Question 01

How does the conditional probability of A given B relate to the probability of the intersection of A and B? Is the $p(A|B)$ less, less than or equal, equal, greater than or equal, or greater than $p(A \cap B)$? Why?

$$p(A|B) \ ? \ p(A \cap B)$$

Question 02 (2.21 in the book)

Mumps is a highly contagious viral infection that most often occurs in children, but can affect adults, particularly if they are living in shared living spaces such as college dormitories. It is most recognizable by the swelling of salivary glands at the side of the face under the ears, but earlier symptoms include headaches, fever, and joint pain. Suppose a college student at a university presents to a physician with symptoms of headaches, fever, and joint pain. Let $A = \{$headaches, fever, and joint pain$\}$, and suppose that the possible disease state of the patient can be partitioned into: B1 = normal, B2 = common cold, B3 = mumps. From clinical experience, the physician estimates $p(A|B_1) = 0.001$, $p(A|B_2) = 0.70$, $p(A|B_3) = 0.95$. The physician, aware that some students have contracted the mumps, then estimates that for students at this university, $p(B_1) = 0.95$, $p(B_2) = 0.025$, and $p(B_3) = 0.025$. Given the previous symptoms, which of the disease states is most likely?

Question 03

Below is data collected from the https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfmaude/search.cfm on all reported adverse events from the manufacturer https://www.medtronic.com/us-en/index.html between the dates 2017 and the present (2020-09-22).

The data is stratified by the date of the event, before or during 2020, and by whether the event led to a death or not.

A traditional analysis you'll see in the real world is a 2×2 table analysis.
Lets compute a few common statistics.

	Before 2020	During 2020
Death	0	7
Not Death	18	454

We can first investigate the probability of a reported event leading to death given the event occurred before 2020 or during 2020. You can estimate probabilities from this table by counting the number of occurrences related to a specific event and dividing by the total number of occurrences.

For example, to compute p(An event occurred before 2020|Not a death) we could count the number of non-deaths that occurred before 2020 (18) and divide by all non-deaths (472) and get 0.038—the probability a non-death was reported before 2020.

A

Please compute the p(Death|An event occurred before 2020)

B

Please compute the p(Death|An event occurred during 2020)

C

Please compute the p(Not Death|An event occurred before 2020)

D

Please compute the p(Not Death|An event occurred during 2020)

E

The risk ratio for an event A given two potential "conditions" is computed as

$$\text{Risk Ratio} = \frac{p(A|B)}{p(A|B^c)} \tag{1}$$

and is one conditional probability divided by another. The Risk ratio describes, at a certain period or "snapshot" of time, the probability event A will occur given B occurs compared to if B had not occurred.

Please compute the Risk ratio of death during 2020 to before 2020 among reported events using Medtronic devices. In other words, please compute

$$\text{Risk} = \frac{p(\text{Death}|\text{An event occurred during 2020})}{p(\text{Death}|\text{An event occurred before 2020})} \tag{2}$$

F

Does this estimate of the risk of death during 2020 by a Medtronic device seem believable? Discuss biases, the target population vs the population collected, the estimate itself, and any additional concerns you have.