15.b - More Basic Probability

0) Group Order for Monday

1) Venn Diagrams and Assignment Correction

2) Notes 15.b : General Multiplication Rule

3) Examples and Tables

4) Notes 15.b : Hey! Put that back!

5) Assignment Time

Presentation Groups and Order

MH, RT, CD
KL, NC, NB
SM, FC, EF
SK, EC
DG, VD, BM, VV
SA, SM, PC, SR
15.b - General Multiplication Rule

**General Multiplication Rule**
- no longer requires independence
- instead it does consider influence
  \[ P(A \cap B) = P(A) \times P(B \mid A) \]
- the probability that A and B happen is the probability of A multiplied by the probability of B happening if A happens
- if A and B are independent events then
  \[ P(B \mid A) = P(B) \]
  this also goes back to the idea in Part I
Rearrange!! : \[ P(B \mid A) = \frac{P(A \cap B)}{P(A)} \]

Remember: Disjoint events cannot be independent
Using Independence and Multiplication Rule

<table>
<thead>
<tr>
<th>Gender</th>
<th>Jeans</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>12</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Females</td>
<td>8</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>16</td>
<td>36</td>
</tr>
</tbody>
</table>

1) What is the probability that a male wears jeans?
\[ P(\text{Jeans} | \text{Male}) = \frac{P(\text{Jeans} \cap \text{Male})}{P(\text{Male})} = \frac{17/36}{12/36} = \frac{17/36}{12/36} = 17/36 \]

2) What is the probability that a someone wearing jeans is male?
\[ P(\text{Male} | \text{Jeans}) = \frac{P(\text{Male} \cap \text{Jeans})}{P(\text{Jeans})} = \frac{12/36}{20/36} = \frac{12/36}{20/36} = 12/36 = 0.333 \]

3) Are being male, and wearing jeans disjoint?
\[ P(\text{Jeans} | \text{Male}) \neq P(\text{Jeans}) \]

4) Are gender and lower apparel choice independent?
\[ P(\text{Jeans} | \text{Male}) \neq P(\text{Jeans}) \]

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15.b - Drawing without Replacement

-we need to be real careful with selecting from a group

-without replacement, the individual trials are not independent

Super Easy Example:
-standard deck of cards, two cards are drawn from top

\[ P(\text{both cards are aces}) = P(A_1) \cdot P(A_2 | A_1) \]
\[ = \frac{4}{52} \cdot \frac{3}{51} \]

\[ = \frac{4}{52} \cdot \frac{3}{51} \]
Using Common Probability Rules

Using a standard deck of cards...

1) One card is drawn, what is the probability it is red or an ace
   \[ P(A \cup \text{Red}) = P(A) + P(\text{Red}) - P(A \cap \text{Red}) \]

2) What is the probability of drawing five cards that are all hearts
   \[ P(H_1, H_2, H_3, H_4, H_5) = P(H_1) \cdot P(H_2|H_1) \cdot \frac{10}{49} \cdot \frac{9}{48} \]

3) I draw a card, tell you it's red. What is the probability it's a heart?
   \[ P(\text{Heart} | \text{Red}) = \frac{P(\text{Red} \cap \text{Heart})}{P(\text{Red})} = \frac{13/52}{26/52} = 1/2 \]

4) I draw a card, tell you it's a heart. What is the probability it's red?
   \[ P(\text{Red} | \text{Heart}) = \frac{P(\text{Red} \cap \text{Heart})}{P(\text{Heart})} = \frac{13/52}{13/52} = 1 \]

Understanding Independent and Mutually Exclusive

Using a standard deck of cards, are the following Independent? Mutually Exclusive? (Disjoint)

1) red card and spade
   \[ \text{NO} \quad \text{Yes} \]

2) red card and ace
   \[ P(\text{red}) = P(\text{red} | \text{ace}) \quad \frac{1}{2} = \frac{2}{3} \]
   \[ \text{Yes} \quad \text{NO} \]

3) face card and king
   \[ P(\text{face}) = P(\text{face} | \text{king}) \quad \frac{12}{52} = \frac{4}{4} \]
   \[ \text{No} \quad \text{No} \]
Assignment (Due Thursday, January 7)

1) Pg. 361, #12-17, 19, 21, 23
   - create Venn diagrams when appropriate
   - look over #1-11 even too!!

2) Read Chapter 15, Pg. 345-354