Problem 1

Define \( A \) = event exactly 9 people say yes.
1. The complement of \( A \) is the event that:
   a) anything other than 9 people say yes
   b) anything other than 9 people say no
   c) exactly 6 people say yes
   d) exactly 6 people say no
   e) more than 6 people say no

Problem 2

At a large university, the probability that a student takes calculus and statistics in the same semester is 0.0125. The probability that a student takes statistics is 0.125; the probability that a student takes calculus is 0.3

2. Find the probability that a student is taking calculus, given that he or she is taking statistics.
   a) 0.1
   b) 0.1125
   c) 0.0016
   d) 0.1375
   e) 0.4800

3. Is the event of taking calculus independent of the event of taking statistics? Justify your answer numerically.

Problem 3

11) If you flip a coin three times, the possible outcomes are HHH, HHT, HTH, THH, TTH, THT, TTT. What is the probability of getting at least one head?
   A) \( \frac{7}{8} \)
   B) \( \frac{1}{4} \)
   C) \( \frac{3}{4} \)
   D) \( \frac{1}{2} \)

12) When a quarter is tossed four times, 16 outcomes are possible.

   HHHH  HHTH  HTTH  THH
   HTHH  HTHT  THTH  TTH
   THHH  THTH  THHT  HTT
   TTHH  THTT  TTTH  TTT

   Here, for example, HTHH represents the outcome that the first toss is heads, the next two tosses are tails, and the fourth toss is heads. The events \( A \) and \( B \) are defined as follows:

   Event \( A \) = the first two tosses are heads
   Event \( B \) = the first and last tosses are the same

   Are the events \( A \) and \( B \) mutually exclusive?
   A) Yes  B) No

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7) In one town, 51% of all voters are Democrats. If two voters are randomly selected for a survey, find the probability that they are both Democrats.

A) 0.510  
B) 1.020  
C) 0.260  
D) 0.255

Problem 4

Topics: contingency table, conditional probability, joint probability, marginal probability.

The family college data set contains a sample of 792 cases with two variables, teen and parents, and is summarized in the following Table:

<table>
<thead>
<tr>
<th></th>
<th>parents</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>degree</td>
<td>not</td>
<td>Total</td>
</tr>
<tr>
<td>college</td>
<td>231</td>
<td>214</td>
<td>445</td>
</tr>
<tr>
<td>not</td>
<td>49</td>
<td>298</td>
<td>347</td>
</tr>
<tr>
<td>Total</td>
<td>280</td>
<td>512</td>
<td>792</td>
</tr>
</tbody>
</table>

The teen variable is either college or not, where the college label means the teen went to college immediately after high school. The parent’s variable takes the value degree if at least one parent of the teenager completed a college degree.

4. If at least one parent of a teenager completed a college degree, what is the chance the teenager attended college right after high school?

\[
\frac{231}{280}
\]

5. Probability of a random teenager from the study went to college:

\[
\frac{445}{792}
\]

Problem 5

Topics: general multiplication rule

A smallpox data set provides a sample of 6,224 individuals from the year 1721 who were exposed to smallpox in Boston. Doctors at the time believed that inoculation, which involves exposing a person to the disease in a controlled form, could reduce the likelihood of death.

Suppose we are given only two pieces of information: 96.08% of residents were not inoculated, and 85.88% of the residents who were not inoculated ended up surviving.

6. How could we compute the probability that a resident was not inoculated and lived?

\[
P(\text{Not inoculated and survived}) = P(\text{survived | not inoculated}) \times P(\text{not inoculated})
= 0.8588 \times 0.9608
\]

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Problem 6

Topics: tree diagram, conditional probability, addition rule.

After an introductory statistics course, 78% of students can successfully construct tree diagrams. Of those who can construct tree diagrams, 97% passed, while only 57% of those students who could not construct tree diagrams passed.

7. Organize this information into a tree diagram.

8. What is the probability that a randomly selected student passed?

\[ P(\text{Pass}) = P(\text{Successful and Pass}) + P(\text{No Successful and Pass}) = .78 \times .97 + .22 \times .57 \]

9. Compute the probability a student pass if it is known that she couldn’t construct a tree diagram?

\[ P(\text{Pass} \mid \text{No successful}) = .57 \]

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