Chapter 6
POST-STRATIFICATION

The MRFSS survey design is based on stratified random sampling, with stratification on the basis of year, state, wave, and mode of fishing. Stratified sampling will usually increase the precision of estimates and often results in lower variance estimates within each stratum. The total variance for all combined strata will also usually be lower than for simple random sampling. The designations of strata in stratified random sampling are based on prior knowledge of the population, with the heterogenous sampling frame being divided into relatively homogenous strata. Due to the inability to anticipate all data requirements, the "default" stratification used in the MRFSS may not be useful for all analyses and post-stratification may be necessary.

The MRFSS data can be post-stratified, which is stratification after selection of the sample. Post-stratification may be necessary for several reasons, including: 1) stratification variables are unknown prior to sampling; 2) estimates may be required for management regions, as opposed to state-specific data; and 3) post-stratification can reduce the variance of estimates if the post-stratification variables are effective. Post-stratification is not quite as efficient in reducing variance as stratification performed at the time of sampling.

Computational Steps:

1.   Redefine the strata boundaries from the original year/state/wave/mode strata. For example, the MRFSS survey design is not stratified by area fished since this variable is unknown until after the angler has been interviewed. The MRFSS data is post-stratified by three fishing areas; inland, ocean less than 3 miles, and ocean greater than three miles. Estimates of catch and fishing effort are then re-calculated for each year/state/wave/mode/area stratum.

2.   Distribute the total estimated number of trips for each original year/state/wave/mode stratum to the new post-stratified year/state/wave/mode/area strata using proportional allocation (see Section II.A.2. for specific calculations).

3.   Recalculate CPUE statistics for each year/state/wave/mode/area stratum following the estimation procedures in Section II.B.1.

4.   Multiply the CPUE times the trip estimates for each year/state/wave/mode/area stratum to calculate catch estimates.

5.   Calculation of variance for catch and effort statistics for the redefined strata boundaries are more complicated, but similar in the calculation procedures.

Post-stratification is demonstrated in the following example using Maryland, Wave 4, 1992 MRFSS data (Table 7). MRFSS data is typically post-stratified by three broad fishing area categories: inland waters, ocean waters less than or equal to three miles, and ocean waters greater than three miles. In the following example, post-stratification is performed for the MRFSS data on the basis of four areas of fishing: inland, ocean <=3 miles, ocean >3 miles, and Chesapeake Bay. In the present MRFSS post-stratification scheme, the Chesapeake Bay data is included in the inland waters fishing area. Therefore, the total trip estimates will be re-allocated from the inland water category to the Chesapeake Bay category based on proportional allocation.

The total estimated number of fishing trips in the shore mode is 139,549 trips, with 23,075 trips fished in ocean waters less than or equal to three miles and 116,474 fishing trips in inland waters (Table 6). Post-stratifying the data to separate out the Chesapeake Bay will proportionally decrease the number of fishing trips in inland waters by the percentage of the total fishing effort in the Chesapeake Bay. Proportional allocation of shore mode fishing trips to the Chesapeake Bay produces estimates of 18,680 fishing trips in inland waters, and 97,794 trips in the Chesapeake Bay, with the Chesapeake Bay having approximately 84% of the total fishing trips for inland waters (Table 7). The estimated number of trips for ocean waters greater than three miles (23,075) and the total estimated number of trips for the year/state/wave/mode strata (139,549) are unaffected by this proportional allocation method. Similar calculations are performed for the charter/party boat and private/rental boat modes of fishing, with the Chesapeake Bay accounting for 92% and 66% of all inland fishing trips, respectively (Table).

Recalculation of catch-per-unit effort and total catch is then performed for Type A caught fish, Type B1 harvested fish, and Type B2 released fish for each year/state/wave/mode/area stratum using the methods described in Section II.B.1.. Estimates of total numbers of fish for Maryland, Wave 4, 1992 by mode and area of fishing are shown in Table 6 for the three fishing areas and in Table 7 when post-stratifying for the separation of the Chesapeake Bay.

Poststratification programs in Statistical Analysis Software (SAS) language are available from the National Marine Fisheries Service upon request.

Table 6.   1993 MRFSS trip and summer flounder catch estimates for Maryland, Wave 4.
Estimates are stratified by mode of fishing (shore, party/charter boat, and
private/rental boat) and area fished (ocean <=3 miles, ocean > 3 miles and ocean
inland)

Wave of Data	Mode of Fishing	Collapsed Area of Fishing	Number of Trips in Area Fished	Estimated Fish Claimed	Estimated Fish Harvested	Estimated Fish Released
July-August	Shore	Ocean (<=3mi)	4,900	2,100	0	0
		Ocean (inland)	137,207	0	0	0
		Wave/Mode Total	142,107	2,100	0	0
	Party/ Charter	Ocean (>3mi)	31.719	0	0	0
		Ocean (inland)	58,632	3,575	0	2,884
		Wave/Mode total	90,352	3,575	0	2,884
	Private/ Rental	Ocean (<=3mi)	0	0	0	0
		Ocean (>3mi)	25,276	1,099	0	7,434
		Ocean (inland)	614,058	139,493	16,355	301,825
		Wave/Mode Total	639,334	140,592	16,355	309,259

Table 7.   1993 MRFSS trip and summer flounder catch estimates for Maryland, Wave 4.
              Estimates are post-stratified by mode of fishing (shore, party/charter boat, and
              private/rental boat) and area fished (ocean <=3 miles, ocean inland, ocean >3 miles
              and Chesapeake Bay)

Wave of Data	Mode of Fishing	Collapsed Area of Fishing	Number of Trips in Area Fished	Estimated Fish Claimed	Estimated Fish Harvested	Estimated Fish Released
July-August	Shore	Ocean (<=3mi)	4,900	2,100	0	0
		Ocean (inland)	3,500	0	0	0
		Chesapeake Bay	133,707			
		Wave/Mode Total	142,107	2,100	0	0
	Party/ Charter	Ocean (>3mi)	31.719	0	0	0
		Ocean (inland)	0	0	0	0
		Chesapeake Bay	58,632	3,575	0	2,884
		Wave/Mode total	90,352	3,575	0	2,884
	Private/ Rental	Ocean (<=3mi)	0	0	0	0
		Ocean (>3mi)	25,276	1,099	0	7,434
		Ocean (inland)	86,236	43,118	10,408	206,668
		Chesapeake Bay	527,822	96,360	5,947	95,157
		Wave/Mode Total	639,334	140,592	16,355	309,259