Delay-Difference models make three major assumptions concerning 1) growth, 2) harvesting (selectivity), and 3) survival.

Assumption1:

Growth in mean body weight at age is described by the linear equation:



Where *a* is age, and α and ρ are fitted constants over the ages *a = k, k+1,* …, and all other ages vulnerable to fishing

Assumption 2:

All fish aged *k* and older are equally vulnerable to fishing = knife-edged selectivity at age *k*.

Assumption 3:

All fish aged *k* and older have the same annual natural mortality rate.

The annual recruitment rate *Rt* is the number of fish reaching age *k* (or, in fact, reaching *wk*). Generally assumed to be some function of spawning biomass in year *t – k + 1*, where the spawning biomass is assumed to be the sum of the biomass of all ages *k* and older, after harvest in year *t*.



Which can also be written as the sum of previously recruited fish and the newly recruited numbers times the mean weight of newly recruited fish:



Every  in the summation term can be written as



That is, the survivors of the previous year. And each of the  can be written as



If we substitute these terms into the biomass definition we get:



Where the sums are over ages *k+1* and older (*k* is dealt with in the recruitment term). Summing over ages *k+1* and older is the same as the total numbers and total biomass in year *t-1*, thus we can dispose of the age subscript:



This equation, along with:



Can be used to replace a complete age-structured model, which is very much simpler, although at the cost of those three assumptions. These two equations can be combined to generate a single delay-difference equation for biomass, which means numbers-at-age can be ignored. Note, from the equation for numbers :



In its turn, from the equation for biomass :



Substituting this into we obtain:



Which can be substituted into to give:



This implies that the biomass in year *t* can be predicted from three terms concerning past biomass levels and past recruitment levels.

Read pages 331 – 335 in Hilborn and Walter.