

Statistics - Math 410, 10/5/2011

1. REVIEW OF NOTATION AND PROBABILITY RULES

- S is the set of all possible outcomes of some experiment.
- $E, F \subseteq S$, so E is a set of *some* possible outcomes, and F is a (usually) different set of possible outcomes.
- $E \cap F = E$ and F means the set of outcomes that are in *both* E and F .
- $E \cup F = E$ or F means the set of outcomes that are in at least one of E or F .

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$$\text{not } E = S - E$$

is the set of outcomes in S that are *not* in E . The text also writes this as E' .

- $P(E)$ means the probability of the outcome (which must be *something* in S) being in E .
- $P(S) = 1$
- $P(\emptyset) = 0$.

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$$P(E \cup F) = P(E) + P(F) - P(E \cap F)$$

which we can rewrite as

$$P(E \cap F) = P(E) + P(F) - P(E \cup F).$$

This is the “Basic Addition Rule” from p. 93

- $P(E|F)$ is the probability of E if we already know F . That is, it is the probability that the outcome of our experiment is in E if we already know it is in F .

$$P(E|F) = \frac{P(E \cap F)}{P(F)}$$

This is the definition of conditional probability, and if we rewrite it, we get

$$P(E \cap F) = P(E|F)P(F)$$

which is the “Basic Multiplication Rule” on p. 99.

- $P(E') = 1 - P(E)$. This is a consequence of the basic addition rule, and the fact that $E \cap E' = \emptyset$.

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$$(E \cap F)' = E' \cup F'$$

This is one of de Morgan’s laws. This is true because x is an outcome that is not in $E \cap F$ if and only if x is either not in E or not in F , so if and only if x is in $E' \cup F'$.

Consequently:

$$P(E' \cup F') = P((E \cap F)') = 1 - P(E \cap F).$$

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$$(E \cup F)' = E' \cap F'$$

This is the other of de Morgan's laws. It is true because x is an outcome not in $E \cup F$ if and only if x is not in E and x is not in F , so if and only if x is in $E' \cap F'$

Consequently:

$$P(E' \cap F') = P((E \cup F)') = 1 - P(E \cup F).$$