Name __________

1. A survey of local car dealers revealed that 64% of all cars sold last month had CD players, 28% had alarm systems, and 22% had both CD players and alarm systems.
   a. What is the probability that one of these cars selected at random had neither a CD player nor an alarm system? Define the events C={car has CD player}; A={car has alarm system}.
   You want the probability of the complement of the union, that is, \( P(C \cup A)' \).
   \[
P(C \cup A) = P(C) + P(A) - P(C \cap A) = .64 + .28 - .22 = .70.
\]
   So \( P(C \cup A)' = 1 - P(C \cup A) = 1 - .70 = .30 \).

   b. What is the probability that a car had a CD player unprotected by an alarm system?
   \[
P(C \cap A') = .64 - .22 = .42
\]

   c. Are having a CD player and an alarm system disjoint events? \( P(C \cap A) = .22 \) so the answer is NO.

2. A survey of an introductory statistics class in a previous semester asked students whether or not they ate breakfast the morning of the survey. Results are as follows:

<table>
<thead>
<tr>
<th>Breakfast</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>15</td>
<td>42</td>
<td>57</td>
</tr>
<tr>
<td>Female</td>
<td>22</td>
<td>37</td>
<td>59</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>79</td>
<td>116</td>
</tr>
</tbody>
</table>

   a. What is the probability that a randomly selected student is a female? \( \frac{59}{116} \)

   b. What is the probability that a randomly selected student ate breakfast? \( \frac{37}{116} \)

   c. What is the probability that a randomly selected student is female and ate breakfast? \( \frac{22}{116} \)

   d. Given that a selected student is female, what is the probability that the student ate breakfast? \( \frac{22}{59} \)

   e. Given that a selected student ate breakfast, what is the probability that the student is female? \( \frac{22}{37} \)

   f. Does it appear that whether or not a student ate breakfast is independent of the student's gender? Since the answers to parts b. and d. are not the same, whether or not a student ate breakfast and gender are DEPENDENT.
3. A typical social security number is 575-38-4444. How many social security numbers are possible?

$10^9 = 1$ billion. How many social security numbers are possible if the first digit cannot be zero?

$9 \times 10^8 = 900,000,000$

4. At Wendy's Old Fashioned Hamburgers, they advertise that you can have hamburgers 256 ways. If they offer catsup, onion, mustard, pickles, lettuce, tomato, mayonnaise, and relish, is their claim correct? Since there are 8 condiments, the number of possible hamburger configurations is $2^8 = 256$.

5. Customer: So what's this new deal?

Pizza chef: Two pizzas.

Customer: [Towards four-year-old boy] Two pizzas. Write that down.

Pizza chef: And on the two pizzas choose any toppings—up to five [from a list of 11 toppings]

Older boy: Do you . . .

Pizza chef: . . . have to pick the same toppings on each pizza? NO!

Four-year-old math whiz: Then the possibilities are endless.

Customer: What do you mean? Five plus five are ten.

Math whiz: (Scribble, scribble) Actually, there are 1,048,576 possibilities.

Customer: Ten was just a ballpark figure.

Old man: You got that right, chump.

a. If you accept the facts of the advertisement (up to 5 toppings from a list of 11 toppings) and order one pizza per day, how many days can you order a different 5-topping pizza? (Does order make a difference here?) $11 \binom{5}{5} = 462$.

b. Answer part a) if you order a 4-topping pizza each day. $11 \binom{4}{4} = 330$.

c. How many days can you order a different 2-topping or 3-topping pizza?

$11 \binom{3}{3} + 11 \binom{2}{2} = 165 + 55 = 220$.

d. (Incorrect analysis by Little Caesar’s). Jean Sherrod of Little Caesar's Enterprises, Inc. explained that in the advertisement they count a “pizza pizza!” order in which the first pizza is ham and the second pizza is pepperoni as different from an order where the first pizza is pepperoni and the second pizza is ham. So here's how the four-year-old math whiz determined
that there were 1,048,576 “pizza pizza!” possibilities: (remember that you order up to 5 toppings from 11 toppings)

$$11 C_0 + 11 C_1 + 11 C_2 + 11 C_3 + 11 C_4 + 11 C_5 = 1024; \ (1024)^2 = 1,048,576.$$  

Do you agree with their calculations? No; they’re counting “order” when ordering the 2 pizzas.

e. The actual number of possibilities is $1024 C_1 + 1024 C_2 = 1024 + 523,776 = 524,800$. Think about it.

\[
\begin{align*}
\text{choose 1 topping comb.} & \quad \uparrow \\
\text{and order twice} & \quad \uparrow \\
\text{choose 2 different topping comb.}
\end{align*}
\]