Statistics

Summer 2021

Lecture 8

Multiplication Rule:

Keyword : AND

Multiple-Action event

$P(A \text{ and } B) = P(A) \cdot P(B \mid A)$

A happens first, then B happens

Given

with some algebra work

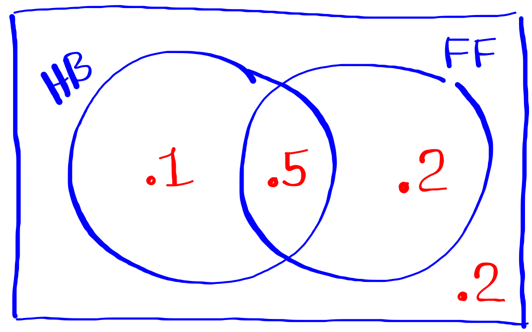
$$\boxed{P(B \mid A) = \frac{P(A \text{ and } B)}{P(A)}}$$

Conditional Prob.

$P(HB) = .6$

$P(FF) = .7$

$P(HB \text{ and } FF) = .5$



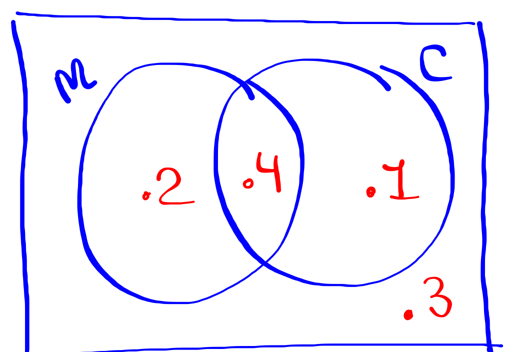
$$P(FF \mid HB) = \frac{P(HB \text{ and } FF)}{P(HB)} = \frac{.5}{.6} = \frac{5}{6} = \boxed{.833}$$

$$P(HB \mid FF) = \frac{P(HB \text{ and } FF)}{P(FF)} = \frac{.5}{.7} = \frac{5}{7} = \boxed{.714}$$

$P(Math) = .6$

$P(Calc) = .5$

$P(math \text{ and } Calc) = .4$



$$P(Calc \mid Math) = \frac{P(Math \;\&\; Calc)}{P(Math)} = \frac{.4}{.6} = \frac{4}{6} = \boxed{\frac{2}{3}} = \boxed{.667}$$

$$P(math \mid Calc) = \frac{P(M \;\&\; C)}{P(C)} = \frac{.4}{.5} = \frac{4}{5} = \boxed{.8}$$

$P(\text{Shoes}) = .8$

$P(\text{pants}) = .7$

$P(\text{Pants} \mid \text{Shoes}) = .75$

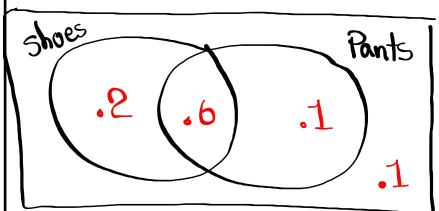
Find $P(\text{Shoes and pants})$

$$P(\text{pants} \mid \text{Shoes}) = \frac{P(\text{Shoes \& Pants})}{P(\text{Shoes})}$$

$$.75 = \frac{P(\text{Shoes \& Pants})}{.8}$$

Cross-Multiply

$P(\text{Shoes \& Pants}) = .75(.8) = \boxed{.6}$



$$P(\text{Shoes} \mid \text{Pants}) = \frac{P(\text{Shoes \& Pants})}{P(\text{pants})} = \frac{.6}{.7} = \boxed{\frac{6}{7}} = \boxed{.857}$$

Remember this example : Shirt & tie

Prob. with at least 1 :

$$\boxed{P(\text{at least } 1) = 1 - P(\text{None})}$$

3 Women & 7 Men Select 3 people
NO replacement

$P(WWW) = \frac{3}{10} \cdot \frac{2}{9} \cdot \frac{1}{8} = \boxed{\frac{1}{120}}$

$P(MMM) = \frac{7}{10} \cdot \frac{6}{9} \cdot \frac{5}{8} = \boxed{\frac{7}{24}}$

W W W

Some M & Some W

M M M

$P(\text{at least 1 woman}) = 1 - P(\text{No Woman})$
$= 1 - P(\text{All Men}) = 1 - \frac{7}{24} = \boxed{\frac{17}{24}}$

$P(\text{at least 1 Man}) = 1 - P(\text{No Man})$
$= 1 - P(\text{All W}) = 1 - \frac{1}{120} = \boxed{\frac{119}{120}}$

5 Red & 10 Blue balls.

Select 4 Balls, No replacement

$P(4 \text{ Red Balls}) = \frac{5}{15} \cdot \frac{4}{14} \cdot \frac{3}{13} \cdot \frac{2}{12} = \boxed{\frac{1}{273}}$

$P(4 \text{ Blue Balls}) = \frac{10}{15} \cdot \frac{9}{14} \cdot \frac{8}{13} \cdot \frac{7}{12} = \boxed{\frac{2}{13}}$

RRRR

Some R & Some B

BBBB

P(at least 1 Red) = 1 − P(No red)

Total Prob.

$= 1 - \frac{2}{13} = \boxed{\frac{11}{13}}$

$\boxed{\frac{272}{273}}$

P(at least 1 Blue) = 1 − P(No Blue) = $1 - \frac{1}{273} =$

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3 Women & 7 Men

Select 3 people

No replacement.

1) How many ways can this be done?

$_{10}C_3 = \boxed{120}$

10 MATH PRB $_nC_r$ 3 Enter

2) How many ways can Select 3 Women?

$_3C_3 = \boxed{1}$

3) $P(3 \text{ Women}) = \frac{_3C_3}{_{10}C_3} = \boxed{\frac{1}{120}}$

4) $P(3 \text{ Men}) = \frac{_7C_3}{_{10}C_3} = \frac{35}{120} = \boxed{\frac{7}{24}}$

5) $P(1W\ 2M) = \frac{_3C_1 \cdot {_7C_2}}{_{10}C_3} = \frac{63}{120} = \boxed{\frac{21}{40}}$

6) $P(2W\ 1M) = \frac{_3C_2 \cdot {_7C_1}}{_{10}C_3} = \frac{21}{120} = \boxed{\frac{7}{40}}$

4 Quarters & 11 Nickels   Select 2 Coins

No replacement

$QQ \to 50¢$ $P(50¢) = \frac{{}_4C_2 \cdot {}_{11}C_0}{{}_{15}C_2} = \boxed{\frac{2}{35}}$

QN
NQ $\to 30¢$ $P(30¢) = \frac{{}_4C_1 \cdot {}_{11}C_1}{{}_{15}C_2} = \boxed{\frac{44}{105}}$

$NN \to 10¢$ $P(10¢) = \frac{{}_4C_0 \cdot {}_{11}C_2}{{}_{15}C_2} = \boxed{\frac{11}{21}}$

Total ¢	P(Total ¢)
50	2/35
30	44/105
10	11/21

Clear all lists

Total ¢ → L1 , P(Total ¢) → L2

1-Var Stats   Tota Prob.

$\bar{x} = 20.667$ S = Blank $\boxed{n = 1}$

[VARS] [5: Statistics] [4: σx] [x^2] [Math] [1:] [Enter] $\frac{9152}{63}$

A Standard deck of playing Cards has 52 Cards, 12 face cards, 4 Aces.

Draw 3 Cards, No replacement

$P(2 \text{ face } \& \ 1 \text{ ace}) = \frac{{}_{12}C_2 \cdot {}_4C_1}{{}_{52}C_3} = \boxed{\frac{66}{5525}}$

$P(1 \text{ face } \& \ 2 \text{ aces}) = \frac{{}_{12}C_1 \cdot {}_4C_2}{{}_{52}C_3} = \boxed{\frac{18}{5525}}$

$P(1 \text{ face}, 1 \text{ ace}, \text{and } 1 \text{ others}) =$

$$\frac{{}_{12}C_1 \cdot {}_4C_1 \cdot {}_{36}C_1}{{}_{52}C_3} = \boxed{\frac{432}{5525}}$$

4 Women & 6 Men

Morning 6

Afternoon 3

Night 1

Night Afternoon Morning

$_{10}C_1 \cdot {}_9C_3 \cdot {}_6C_6 = \boxed{840}$

Morning Afternoon Night

$_{10}C_6 \cdot {}_4C_3 \cdot {}_1C_1 = \boxed{840}$

P(at least 1 man in afternoon shift)

$= 1 - P(\text{No man in afternoon shift})$

$= 1 - \frac{_4C_3}{_{10}C_3} = \boxed{\frac{29}{30}}$

$P(E) = .25$

1) $P(\bar{E}) = 1 - P(E) = \boxed{.75}$

2) odds in favor of event E. $1:3$

$\frac{P(E)}{P(\bar{E})} = \frac{.25}{.75} = \frac{1}{3}$

3) odds against event E. $3:1$

switch

Odds for certain event E are 33:7

1) Odds against event E.

Switch $\boxed{7:33}$

2) $P(E) = \frac{33}{33+7} = \boxed{\frac{33}{40}}$

3) $P(\overline{E}) = \frac{7}{33+7} = \boxed{\frac{7}{40}}$

A deck of cards has 45 cards, 20 Red, 10 face, and 3 Aces.

1) Find the odds in favor of selecting a red card.

20 Red : 25 $\overline{\text{Red}}$ $\boxed{4:5}$

2) Find the odds against selecting an Ace.

42 $\overline{\text{ACE}}$: 3 Ace $\Rightarrow$ $\boxed{14:1}$

3) Find the odds in favor of selecting face or ace.

13 Face or Ace : 32 $\overline{\text{Face or Ace}}$

$\boxed{13:32}$