Sample Spaces

random experiment: same experiment repeated the same way every time gives different outcomes.

Sample space: set of all possible outcomes of a random experiment

denoted S { }

discrete: finite or "countably infinite" set of outcomes

ex: S {yes no}

S {heads tails}

S {1 2 3 4 5 6}

Continuous : interval of real numbers

ex : $S = \{118 < V < 122\}$ (V_{RMS})

event : subset or included unit in a sample space, denoted E_1, E_2, E_3 etc..

- combination of existing events is also an event!

Set Operations

Union of two events : includes all outcomes in either event

$$E_1 \cup E_2$$

intersection of two events: includes only outcomes common to both events

$$E_1 \cap E_2$$

Compliment of an event: all outcomes in sample space not in the event, including outcomes not in other events!

$$E'$$

ex: two manufactured parts

∴ each part is either good or bad;

i.e., conforms to some spec or doesn't

y n

∴ Sample space is

$$S\{yy \quad yn \quad ny \quad nn\}$$

yy: both parts good

yn: first good, second bad

ny: first bad, second good

nn: both bad

(later: will determine probabilities associated with these outcomes)

define E_1: outcomes in which at least <u>one</u> part conforms

$\therefore E_1 \{ yy \;\; yn \;\; ny \}$

define E_2: <u>neither</u> part conforms

$\therefore E_2 \{ nn \}$

define E_5: at least one <u>fails</u> to conform

$\therefore E_5 \{ yn \;\; ny \;\; nn \}$

determine $E_1 \cup E_5$, $E_1 \cap E_5$, and E_1'

$$E_1 \cup E_5 = \{yy \quad yn \quad ny \quad nn\}$$

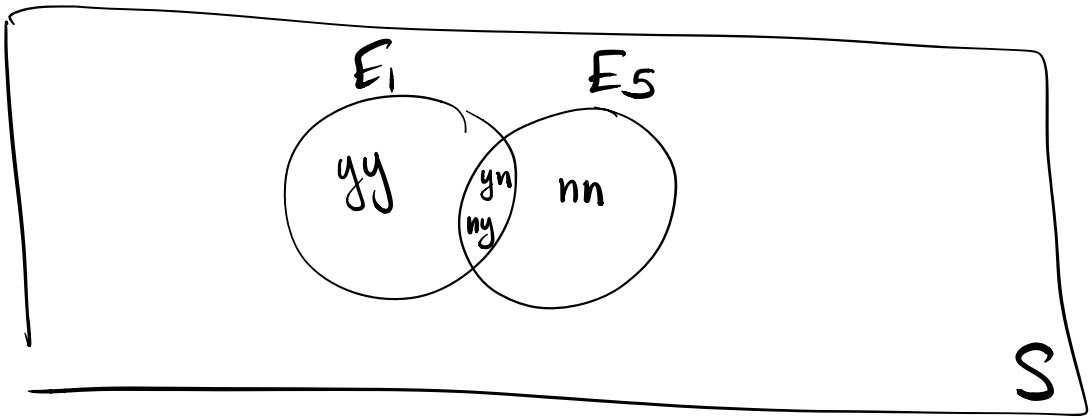
all events included in both, but don't count twice

$$= S \quad \text{(entire sample space)}$$

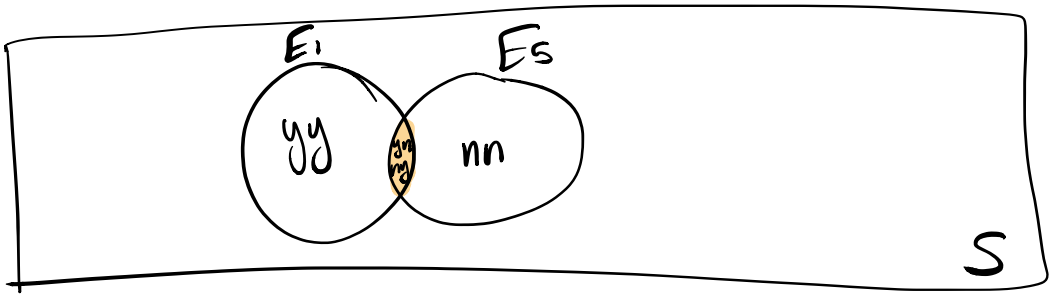
$$E_1 \cap E_5 = \{yn \quad ny\}$$

$$E_1' = \{nn\}$$

Venn Diagrams

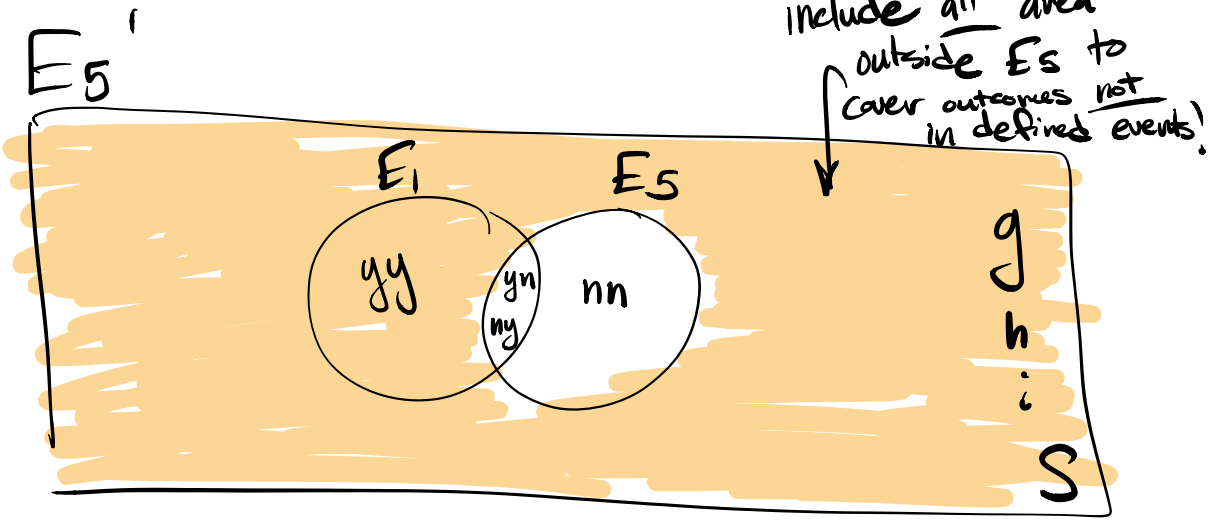


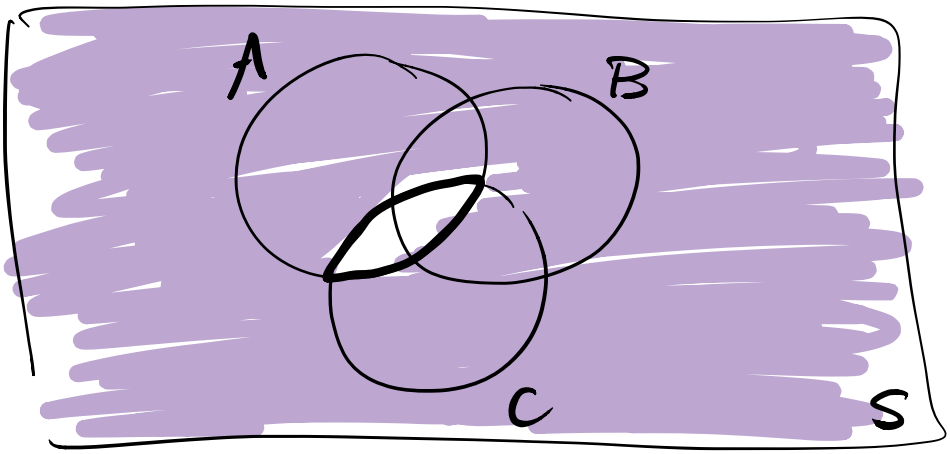
ex: $E_1 \cap E_5$



E_5'

include all area outside E_5 to cover outcomes not in defined events!





$(A \cap C)'$

∴ if two events are mutually exclusive:

$$A \cap B = \emptyset$$

↑ null set!