Notes--Adding Probabilities

mutually exclusive events are events which have no elements in common.

example: draw a card. p(ace or 2)

not an example: draw a card. p(heart or red)

> If A and B are mutually exclusive:
>
> $p(A \cup B) = p(A) + p(B)$
>
> ↑ "OR"
>
> If A and B are not mutually exclusive:
>
> $p(A \cup B) = p(A) + p(B) - p(A \cap B)$

Example 1 Draw a card. Find:

A. p(ace or 2) $= p(\text{ace}) + p(2) = \frac{4}{52} + \frac{4}{52} = \frac{2}{13} = .154$

m.e.

B. p(heart or red) $= p(\text{heart}) + p(\text{red}) - p(\text{ht. AND red})$

not m.e. $= \frac{13}{52} + \frac{26}{52} - \frac{13}{52} = \frac{1}{2} = .5$

C. p(ace or heart) $= p(\text{ace}) + p(\text{heart}) - p(\text{ace \& heart})$

not m.e. $= \frac{4}{52} + \frac{13}{52} - \frac{1}{52} = \frac{4}{13} = .308$

D. p(black or a # less than 4)

$= p(\text{black}) + p(\#<4) - p(\text{blk AND } \#<4)$

not m.e. $= \frac{26}{52} + \frac{8}{52} - \frac{4}{52} = \frac{15}{26} = .577$

Example 2 Roll 2 dice. Find:

A. p(sum is 3 or 4) $p(\text{sum}=3) + p(\text{sum}=4)$

m.e. $\frac{2}{36} + \frac{3}{36} = \frac{5}{36} = .139$

B. p(sum is 1 or 2) $p(\text{sum}=1) + p(\text{sum}=2)$

m.e. $\frac{0}{36} + \frac{1}{36} = \frac{1}{36} = .028$

Example 3 Roll 1 die. Find:

A. p(odd # or even #) $= p(\text{odd}) + p(\text{even}) = \frac{3}{6} + \frac{3}{6} = 1$

m.e.

B. p(even # or 4) $= p(\text{even}) + p(4) - p(\text{even} \text{ \& } 4)$

not m.e.

$= \frac{3}{6} + \frac{1}{6} - \frac{1}{6} = \frac{1}{2} = .5$

Example 4 A high school has 1400 students. 550 take French, 700 take algebra, and 400 take both French and algebra. Select a student. Find p(French or algebra).

not m.e.

$p(\text{Fr.}) + p(\text{alg}) - p(\text{Fr \& alg})$

$\frac{550}{1400} + \frac{700}{1400} - \frac{400}{1400} = \frac{850}{1400} = \frac{17}{28} = .607$

Example 5 From a deck of cards, pick 2 cards. Find:

A. p(both jacks or both 10's) $= p(\text{both jacks}) + p(\text{both 10's})$

m.e.

$\frac{4}{52} \cdot \frac{3}{51} + \frac{4}{52} \cdot \frac{3}{51} = \frac{24}{2652} = \frac{2}{221} = .009$

B. p(both black or both 5's) $= p(\text{both blk}) + p(\text{both 5's}) - p(\text{both blk \& 5's})$

not m.e.

$= \frac{26}{52} \cdot \frac{25}{51} + \frac{4}{52} \cdot \frac{3}{51} - \frac{2}{52} \cdot \frac{1}{51} = \frac{660}{2652} = \frac{55}{221}$

$= .249$

Example 6 The data below represents the distribution, by branch and gender, of active-duty personnel in the US military. If one person is randomly selected from the US military, find the probability that this person is in the Army or is a woman.

Active-duty US Military Personnel (in thousands)

	Air Force	Army	Marine Corps	Navy	Total
Male	290	400	160	320	1170
Female	70	70	10	50	200
Total	360	470	170	370	1370

p(Army OR woman)

not m.e.

$p(\text{Army}) + p(\text{woman}) - p(\text{Army \& woman})$

$\frac{470}{1370} + \frac{200}{1370} - \frac{70}{1370} = \frac{600}{1370} = \frac{60}{137} = .438$