Bootstrapped quantiles

The use of bootstrapping to estimate the required number of iterations for a given quantile precision when conducting MSE

28 February, 2019

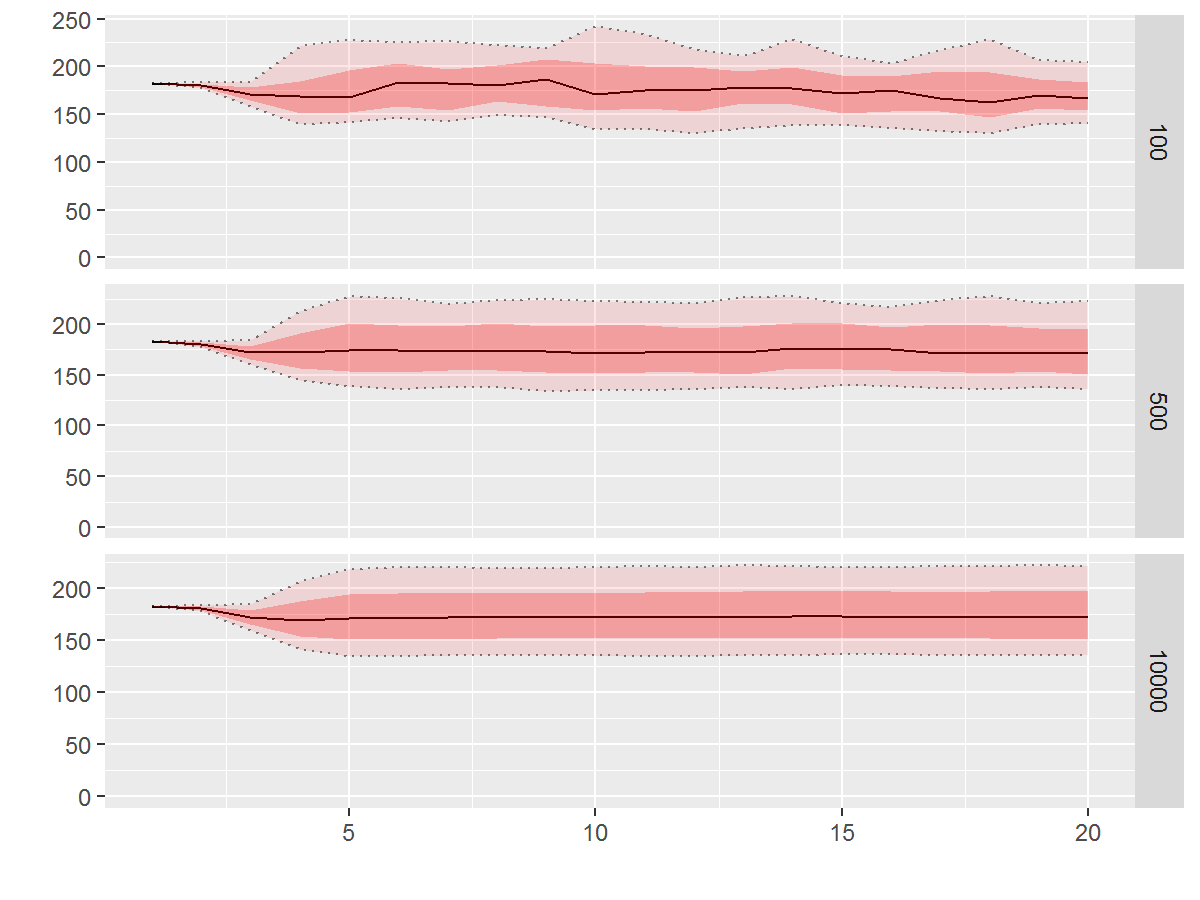
## Setup

# packages  
library(FLCore)  
library(ggplotFL)  
library(reshape2)  
# functions  
source("../R/qboot.R")  
source("../R/qbootplot.R")

## A synthetic example

The proposed methodology calculates an estimate of relative standard error for quantiles (se/mean; “semu”) of a simulation iterations used in management strategy evaluations (MSE).

load(file="../data/ssb.RData")  
L <- FLQuants("100" = ssb[,,,,,1:50], "500" = ssb[,,,,,1:500], "10000" = ssb)  
plot(L)

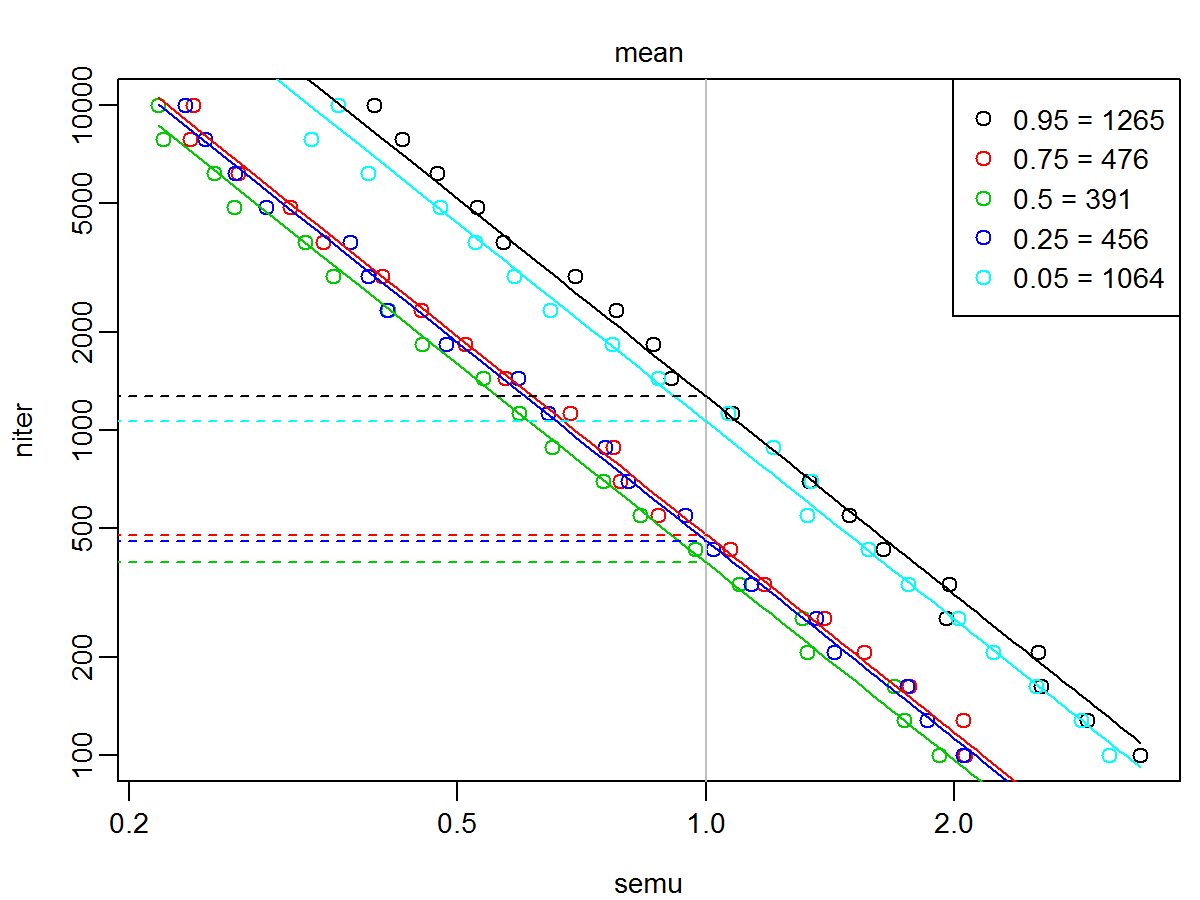


**Figure 1** Quantile distributions of spawning stock biomass for a synthetic stock by differing number of iterations. Darker shaded areas shows the 25% and 75% quantiles, with median indicated by a solid line, and 5% and 95% quantiles as dashed lines.

## Predicting number of iterations for a given error level

The following shows mean semu (across years) by defined quantile and number of iterations. This is related to ‘Prob1’ risl estimation.

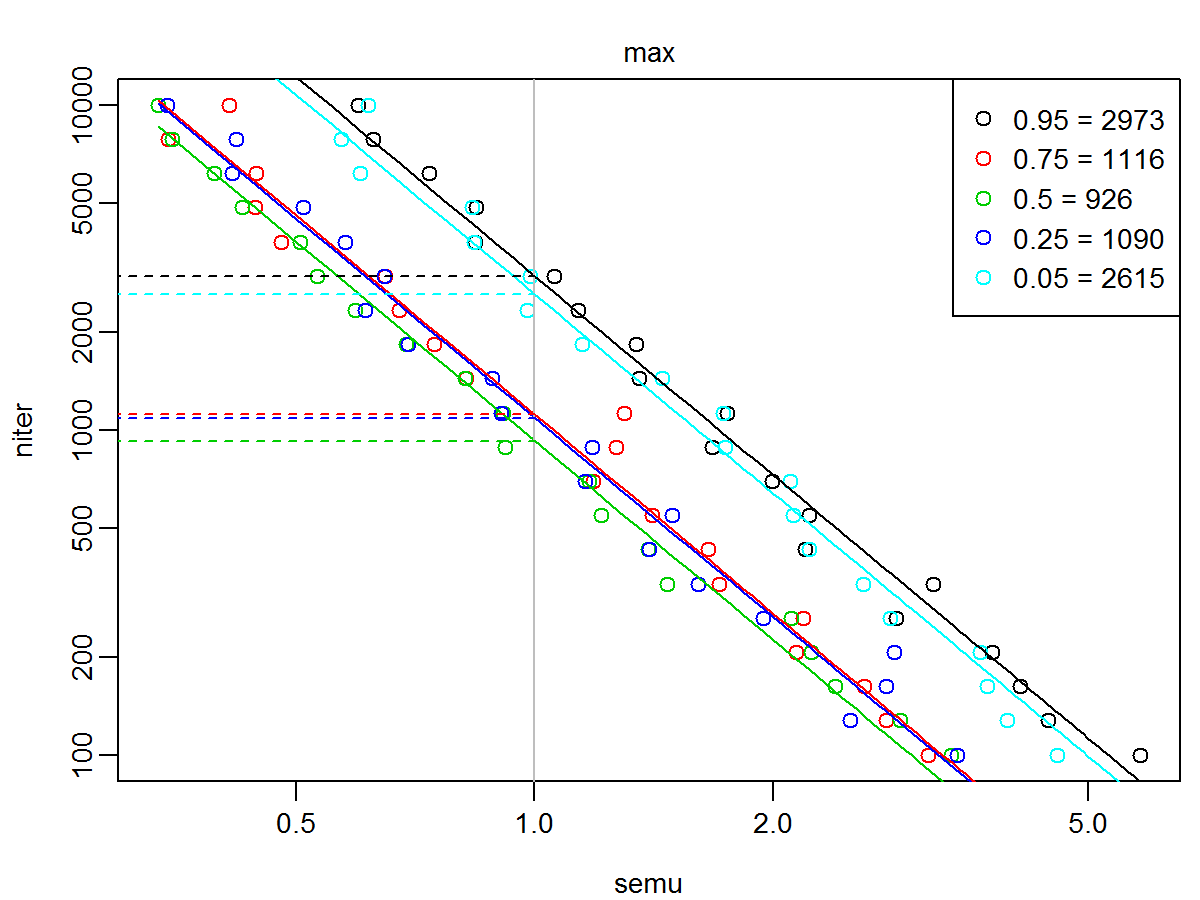
# Convert to matrix (year by iteration)  
X <- array(ssb, dim = dim(ssb)[c(2,6)])  
dimnames(X) <- dimnames(ssb)[c(2,6)] # add dim names  
  
set.seed(1)  
# run bootstrapping, model mean  
res <- qboot(X, nboot = 20, aggfun = "mean", targsemu = 1, verbose = FALSE)  
# res$nsim # predicted number of iterations needed for targsemu  
par(mar=c(3,3,2,0.5), ps=10, mgp = c(2,0.5,0))  
qbootplot(res)  
mtext("mean", side = 3, line = 0.25)



**Figure 2** Log-log plot of mean bootstrapped relative error (semu) versus number of iterations by quantile. Predicted linear regressions are shown by solid lines, and predicted number of iterations needed for the target error level are shown by dashed lines, with values in the legend.

The following shows max semu (across years) by defined quantile and number of iterations. This is related to ‘Prob3’ risl estimation.

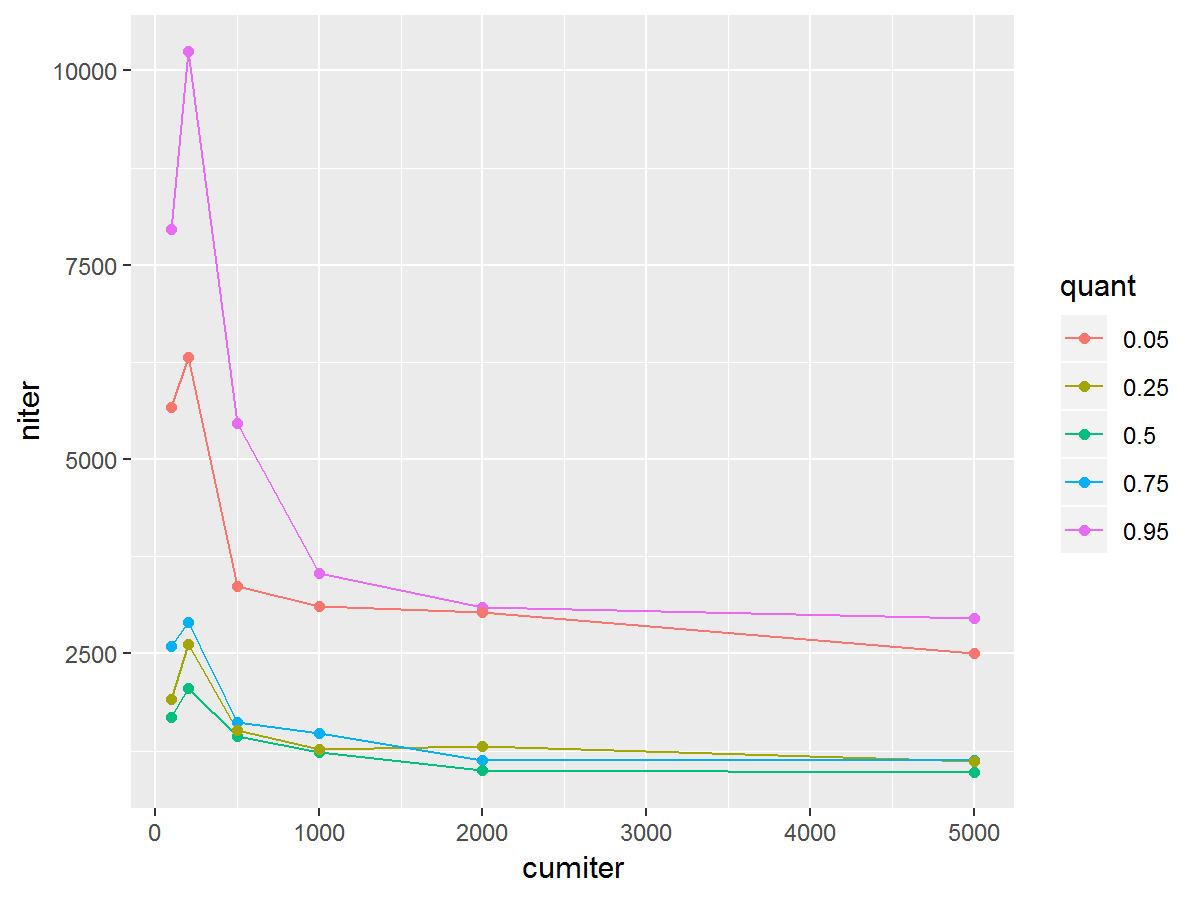
set.seed(1)  
# run bootstrapping, model max  
res <- qboot(X, nboot = 20, aggfun = "max", targsemu = 1, verbose = FALSE)  
# res$nsim # predicted number of iterations needed for targsemu  
par(mar=c(3,3,2,0.5), ps=10, mgp = c(2,0.5,0))  
qbootplot(res)  
mtext("max", side = 3, line = 0.25)



**Figure 3** Log-log plot of max bootstrapped relative error (semu) versus number of iterations by quantile. Predicted linear regressions are shown by solid lines, and predicted number of iterations needed for the target error level are shown by dashed lines, with values in the legend.

Still need to understand this…

cumiter <- c(100, 200, 500, 1000, 2000, 5000)  
RES <- vector("list", length(cumiter))  
set.seed(1)  
for(i in seq(RES)){  
 set.seed(1)  
 res <- qboot(X[,seq(cumiter[i])], nboot = 20, aggfun = "max",   
 targsemu = 1, verbose = FALSE)  
 res$nsim$cumiter <- cumiter[i]  
 RES[[i]] <- res$nsim  
}  
RES <- do.call("rbind", RES)  
  
ggplot(RES, aes(x = cumiter, y = niter, group = quant, colour = quant)) +   
 geom\_line() + geom\_point()



**Figure 4** Influence of cumulative sample size on predicted number of iterations needed for a given error level (1%).

## Software Versions

* R version 3.5.1 (2018-07-02)
* FLCore: 2.6.12
* ggplotFL: 2.6.5
* reshape2: 1.4.3
* **Compiled**: 2019-Feb-28

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