KEY

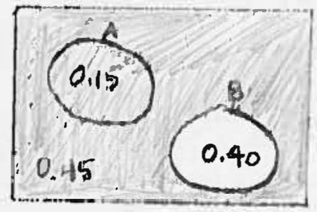
Mr Murphy
AP Statistics
Probability Review

Probability

- $\cup$ = union of events, $\cap$ = intersection of events, ^{C} = complement of an event
- Disjoint/Mutually Exclusive Events - two events with no outcomes in common
- General Addition Rule : $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ **ON FORMULA SHEET
- Venn Diagrams, Tree Diagrams, Formulas, Tables - choose appropriate tool

1. If A and B are two mutually exclusive events with $P(A) = 0.15$ and $P(B) = 0.4$, then $P(A \cup B^C)$ is

$P(A \cup B^c) = 0.60$

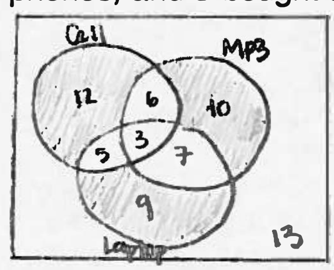


(a) 0.65
(b) 0.15
(c) 0.40
(d) 0.60

2. A store ran a sale on cell phones, mp3 players, and laptop computers. During the day 65 people came in to shop. Of these 65 people, 13 bought none of the sale items. 26 people bought cell phones, 9 bought cell phones and mp3 players, 10 bought mp3 players and laptops, 9 bought only laptops, 12 bought only cell phones, and 3 bought all three items. How many people bought exactly one sale item?

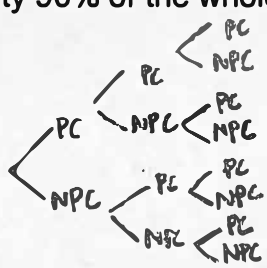
$(C \cap MP3^c \cap L^c) \cup (C^c \cap MP3 \cap L^c) \cup (C^c \cap MP3^c \cap L)$

$= 31$



(a) 3
(b) 8
(c) 21
(d) 31
(e) 52

3. An inspection procedure at a manufacturing plant involves picking three items at random and then accepting the whole lot if at least two of the three items are in perfect condition. If in reality 90% of the whole lot are perfect, what is the probability that the lot will be accepted?



$P(PC) = 0.90$

Assume independence

$P(\text{LOT Accepted})$

$= P(2 \text{ items PC}) + P(3 \text{ items PC})$

$= P(PC \cap PC \cap NPC) + P(PC \cap NPC \cap PC) + P(NPC \cap PC \cap PC) + P(PC \cap PC \cap PC)$

$= (0.90)(0.90)(0.10) + (0.90)(0.10)(0.90) + (0.10)(0.90)(0.90) + (0.90)(0.90)(0.90)$

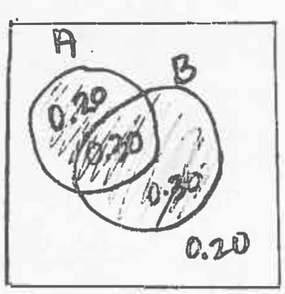
$= 0.081 + 0.081 + 0.081 + 0.729$

$= 0.972$

(a) 0.600
(b) 0.667
(c) 0.729
(d) 0.810
(e) 0.972

4. If $P(A) = 0.5$, $P(B) = 0.6$, and $P(A \cap B) = 0.3$, then $P(A \cup B)$ is

(a) 0.8
(b) 0.5
(c) 0.6
(d) 0



$P(A \cup B) = 0.80$

OR $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$= 0.5 + 0.6 - 0.3$

$= 0.8$

- **LOLN (The Law of Large Numbers) : As the number of repetitions of a random experiment increases, the relative frequency of an event will tend to converge toward the probability of the event.**

5. The law of large numbers states that, as the number of repetitions of random experiment with known probability *P* increases, the relative frequency of the event
(a) gets larger and larger.
(b) gets smaller and smaller.
(c) gets closer and closer to the probability *P*.
(d) fluctuates steadily between one standard deviation above and one standard deviation below the mean.
(e) captures 68% of the observed values.

6. Which of the following scenarios is consistent with the expectations of the law of large numbers?
(a) Getting 200 3s after 600 separate rolls of a single die.
(b) Getting 50 2s after 600 separate rolls of a single die.
(c) Getting 100 6s after 600 separate rolls of a single die.
(d) All of the above
(e) None of the above

Conditional Probability

- **Formula :** $P(A|B)=\dfrac{P(A\cap B)}{P(B)}$ ****ON FORMULA SHEET**
- **Formula, Charts, and Tree Diagram problems are common**

7. If $P(A)=0.3$, $P(B)=0.5$, and $P(A\cup B)=0.6$, then $P(A\mid B)$ is
(a) 0.50
(b) 0.83
(c) 0.40
(d) 0.45

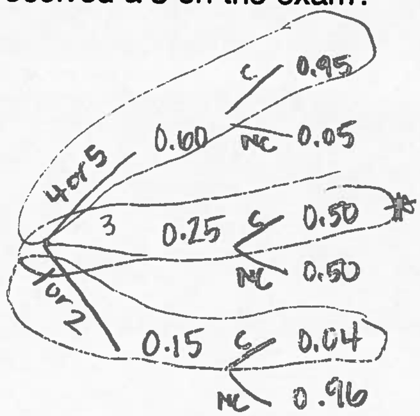
$P(A|B)=\dfrac{P(A\cap B)}{P(B)} \leftarrow P(A\cup B)=P(A)+P(B)-P(A\cap B)$

$0.6=0.3+0.5-P(A\cap B)$

$P(A\cap B)=0.2$

$=\dfrac{0.2}{0.5}=0.40$

8. Suppose that 60% of students who take the AP statistics exam score a 4 or 5, 25% score 3, and the rest score 1 or 2. Suppose further that 95% of those scoring 4 or 5 receives college credit, 50% of those scoring 3 receive such credit, and 4% of those scoring 1 or 2 receive credit. If a student receives college credit, what is the probability that (s)he received a 3 on the exam?
(a) 0.125
(b) 0.178
(c) 0.701
(d) 0.813
(e) 0.822



P(3|Credit)

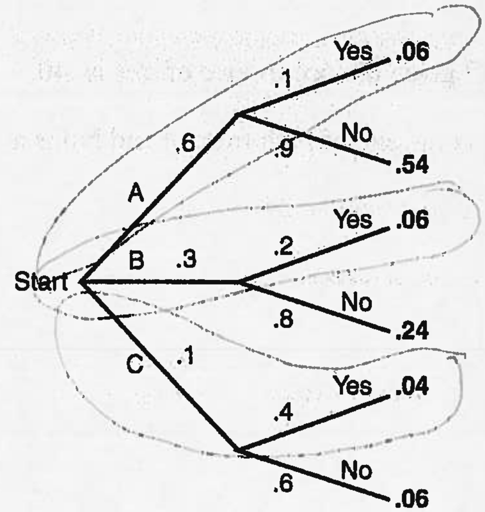
$=\dfrac{(0.25)(0.50)}{(0.60)(0.95)+(0.25)(0.50)+(0.15)(0.04)}$

$=\dfrac{0.125}{0.701}=0.178$

9. $P(Yes) =$ $(0.6)(0.1) + (0.3)(0.2) + (0.1)(0.4)$

$= 0.06 + 0.06 + 0.04 = 0.16$

(a) 0.16
(b) 0.9
(c) 0.12
(d) 0.70
(e) 0.012



Independent Events

- **Two events *A* and *B* are said to be *independent* if** $P(A|B) = P(A)$
- **If two events are independent, then** $P(A \cap B) = P(A) \cdot P(B)$
- **Disjoint Events are NOT independent.**
- **Events that are not disjoint could be independent or dependent.**

10. If *A* and *B* are independent events and $P(A) = .3$ and $P(B) = .6$, then $P(A \cup B)$ is

(a) 0.90
(b) 0.18
(c) 0.50
(d) 0.72

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$= P(A) + P(B) - P(A) \cdot P(B)$
$= 0.3 + 0.6 - 0.3 \cdot 0.6$
$= 0.72$

11. For two events *A* and *B*, $P(A) = 0.8$, $P(B) = 0.2$, and $P(A \cap B) = 0.16$. It follows that *A* and *B* are

(a) ~~disjoint but not independent.~~
(b) neither disjoint nor independent.
(c) independent but not disjoint.
(d) ~~both disjoint and independent.~~
(e) complementary.

$P(A \cap B) = 0.16 \neq 0$ ∴ not disjoint

$P(A \cap B) \stackrel{?}{=} P(A) \cdot P(B)$
$0.16 \stackrel{?}{=} 0.8 \cdot 0.2$
$0.16 \stackrel{✓}{=} 0.16$
∴ independent

12. Event *A* occurs with probability 0.2. Event *B* occurs with probability 0.9. Events *A* and *B*

(a) are disjoint.
(b) cannot be independent.
(c) cannot be disjoint.
(d) are disjoint and independent.
(e) are complementary.

If A & B were disjoint then $P(A \cap B) = 0$.

But, then $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$= 0.9 + 0.2 - 0$
$= 1.1$ ← not possible

11
0

Simulation

- Assign the digits for the random digit table or for your calculator.
- Describe how the simulation will be run. If using random digits, be sure to state whether duplicates are allowed.
- Give a stopping rule.
- State what is to be measured.
- Conduct the simulation with a reasonable number of replications.
- State the conclusion reached in the context of the problem.

13. There are four different blood types, A, B, AB, and O. The estimated percentage of each blood type in the general population is shown below.

Type	A	B	AB	O
	40%	10%	5%	45%

In addition, 85% of all people are Rh positive which means they carry the Rh factor in their blood. The other 15% are Rh negative, which means they do not have the Rh factor in their blood.

Row 1	10480	15011	01536	02011	81647	91646	69179	14194	62590	36207
Row 2	20969	99570	91291	90700	22368	46753	25595	85333	30995	89198

Using a random number table below, simulate the selection of 10 people and determine which blood type they have.

Type A: 01-40
Type B: 41-50
Type AB: 51-55
Type O: 56-99, 00

Choose 20 digits, 2 at a time, repeats allowed
Measure the # of people with each blood type.

Totals:

A	B	AB	O
𝍸 I	II	I	I

Now simulate the presence or absence of the Rh factor.

Rh+: 01-85
Rh-: 86-99, 00

Choose 20 digits, 2 at a time, repeats allowed.
Measure the # of people of each Rh factor.

Totals:

Rh+	Rh-
𝍸 I	IIII