

2DAR selectivity for Stock Synthesis

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Introduction

This document demonstrates how to use the stand-alone TMB code mentioned in Xu et al. (2019) to estimate the two correlation coefficients for selectivity devs (ρ_a and ρ_t) outside Stock Synthesis. The SS files for this example code can be found [here](#).

Tuning SigmaS

The tuning algorithm is based on Equation 19 in Xu et al. (2019). Estimated selectivity devs and their standard errors can be found in the report file. They are saved as a `csv` file in this example but they can also be directly extracted in R using `r4ss`. `SigmaS_new` should be used in new the control file as the new SigmaS until it is close to the value specified in the current control file.

```
Selex_devs <- read.csv("D:/OneDrive - IATTC/Git/2DAR4ss/SS files/Selex_devs.csv", header = TRUE)
head(Selex_devs)
```

##	Num	Label	Value	Active_Cnt	Phase	Min	Max	Init	Used
## 1	203	Fishery_ARDEV_y1948_a1	-1.538020	149	5	-10	10	0	0
## 2	204	Fishery_ARDEV_y1948_a2	-1.528980	150	5	-10	10	0	0
## 3	205	Fishery_ARDEV_y1948_a3	0.516889	151	5	-10	10	0	0
## 4	206	Fishery_ARDEV_y1948_a4	-0.103545	152	5	-10	10	0	0
## 5	207	Fishery_ARDEV_y1948_a5	0.540970	153	5	-10	10	0	0
## 6	208	Fishery_ARDEV_y1948_a6	0.390612	154	5	-10	10	0	0
##	Status	Parm_StDev	Gradient	Pr_type					
## 1	act	0.607388	-1.99e-08	dev					
## 2	act	0.606005	-1.56e-07	dev					
## 3	act	0.276867	-1.25e-07	dev					
## 4	act	0.333144	-5.05e-08	dev					
## 5	act	0.291907	-1.44e-07	dev					
## 6	act	0.299511	-5.43e-08	dev					

```
SigmaS_new <-
  sqrt(sd(Selex_devs$Value) ^ 2 + sum(Selex_devs$Parm_StDev ^ 2) / nrow(Selex_devs)) # Equation 19
b <-
  1 - sum(Selex_devs$Parm_StDev ^ 2) / nrow(Selex_devs) / SigmaS_new ^ 2 # Equation 20
```

Estimating autocorrelation coefficients

The two autocorrelation coefficients can be estimated after the tuning is finished. A stand-alone TMB code is developed to estimate ρ_a and ρ_t . You need to install the R package *TMB* to compile the code on your machine.

```
library(TMB)
```

```
## Warning: package 'TMB' was built under R version 4.2.3
```

```
setwd("D:/OneDrive - IATTC/Git/2DAR4ss/User Manual/")
```

```
compile("2DAR_Selex.cpp")
```

```
## [1] 0
```

```
dyn.load("2DAR_Selex.dll")
```

```
# format Selex_devs as a matrix
```

```
Nages = 6 # 6 age bins
```

```
Nyears = 64 # 64 time steps
```

```
Selex_devs_matrix <- matrix(Selex_devs$Value, nrow = Nages)
```

```
Obj <-
```

```
  MakeADFun(
```

```
    data = list(
```

```
      "Nyears" = Nyears,
```

```
      "Nages" = Nages,
```

```
      "SDev_hat" = Selex_devs_matrix
```

```
    ),
```

```
    parameters = list(
```

```
      "rho_a" = -log(1 / 0.5 - 1),
```

```
      "rho_t" = -log(1 / 0.5 - 1),
```

```
      "ln_SigmaS" = log(0.96) # SigmaR is fixed at 0.96 based on the tuning above
```

```
    ),
```

```
    map = list(ln_SigmaS = factor(NA)), # SigmaR is not estimated here
```

```
    random = NULL
```

```
  )
```

```
## Constructing atomic invpd
```

```
Upr = rep(Inf, length(Obj$par))
```

```
Lwr = rep(-Inf, length(Obj$par))
```

```
Opt = nlminb(
```

```
  start = Obj$par,
```

```
  objective = Obj$fn,
```

```
  gradient = Obj$gr,
```

```
  upper = Upr,
```

```
  lower = Lwr
```

```
)
```

```
## outer mgc: 45.18449
```

```
## outer mgc: 16.30322
```

```
## outer mgc: 3.895717
```

```
## outer mgc: 6.698107
```

```
## outer mgc: 5.917633
## outer mgc: 0.1636427
## outer mgc: 0.1641171
## outer mgc: 0.003624227
## outer mgc: 3.462539e-06
## outer mgc: 2.078394e-08
```

```
# rho_a and rho_t are estimated to be:
exp(0pt$par) / (exp(0pt$par) + 1)
```

```
##      rho_a      rho_t
## 0.4735453 0.8123478
```

Xu, Haikun, James T. Thorson, Richard D. Methot, and Ian G. Taylor. 2019. “A New Semi-Parametric Method for Autocorrelated Age- and Time-Varying Selectivity in Age-Structured Assessment Models.” *Canadian Journal of Fisheries and Aquatic Sciences* 76 (2): 268–85. <https://doi.org/10.1139/cjfas-2017-0446>.