

1. A company designs a satellite so that all three computers must function in order to get a successful launch. If each computer functions properly 95% of the time, what's the probability that the launch will fail? In other words, what's the probability that at least one computer will fail?

Use the General Addition Rule, where $P(A) = P(\text{computer 1 fails}) = 0.05$.

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C)$$

This time, answer the same question using the complement rule:

$$P(\text{failed launch}) = 1.0 - P(\text{computer 1 works and computer 2 works and computer 3 works})$$

2. Cognitive neuroscientists investigate which areas of the brain are active during particular mental tasks. In many situations, researchers observe that a certain region of the brain is active and infer a particular cognitive function is therefore being carried out. Poldrack (2006) cautioned that such inferences are not necessarily firm and need to be made with Bayes' rule in mind. Poldrack reported the following frequency table of previous studies that involved any language-related task and whether or not a particular region of interest (ROI) in the brain was activated:

	Language Study	Not language study	Total
ROI Activated	166	199	365
ROI not activated	703	2154	2857
Total	869	2353	3222

Suppose a new study is conducted and finds that the ROI is activated. Given the ROI is activated, what's the probability that the task involved language processing? To calculate this, assume there's a 50% chance any task involves language processing. In other words, assume $P(\text{language study}) = 0.50$. Poldrack reports this probability is 0.69. Your task is to verify this result.

Source: Doing Bayesian Data Analysis by John K. Kruschke

3. The 9/21/1978 edition of the Wall Street Journal reported that Georgia residents working in shipyards had higher cancer rates than other Georgia residents.

The Journal reported: 22% of residents with cancer had worked in a shipyard
 14% of residents without cancer had worked in a shipyard
 4% of residents had cancer

We can rewrite these as: $0.22 = P(\text{shipyard} \mid \text{cancer})$
 $0.14 = P(\text{shipyard} \mid \text{no cancer})$
 $0.04 = P(\text{cancer})$

Someone living in Georgia at the time who had worked in a shipyard would be most interested in knowing the probability that he or she will be diagnosed with cancer: $P(\text{cancer} \mid \text{shipyard})$.

- a) Calculate the probability of working in a shipyard and being diagnosed with cancer:

$$P(\text{shipyard} \cap \text{cancer}) = \underline{\hspace{2cm}}$$

- b) Calculate the probability of working in a shipyard and not being diagnosed with cancer:

$$P(\text{shipyard} \cap \text{no cancer}) = \underline{\hspace{2cm}}$$

- c) Calculate the probability of working in a shipyard:

$$P(\text{shipyard}) = \underline{\hspace{2cm}}$$

- d) Finally, calculate the probability of being diagnosed with cancer given you worked in a shipyard:

$$P(\text{cancer} \mid \text{shipyard}) = \underline{\hspace{2cm}}$$

Source: <http://www.cnn.com/ELECTION/2000/results/index.epolls.html>

CNN conducted exit polls during the 2000 Presidential election. Voters were asked (1) *Who did you vote for?* and (2) *What is your race/ethnicity?*. Results available at [cnn.com](http://www.cnn.com) reveal:

- a) 54% of white voters (W) voted for George W. Bush (B)
- b) 41% of Asian voters (A) voted for Bush (B)
- c) 35% of Hispanic voters (H) voted for Bush (B)
- d) 9% of African-American (Af) voted for Bush (B)
- e) 39% of other races (O) voted for Bush (B)

Suppose that one of the voters interviewed by CNN is selected at random.

- 4) Explain why we cannot simply average these five percentages to find the percentage of all voters who voted for Bush. What would you need to know in order to find the total percent of voters who voted for Bush?

- 5) Translate the five percentages into probability statements:

$$.54 = P(\text{___} | \text{___}) \quad .41 = P(\text{___} | \text{___}) \quad .35 = P(\text{___} | \text{___}) \quad .09 = P(\text{___} | \text{___}) \quad .39 = P(\text{___} | \text{___})$$

- 6) The CNN exit poll results further revealed that 80% of those polled were white, 10% were African-American, 7% Hispanic, 2% Asian, and 1% other races. Record these as (unconditional) probabilities in the bottom row of the following table:

	White (W)	Asian (A)	Hispanic (H)	African-Amer (Af)	Others (O)	Total
Bush (B)						
Gore (G)						
Others (E)						
Total						1.00

- 7) Calculate $P(W \cap B)$ and write its value in the corresponding cell in the table. Explain what this probability represents.

- 8) Calculate the remaining probabilities to complete the first row of the table.

9) What is the probability of randomly selecting a voter who voted for Bush?

10) Use the following information to complete the table:

Al Gore (G) received: 42% of the white vote, 90% of the African-American vote, 62% of the Hispanic vote, 55% of the Asian vote, and 55% of the "other" vote.