log.location

The goal of log.location is to …

Installation

You can install the released version of log.location from CRAN with:

```
install.packages("log.location")
```

And the development version from GitHub with:

```
# install.packages("devtools")
devtools::install_github("nilanjanalaha/log.location")
```

Let us simulate some Toy data

```
library(log.location)
x <- rgamma(1000, 1, 1)
```

Beran (1974) 's estimator : the fourier coefficients

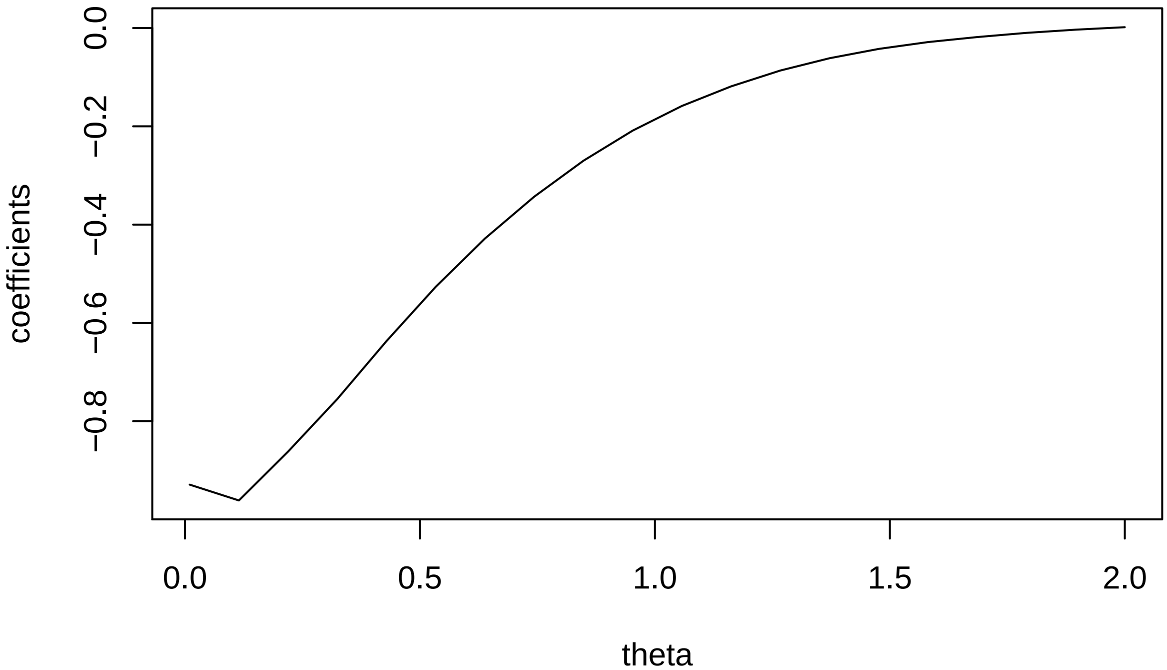
The following function computes the Fourier coefficients of the scores. Here theta is a tuning parameter which controls the precision of the estimation and "indices" is the vector of indexes corresponding to the basis functions.

```
score.coeff(x, theta=0.01, indices= c(1,2,4))
#>       real.part    im.part
#> [1,] -0.9291524  0.0808902
#> [2,] -1.1999730  0.0736837
#> [3,] -1.1712233 -0.2413274
```

If we want only real parts or only imaginary parts, we can indicate so by setting "which" to be one and two, respectively.

```
# To output only the real part of the cefficients
score.coeff(x, theta=0.01, indices= c(1,2,4), which=1)
#> [1] -0.9291524 -1.1999730 -1.1712233
```

We plot the real parts of the estimated Fourier coefficients as a function of theta.

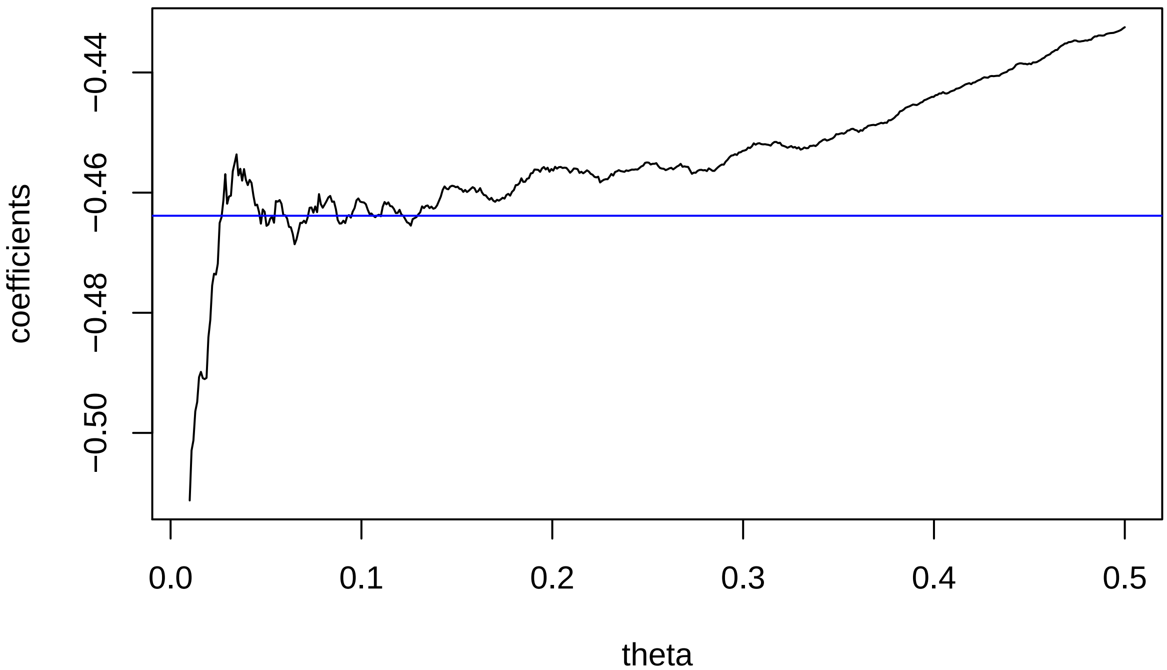


We repeat the same procedure for normal data. The true score for the normal location odel is $\Phi^{-1}(x)$ where Φ is the standard normal distribution function. We use the stats functon integrate to calculate the imaginary part of its first Fourier coefficient (k=1). The real part will be zero because standard normal density is symmetric about 0.

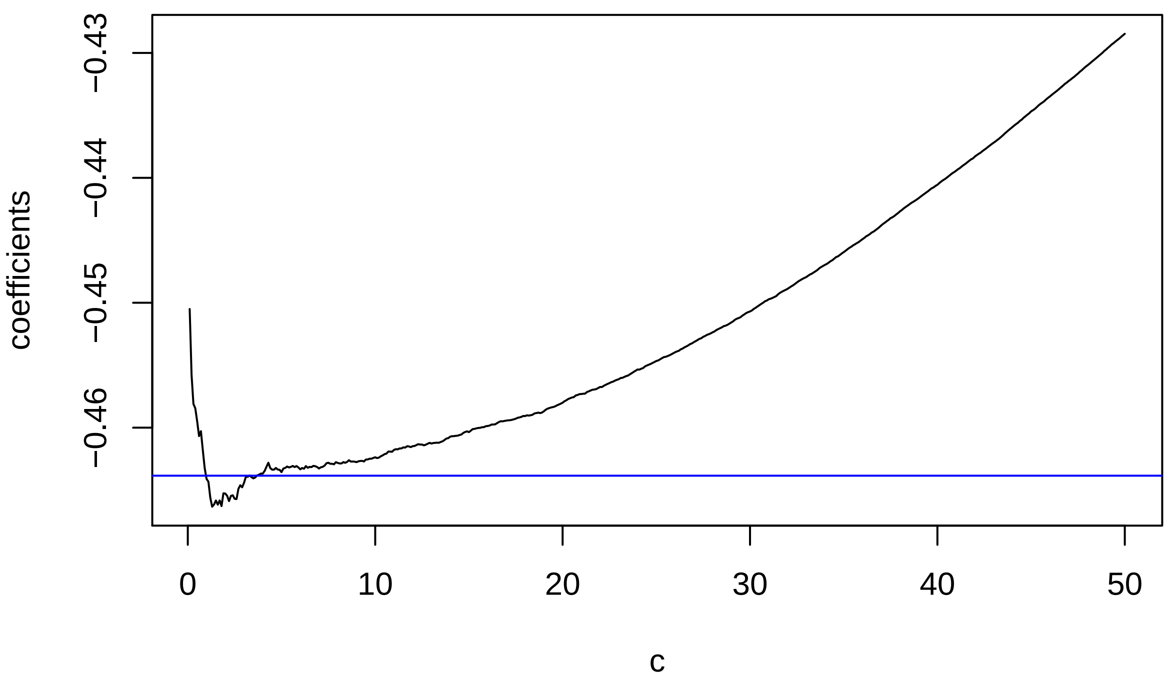
```
f <- function(x) qnorm(x)*sin(2*pi*x)
val <- stats::integrate(f, 0, 1)$value
val
#> [1] -0.4638467
```

Overlaying the true value on the plot:

```
set.seed(5)
x <- rnorm(1000)
grid.theta <- seq(0.01, 0.5, length.out= 500)
reals <- sapply(grid.theta, score.coeff, x=x, indices=1, which=2)
plot(grid.theta, reals, xlab="theta", ylab="coefficients", type='l')
abline(h=val, col='blue')
```



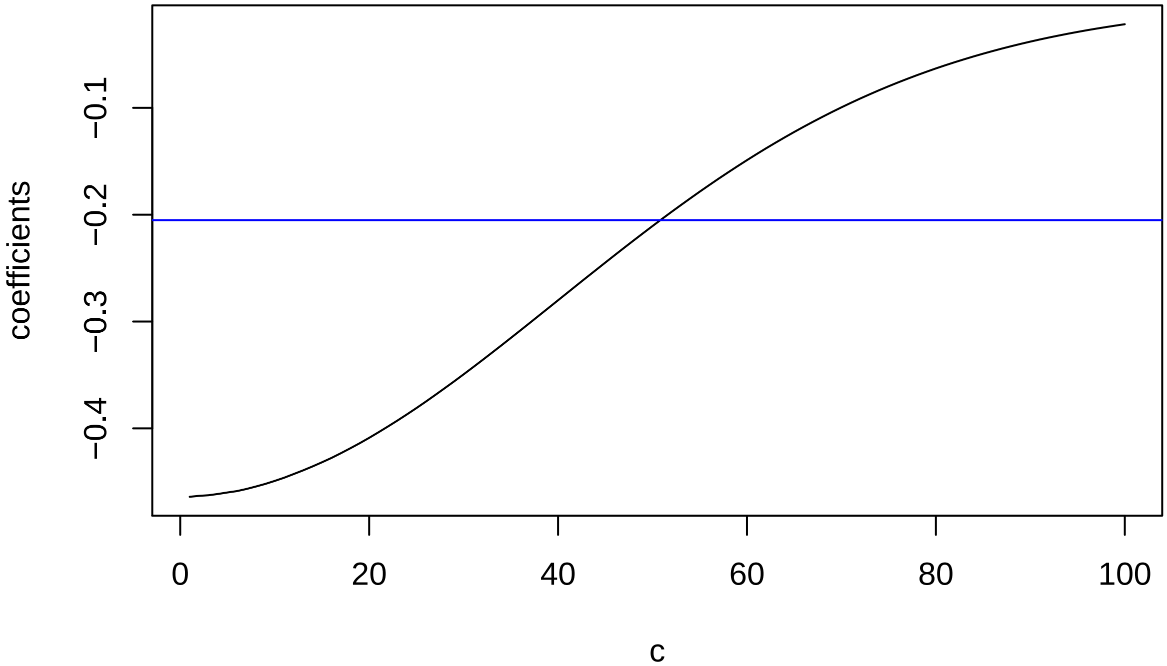
The suggested value of theta in Beran (1974) is of order $n^{-1/2}$. We set $\theta = cn^{-1/2}$. Let us plot the real part of the first Fourier coefficient as a function of c.



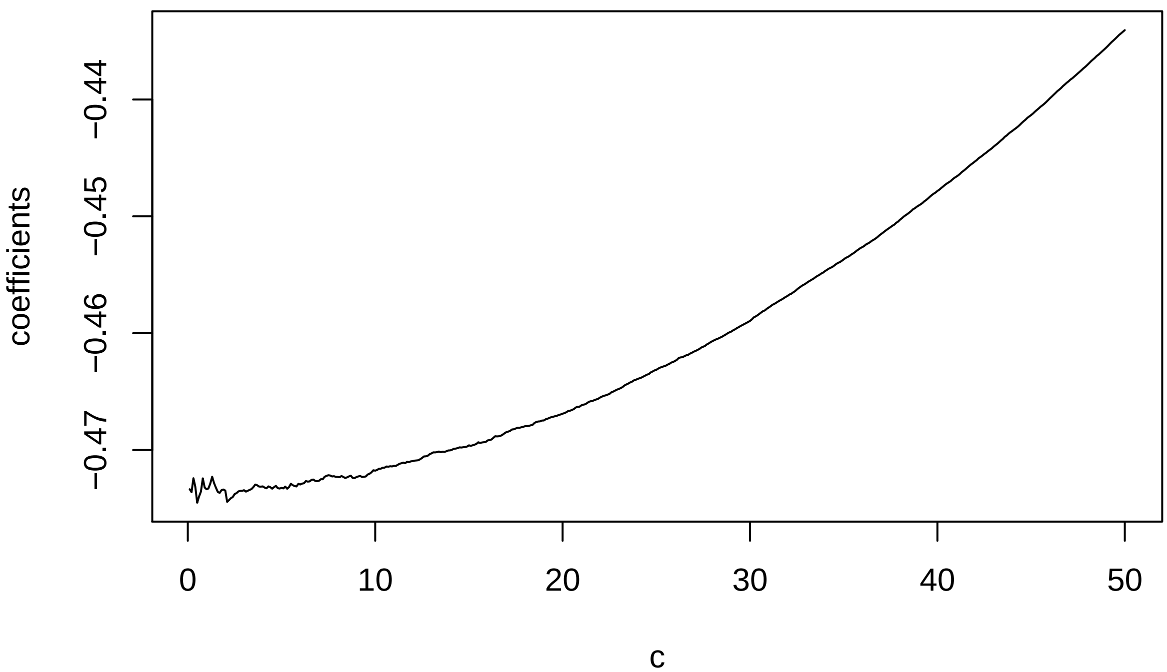
We observe that for Gaussian samples, $cn^{-1/2}$ is not a very good choice for θ. We consider k=3 now.

```
set.seed(8)
grid.theta <- seq(1, 100, by= 1)
reals <- sapply(grid.theta/sqrt(1000), score.coeff, x=x, indices=3, which=2)
plot(grid.theta, reals, xlab="c", ylab="coefficients", type='l')

f <- function(x) qnorm(x)*sin(2*3*pi*x)
val <- stats::integrate(f, 0, 1)$value
```

```r
print(val)
#> [1] -0.2052047
abline(h=val, col='blue')
```



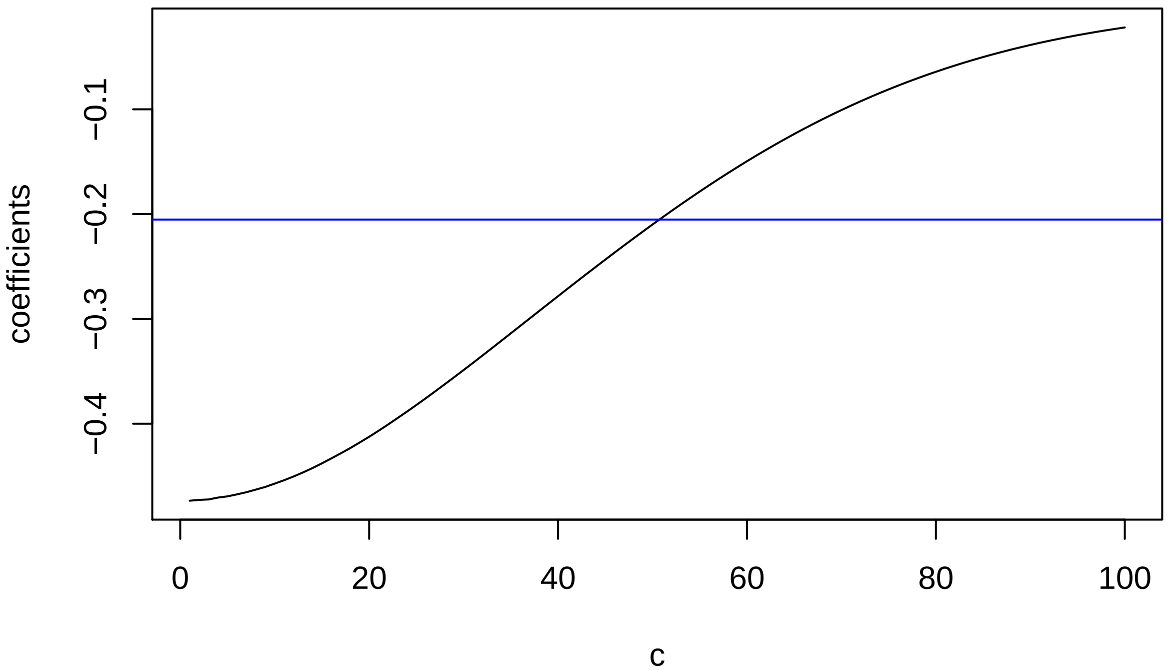
We run the same calculations by changing the seed.



Note that the previous c no longer works.

```r
set.seed(1)
grid.theta <- seq(1, 100, by= 1)
reals <- sapply(grid.theta/sqrt(1000), score.coeff, x=x, indices=3, which=2)
plot(grid.theta, reals, xlab="c", ylab="coefficients", type='l')
```

```r
f <- function(x) qnorm(x)*sin(2*3*pi*x)
val <- stats::integrate(f, 0, 1)$value
print(val)
#> [1] -0.2052047
abline(h=val, col='blue')
```



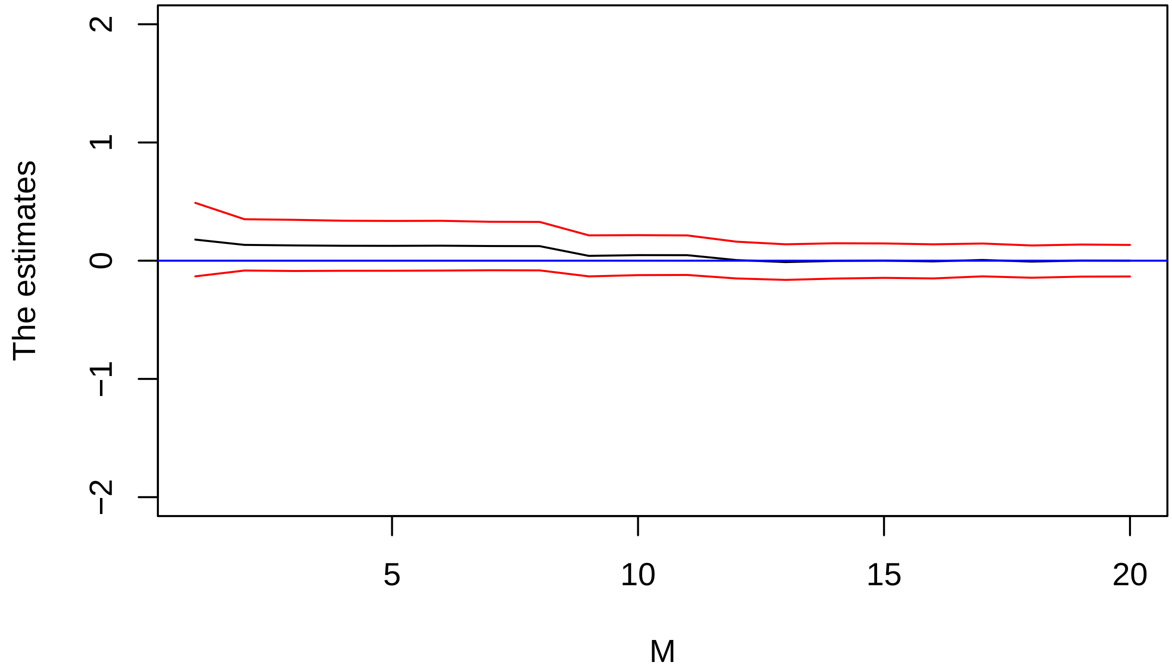
It seems that the estimates are more stable with larger values of k.

Beran (1974) 's estimator

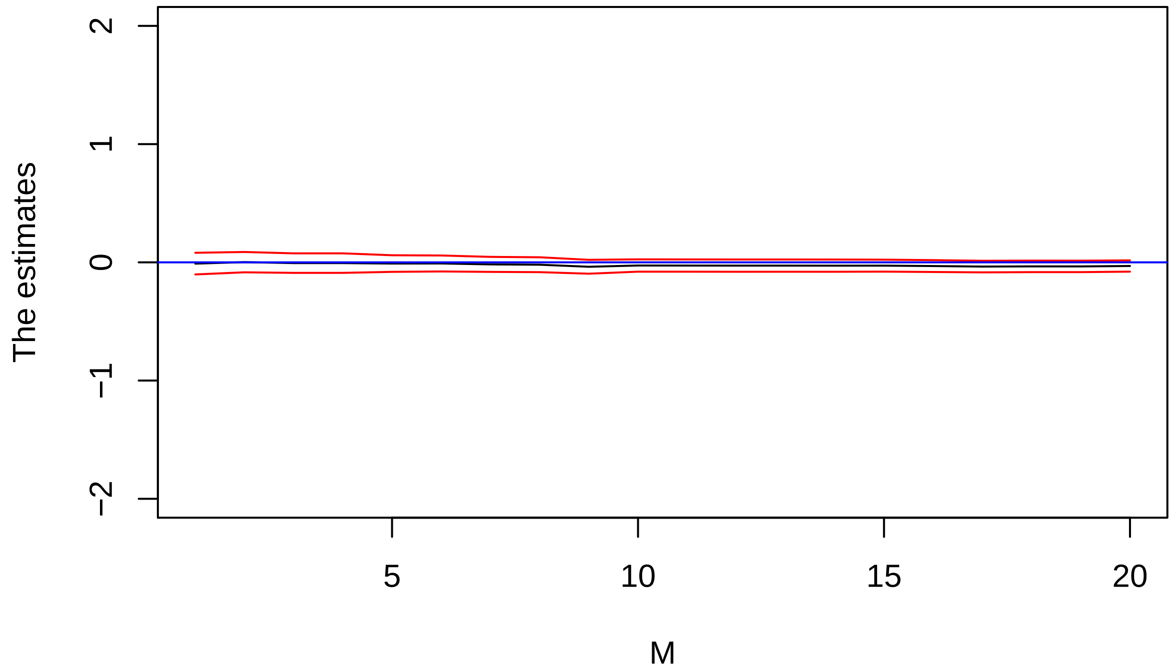
Beran (1974)'s estimator is given by the function beran.est. This function also computes $(1-\alpha)\%$ confidence intervals. If α is missing, 0.95 confidence intervals are calculated. One important tuning parameter is the number of basis functions, which is given by M. Below we plot the estimates given by Beran's estimator versus M for a standard logistic sample, whose location parameter θ is 0. The true value of θ is given by the blue line. The confidence intervals are in red.

```r
set.seed(1)
grid.M <- seq(1, 20, by= 1)
#The data
x=rlogis(100)
est <- CI.lb <- CI.ub <- numeric(length(grid.M))

#The estimates
for(M in grid.M)
{
  est[M] <- beran.est(x, M=M)$estimate
  CI.lb[M] <- beran.est(x, M=M)$CI[,1]
  CI.ub[M] <- beran.est(x, M=M)$CI[,2]
}

plot(grid.M, est, xlab="M", ylab="The estimates", type='l', ylim=c(-2,2))

#Confidence intervals are in red
```

```
lines(grid.M, CI.lb, col='red')
lines(grid.M, CI.ub, col='red')
abline(h=0, col='blue')
```



We observe that the confidence intervals are too large for n=100. We try n=1000, which still has high confidence intervals.



Stone's estimators

Stone (1975)'s estimators also give the estimator of the location θ.