

Stat 101L: Lecture 22

Probability Rules

*In Chapter 14 we were introduced to some simple rules of probability in Chapter 15 we will look at more general rules.

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Surviving the Titanic

	Crew	First	Second	Steerage	Total
Saved	214	199	119	174	706
Lost	685	130	166	536	1517
	899	329	285	710	2223

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Probability of Surviving

- *If we select an individual at random from the Titanic, what is the chance that individual survived?
- *Each individual has an equal chance of being selected.

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Formal Probability

$$P(\text{Event}) = \frac{\text{\# of outcomes in Event}}{\text{Total \# of outcomes}}$$

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Probability of survival

- *Probability individual selected was saved
– $706/2223=0.318$ or 31.8%
- *Probability individual selected was lost
– $1517/2223=0.682$ or 68.2%

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General Addition Rule

- * $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$
- * $P(\text{Saved or First Class}) = P(\text{Saved}) + P(\text{First Class}) - P(\text{Saved and First Class}) = 706/2223 + 329/2223 - 199/2223 = 0.376$ or 37.6%

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Special Addition Rule

- * Disjoint (mutually exclusive) events
 - no outcomes in common.
 - $P(A \text{ and } B) = 0$
- * Addition Rule for disjoint events.
 - $P(A \text{ or } B) = P(A) + P(B)$
 - $P(\text{First or Second}) = P(\text{First}) + P(\text{Second}) = 329/2223 + 285/2223 = 614/2223 = 0.276$ or 27.6%

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Conditional Probability

- * Probability relative to a pre-existing condition.
- * $P(A|B)$: The probability of A occurring, given B has already 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
 - $P(\text{Saved}|\text{First Class}) = 199/329 = 0.605$ or 60.5%.

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General Multiplication Rule

- * $P(A \text{ and } B) = P(A) * P(B|A)$
- * $P(\text{First Class and Saved}) = P(\text{First Class}) * P(\text{Saved}|\text{First Class}) = (329/2223) * 0.605 = 0.09$ 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.
- * $P(A) = P(A|B) = P(A|B^C)$

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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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Independent Trials

- *Sampling with replacement creates independent trials.
- $P(\text{Red on 1}^{\text{st}} \text{ and Red on 2}^{\text{nd}}) = P(\text{Red on 1}^{\text{st}})P(\text{Red on 2}^{\text{nd}})$

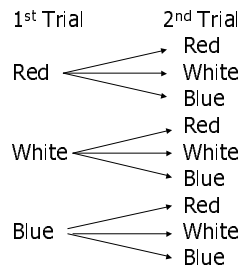
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Dependent Trials

- *Sampling without replacement creates dependent trials.
- $P(\text{Red on 1}^{\text{st}} \text{ and Red on 2}^{\text{nd}}) = P(\text{Red on 1}^{\text{st}})P(\text{Red on 2}^{\text{nd}}|\text{Red on 1}^{\text{st}})$

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Tree diagram



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