Tutorial Questions Week 4

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1. Joan has two children. Assume that each time someone has a child, the probability of having a girl is the same as the probability of having a boy (and that whether the mother had a boy or a girl the first time round does not affect the probabilities involved the second time around).

(a) If Joan tells you that at least one of her children is a girl,
then what is the probability that her other child is a girl too?

(b) If instead Joan tells you that her eldest child is a girl,
then what is the probability that her other child is also a girl?

2. The Australian Powerball lottery draws six regular numbers from one pool of 40, with the Powerball drawn from a separate pool of 20 numbers. To win Division 1 requires a person to select all seven numbers drawn.

(a) What is the probability you are a Division 1 winner any one time you play? (Be sure to make explicit what assumptions you are making regarding the draw of the regular numbers and the Powerball draw.)

(b) Given the answer you calculated for part (a), if you were to play Powerball once a week, how often (in years) would you expect to be a Division 1 winner?

3. John tests for an incurable disease and obtains a positive test result. The proportion of the population with the disease is 0.01% (that is, 1 person in 10,000). The test has a failure rate of 1% in reporting "false positives" as well as a failure rate of 1% in reporting "false negatives." Recall a false positive is a test result stating the person has the disease when in fact they do not. A false negative on the other hand is a test result stating the person does not have the disease when in fact they do.

(*a*) What is the probability that John has the disease given his test result?

(*b*) What would be the probability he has the disease if John discovers that for his particular demographic group the incidence of the disease is 0.1% (that is, 1 person in 1,000)?

(*c*) What would be the probability he has the disease if John discovers that after considering all his personal circumstances, the *ex ante* probability that he has the disease is still 0.1% (that is, 1 person in 1,000), but the test has a failure rate of only 0.1% in reporting both false positives and false negatives?

4. Suppose Mr Chump is shopping for a private jet and is deciding between a jet with one engine and another with two engines. Let p denote the probability that an engine fails during any one flight. A "catastrophic engine failure" is an engine failure that makes the plane unable to fly.

(*a*) What is the probability of a catastrophic engine failure during any one flight with the one engine plane?

(*b*) Suppose the two engine plane cannot fly with only one functioning engine. Assuming that engine failures are independent events, what is the probability of a catastrophic engine failure during any one flight with this plane?

(*c*) Which jet strikes you as safer?

(*d*) What if the twin-engine jet can fly with only one functioning engine?