y1 = .
        gen y2 = .
        local c = '1'
        set seed `c'
        simulate c=r(c) mul=r(mul) ss_mu1 = r(ss_mu1) ///
            mul=r(mu2) ss_mu2 = r(ss_mu2), ///
            saving(cc1, replace) nodata reps(`reps'): ///
            mcsimul1, 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

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



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Recomendations on its usage

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parallel suit ...
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- ▶ (already) fast commands.
- ▶ Regressions, ARIMA, etc.
- ▶ Linear Algebra.
- ▶ Whatever StataMP does better.



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  - ▶ `parnnmatch`
  - ▶ ... You name it!

Thank you very much!

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