Hypothetical example illustrating how zero values (which lead to biased-low contributions to adjusted fatality, Ma) are offset by nonzero values (which are biased-high contributions to adjusted fatality).

By Julie Yee, March 25, 2008

For simplicity in this example, consider a low and constant R and a perfect 1:

scavenger and detection parameters	
R =	0.1
p =	1
R*p =	0.1

Consider this hypothetical truth:

frequency of turbines	actual fatalities at each of these turbines	total fatalities
100	0	0
200	1	200
100	2	200
Total		**400**

All 100 turbines that had zero actual fatalities will show a count of zero (ignoring for the moment the possibility of a bird crippled by another turbine moving onto the field of an "innocent" turbine). On average, (1-0.1)=90% of the 200 turbines that had 1 fatality, i.e. 180 turbines, will also show counts of zero. Similarly, on average, (1-0.1)*(1-0.1)=81% of the 100 turbines, i.e. 81 turbines, that had 2 fatalities, i.e. 81 turbines, will also show counts of zero. So, we expect 100+180+81=361 turbines to have zero counts, and these turbines contribute a net sum of 0/0.1=0 to the adjusted mortality estimate. Clearly this is a negative source of bias because the sum of actual fatalities at these 361 turbines is 100*0+180*1+81*2=342.

However, the negative bias is always offset by the positive bias at the other turbines which had true counts. On average, 0.1=10% of the 200 turbines that had 1 fatality, i.e. 20 turbines will show its true count (one). Similarly, on average, 0.1*0.1=1% of the 100 turbines that had 2 fatalities, i.e. 1 turbine, will show its true count (two). The adjusted count for these turbines is 1/0.1=10 or 2/0.1=20, which are clearly positive sources of biases.

There is a third type of count which falls between zero and truth. This occurs for turbines that had two or more actual fatalities, where the counted fatalities is greater than zero but less than truth. This may contribute a negative bias, positive bias, or no bias at all. Whatever the case may be, it always contributes an adjustment leading to an overall unbiased estimate of the total. In this example, on average, 2*0.1*(1-0.1)=18% of the 100 turbines that had 2 fatalities will show a count of one. The adjusted count for these turbines is 1/0.1=10.

frequency of turbines	actual fatalities	counted fatality (M_u)	adjusted fatality (M_a)	Total adjusted fatalities (M_a)
100	0	0	0	0
180	1	0	0	0
20	1	1	10	200
81	2	0	0	0
18	2	1	10	180
1	2	2	20	20
Total				**400**

Notice that the observed data consists of 361 turbines with a count of 0, 38 turbines with a count of 1, and 1 turbine with a count of 2. The sum of the adjusted estimate of fatalities is 400. On average, the adjustment leads to truth.

Play with other examples by changing the values in the yellow cells