there are 3 defects left in the product, or 12–9=3.

To calculate the inspection yields, divide the number of major defects each engineer found by the estimated total defects in the product. In the Table C.3 example, the total estimate was 12 defects, and engineer A found 7. Thus, A's yield is 100*7/12 = 58.3%. Similarly, B's yield is 41.7% Because the total inspection found 9 defects, the estimated inspection yield is 100*9/12 = 75%.

To find the total inspection time, multiply the meeting time by the number of engineers in the meeting, add the preparation time for all the engineers, and divide this number by 60 to get the inspection hours. For this example, there were three engineers in the meeting (the developer plus two reviewers), so total meeting time was 43*3=129 minutes. The total preparation time for engineers A and B is shown on the inspection form as 153 minutes, so the total inspection time was 282 minutes, or 4.7 hours.

A Three-engineer Estimating Example

For an inspection with three or more engineers, the method is the same except that it has an additional step. As shown in Table C.4, you enter the data as before. Now, however, you must decide which engineer to treat as engineer A. You then combine the data for all the other engineers and treat that combination as engineer B.

Table C.3 Two-Engineer Inspection Report Example

Name		Date	
Team		Instructor	
Part/Level		Cycle	
Moderator		Owner	

Engineer Data

Name	Defects[1]		Preparation Data			Est. Yield
	Major	Minor	Size	Time	Rate	
A	7	3	380	85	268	58.3
B	5	4	380	68	335	41.7
Totals:	12	7	760	153	298	75.0

Defect Data

No.	Defect Description	Defects		Engineers (finding major defects)					
		Maj	Min					A	B
1	} =>)	1							1
9	, => ;	1						1	
12	Convert => Converter	1						1	
13	Test not declared	1						1	
19	N := 10000	1						1	1
29	>=	1						1	1
31	Begin	1						1	1
37	Flag := true	1							1
41	Misspelling	1						1	
Totals		9						7	5
Unique Defects								4	2

Inspection Summary		**Product Size:**	380	**Size Measure:**	LOC
Total Defects for A:	7	**Total Defects for B:**	5	**C (# common):**	3
Total Defects (AB/C):	12	**Number Found (A+B–C):**	9	**Number Left:**	3
Meeting Time:	43	**Total Inspection Hours:**	4.7	**Overall Rate:**	80.9

[1] Major defects either change the program source code or would ultimately cause a source code change if not fixed in time; all other defects are considered minor.

To do this, look for the engineer who found the most unique defects—that is, find the engineer who found the greatest number of defects that no one else found. Then put that engineer's data in column A. In this example, engineer DB is the only one who found the defect on line 12. Every other defect he found was also found by one or both of the other engineers. The number of his unique defects is thus 1. Similarly, engineer BP is the only one who found the defects on lines 15 and 35, and engineer PA found no unique defects. Because engineer BP found the most unique defects, copy his data into the A column. Next, combine the data for the other two engineers and treat the combination as engineer B. Here, in the B column, put a 1 for every defect that either DB or PA or both of them found.

Now make the estimate exactly as before. As you can see from Table C.4, this gives

A = 9

B = 9

C = 7

So the total estimated defects are A*B/C = 9*9/7 = 11.57 = 12, and the number found is 9 + 9 – 7 = 11. So one defect is left to find.

From this example, you can see that adding one engineer to the inspection team increased the inspection yield from 75% in the example in Table C.3 to 91.7% in the Table C.4 example. The improvement is so great because the added engineer, BP, had a personal yield of more than 70%.

Cautions

As with any statistical method, the capture-recapture approach involves a number of assumptions. First, there must be an equal chance of finding every defect. This would certainly not be the case if the engineers decided to specialize on different product areas or to use different review methods. Similarly, if no one looked for an entire category of defect, none of these defects would be found even though the estimate might show that no defects remained in the product. This would be a little like using worms to catch perch and expecting the estimate of the fish in the lake to include the bass and trout (which you won't likely catch with worms).

The second caution is that the numbers of defects found must be reasonably large. As is true of all statistical methods, the capture-recapture approach deals with probabilities. Thus, accuracy generally requires that the numbers of items involved be reasonably large. Also, the number of unique defects found by engineers A and B must be reasonably large. If this number is 0 or 1, the method will not work, or the estimating error will be quite large.

In small, high-quality programs, the number of defects that you find will probably be small. I have found, however, that if the numbers A and B are both 5 or larger and if *A–C* and *B–C* are both greater than or equal to 2, the method should give a reasonable yield estimate. Even then, expect errors of around 10% or a little more. In general, the higher the engineers' yields, the more accurate the estimate is likely to be. Remember, however, that these estimates should never be used as absolutes. They are useful only as general guidelines on the quality of the inspection.

Table C.4 Three-Engineer Inspection Report Example