PHI 169 – CRITICAL REASONING - FALL 2017 – PROBABILITY QUIZ – SOLUTIONS

(a) In Orange Beach, Alabama, there were 5,000 people living in 2015 and during that year there were 100 violent crimes. What is the probability that Aristeo, a random person living there, would be the victim of a violent crime that year? (NB: Assume that, if at all, each person can be the victim of one crime, not more than one crime. Further, assume that each person is equally likely to be the victim of a crime absent any further information.)

$P(CrimeVictimAristeo) = \frac{100}{5000} = 0.02$

(b) It turns out that that year 5 of the 100 violent crimes happened to people who were working in the "drug business" and there were 100 people in that business in Orange Beach that year. Aristeo was among them. Conditional on the fact that Aristeo was involved in the drug business, what is the probability that Ariteo would be the victim of a violet crime that year?

$P(CrimeVictimAristeo|DrugAristeo) = \frac{5}{100} = 0.05$

(c) Are the events "being the victim of a violent crime" and "working in the drug business" probabilistically dependent or independent? Explain and show the definition you used.

Dependent because $P(CrimeVictimAristeo) \neq P(CrimeVictimAristeo|DrugAristeo)$

(d) Avital also lived in Orange Beach in 2015. How probable is it that Avital was involved in the drug business *and* also was the victim of a violent crime that year? Show your calculations.

$P(DrugAvital \wedge CrimeVictimAvital) =$
$P(DrugAvital)P(CrimeVictimAvital|DrugAvital) =$
$0.02 \times 0.05 = 0.001$

(e) How probable is it that both Avital and Aristeo would be victims of a violent crime that year (keeping in mind that Aristeo was in the drug business while we don't know about Avital)?

$P(CrimeVictminAvital \wedge CrimeVictimAristeo) =$
$P(CrimeVictimAristeo)P(CrimeVictimAvital|CrimeVictimAristeo) =$
$\frac{5}{100} \times \frac{99}{4999} \approx 0.05 \times 0.02 = 0.001$

(f) Are the events "Avital was victim of a violent crime" and "Aristeo was victim of a violent crime" probabilistically dependent or not? Assume that a person cannot be the victim of a violent crime twice and each person is equally likely to be a victim absent other information. Explain your reasoning carefully.

Strictly speaking dependent, but minimally so. If the number of violent crimes is fixed and one crime happened to a person, the chances will vary for another person (assuming already one person was victimized). Suppose, for example, there were 100 crimes in total and a 1,000 people. If we assumed 50 people were victimized, the chance that another person would be victimized would be $\frac{100-50}{1000-50}$. One needs to subtract 50 from the total number of people and from the total number of victimized people.