An engineering construction firm is currently working on power plants at three different sites. Let $A_i$ denote the event that the plant at site $i$ is completed by the contract date. Use the operations of union, intersection, and complementation to describe each of the following events in terms of $A_1$, $A_2$, and $A_3$, draw a Venn diagram, and shade the region corresponding to each one.

(a) At least one plant is completed by the contract date.

- $A_1 \cap A_2 \cap A_3$
- $(A_1 \cap A_2' \cap A_3') \cup (A_1' \cap A_2 \cap A_3) \cup (A_1' \cap A_2' \cap A_3)$
- $A_1 \cup (A_2 \cap A_3)$
- $A_1 \cup A_2 \cup A_3$
- $A_1 \cap A_2 \cap A_3$
(b) All plants are completed by the contract date.

\[ (A_1 \cap A_2' \cap A_3') \cup (A_1' \cap A_2 \cap A_3') \cup (A_1' \cap A_2' \cap A_3') \]

- \( A_1 \cup A_2 \cup A_3 \)
- \( A_1 \cup (A_2 \cap A_3) \)
- \( A_1 \cap A_2' \cap A_3' \)
- \( A_1 \cap A_2 \cap A_3 \)
(c) Only the plant at site 1 is completed by the contract date.

- $A_1 \cap A_2 \cap A_3$
- $A_1 \cup A_2 \cup A_3$
- $(A_1 \cap A_2' \cap A_3') \cup (A_1' \cap A_2 \cap A_3') \cup (A_1' \cap A_2' \cap A_3')$
- $A_1 \cup (A_2 \cap A_3)$
- $A_1 \cap A_2' \cap A_3'$
(d) Exactly one plant is completed by the contract date.

- A₁ ∪ (A₂ ∩ A₃)
- A₁ ∩ A₂ ∩ A₃
- A₁ ∪ A₂ ∪ A₃
- (A₁ ∩ A₂' ∩ A₃) ∪ (A₁' ∩ A₂ ∩ A₃') ∪ (A₁' ∩ A₂' ∩ A₃)
- A₁ ∩ A₂' ∩ A₃'
(e) Either the plant at site 1 or both of the other plants are completed by the contract date.

- $A_1 \cap A_2 \cap A_3$
- $A_1 \cup A_2 \cup A_3$
- $(A_1 \cap A_2' \cap A_3') \cup (A_1' \cap A_2 \cap A_3') \cup (A_1' \cap A_2 \cap A_3')$
- $A_1 \cup (A_2 \cap A_3)$
- $A_1 \cap A_2' \cap A_3'$
2. 10/10 points  |  Previous Answers  |  DevoreStat8 2.E.012.
Consider randomly selecting a student at a certain university, and let \( A \) denote the event that the selected individual has a Visa credit card and \( B \) be the analogous event for a MasterCard. Suppose that \( P(A) = 0.2 \), \( P(B) = 0.3 \), and \( P(A \cap B) = 0.05 \).

(a) Compute the probability that the selected individual has at least one of the two types of cards (i.e., the probability of the event \( A \cup B \)).
\[
0.45 \quad \text{✓} \quad 0.45
\]

(b) What is the probability that the selected individual has neither type of card?
\[
0.55 \quad \text{✓} \quad 0.55
\]

(c) Describe, in terms of \( A \) and \( B \), the event that the selected student has a Visa card but not a MasterCard.
\[
\boxed{A' \cap B}
\]
Calculate the probability of this event.
\[
0.15 \quad \text{✓} \quad 0.15
\]

Need Help?  |  Read It

3. 10/10 points  |  Previous Answers  |  DevoreStat8 2.E.019.
Human visual inspection of solder joints on printed circuit boards can be very subjective. Part of the problem stems from the numerous types of solder defects (e.g., pad non-wetting, knee visibility, voids) and even the degree to which a joint possesses one or more of these defects. Consequently, even highly trained inspectors can disagree on the disposition of a particular joint. In one batch of 10,000 joints, inspector A found 731 that were judged defective, inspector B found 748 such joints, and 1058 of the joints were judged defective by at least one of the inspectors. Suppose that one of the 10,000 joints is randomly selected.

(a) What is the probability that the selected joint was judged to be defective by neither of the two inspectors? (Enter your answer to four decimal places.)
\[
0.8942 \quad \text{✓} \quad 0.8942
\]

(b) What is the probability that the selected joint was judged to be defective by inspector B but not by inspector A? (Enter your answer to four decimal places.)
\[
0.0327 \quad \text{✓} \quad 0.0327
\]

Need Help?  |  Read It
An insurance company offers four different deductible levels—none, low, medium, and high—for its homeowner’s policyholders and three different levels—low, medium, and high—for its automobile policyholders. The accompanying table gives proportions for the various categories of policyholders who have both types of insurance. For example, the proportion of individuals with both low homeowner’s deductible and low auto deductible is 0.06 (6% of all such individuals).

<table>
<thead>
<tr>
<th>Homeowner’s</th>
<th>N</th>
<th>L</th>
<th>M</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>0.04</td>
<td>0.06</td>
<td>0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>M</td>
<td>0.07</td>
<td>0.09</td>
<td>0.20</td>
<td>0.13</td>
</tr>
<tr>
<td>H</td>
<td>0.02</td>
<td>0.03</td>
<td>0.15</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Suppose an individual having both types of policies is randomly selected.

(a) What is the probability that the individual has a medium auto deductible and a high homeowner’s deductible?

\[
\begin{align*}
\text{Auto deductible} & \quad 0.16 \quad 0.16 \\
\text{homeowner's deductible} & \quad 0.18 \quad 0.18
\end{align*}
\]

(b) What is the probability that the individual has a low auto deductible? A low homeowner’s deductible?

\[
\begin{align*}
\text{auto deductible} & \quad 0.16 \quad 0.16 \\
\text{homeowner's deductible} & \quad 0.18 \quad 0.18
\end{align*}
\]

(c) What is the probability that the individual is in the same category for both auto and homeowner’s deductibles?

\[
\begin{align*}
\text{N} & \quad 0.41 \quad 0.41 \\
\text{L} & \quad 0.41 \quad 0.41 \\
\text{M} & \quad 0.41 \quad 0.41 \\
\text{H} & \quad 0.41 \quad 0.41
\end{align*}
\]

(d) Based on your answer in part (c), what is the probability that the two categories are different?

\[
\begin{align*}
\text{N} & \quad 0.59 \quad 0.59 \\
\text{L} & \quad 0.59 \quad 0.59 \\
\text{M} & \quad 0.59 \quad 0.59 \\
\text{H} & \quad 0.59 \quad 0.59
\end{align*}
\]

(e) What is the probability that the individual has at least one low deductible level?

\[
\begin{align*}
\text{N} & \quad 0.28 \quad 0.28 \\
\text{L} & \quad 0.28 \quad 0.28 \\
\text{M} & \quad 0.28 \quad 0.28 \\
\text{H} & \quad 0.28 \quad 0.28
\end{align*}
\]

(f) Using the answer in part (e), what is the probability that neither deductible level is low?

\[
\begin{align*}
\text{N} & \quad 0.72 \quad 0.72 \\
\text{L} & \quad 0.72 \quad 0.72 \\
\text{M} & \quad 0.72 \quad 0.72 \\
\text{H} & \quad 0.72 \quad 0.72
\end{align*}
\]
5. 10/10 points | Previous Answers

The route used by a certain motorist in commuting to work contains two intersections with traffic signals. The probability that he must stop at the first signal is 0.43, the analogous probability for the second signal is 0.46, and the probability that he must stop at least one of the two signals is 0.53. What is the probability that he must stop

(a) At both signals?

0.36 ✓ 0.36

(b) At the first signal but not at the second one?

0.07 ✓ 0.07

(c) At exactly one signal?

0.17 ✓ 0.17


Need Help? Read It

6. 7/10 points | Previous Answers

A family consisting of three persons—A, B, and C—goes to a medical clinic that always has a doctor at each of stations 1, 2, and 3. During a certain week, each member of the family visits the clinic once and is assigned at random to a station. The experiment consists of recording the station number for each member. Suppose that any incoming individual is equally likely to be assigned to any of the three stations irrespective of where other individuals have been assigned. What is the probability that

(a) All three family members are assigned to the same station? (Round your answer to three decimal places.)

0.111 ✓ 0.111

(b) At most two family members are assigned to the same station? (Round your answer to three decimal places.)

0.666 × 0.889

(c) Every family member is assigned to a different station? (Round your answer to three decimal places.)

0.222 ✓ 0.222

Need Help? Read It
The population of a particular country consists of three ethnic groups. Each individual belongs to one of the four major blood groups. The accompanying joint probability table gives the proportions of individuals in the various ethnic group-blood group combinations.

<table>
<thead>
<tr>
<th>Blood Group</th>
<th>O</th>
<th>A</th>
<th>B</th>
<th>AB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.082</td>
<td>0.110</td>
<td>0.008</td>
<td>0.004</td>
</tr>
<tr>
<td>Ethnic Group 2</td>
<td>0.131</td>
<td>0.141</td>
<td>0.018</td>
<td>0.006</td>
</tr>
<tr>
<td>3</td>
<td>0.215</td>
<td>0.195</td>
<td>0.070</td>
<td>0.020</td>
</tr>
</tbody>
</table>

Suppose that an individual is randomly selected from the population, and define events by $A = \{\text{type A selected}\}$, $B = \{\text{type B selected}\}$, and $C = \{\text{ethnic group 3 selected}\}$.

(a) Calculate $P(A)$, $P(C)$, and $P(A \cap C)$. (Enter your answers to three decimal places.)

- $P(A) = 0.446$
- $P(C) = 0.500$
- $P(A \cap C) = 0.195$

(b) Calculate both $P(A \mid C)$ and $P(C \mid A)$. (Round your answers to three decimal places.)

- $P(A \mid C) = 0.390$
- $P(C \mid A) = 0.437$

Explain in context what each of these probabilities represents. (Select all that apply.)

- [ ] If a person has type B blood, the probability that he is from ethnic group 3 is given by $P(C \mid A)$.
- [ ] If we know that the individual came from ethnic group 3, the probability that he has type A is given by $P(C \mid A)$.
- [x] If we know that the individual came from ethnic group 3, the probability that he has type A is given by $P(A \mid C)$.
- [ ] If a person has type B blood, the probability that he is from ethnic group 3 is given by $P(A \mid C)$.
- [x] If a person has type A blood, the probability that he is from ethnic group 3 is given by $P(C \mid A)$.
- [ ] If a person has type A blood, the probability that he is from ethnic group 3 is given by $P(A \mid C)$.

(c) If the selected individual does not have type B blood, what is the probability that he or she is from ethnic group 1? (Round your answer to three decimal places.)

- $0.217$

Need Help? Read It
8. 10/10 points | Previous Answers

Consider randomly selecting a student at a certain university, and let $A$ denote the event that the selected individual has a Visa credit card and $B$ be the analogous event for a MasterCard where $P(A) = 0.50$, $P(B) = 0.45$, and $P(A \cap B) = 0.30$. Calculate and interpret each of the following probabilities (a Venn diagram might help). (Round your answers to four decimal places.)

(a) $P(B | A)$

(b) $P(B' | A)$

(c) $P(A | B)$

(d) $P(A' | B)$

(e) Given that the selected individual has at least one card, what is the probability that he or she has a Visa Card? Hint: Mathematically, this can be expressed as $P(A | A \cup B)$. Like parts (a)-(d), this may be solved by dividing two numbers.

9. 10/10 points | Previous Answers

Suppose that the proportions of blood phenotypes in a particular population are as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.48</td>
</tr>
<tr>
<td>B</td>
<td>0.14</td>
</tr>
<tr>
<td>AB</td>
<td>0.04</td>
</tr>
<tr>
<td>O</td>
<td>0.34</td>
</tr>
</tbody>
</table>

Assuming that the phenotypes of two randomly selected individuals are independent of one another, what is the probability that both phenotypes are O? (Enter your answer to four decimal places.)

What is the probability that the phenotypes of two randomly selected individuals match? (Enter your answer to four decimal places.)
10. 10/10 points | Previous Answers

Consider the system of components connected as in the accompanying picture. Components 1 and 2 are connected in parallel, so that subsystem works if and only if either 1 or 2 works; since 3 and 4 are connected in series, that subsystem works if and only if both 3 and 4 work. If components work independently of one another and \( P(\text{component works}) = 0.85 \), calculate \( P(\text{system works}) \). (Round your answer to four decimal places.)

\[ 0.9938 \]

11. 10/10 points | Previous Answers

Sixty percent of all vehicles examined at a certain emissions inspection station pass the inspection. Assuming that successive vehicles pass or fail independently of one another, calculate the following probabilities. (Enter your answers to three decimal places.)

(a) \( P(\text{all of the next three vehicles inspected pass}) \)

\[ 0.216 \]

(b) \( P(\text{at least one of the next three inspected fails}) \)

\[ 0.784 \]

(c) \( P(\text{exactly one of the next three inspected passes}) \)

\[ 0.288 \]

(d) \( P(\text{at most one of the next three vehicles inspected passes}) \)

\[ 0.352 \]

(e) Given that at least one of the next three vehicles passes inspection, what is the probability that all three pass? Round your answer to three decimal places. \( \text{Hint}: \) This may be written as \( P(\text{all three pass} | \text{at least one passes}) \).

\[ 0.231 \]

12. 10/10 points | Previous Answers

A lumber company has just taken delivery on a lot of 10,000 2 x 4 boards. Suppose that 20% of these boards (2,000) are actually too green to be used in first-quality construction. Two boards are selected at random, one after the other. Let \( A = \{\text{the first board is green}\} \) and \( B = \{\text{the second board is green}\} \).

(a) Compute \( P(A), P(B), \) and \( P(A \cap B) \) (a tree diagram might help). (Round your answer for \( P(A \cap B) \) to five decimal places.)

\[ P(A) = 0.2 \]
\[ P(B) = 0.2 \]
\[ P(A \cap B) = 0.03998 \]

Are \( A \) and \( B \) independent?
(b) With \(A\) and \(B\) independent and \(P(A) = P(B) = 0.2\), what is \(P(A \cap B)\)?

\[0.04\]  

How much difference is there between this answer and \(P(A \cap B)\) in part (a)?

- No, the two events are not independent.
- Yes, the two events are independent.

For purposes of calculating \(P(A \cap B)\), can we assume that \(A\) and \(B\) of part (a) are independent to obtain essentially the correct probability?

- Yes
- No

(c) Suppose the lot consists of ten boards, of which two are green. Does the assumption of independence now yield approximately the correct answer for \(P(A \cap B)\)?

- Yes
- No

What is the critical difference between the situation here and that of part (a)?

- The critical difference is that the population size in part (a) is small compared to the random sample of two boards.
- The critical difference is that the percentage of green boards is smaller in part (a).
- The critical difference is that the percentage of green boards is larger in part (a).
- The critical difference is that the population size in part (a) is huge compared to the random sample of two boards.

When do you think that an independence assumption would be valid in obtaining an approximately correct answer to \(P(A \cap B)\)?

- This assumption would be valid when the population is much larger than the sample size.
- This assumption would be valid when there are fewer green boards in the sample.
- This assumption would be valid when the sample size is very large.
- This assumption would be valid when there are more green boards in the sample.