

**THE CASE OF**

**THE BODY**

**IN THE BAG**

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**CS 206 CASE STUDY**

Interesting. 60/60 ✓

OBJECTIVE: The problem below is an application of probability on crime investigations. It is taken from the book

**PROBLEM: THE CASE OF THE BODY IN THE BAG**

The late spring morning broke sharply along the banks of a river. Robert Donkin, an elderly retiree with fishing pole in hand, slipped through the underbrush that lined the river's banks. As he neared the shore, he saw a rather large canvas bag floating in the water, held by the foliage that leaned over the river. The bag appeared to be stuffed, well worn, and heavily stained. Upon closer inspection, Mr. Donkin observed what he believed to be hair floating through the bag's opening. Marking the spot of his discovery, the fisherman fetched the authorities.

Preliminary investigation at the scene revealed a body in the bag. Unfortunately, it was impossible to identify the corpse's sex or race immediately. Estimating age was also out of the question. Forensics was assigned the task of identifying the victim and estimating the cause and time of death.

While waiting for the forensic analysis, you, as the detective in charge, have gathered the information shown on concerning victim/offender relationships from the FBI.

<b>Age of offender</b>					
	<b>Less than</b>	<b>At least</b>			
<b>Age of the victim</b>	18	18	<b>TOTAL</b>	<b>Unknown</b>	<b>TOTAL</b>
Less than 18	148	596	<b>744</b>	32	<b>776</b>
At least 18	310	4870	<b>5180</b>	399	<b>5579</b>
<b>TOTAL</b>	<b>458</b>	<b>5466</b>	<b>5924</b>		
Unknown	2	66		11	<b>79</b>
<b>TOTAL</b>	<b>460</b>	<b>5532</b>		<b>442</b>	<b>6434</b>

<b>Sex of offender</b>					
	<b>Male</b>	<b>Female</b>			
<b>Sex of victim</b>	Male	Female	<b>TOTAL</b>	<b>Unknown</b>	<b>TOTAL</b>
Male	3946	497	<b>4443</b>	65	<b>4508</b>
Female	1659	196	<b>1855</b>	23	<b>1878</b>
<b>TOTAL</b>	<b>5605</b>	<b>693</b>	<b>6298</b>		
Unknown	26	4		18	<b>48</b>
<b>TOTAL</b>	<b>5631</b>	<b>697</b>		<b>106</b>	<b>6434</b>

<b>Race of offender</b>						
	<b>White</b>	<b>Black</b>	<b>Other</b>			
<b>Sex of victim</b>	White	Black	Other	<b>TOTAL</b>	<b>Unknown</b>	<b>TOTAL</b>
Male	1929	2391	123	<b>4443</b>	65	<b>4508</b>
Female	1038	752	65	<b>1855</b>	23	<b>1878</b>
<b>TOTAL</b>	<b>2967</b>	<b>3143</b>	<b>188</b>	<b>6298</b>		
Unknown	17	12	1		18	<b>48</b>
<b>TOTAL</b>	<b>2984</b>	<b>3155</b>	<b>189</b>		<b>106</b>	<b>6434</b>

<b>Race of offender</b>						
<b>Race of victim</b>	White	Black	Other	TOTAL	Unknown	TOTAL
White	2779	452	51	3282	54	3336
Black	154	2674	10	2838	31	2869
Other	34	17	127	178	3	181
<b>TOTAL</b>	<b>2967</b>	<b>3143</b>	<b>188</b>	<b>6298</b>		
Unknown	17	12	1		18	48
<b>TOTAL</b>	<b>2984</b>	<b>3155</b>	<b>189</b>		<b>106</b>	<b>6434</b>

<b>Sex of offender</b>					
<b>Race of victim</b>	Male	Female	TOTAL	Unknown	TOTAL
White	2939	343	3282	54	3336
Black	2510	328	2838	31	2869
Other	156	22	178	3	181
<b>TOTAL</b>	<b>5605</b>	<b>693</b>	<b>6298</b>		
Unknown	26	4		18	48
<b>TOTAL</b>	<b>5631</b>	<b>697</b>		<b>106</b>	<b>6434</b>

Using the information contained in the tables, you are to develop a preliminary profile of victim and offender by answering the following questions.

1. How likely is it that the offender is at least 18?
2. How likely is it that the offender is white?
3. How likely is it that the offender is male?
4. How likely is it that the offender is a white male?
5. How likely is it that the offender is either white or male?

6. How likely is it that the victim and the offender are from the same age group?
7. How likely is it that the victim and the offender are from the different age group?
8. How likely is it that the victim and the offender are of the same race?
9. How likely is it that the victim and the offender are of different races?
10. How likely is it that the victim and the offender are of the same sex?
11. How likely is it that the victim and the offender are of the different sexes?
12. Without knowing the contents of the forensic team's report, what is your best prediction of the age, race, and sex of the victim? Explain your reasoning.
13. What is your best prediction of the age, race, and sex of the offender? Explain your reasoning.

Soon after you finished this analysis, the preliminary forensics report was delivered to your desk. Although no identification had been made, the autopsy suggested that the cause of death was blunt-force trauma and that the body had been in the water at least two weeks. By using a variety of techniques, it was determined that the victim was white female with blonde hair. She was estimated as being in her mid-thirties, showed no sign of having children, and was wearing no jewelry.

Base on this new information, you develop a new offender profile by answering the following questions.

14. How likely is that the offender is at least 18?
15. How likely is that the offender is white?
16. How likely is that the offender is male?
17. How likely is that the offender is a white male?

18. How likely is that the offender is either white or male?
19. How likely is that the victim and the offender are from the same age group?
20. How likely is that the victim and the offender are from different age groups?
21. How likely is that the victim and the offender are of the same race?
22. How likely is that the victim and the offender are of different races?
23. How likely is that the victim and the offender are of the same sex?
24. How likely is that the victim and the offender are of different sexes?
25. What is your best prediction of the age, race, and sex of the offender? Explain your reasoning.

Did your answers to the offender questions change once you knew the age, race and sex of the victim? Explain.

Suppose that 45% of murder victims were known to be related to or acquainted with the offender, that 15% were murdered by a related stranger, and that for 40 % of victims, relationship to their killer is unknown. Based on the information available, complete your offender profile for this case.

**SOLUTIONS to questions 1-13:**

$$P\{\text{offender is at least 18}\} = 5532 \div (460+5532) = 0.923$$

$$P\{\text{offender is white}\} = 2984 \div (2984+3155+189) = 0.472$$

$$P\{\text{offender is male}\} = 5631 \div (5631+697) = 0.8899$$

$$P\{\text{offender is a white male}\} = P\{\text{offender is white}\} * P\{\text{offender is male}\}$$

$$= 0.472 * 0.8899$$

$$= 0.420$$

$$P\{\text{offender is either white or male}\} =$$

$$= P\{\text{offender is white}\} + P\{\text{offender is male}\} - 2P\{\text{offender is a white male}\}$$

$$= 0.472 + 0.8899 - 2 * 0.472 * 0.8899$$

$$= 0.5219$$

$$P\{\text{offender and the victim are from the same age group}\} = (148+4870) \div (460+5532)$$

$$= 0.837$$

$$P\{\text{offender and the victim are from different age groups}\} = (596+310) \div (460+5532)$$

$$= 0.151$$

$$P\{\text{offender and the victim are from the same race}\} =$$

$$= (2779+2674+127) \div (2984+3155+189)$$

$$= 0.882$$

$$P\{\text{offender and the victim are from different races}\} =$$

$$= (452+51+154+10+34+17) \div (3143+2967 +188)$$

$$= 718 \div 6298$$

$$= 0.114$$

$$P\{\text{offender and the victim are from the same sex}\} = (3946+196) \div 6298$$

$$= 0.658$$

$$P\{\text{offender and the victim are from different sexes}\} = (497+1659) \div 6298$$

$$= 0.342$$

*To make the best prediction about the offender and the victim, we need to do following calculations for the comparisons among the possibilities:*

$$P\{\text{offender and the victim are from the same age, race, and sex groups}\} =$$

$$P\{A\} = P\{\text{the same age group}\} * P\{\text{the same race group}\} * P\{\text{the same sex group}\}$$

$$0.837 * 0.882 * 0.658 = 0.486$$

$$P\{\text{offender and the victim are from the same age, race, and different sex groups}\} =$$

$$P\{B\} = P\{\text{the same age group}\} * P\{\text{the same race group}\} * P\{\text{different sex groups}\}$$

$$0.837 * 0.882 * 0.342 = 0.252$$

$$P\{\text{offender and the victim are from the same age, sex, and different race groups}\} =$$

$$P\{C\} = P\{\text{the same age group}\} * P\{\text{different race groups}\} * P\{\text{the same sex group}\}$$

$$0.837 * 0.114 * 0.658 = 0.063$$

$$P\{\text{offender and the victim are from the same age, and different race and sex groups}\} =$$

$$P\{D\} = P\{\text{the same age group}\} * P\{\text{different race groups}\} * P\{\text{different sex groups}\}$$

$$0.837 * 0.114 * 0.342 = 0.033$$

$$P\{\text{offender and the victim are from different age, and the same race and sex groups}\} =$$

$$P\{E\} = P\{\text{different age groups}\} * P\{\text{the same race group}\} * P\{\text{the same sex group}\}$$

$$0.151 * 0.882 * 0.658 = 0.088$$

$$P\{\text{offender and the victim are from the same race, and different age and sex groups}\} =$$



$$P\{F\} = P\{\text{different age groups}\} * P\{\text{the same race group}\} * P\{\text{different sex groups}\}$$

$$0.151 * 0.882 * 0.342 = 0.046$$

$P\{\text{offender and the victim are from different age and race, and the same sex groups}\} =$

$$P\{G\} = P\{\text{different age groups}\} * P\{\text{different race groups}\} * P\{\text{the same sex group}\}$$

$$0.151 * 0.114 * 0.658 = 0.011$$

$P\{\text{offender and the victim are from different age and race, and sex groups}\} =$

$$P\{H\} = P\{\text{different age groups}\} * P\{\text{different race groups}\} * P\{\text{different sex groups}\}$$

$$0.151 * 0.114 * 0.342 = 0.0059$$

$$P\{\text{offender is black}\} = 3155 \div 6298 = 0.50$$

Since  $P\{A\}=0.486 > P\{B\}=0.252 > P\{E\}=0.088 > P\{C\}=0.063 > P\{F\}=0.046 >$

$P\{D\}=0.033 > P\{G\}=0.011 > P\{H\}=0.0059$ , it is the most likely that the offender and the victim are from the same age, race, and sex groups.

And, since  $P\{\text{offender is male}\} = 0.8899 > P\{\text{offender is female}\}=0.1101$ ,

$$P\{\text{offender is at least 18}\}=0.923 > P\{\text{offender is less than 18}\} = 0.077,$$

$$P\{\text{offender is black}\} = 0.50 > P\{\text{offender is white}\} = 0.472,$$

it is most likely that the offender is a black male who is at least 18 years old, and that, thus, the victim is a black male who is at least 18 years old.

### **SOLUTIONS to the questions 14 – 25**

$P\{\text{victim is white and female}\} =$

$$P\{\text{offender is at least 18/victim is at least 18}\} = \frac{P\{\text{offender and victim are at least 18}\}}{P\{\text{victim is at least 18}\}}$$

$$= 4870 \div (310+4870)$$

$$= 0.940$$

$$\begin{aligned}
 P\{\text{offender is white /victim is white}\} &= \frac{P\{\text{offender and victim are white}\}}{P\{\text{victim is white}\}} \\
 &= 2779 \div (2779+452+51) \\
 &= 0.847
 \end{aligned}$$

$$\begin{aligned}
 P\{\text{offender is male /victim is female}\} &= \frac{P\{\text{male offender and female victim}\}}{P\{\text{female victim}\}} \\
 &= 1659 \div (1659+196) \\
 &= 0.894
 \end{aligned}$$

$P\{\text{white male offender}\} =$

$P\{\text{white offender/female white victim and male offender/female white victim}\}$

$P\{\text{white offender /white victim}\} * P\{\text{male offender/female victim}\}$

$$0.847 * 0.894 = 0.757$$

$P\{\text{white offender or male offender}\} =$

$P\{\text{white offender/female white victim or male offender/female white victim}\}$

$P\{\text{white offender /white victim}\} * P\{\text{white offender/female victim}\} + P\{\text{male offender/female victim}\} * P\{\text{male offender/white victim}\}$



