ANSWER KEY

Titanic

Before we begin:

This data in this lab comes from:

www.encyclopedia-titanica.org/titanic-statistics.html

and some of the questions come from:

Statistics In Action, A Watkins, R Scheaffer, G Cobb. **Key Curriculum Press**, Emeryville 2008, 978 -1-55953-909-8.

Questions:

You've heard expressions like, "the chance of striking out a right-handed batter given that you are a left-handed pitcher" or "the chance of having a boy given that you already have 2 girls." How can you answer these questions effectively?

In this Activity:

In this lab, we explore these expressions of *conditional probability*. We begin the disastrous event of April 15th, 1912, when the unsinkable Royal Mail Ship *Titanic* struck an iceberg in the North Atlantic and sank. Only 710 of her 2204 passengers and crew survived. The following *two-way table* records the data on the fate of her passengers.

Titanic Survival Data

	Survived	Did Not Survive	Total
First Class	201	123	324
Second Class	118	166	284
Third Class	181	528	709
Total Passengers	500	817	1317

Materials:

Pencils and paper.

Procedure:

1. Calculate the following probabilities. Leave your answers in fraction form.

A. If one passenger is randomly selected, what is the probability that the passenger was in first class? P(1ST CLASS) = $\boxed{324/1317}$

B. If one passenger is randomly selected, what is the probability that this passenger survived? P(SURVIVED) = $\boxed{500/1317}$

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

P(1ST CLASS AND SURVIVED) = $\boxed{201/1317}$

There are many ways to get this

D. If one passenger is randomly selected, what is the probability that this passenger was either in first class or survived or possibly both?

P(1ST CLASS OR SURVIVED) = $\frac{500+324-201}{1317}$ = $\boxed{623/1317}$

E. If one of the passengers is randomly selected from the first class passengers, what is the probability that this passenger survived? P(SURVIVE | 1STCLASS) = $\boxed{201/324}$

F. If one of passengers is randomly selected from the group of survivors, what is the probability that this passenger was in first class? P(1ST CLASS | SURVIVE) = $\boxed{201/500}$

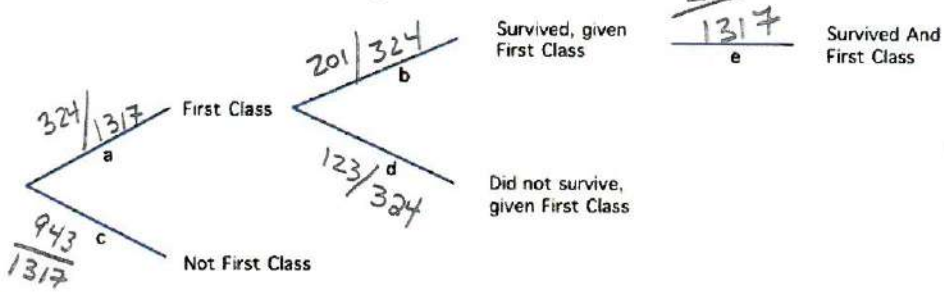
2. Why is the answer to part **E** above larger than the answer to part **C** above?

b/c FEWER PEOPLE IN 1ST CLASS COMPARED TO # WHO SURVIVED

3. The questions asked in parts **E** and **F** are examples of *conditional probability.* In part **E** we already know that the passenger is in first class. This is the condition. We could rephrase the question as, "What is the probability that the passenger survived, given that he/she is in first class?" Rephrase the question to part **F** using this phrasing.

4. How are your answers to parts **A**, **C** and **E** above related? (A) $\frac{324}{1311}$ (C) $\frac{201}{1317}$ (E) $\frac{201}{324}$

5. A *tree diagram* is a great way to help answer the previous question. Below is a part of the tree which illustrates this story.



$E = \frac{C}{A}$

$P(S|F) = \frac{P(F \cap S)}{P(F)}$

conditional formula

Each lowercase letter in the diagram should be replace with the probability of the event at the end of the branch. You have already computed some of the probabilities, add in all of the probabilities to the tree.

S = 1ST CLASS
T = SURVIVED

6. The conventional shorthand for writing the probability of event S is $P(S)$, so $P(\text{first class}) = 324/1317$. Use your answers to question 5 to find a formula for $P(S \text{ given } T)$ in terms of $P(S \text{ and } T)$ and $P(T)$. $P(S|T) = \frac{P(S \text{ and } T)}{P(T)}$ OR $P(S \text{ and } T) = P(S|T) \cdot P(T)$

7. One more example before we go.This problem is a classic example of a probability question with a surprising outcome. Suppose there is a rare but serious disease that affects 1 % (0.01) of the population. There is a test that correctly identifies 95% (0.95) of the time that you have the disease if you are in fact infected. The test also correctly identifies 95% of the time that you are not infected if you are in fact not infected. do work on next page

Suppose that during a routine physical you take the test which turns out positive. The test says that you are infected.

(A) What is the probability that the test reports a positive result if you are infected?

(B) What is the probability that you are infected if the tests reports a positive result?

It may help to assume that the population is one million people. You might also want to use a tree diagram or a two-way table like the one shown earlier in this lab. In the case of the table the variables would be **test: positive** or **test: negative** and **infected** or **not infected**.

I = INFECTED

$P(I) = .01$

① CORRECT + TEST WHEN INFECTED = .95

② CORRECT − TEST WHEN NOT INFECTED = .95

Ⓐ $P(+|I) = \dfrac{P(+ \text{ and } I)}{P(I)} = \dfrac{(.95)(.01)}{.01} = \boxed{.95}$

Ⓑ

$.01$ → I → $.95$ → $+$ $(.01)(.95) = .0095 \leftarrow \boxed{P(I \text{ and } +)}$

$.01$ → I → $.05$ → $-$ $(.01)(.05) = .0005$

$.99$ → $\bar{I}$ → $.05$ → $+$ $(.99)(.05) = .0495$

$.99$ → $\bar{I}$ → $.95$ → $-$ $(.99)(.95) = .9405$

$\overline{1.000}$

Conditional prob's

"AND" prob's

$P(I|+) = \dfrac{P(I \text{ and } +)}{P(+)} = \dfrac{.0095}{.0095 + .0495} = .161 = 16.1\%$