Homework Problem Set 16: Mark-Recapture Designs

Instructions: The following problems will test your understanding of the use of mark-recapture designs to estimate population size. When computing margins of error use a "multiplier" of $z = 1.96$ for an approximate 95% confidence level. The answers are given within each problem. You are asked to confirm these answers by computing them yourself.

1. Wildlife biologists used a mark-recapture design to estimate the size of the bobwhite quail population in part of Florida. Initially they trapped, tagged, and released 320 quail. Their second sample of 515 quail included 90 tagged quail. The data can be summarized in the following table.

	Second Sample		
First Sample	included	excluded	Total
included	90	230	320
excluded	425	?	?
Total	515	?	N

   Confirm that the estimate of the population size is approximately 1831 quail. Also confirm that the margin of error would be approximately 291 if the researchers had used *direct sampling*, and approximately 342 if the researchers had used *inverse sampling*.

2. A student at the University of Idaho decides to estimate the number of undergraduate students at the University of Idaho. She recruits two popular students at the university, Beth and Wendy, who both have many fellow students as friends on Facebook. Beth has 300 friends on Facebook who are undergraduate University of Idaho students. Wendy has 400 friends on Facebook who are undergraduate University of Idaho students. When comparing the two sets of friends the she finds that these two students have 15 friends in common who are students at the University of Idaho. The data can be summarized in the following table.

	Wendy's Friends List		
Beth's Friends List	included	excluded	Total
included	15	285	300
excluded	385	?	?
Total	400	?	N

   Confirm that the estimate of the number of students at the University of Idaho is 8000 students.

3. Suppose I wanted to estimate the number of jellybeans in a jar. From this jar I grab a handful of 100 jellybeans, paint each of these jellybeans black, and then replace them back into the jar. After shaking the jar I grab another handful of 200 jellybeans and notice that 25 of these jellybeans are painted black. Confirm that the estimate of the number of jellybeans in the jar is 800 jellybeans, and that the margin of error is approximately 254 if I had used *direct sampling*, giving a confidence interval for the number of jellybeans in the jar of 800 ± 254 jellybeans.

4. An early real example of mark-recapture methodology was a study from 1949 that estimated the number of births in an area near Calcutta, India. Like the Hobbit example from class and the Facebook example above, this study used lists of individuals rather than actually marking people. The researchers had access to two lists of births — lists A and B (one of the lists was from the Maternity and Child Welfare

Department, and the other was complied by the All-India Institute of Hygiene and Public Health). Neither list contained all births. List A recorded 1504 births, and list B recorded 1535 births. When the two lists were compared (births were recorded by name so common records could be identified), it was observed that there were 794 births that were on *both* lists. The data can be summarized in a table tabulating the number of actual births that were present or absent from each list.

	List B		
List A	included	excluded	Total
included	794	710	1504
excluded	741	?	?
Total	1535	?	N

Confirm that the estimate of the number of births is approximately 2908 births.