**10.8.8 Two-Dimensional Auto-Regressive Selectivity**

A new experimental feature added within SS v. 3.30.03.02. Earlier versions do not have this feature and hence this input is not expected. This feature allows for autocorrelation by age and/or time.

Value Label Description

0 Two-dimensional auto-regressive selectivity 0 = not used

1 = use

COND = 1 Read the following long parameter lines:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| #Fleet | Ymin | Ymax | Amin | Amax | Sigma  Amax | Use  Rho | Len(1)/  Age(2) | Phase | Before  Range | After  Range |
| 1 | 1978 | 2010 | 2 | 10 | 10 | 1 | 2 | 5 |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| #Lo | Hi | Init | Prior | Prior SD | Type | Phase | Label |
| 0 | 4 | 1 | 1 | 0.10 | 6 | -4 | #Sigma selex |
| -1 | 1 | 0 | 0 | 0.10 | 6 | -4 | #Rho year |
| -1 | 1 | 0 | 0 | 0.10 | 6 | -4 | #Rho age |

* **How is the two-dimensional autoregressive selectivity parameterized in SS?**

When the two-dimensional autoregressive selectivity feature in turned on for a fleet, the selectivity of which is calculated as a product of the assumed selectivity pattern and a non-parametric deviation term away from this assumed pattern:

where is specified in the corresponding age/length selex types section and it can be either parametric (recommended) or non-parametric (including any of the existing selectivity options in Stock Synthesis); is simulated as a two-dimensional first-order autoregressive (2D AR1) process:

where is the two-dimensional deviation matrix and is the covariance matrix for the 2D AR1 process. More specifically, quantifies the variance in selectivity deviations and is equal to the kronecker product () of the two correlation matrices for the among-age and among-year AR(1) processes:

where  and are the among-age and among-year AR(1) coefficients, respectively. When both of them are zero, and are two identity matrices and their Kronecker product, , is also an identity matrix. In this case, selectivity deviations are essentially identical and mutually independent:

* **How should the two-dimensional autoregressive selectivity feature be used in SS?**

First, fix the two AR1 coefficients ( and ) at 0 and tune iteratively to match the relationship:

The minimal and maximal ages/lengths and years for the 2D AR1 process can be freely specified by users in the control file. However, we recommend specifying the minimal and maximal ages and years to cover the relatively “data-rich” age/length and year ranges only. Particularly, we introduce

as a measure of how rich the composition data is regarding estimating selectivity deviations. We also recommend using the Dirichlet-Multinomial method to “weight” the corresponding composition data while is interactively tuned in this step.

Second, fix at the value iteratively tuned in the previous step and estimate . Plot both Pearson residuals and out on the age-year surface to check their 2D distributions. If their distributions seems to be not random but rather be autocorrelated (deviation estimates have the same sign several ages and/or years in a row), users should consider estimating and then including the autocorrelations in .

Third, extract the estimated selectivity deviation samples from the previous step for estimating and externally by fitting the samples to a stand-alone model written in TMB. In this model, both and are bounded between 0 and 1 via applying a logic transformation. If at least one of the two AR1 coefficients are notably different from 0, Stock Synthesis should be run one more time by fixing the two AR1 coefficients at their values externally estimated from deviation samples. The Pearson residuals and from this run are expected to distribute more randomly as the autocorrelations in selectivity deviations can be at least partially included in the 2D AR1 process.