**MA 207 Conditional Probability Name: \_\_\_\_\_\_\_\_\_Key\_\_\_Date:\_\_\_\_\_Time:\_\_\_\_\_**

1. In a certain city, the police recorded the data in the contingency table below on traffic accidents involving a motorcycle, listing whether the rider wore a helmet (Y) or not (N) and whether they survived (S) or died (D).

|  |  |  |
| --- | --- | --- |
|  | Survived (S) | Died (D) |
| Wore a helmet (Y) | 78 | 2 |
| Didn’t wear a helmet (N) | 19 | 1 |

* 1. Someone said that, since there are only two possible outcomes for the survival variable (survived or died), the probability of surviving is P(S) = ½. Is this reasoning correct: Yes or no? Explain.

No!! The Equally Likely Outcomes Rule only applies if the outcomes are equally likely. Surviving and dying are NOT equally likely, so the Equally Likely Outcomes Rule does NOT apply.

* 1. Find P(S)



* 1. Find P(S|Y).

 which simplifies to , so it would be okay to just write the simplified fraction.

* 1. Find P(S|N).

The simplified fraction is 

* 1. Someone said that, since more people died who wore a helmet than who did not wear a helmet, it is a bad idea to wear a helmet. Is this reasoning correct: Yes or no? Explain why or why not.

No, it is not the number of deaths but the proportion of deaths in each helmet status that matters.

* 1. Is P(S) = P(S|Y)? Yes or no?

No!!

* 1. If S and Y are independent events, then P(S) = P(S|Y). Are they independent? Yes or no?

No!!

Phrased another way, is there an association between S and Y? Yes or no?

Yes!!

* 1. Are S and Y disjoint events? Explain why or why not.

No! They have outcomes in common. There are people who both survived and wore their helmet.

* 1. Are S and D disjoint events? Explain why or why not.

Yes! They have no outcomes in common. There is nobody who both survived and died.

* 1. Find P(S|D).

0

There is nobody who survived given the condition that we know they died!

* 1. Are S and D independent events?

No! Because P(S|D) = 0 is not equal to P(S) = 0.97.

* 1. Find P(Y).



* 1. Find P(Y and S) using the Multiplication Rule: P(Y and S) = P(Y)P(S|Y).



* 1. Find P(Y and S) using the table. Did you get the same answer as above: Yes or no?

 Yes, they are the same, of course!

* 1. Find P(Y)P(S).



* 1. Is P(Y and S) = P(Y)P(S): Yes or no? Why doesn’t this violate the Multiplication Rule for Independent Events?

No!! It doesn’t violate the Multiplication Rule for Independent Events because the events are not independent.

* 1. Find P(Y|S).



* 1. Is P(S|Y) = P(Y|S)? Yes or no? Would you expect them to be equal? Yes or no way?

No way!! They measure totally different things!

* 1. Find the ratio of P(D|N) and P(D|Y), and explain what it means.



You are two times *as* likely to have died if you were not wearing a helmet than if you were wearing a helmet. Equivalently, you can say that you are 100% *more* likely to have died if you were not wearing a helmet than if you were wearing a helmet.

* 1. Come up with a different real world setting that helps you illustrate the difference between disjoint events and independent events.