This description will be considered for inclusion in the SS user manual.

The bootstrapping procedure within SS is done via the following steps:

* Expected values of all input data are calculated (these are also used in the likelihood which compares observed to expected values for all data). The calculation of these expected values is described in detail under the "Observation Model" section of the appendix to Methot and Wetzel (2013).
* Parametric bootstrap data are calculated for each observation by sampling from a probability distribution corresponding to the likelihood for that data type using the expected values noted above. Examples of how this happens include the following:
  + Indices of abundance are sampled from the distribution used in the estimation model (as set in the “Errtype” column of the index configuration, most commonly lognormal but could be normal or T-distribution). The variability of the distribution from which the random sample is drawn is based on the combination of the input uncertainty and any estimated "Extra SD" parameter and any "add\_to\_survey\_CV" value included under the input variance adjustments factors.
  + Length and age compositions are sampled from multinomial distributions with expected proportions in each bin based on the expected values and sample size equal to the adjusted input sample size (input sample size multiplied by any inputs for "mult\_by\_lencomp\_N" or "mult\_by\_agecomp\_N" under the input variance adjustments factors).
  + Discard data (fractions or absolute amounts) are generated from the chosen distribution (T-distribution, normal, log-normal, truncated-normal)
  + Tagging data is generated using a negative binomial distribution to get the total number of recaptures for each tag group and a multinomial distribution to allocate those recaptures among fleets.

Given this, there are some assumptions implicit in the bootstrapping procedure (as implemented as of 3.30.14) that users should be aware of:

* This procedure is strictly an observation error approach (i.e., process error in recruitment or any other time-varying parameter is not added). For simulation analyses, a common approach has been to input a new time series of recruitment deviations for each bootstrap data set.
* The sample size for conditional age-at-length data matches the inputs for each length bin. If stratified sampling is used, this may be appropriate, but if the ages represent a random subset of the selected population, this may result in less variability than if the associated length distribution were resampled.
* Currently, the aging error matrix is multiplied by the expected distribution of proportions at age, while the more correct order of operations would be to sample true ages, and then sample the observed age including aging error (it is possible these are mathematically identical).

**Some publications that have used the SS bootstrap procedure)**

* Garrison et al. (2011). Can data collected from marine protected areas improve estimates of life-history parameters? <https://doi.org/10.1139/f2011-073>
* Lee et al. (2019). On the use of conditional age at length data as a likelihood component in integrated population dynamics models. <https://doi.org/10.1016/j.fishres.2019.04.007>
* Methot and Taylor (2011). Adjusting for bias due to variability of estimated recruitments in fishery assessment models. <https://doi.org/10.1139/f2011-092>