S-CP The Titanic 1

Task

On April 15, 1912, the Titanic struck an iceberg and rapidly sank with only 710 of her 2,204 passengers and crew surviving. Data on survival of passengers are summarized in the table below. (Data source: http://www.encyclopedia-titanica.org/titanic-statistics.html)

	Survived	Did not survive	Total
First class passengers	201	123	324
Second class passengers	118	166	284
Third class passengers	181	528	709
Total passengers	500	817	1317

a. Calculate the following probabilities. Round your answers to three decimal places.

i. If one of the passengers is randomly selected, what is the probability that this passenger was in first class?

ii. If one of the passengers is randomly selected, what is the probability that this passenger survived?

iii. If one of the passengers is randomly selected, what is the probability that this passenger was in first class and survived?

iv. If one of the passengers is randomly selected from the first class passengers, what is the probability that this passenger survived? (That is, what is the

probability that the passenger survived, given that this passenger was in first class?)

v. If one of the passengers who survived is randomly selected, what is the probability that this passenger was in first class?

vi. If one of the passengers who survived is randomly selected, what is the probability that this passenger was in third class?

b. Why is the answer to part (a.iv) larger than the answer to part (a.iii)?

c. Why is the answer to part (a.v) larger than the answer to part (a.vi)?

d. What other questions can you ask and answer using information in the given table? List at least three.

IM Commentary

This is the first task in the series of three, which ask related questions, but use different levels of scaffolding. Also, the third task uses a more detailed version of the data table. This task guides students by asking the series of specific questions and lets them explore the concepts of probability as a fraction of outcomes, and using two-way tables of data. The emphasis is on developing their understanding of conditional probability. Students should understand the difference between $P(A \text{ and } B)$ and $P(A|B)$, and notice that $P(A|B)$ is not the same as $P(B|A)$. Parts b and c require students to verbalize their understanding of probability. The last part of the task is open ended, and there are many possible questions we could ask, and answer, using the given table. For example, questions could be posed about second class passengers.

The task could lead to extended class discussions about the chances of events happening, and differences between unconditional and conditional probabilities. Special emphasis should be put on understanding what the sample space is for each question.

The other tasks in this series are S-CP.3,4,5,6 The Titanic 2 and S-CP.4,5,6 The Titanic 3.

Solution

a. i. The probability of the passenger being in first class is the number of all first class passengers divided by total number of passengers , that is
$P(\text{passenger being in first class}) = \frac{324}{1317} \approx 0.246$

ii. The probability that the passenger survived is the number of all passengers who survived divided by total number of passengers, that is
$P(\text{passenger survived}) = \frac{500}{1317} \approx 0.380$

iii. This is the fraction of all passengers that are both in first class and survived, which is
$P[(\text{passenger was in first class}) \text{ and } (\text{passenger survived})] = \frac{201}{1317} \approx 0.153$

iv. This is a conditional probability. To find the probability that the passenger survived, given this passenger was in first class, we calculate the fraction of first class passenger who survived, that is
$P(\text{passenger survived}|\text{passenger was in first class}) = \frac{201}{324} \approx 0.620.$

v. This is a conditional probability:
$P(\text{passenger was in first class}|\text{passenger survived})$. We can calculate it as the fraction of surviving passengers who were in first class, which is $\frac{201}{500} \approx 0.402$

vi. This is a conditional probability:
$P(\text{passenger was in third class}|\text{passenger survived})$. We can calculate it as the fraction of surviving passengers who were in third class, which is $\frac{181}{500} \approx 0.362$

b. Even though in both parts (a.iii) and (a.iv) we have the same numerator (201), in part (a.iii) the sample space consists of all the passengers, but in part (a.iv) the sample space is restricted to only the first class passengers. Since in part (a.iv) we divide by a smaller number, the answer in part (a.iv) is larger than in part (a.iii).

c. In both parts (a.v) and (a.vi) the sample space is restricted to all the passengers who survived. But since among that group there were more first class than third class passengers, the answer to part (a.v) is larger than the answer to part (a.vi).

d. There are many questions that can be answered using the given table. Possible answers may include, but are not limited, to the following:

- If one of the passengers is randomly selected, what is the probability that this passenger was in second class?

Answer: $P(\text{passenger was in second class}) = \frac{284}{1317} \approx 0.216.$

- If one of the passengers is randomly selected, what is the probability that this passenger was in second class and survived?

Answer:
$P[(\text{passenger was in second class}) \text{ and } (\text{passenger survived})] = \frac{118}{1317} \approx 0.090..$

- If one of the passengers is randomly selected from among the second class passengers, what is the probability that this passenger survived?

Answer: $P(\text{passenger survived} \mid \text{passenger was in second class}) = \frac{118}{284} \approx 0.415.$

- If one of the passengers who survived is randomly selected, what is the probability that this passenger was in second class?

Answer: $P(\text{passenger was in second class} \mid \text{passenger survived}) = \frac{118}{500} \approx 0.236.$