

EE 162

Random Processes for Communication and Signal Processing

Fall 2004

<http://ee162.caltech.edu/>

1. *How to Ask an Embarrassing Question*
(A Warm-up Question Requiring only Arithmetic)

Suppose you are assigned the following task: You are to determine the fraction of the population that practices a certain private act (use your imagination). If you could gather a large number of randomly selected people together into a large room or auditorium, you could then simply have each person fill out an anonymous questionnaire. Since no one could be identified from such a form, people would presumably tell the truth. But suppose this is not possible, and your task is to be accomplished over time through individual encounters. It is clear that you cannot just ask people, because they may or may not answer truthfully when confronted with the embarrassing question (EQ); you can't even use the form, because now no one "gets lost in the crowd." So how can you gather accurate data? You can use the following clever technique.

You, or a member of your staff, give each person in the survey a fair coin as he or she arrives at your office. You then ask the individual to briefly step into a private room. There, all alone, the person flips the coin. If it shows tails, then the person writes the answer (YES or NO) to the EQ on a piece of paper. If, on the other hand, the coin shows heads, then the subject flips the coin a second time and writes the answer (YES or NO) to the non-EQ, "Did the coin show heads on the second toss?" After that, the person returns to your office and gives you the paper.

Now, each piece of paper will have a single YES or NO on it, and eventually you'll have, let's say, 10,000 such pieces of paper. You do not know which question each particular person was actually answering, and yet you can now calculate the answer to your question: What percentage of the population (or, at least, of the people in the survey) practices the "private act"? Explain why this is so, and illustrate your analysis by calculating the percentage of people that practice the private act if 6,230 write YES and 3,770 write NO.

Reference

Stanely L. Warner, "Randomized response: A survey technique for eliminating evasive answer bias," *Journal of the American Statistical Association*, vol. 60, pp. 63-69, March 1965.