Basic Data Analysis

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Business Administration and Public Policy

Homework 3: Due June 4, 2009

Requirements

Exercises on probability, events, and random variables.
Due 2009-06-04, 12:00 noon. Submit by email to `turnbull@sk.tsukuba.ac.jp`.
Your header should look like this:

```
From:  a-student@sk.tsukuba.ac.jp
To:  turnbull@sk.tsukuba.ac.jp
Subject:  Basic Data Analysis HW#3
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The subject should be all half-width Roman letters (ASCII). *Spelling must be exact* because it is sorted by the computer.

Homework 3

1. A die has six sides, so we assess the probability of each side occuring in a single roll as 1/6. There are two human sexes, so we assess that probability that the next person to walk through a particular door is female to be 1/2. Discuss this analysis.

   For the die, we know that dice are usually constructed to be equally likely to come up on any side. Only if the owner of the die has something to gain by cheating would we worry that the die is weighted or otherwise unfair. Social behavior is far more complicated. If people follow the Western practice of "ladies first", then any group including a woman would likely allow the women through first, biasing the probablity in favor of women. If men and women have different degrees of "on-time performance," that would lead to bias, as would a male-female ratio which is not 1-to-1.

2. We assess that probability that the next person to walk through the door will be either male or female to be 1. What assumption have we made about humans to come to this conclusion?

   There are only two types of humans, male and female.

3. What are the *primitive events* in the example of a person walking through a door?

   Various answers are possible. One answer would be all of the people in the world, any of whom might walk through the door. We assign probability of zero to each person already in the room.

4. The automobile industry is in recession about 1/2 the time. The tire industry is in recession about 1/2 the time. What assumption about the events "the automobile industry is in recession" and "the tire industry is in recession" would be used to justify the computation that "the probability of both industries being in recession at the same time is $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$?

   The event that each industry is in recession is independent *of the other's economic condition.*

5. Do you think this assumption is valid?

   I hope not! Demand for tires clearly depends in part on whether new automobiles are being produced, and if the auto industry is in recession, new automobiles will be produced in smaller quantity.

6. Give an example from business of two *mutually exclusive* events. Explain why they are mutually exclusive. Describe a *primitive event* in your example, and discuss whether it is contained in the two events you chose.

   In an auction to perform a construction project, Firm A being the lead contractor ("Firm A wins") is mutually exclusive with Firm B being the lead contractor. A primitive event might be a list of the bids entered by each firm. The primitive event is definitely not in the event "Firm A wins" if the bid of Firm B is lower than that of Firm A. In that case, it might be in the event "Firm B wins," but it might not (if some other firm had an even lower bid.)

7. Give a different example from business of two *independent* events. Explain why they are independent. Describe a *primitive event* in your example, and discuss whether it is contained in the two events you chose.

   It is very difficult to give such an example that is "interesting," because all interesting events in business involve management decisions, and management decisions are affected by the general condition of the economy. The creates indirect dependencies between all *business decisions.*
   Something like the event that "Firm A's president's company car breaks down in Tokyo at 9am on July 1, 2009" and the event that "a janitor for Firm B spills wash water on the floor of a factory in Osaka at 9am on July 1, 2009" might do. See? Too weird to be interesting!

8. Give a third example from business of two events that are *neither* independent nor mutually exclusive. Pick one to be event A, the other event B. *Estimate* $P(A|B)$ *and* $P(A|\bar{B})$. (Recall that $\bar{B}$ is the *complement* of B.) Explain why you chose those estimates. (The important thing is to explain why one is bigger than, equal to, or smaller than, the other.

   The events that A, "General Motors goes bankrupt" and B, "Delphi Automotive Systems" (a major supplier to GM) goes bankupt (considering the situation in say January 2009). $P(A|B) = 0.8$, $P(A|\bar{B}) = 0.1$. The reason for these estimates is (1), if GM goes bankrupt, many of its suppliers including Delphi will surely go bankrupt, too. If GM is OK, they probably will be, too. Note that the causality goes GM $\rightarrow$ Delphi, but what you need to estimate is "suppose Delphi goes (or does not go) bankrupt. What do you conclude about the probability that GM goes bankrupt?"