

**Section 4 – 3C: Probabilities Using AND or OR Notation
With Contingency Tables**

P (event E) means find probability of event E happening. We define the probability of event E happening as the ratio of the number of outcomes in event E divided by the number of outcomes in the sample space.

$$P(\text{event E}) = \frac{\text{the number of outcomes in event E}}{\text{the total number of outcomes in the sample space}}$$

Example 1
Find **P(Guard)**

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

P(Guard) asks if we select one player at random from all of the 25 total players what is the probability that the player selected will be a **Guard**.

Solution:

There are 3 + 6 for a total of a total of 9 **Guards** out of a total of 25 players

$$P(\text{Guard}) = \frac{\text{the number of Guards}}{\text{the total number of players}} = \frac{9}{25} = .36$$

Example 2
Find **P(Jr. Varsity)**

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

P(Jr. Varsity) asks if we select one player at random from all of the 25 total players what is the probability that the player selected will be on the Jr. Varsity Team

Solution:

There are 6 + 8 + 1 for a total of 15 Jr. Varsity Players out of a total of 25 players

$$P(\text{Jr. Varsity}) = \frac{\text{the number of Jr. Varsity Players}}{\text{the total number of players}} = \frac{15}{25} = .60$$

Example 3

And

Find $P(\text{Varsity Guard}) = P(\text{Varsity and Guard})$

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

Solution:

A Varsity Guard must be on the Varsity Team **AND** a Guard. The frequency for Varsity Guards is at the **intersection of the Varsity Row and Guards column**.

3

represents the frequency for varsity guards. There are a total of 25 players

25

$$P(\text{Varsity Guard}) = \frac{\text{the number of Varsity Guards}}{\text{the total number of players}} = \frac{3}{25} = .12$$

Example 4

And

Find $P(\text{Jr. Varsity Forward}) = P(\text{Jr. Varsity and Forward})$

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

Solution:

A Jr. Varsity Forward must be on the Jr. Varsity Team **AND** a Forward. The frequency for Jr. Varsity Guards is at the **intersection of the Jr. Varsity Row and Forwards column**.

8

represents the frequency for Jr. Varsity Guards. There are a total of 25 players.

25

$$P(\text{Jr. Varsity Guard}) = \frac{\text{the number of Jr. Varsity Forwards}}{\text{the total number of players}} = \frac{8}{25} = .32$$

Example 5
OR
 Find **P(Guard OR Center)**

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

P(Guard or Center) asks if we select one player at random from all of the 25 total players on both teams what is the probability of that selection being a **Guard OR a Center**.

$$P(\text{Guard OR Center}) = \frac{\text{the number of Guards or centers}}{\text{the total number of players}}$$

Solution (using individual cells):

$$P(\text{Guard or Center}) =$$

There are 3 **Varsity Guards** and there are 6 **Jr. Varsity Guards**

There are 2 **Varsity Centers** and there are 1 **Jr. Varsity Centers**

There are 12 individual players that are a Guard **OR** a Center. There are a total of 25 players.

$$P(\text{Guard or Center}) = \frac{\text{the number of Guards or centers}}{\text{the total number of players}} = \frac{3+6+2+1}{25} = \frac{12}{25} = .48$$

Example 5 (using totals)

P(Guard **OR** Center) =

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

P(Guard or Center) asks if we select one player at random from all of the 25 total players on both teams what is the probability of that selection being a **Guard or a Center**.

Solution using totals:

$$P(\text{Guard or Center}) = \frac{\text{the number of Guards or Centers}}{\text{the total number of players}}$$

There are a **total** of 9 guards 9 (found at the bottom of the Guards column)

There are a **total** of 3 centers 3 (found at the bottom of the Centers column)

There are 12 players that are a Guard **OR** a Center. There are a total of 25 players.

$$P(\text{Guard or Center}) = \frac{\text{the number of Guards or Centers}}{\text{the total number of players}} = \frac{9 + 3}{25} = \frac{12}{25} = .48$$

Example 6 (using individual cells)

$$P(\text{Guard OR Varsity Team}) =$$

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

Solution using individual cells:

$$P(\text{Guard OR Varsity Team}) = \frac{\text{the number of Guards or Varsity Players}}{\text{the total number of players}}$$

Guards

There are 3 Varsity Guards and there are 6 Jr. Varsity Guards

Varsity Team

There are 3 Varsity Guards and 5 Varsity Forwards and 2 Varsity Centers

WE CANNOT JUST ADD ALL OF THESE NUMBERS UP.

THE 3 Varsity Guard cell has been listed twice.

Once as a Guard and once as a Varsity player

DO NOT COUNT THE REPEATED CELL TWICE

We add ONE 3 and a 6 and a 5 and a 2 to get the total.

There are 16 individual players that are a Guard **OR** on the Varsity Team and a total of 25 players.

$$P(\text{Guard OR Varsity Team}) = \frac{\text{the number of Guards or Varsity Players}}{\text{the total number of players}} = \frac{3+5+2+6}{25} = \frac{16}{25} = .64$$

Example 6 (using Totals):

P(Guard **OR** Varsity Team)

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

Solution using totals:

$$P(\text{Guard OR Varsity Team}) = \frac{\text{the number of Guards or Varsity Players}}{\text{the total number of players}}$$

There are a **total** of 9 guards 9 (found at the bottom of the Guards column)

There are a **total** of 10 Varsity players 10 (found at the far right of the Varsity row)

WE CANNOT JUST ADD 9 **and** 10 **to get the correct total**

THE 3 **Varsity Guard cell has been used twice.**

Once in the Total Guards and once in the Varsity Team Total

We need to add 9 **and** 10 **and subtract the overlapping cell** 3 **to get the total.**

There are 16 individual players that are a Guard **OR** on the **Varsity Team**

$$P(\text{Guard OR Varsity Team}) = \frac{\text{the number of Guards or Varsity Players}}{\text{the total number of players}} = \frac{9+10-3}{25} = \frac{16}{25} = .64$$

Example 7

P(Jr. Varsity **OR** Center)

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

Solution using individual cells:

$$P(\text{ Jr. Varsity } \mathbf{OR} \text{ Center}) = \frac{\text{the number of Jr. Varsity Players or Centers}}{\text{the total number of players}} = \frac{6 + 8 + 1 + 2}{25} = \frac{17}{25} = .68$$

Solution using totals:

$$P(\text{ Jr. Varsity } \mathbf{OR} \text{ Center}) = \frac{\text{the number of Jr. Varsity Players or Centers}}{\text{the total number of players}} = \frac{15 + 3 - 1}{25} = \frac{17}{25} = .68$$

Example 8

P(Forward **OR** Center)

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

Solution using individual cells:

$$P(\text{ Forward } \mathbf{OR} \text{ Center}) = \frac{\text{the number of Forwards or Centers}}{\text{the total number of players}} = \frac{5 + 8 + 2 + 1}{25} = \frac{16}{25} = .64$$

Solution using totals:

$$P(\text{ Forward } \mathbf{OR} \text{ Guard}) = \frac{\text{the number of Forwards or Centers}}{\text{the total number of players}} = \frac{13 + 3}{25} = \frac{16}{25} = .64$$

Extra Examples of And – OR

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

Example 9

$$P(\text{ Jr. Varsity } \mathbf{AND} \text{ Center}) = \frac{1}{25} = .04$$

Example 10

$$P(\text{ Guards } \mathbf{OR} \text{ Forward}) = \frac{9+13}{25} = \frac{22}{25} = .84$$

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

Example 11

$$P(\text{ Jr. Varsity } \mathbf{OR} \text{ Guard}) = \frac{15+9-3}{25} = \frac{21}{25} = .84$$

Example 12

$$P(\text{ Forward } \mathbf{AND} \text{ Guard}) = \frac{0}{25} = 0$$

	Guards	Forwards	Centers	Total
Varsity Team	3	5	2	10
Jr. Varsity Team	6	8	1	15
Total	9	13	3	25

Example 13

$$P(\text{ Jr. Varsity } \mathbf{OR} \text{ Forward}) = \frac{15+13-8}{25} = \frac{20}{25} = .80$$

Example 14

$$P(\text{ Center } \mathbf{OR} \text{ Varsity}) = \frac{3+10-2}{25} = \frac{11}{25} = .22$$