

Stat 104 – Lecture 13

Special Addition Rule

- Addition Rule for disjoint events.

$$-P(A \text{ or } B) = P(A) + P(B)$$

$$-P(\text{First or Second})$$

$$= P(\text{First}) + P(\text{Second})$$

$$= 329/2223 + 285/2223$$

$$= 614/2223 = 0.276 \text{ or } 27.6\%$$

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General Addition Rule

- $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

- $P(\text{Saved or First Class})$

$$= P(\text{Saved}) + P(\text{First Class})$$

$$- P(\text{Saved and First Class})$$

$$= 706/2223 + 329/2223$$

$$- 199/2223 = 0.376 \text{ or } 37.6\%$$

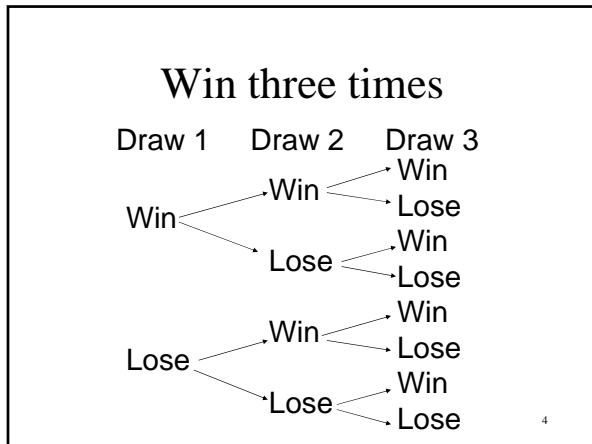
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Independent Trials

- Independent trials – sampling with replacement.
- Mix population, draw an item from the population, return the item before the next mix and draw.

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Independent Trials

- Multiplication rule for independent trials.

$$P(\text{Win 1}^{\text{st}} \text{ and Win 2}^{\text{nd}} \text{ and Win 3}^{\text{rd}}) = P(\text{Win 1}^{\text{st}}) * P(\text{Win 2}^{\text{nd}}) * P(\text{Win 3}^{\text{rd}})$$

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Example

- What is the chance that three people in a row win bonus points?
 - $P(\text{Win 1}^{\text{st}}) = P(\text{Blue or Red}) = P(\text{Blue}) + P(\text{Red}) = 0.4$
 - $P(\text{Win 2}^{\text{st}}) = 0.4, P(\text{Win 3}^{\text{rd}}) = 0.4$
 - $P(\text{Win 1}^{\text{st}} \text{ and Win 2}^{\text{nd}} \text{ and Win 3}^{\text{rd}}) = P(\text{Win 1}^{\text{st}}) * P(\text{Win 2}^{\text{nd}}) * P(\text{Win 3}^{\text{rd}}) = 0.4 * 0.4 * 0.4 = 0.064 \text{ or } 6.4\%$

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Conditional Probability

- Probability relative to a pre-existing condition.
- $P(A|B)$: The probability of A occurring given B has occurred.

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Conditional Probability

- $P(\text{Saved}|\text{First Class})$ =number of First Class who were saved relative to the total number of First Class passengers
– $P(\text{Saved}|\text{First Class}) = 199/329$
= 0.61 or 61%.

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Conditional Probability

$$P(A | B) = \frac{P(A \text{ and } B)}{P(B)}$$
$$P(\text{Saved} | \text{FirstClass}) = \frac{P(\text{Saved and First Class})}{P(\text{First Class})}$$
$$= \frac{0.090}{0.148} = 0.61$$

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Multiplication Rule

- $P(A \text{ and } B) = P(A) * P(B|A)$
- $P(\text{First Class and Saved}) = P(\text{First Class}) * P(\text{Saved}|\text{First Class}) = (329/2223) * 0.61 = 0.09$ or 9%
- $P(\text{First Class and Saved}) = 199/2223 = 0.09$ or 9%

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Independent Events

- Two events are independent if the probability of the occurrence of one event does not effect nor is it affected by the occurrence of the other event.
- $P(A) = P(A|B) = P(A|B^C)$
- $P(B) = P(B|A) = P(B|A^C)$

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Not independent events

- Saved and First Class are not independent events because:
 - $P(\text{Saved}) = 0.318$
 - $P(\text{Saved}|\text{First Class}) = 0.605$
 - The two probabilities are not equal.

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