Chapter 3: Consuming Statistical Data

Problems

Problem 3.1

A newly developed test for a rare disease has the following features: if you do not suffer from the disease, the probability that you test positive ("false positive") is 5%. However, if you do have the disease, the probability that the test fails to show it ("false negative") is 10%.

You took the test, and, unfortunately, you tested positive. The probability that you have the disease is:_____

Problem 3.2

You are going to play the roulette. You first sit there and observe, and you notice that the last five times it came up "black." Would you bet on "red" or on "black"? _____

_____

Problem 3.3

A study of students' grades in the US showed that immigrants had, on average, a higher grade point average than did US-born students. The conclusion was that Americans are not very smart, or at least do not work very hard, as compared to other nationalities.

What do you think?

Problem 3.4

In order to estimate the average number of children in a family, a researcher sampled children in a school, and asked them how many siblings they had. The answer, plus one, was averaged over all children in the sample to provide the desired estimate.

Is this a good estimate?

Problem 3.5

A contractor of small renovation projects submits bids and competes for contracts. He noticed that he tends to lose money on the projects he runs. He started wondering how he can be so systematically wrong in his estimates.

Can you explain that?

Problem 3.6

Comment on the following.

[At a restaurant] Ann: I hate it. It's just like I told you: they don't make an effort anymore.

Barbara: They?

Ann: Just taste it. It's really bad food. Don't you remember how it was the first time we were here?

Barbara: Well, maybe you're tired.

Ann: Do you like your dish?

Barbara: Well, it isn't bad. Maybe not as good as last time, but…

Ann: You see? They first make an effort to impress and lure us, and then they think that we're anyway going to come back. No wonder that so many restaurants shut down after less than a year.

Barbara: Well, I'm not sure that this restaurant is so new.

Ann: It isn't?

Barbara: I don't think so. Jim mentioned it to me a long time ago, it's only us who didn't come here for so long.

Ann: So how did they know they should have impressed us the first time and how did they know it's our second time now? Do you think the waiter was telling the chef, "Two sirloins at no. 14, but don't worry about it, they're here for the second time"?

Problem 3.7

Studies show a high correlation between years of education and annual income. Thus, argued your teacher, it's good for you to study: the more you do, the more money you will make in the future.

Is this conclusion warranted?

Problem 3.8

In a recent study, it was found that people who did not smoke at all had more visits to their doctors than people who smoked a little bit. One researcher claimed, "Apparently, smoking is just like consuming red wine – too much of it is dangerous, but a little bit is actually good for your health!"

Do you accept this conclusion?

Problem 3.9

Comment on the following.

Charles: I don't use a mobile phone anymore.

Daniel: Really? Why?

Charles: Because it was found to be correlated with brain cancer.

Daniel: Com'n, you can't be serious. I asked an expert and they said that the effect is so small that it's not worth thinking about.

Charles: As long as you have something to think with. Do as you please, but I'm not going to kill myself.

Daniel: Fine, it's your decision. But I tell you, the effects that were found were insignificant.

Charles: Insignificant? They were significant at the 5% level!

Problem 3.10

Comment on the following.

Mary: My skin is killing me. Look how red it is.

Paula: Yeah, it's really bad. Why don't you take something?

Mary: I tried everything. Nothing works.

Paula: Nothing?

Mary: I'm telling you, I tried anything I could put my hands on.

Paula: Look, maybe I can help you. I know this guy who works for BigMed, you know, the drug company.

Mary: Sure I know, they're big.

Paula: Well, they are in the final phase of testing an ointment, and I think it's precisely for this type of rash. They need volunteers for the test – why don't you join the study? They even give you all kinds of skin products as a gift.

Mary: I don't need any gifts. If it can help, I have enough of an incentive to take it, believe me. But what if it's going to be worse?

Paula: It won't. They're a serious company and the product has already passed many tests.

Mary: So was it approved by the FDA [Food and Drug Administration]?

Paula: No, they're still testing it, that's the point of the test.

Mary: I don't get it. It's either or: if you're so sure it's OK, why isn't it approved? If it's not yet approved, it's probably not yet OK.

Paula: It's never 100% sure to be 'OK', as you put it. A drug can be approved and then still kill people. It's all a matter of probabilities and statistics.

Mary: What does it help me that you call this probability? Again: either the probability is low enough so that it can be approved, or it's not low enough and then I don't want to take it.

Paula: Which probability?

Mary: The probability that something bad might happen. I don't know what, but they are testing something, aren't they?

Paula: It's up to you, of course. It's your skin and it's your decision. But we always take risks, when we board planes and when we play squash. All I'm saying is that, given BigMed's reputation, this is a very reasonable risk to take, and it's a pity to go on suffering.

Mary: Well, then, given BigMed's reputation, why are they still testing it instead of the FDA just approving it?

Exercises – Chapter 3

1. A home owner who has a mortgage and who is not going to default may miss a payment on a particular month with probability 2.8%. (One who defaults obviously misses the payment for sure). If Mr A missed a payment, what is the probability that he is going to default?

    a. 2.8%

    b. 2.8%/[2.8%+1]

    c. 1/[2.8%+1]

    d. Cannot be determined.

    e. Can be determined, but differs from (a)-(c).

2. A leading newspaper followed up on the inflation rate predictions by several economists. It has selected the five with the best record, and asked them to predict the inflation in the current year. At the end of the year, it appeared that they were not so successful. The journalist concluded that we must be living in a very tumultuous period, where even top experts cannot make good predictions. This conclusion is

    a. Erroneous, and it reflects the journalist's anchoring bias.

    b. Reasonable, because the journalist can't tell the inflation rate either.

    c. Erroneous, as this might be a case of regression to the mean.

    d. Quite likely, though the journalist may still be exposed to an availability bias.

3. "Most journalists I met were superficial. Next time I see someone superficial, I'm going to ask them if they are journalists." Which statement would you endorse?

    a. It's not enough to know that most journalists are superficial – maybe most people are superficial anyway. One has to look at the comparison between superficial people among journalists and among non-journalists.

    b. Even if most journalists are superficial, it doesn't mean that most superficial people are journalists.

    c. Assuming that there are many more superficial people in the population that there are journalists, the percentage of superficial among the journalists must be larger than the percentage of journalists among the superficial.

    d. All of the above.

    e. None of the above.

4. Suppose that fashion models tend to be stupid more than the rest of the population. In this case

    a. We can conclude that the fashion industry tends to hire stupid people for modeling.

    b. We can conclude that the life of a model tend to dull the mind.

    c. We can conclude that the fashion industry chooses its models according to some criteria that correlate negatively with intelligence.

    d. All of the above (All are warranted conclusions).

    e. None of the above.

5. Your friend has a car repair shop, specializing in transmission systems. You told him that you consider buying a car of make A, which is not very popular. His reaction was, "Don't get near them – I fix their transmission all the time. In fact, they're 90% of my business!" What can you say based on your friend's experience?

    a. That, if you buy a car of make A, you'll have 90% probability of transmission problems.

    b. That, if you buy a car of make A, you'll be more likely to have transmission problems than not.

    c. That, if you buy a car of make A, you'll be more likely to have transmission problems than if you buy a car made by another make.

    d. All of the above.

    e. None of the above.

6. A certain genetic disease is recessive, which implies that a child might have it only if both parents are carriers of the disease. The probability of each person being a carrier is 2%. One of two prospective parents took a test and was found to be a carrier. Before the second took the test, the doctor said, "Oh, don't worry: I have seen people who were carriers of the disease in my life, but I've never seen two parents being carriers!" Do you support the doctor's view?

7. We wish to estimate the expectation μ of a random variable X. We ask two statisticians, one classical and the other Bayesian, to do the job. The difference between them will be that

    a. The Bayesian one will have a guess about μ even before taking the sample.

    b. The Bayesian one will not take a sample at all.

    c. The classical one will generate a confidence interval, but she will not truly think that it contains the parameter μ.

    d. The classical one will prefer counter-intuitive answers.

    e. All of the above.

8. The difference between confidence intervals and hypotheses tests is that

    a. The confidence level is a probability only a priori, before taking the sample, whereas significance is a probability also after the sample has been taken.

    b. Significance looks at the difference between values of the unknown parameters, and not just at the probabilities of type I and type II errors.

    c. Confidence intervals are general-purpose estimation technique, whereas each hypothesis test is tailored to a particular statement.

    d. All of the above.

    e. None of the above.