

The probability is 1 in 4,000,000 that a single auto trip in the United States will result in fatality. Over a lifetime, an average U.S. driver takes 50,000 trips. (a) What is the probability of a fatal accident over a lifetime?

Explain your reasoning carefully. *Hint:* Assume independent events. Why might the assumption of independence be violated?

Ans.

If $A_1, A_2, A_3 \dots A_n$ are independent events then

$$P(A_1, A_2, A_3 \dots A_n) = P(A_1)P(A_2)P(A_3) \dots P(A_n)$$

A = fatal accident in a single trip

$$P(A) = 1/4000000$$

$$P(\bar{A} = \text{No fatal accident in a single trip}) = 1 - P(A)$$

$$P(\text{fatal accident over a lifetime}) = P(\text{At least one fatal accident in lifetime i.e. 50000 trips})$$

$$= 1 - P(\text{No fatal accidents in 50000 trips})$$

$$= 1 - [P(\text{No fatal accidents in a single trip})]^{50000} \quad (\text{As trips are independent events})$$

$$= 1 - \left(1 - \frac{1}{4000000}\right)^{50000}$$

$$= 1 - 0.987577799 = 0.012422201$$

As we have assumed independence but the assumption of independence may be violated. For example if there are lot of trips on a single day or in continuation the driver gets exhausted and so the risk of fatality increases and depends on the no of trips he had taken in continuation on that day making the events dependent. Also as the driver ages his visibility may decrease making him more prone to fatal accidents.

(b) Why might a driver be tempted not to use a seat belt "just on this trip"?

Ans.

The probability of a fatal accident is only 0.0124 that is about 1 driver in 100 drivers have the possibility of fatal accident in lifetime which is very less. Thus this low chance of fatality may tempt a driver not to use a seat belt "just on this trip".