Problem Set 4: Probability I

1. ***Fundamentals of Probability** $\mathbb{P}(A) = 0.3$, $\mathbb{P}(B) = 0.7$
   a. Can you compute $\mathbb{P}(A \text{ and } B)$ if you only know $\mathbb{P}(A)$ and $\mathbb{P}(B)$?
   b. Assuming that events A and B arise from independent random processes, What is $\mathbb{P}(A \text{ and } B)$? What is $\mathbb{P}(A \text{ or } B)$? What is $\mathbb{P}(A \mid B)$?
   c. If we are given that $\mathbb{P}(A \text{ and } B) = 0.1$, are the random variables giving rise to events A and B independent?
   d. If we are given that $\mathbb{P}(A \text{ and } B) = 0.1$, what is $\mathbb{P}(A \mid B)$?
2. **Experimental Design Review**
   a. Did your group utilize random assignment in your protocol? What was the unit that was being assigned? What were the different treatments they were being assigned to? What confounding variables were you trying to balance out through random assignment? If you did not use random assignment, how could you introduce it into your protocol?
   b. In what ways did your group work to control other factors that detracted from what you were trying to study? Did you use blinding? Double blinding? If not, how could you introduce it into your protocol?
   c. How many replicates of each condition / specific treatment did you use in your protocol? Do you think it was sufficient to eliminate random chance as a possible explanation for any effect you might see? If you were to conduct your experiment again, still with 50 minutes, how many replicate of each condition would you use?
   d. *Challenge Problem*: Transcribe your data from your handout to a data frame in R using the `data.frame()` function and create the plot that shows your results. Are they consistent or inconsistent with your original claim?