CZPoisson

Cynthia K. Zajac

2019-11-24

The CZPoisson R package is designed to replicate Catherine Loader's[1] dpois implementation to calculate the approximate Poisson distribution.

Package Info

The repo for CZPoisson can be found:

https://github.com/cynzajac/CZPoisson

CZPoisson containes two functions:

1. Poisson probability mass function `r`
2. Poisson cumulative distribution `cdf`

`r` takes two or three arguments:

- `x` (required) -> count
- `lamb` (required) -> mean of distribution of counts
- `log` (optional) -> returns the log of probabilities

`cdf` takes between two or four arguments:

- `x` (required) -> count
- `lamb` (required) -> mean of distribution of counts
- `lower.tail` (optional) -> returns the lower tail probabilities
- `log.p` (optional) -> returns the log of probabilities

Examples

The following is the complete example from the `CZPoisson` package

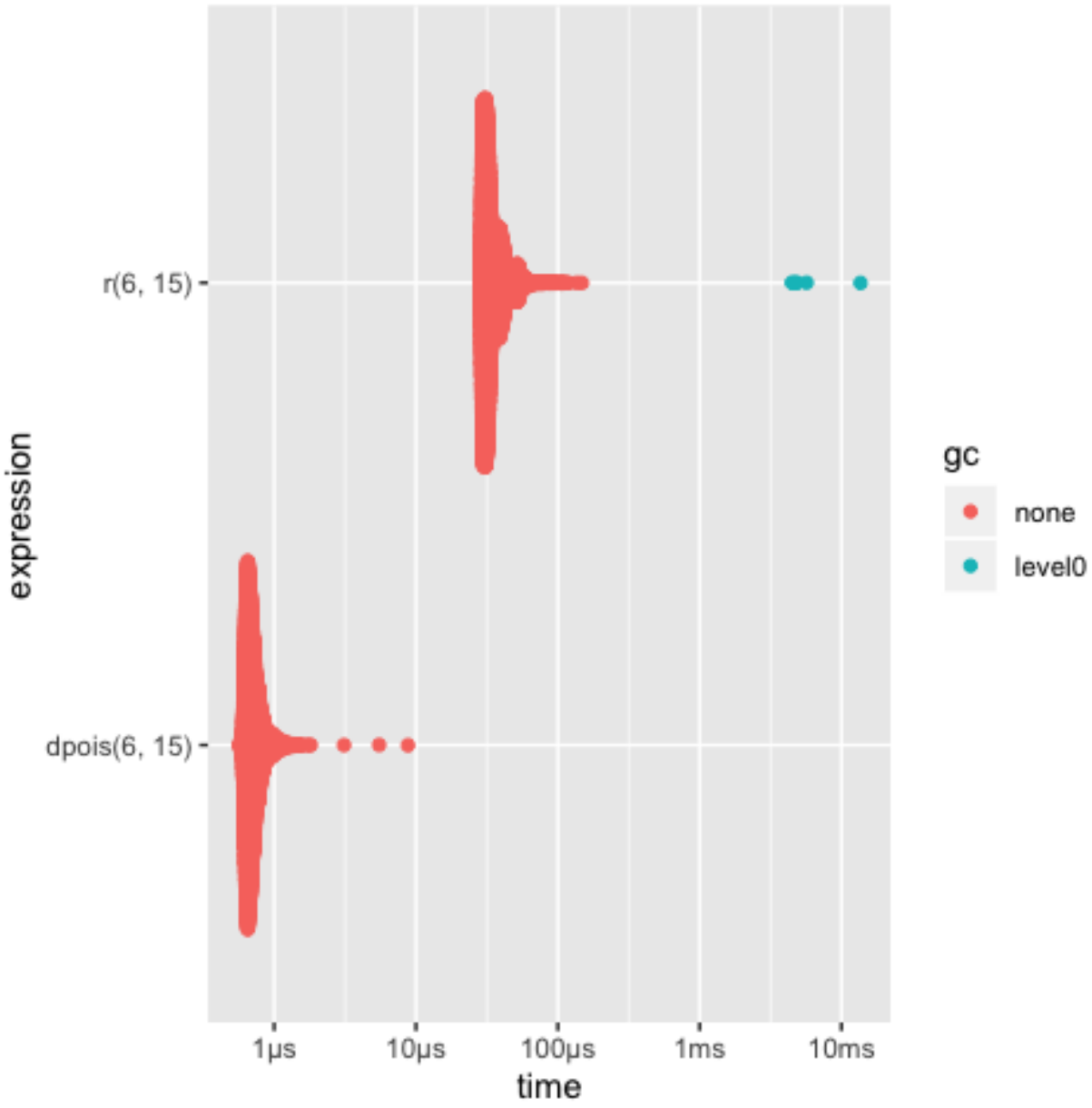
```
> ## After installing CZPoisson
> library(CZPoisson)

> # Poisson probability mass function 'r'
> r(6,15)
[1] 0.00483947

> #Check against dpois
> dpois(6, 15)
[1] 0.00483947

> ## Calculating log probability of the poisson distribution

> r(1234568,1234567,T)
[1] -7.932055
> dpois(1234568,1234567,T)
[1] -7.932055
```

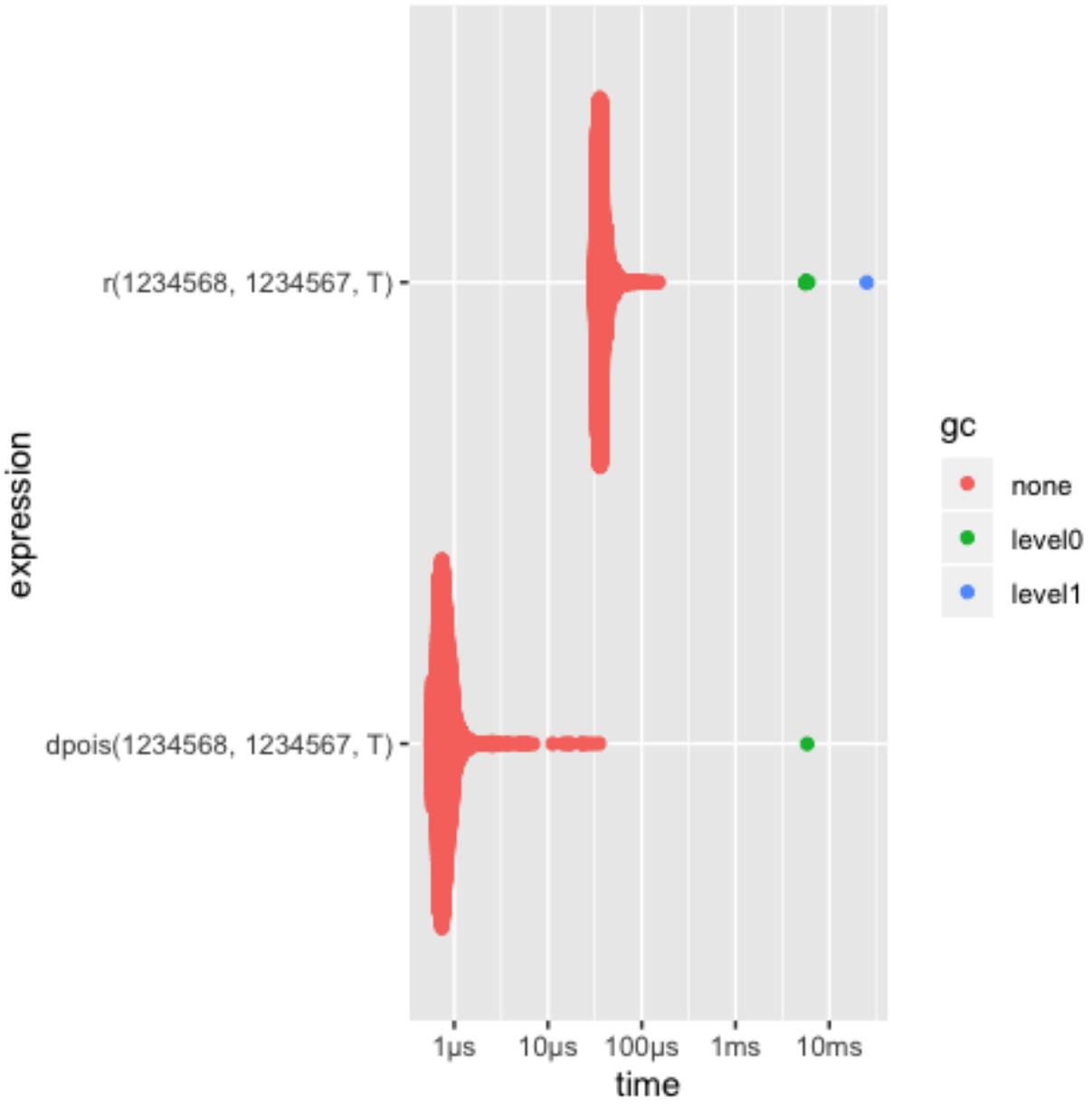
[1] Loader, C. (2000). Fast and accurate computation of binomial probabilities. https://lists.gnu.org/archive/html/octave-maintainers/2011-09/pdfK0uKOST642.pdf

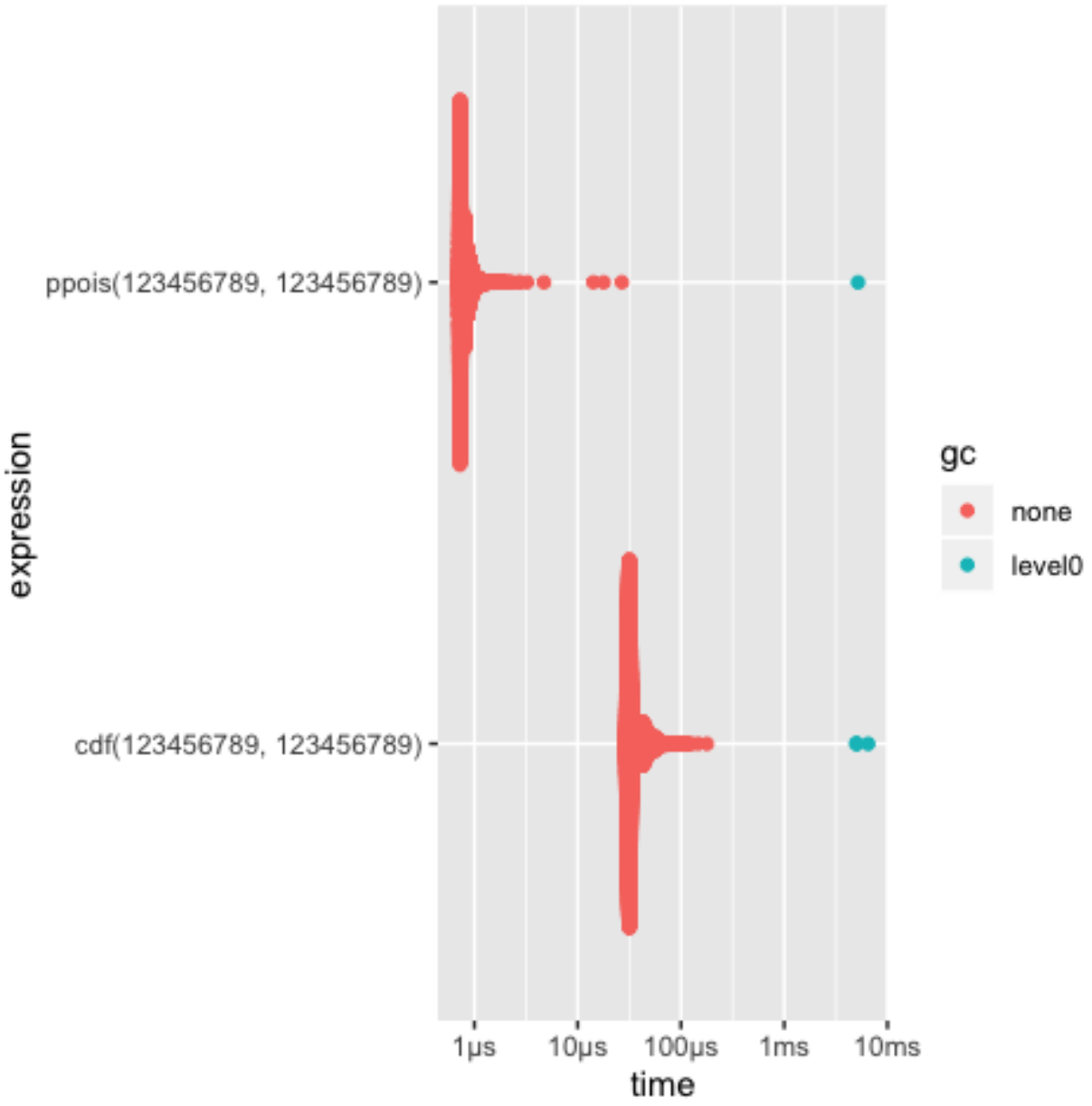
```
> # Poisson cumulative distribution function 'cdf'

> cdf(123456789, 123456789)
[1] 0.5000239
> ppois(123456789, 123456789)
[1] 0.5000239

> # Calculating log probability for the upper tail

> cdf(5, 5:10, lower.tail = FALSE)
[1] 0.3840393 0.5543204 0.6992917 0.8087639 0.8843095 0.9329140
> ppois(5, 5:10, lower.tail = FALSE)
[1] 0.3840393 0.5543204 0.6992917 0.8087639 0.8843095 0.9329140

> # Comparing original CZPoisson against original

> ## use 'all.equal()'
> all.equal(c(r(6,15),
    r(1234568,1234567,T),
    cdf(123456789,123456789),
    cdf(5, 5:10, lower.tail = FALSE)),
  c(dpois(6, 15),
    dpois(1234568,1234567,T),
    ppois(123456789, 123456789),
    ppois(5, 5:10, lower.tail = FALSE)))
[1] TRUE

> #Benchmarking

> ## Install packages for comparison visualization
> library(bench)
> library(gmp)
> library(ggbeeswarm)

> # Load test cases for both: 'r' & 'cdf' functions
> ## print(result);plot(result)

> result1 = mark(r(6,15), dpois(6,15))
> print(result1);plot(result1)
# A tibble: 2 x 13
  expression       min  median `itr/sec` mem_alloc `gc/sec` n_itr
  <bch:expr>   <bch:t> <bch:t>     <dbl> <bch:byt>    <dbl> <int>
1 r(6, 15)      28.2µs  32.4µs    28218.        0B     16.9  9994
2 dpois(6, 15)   566ns   685ns  1390565.        0B      0   10000
# ... with 6 more variables: n_gc <dbl>, total_time <bch:tm>,
#   result <list>, memory <list>, time <list>, gc <list>

> result2 = mark(r(1234568,1234567,T),
    dpois(1234568,1234567,T))
> print(result2);plot(result2)
# A tibble: 2 x 13
  expression                    min  median `itr/sec` mem_alloc
  <bch:expr>                <bch:t> <bch:t>     <dbl> <bch:byt>
1 r(1234568, 1234567, T)     30.7µs  36.4µs    26197.        0B
```

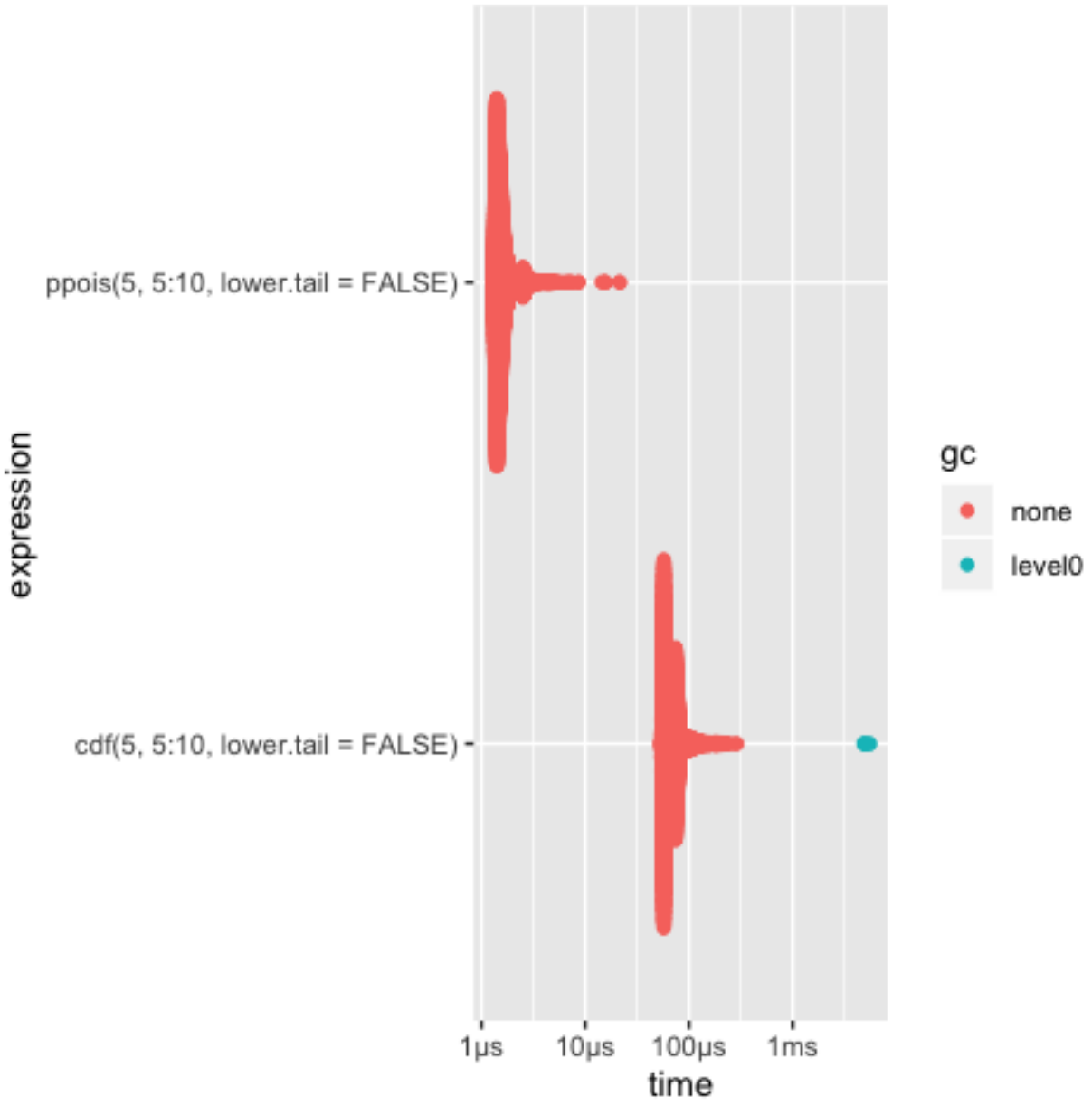
```
2 dpois(1234568, 1234567, T)   557ns   766ns  1199370.        0B
# ... with 8 more variables: `gc/sec` <dbl>, n_itr <int>, n_gc <dbl>,
#   total_time <bch:tm>, result <list>, memory <list>, time <list>,
#   gc <list>

> result3 = mark(cdf(123456789,123456789),
    ppois(123456789,123456789))
> print(result3);plot(result3)
# A tibble: 2 x 13
  expression                      min median `itr/sec` mem_alloc
  <bch:expr>                  <bch:t> <bch:>     <dbl> <bch:byt>
1 cdf(123456789, 123456789)    28.8µs   32µs    28203.        0B
2 ppois(123456789, 123456789)   698ns  766ns  1231749.        0B
# ... with 8 more variables: `gc/sec` <dbl>, n_itr <int>, n_gc <dbl>,
#   total_time <bch:tm>, result <list>, memory <list>, time <list>,
#   gc <list>

> result4 = mark(cdf(5, 5:10, lower.tail = FALSE),
    ppois(5, 5:10, lower.tail = FALSE))
> print(result4);plot(result4)
# A tibble: 2 x 13
  expression                           min  median `itr/sec`
  <bch:expr>                       <bch:t> <bch:t>     <dbl>
1 cdf(5, 5:10, lower.tail = FALSE)   53.01µs 64.07µs    14489.
2 ppois(5, 5:10, lower.tail = FALSE)  1.28µs  1.48µs   620517.
# ... with 9 more variables: mem_alloc <bch:byt>, `gc/sec` <dbl>,
#   n_itr <int>, n_gc <dbl>, total_time <bch:tm>, result <list>,
#   memory <list>, time <list>, gc <list>
```

Examples' Figures




r(1234568, 1234567, T)
dpois(1234568, 1234567, T)
expression
1µs
10µs
100µs
1ms
10ms
time
gc
none
level0
level1


ppois(123456789, 123456789)
cdf(123456789, 123456789)
expression
1µs
10µs
100µs
1ms
10ms
time
gc
none
level0


ppois(5, 5:10, lower.tail = FALSE)
cdf(5, 5:10, lower.tail = FALSE)
expression
1µs
10µs
100µs
1ms
time
gc
none
level0