## 1. Comprender el espacio muestral.

El espacio muestral (S) es el conjunto de todos los resultados posibles al lanzar tres dados de 20 caras. Como cada dado puede tomar valores de 1 al 20, el número total de combinaciones posibles es:

$$|S| = 20 * 20 * 20 = 8000$$

Hay 8000 posibles resultados diferentes.

### **2.** Enumerar todos los resultados posibles.

Cada lanzamiento de los tres dados generara una combinación de tres valores, donde  $d_1$ ,  $d_2$ ,  $d_3$  pueden ser cualquier número entre 1 y 20.

(1,1,1), (1,1,2), (1,1,3), (1,1,4), (1,1,5), (1,1,6), (1,1,7), (1,1,8), (1,1,9), (1,1,10), (1,1,11),(1,1,12), (1,1,13), (1,1,14), (1,1,15), (1,1,16), (1,1,17), (1,1,18), (1,1,19), (1,1,20), (1,2,1),(1,2,2), (1,2,3), (1,2,4), (1,2,5), (1,2,6), (1,2,7), (1,2,8), (1,2,9), (1,2,10), (1,2,11), (1,2,12),(1,2,13), (1,2,14), (1,2,15), (1,2,16), (1,2,17), (1,2,18), (1,2,19), (1,2,20), (1,3,1), (1,3,2), (1,3,3), (1,3,4), (1,3,5), (1,3,6), (1,3,7), (1,3,8), (1,3,9), (1,3,10), (1,3,11), (1,3,12),(1,3,13), (1,3,14), (1,3,15), (1,3,16), (1,3,17), (1,3,18), (1,3,19), (1,3,20), (1,4,1), (1,4,2), (1,4,3), (1,4,4), (1,4,5), (1,4,6), (1,4,7), (1,4,8), (1,4,9), (1,4,10), (1,4,11), (1,4,12),(1,4,13), (1,4,14), (1,4,15), (1,4,16), (1,4,17), (1,4,18), (1,4,19), (1,4,20), (1,5,1), (1,5,2),(1,5,3), (1,5,4), (1,5,5), (1,5,6), (1,5,7), (1,5,8), (1,5,9), (1,5,10), (1,5,11), (1,5,12),(1,5,13), (1,5,14), (1,5,15), (1,5,16), (1,5,17), (1,5,18), (1,5,19), (1,5,20), (1,6,1), (1,6,2), (1,6,3), (1,6,4), (1,6,5), (1,6,6), (1,6,7), (1,6,8), (1,6,9), (1,6,10), (1,6,11), (1,6,12),(1,6,13), (1,6,14), (1,6,15), (1,6,16), (1,6,17), (1,6,18), (1,6,19), (1,6,20), (1,7,1), (1,7,2),(1,7,3), (1,7,4), (1,7,5), (1,7,6), (1,7,7), (1,7,8), (1,7,9), (1,7,10), (1,7,11), (1,7,12),(1,7,13), (1,7,14), (1,7,15), (1,7,16), (1,7,17), (1,7,18), (1,7,19), (1,7,20), (1,8,1), (1,8,2),(1,8,3), (1,8,4), (1,8,5), (1,8,6), (1,8,7), (1,8,8), (1,8,9), (1,8,10), (1,8,11), (1,8,12),(1,8,13), (1,8,14), (1,8,15), (1,8,16), (1,8,17), (1,8,18), (1,8,19), (1,8,20), (1,9,1), (1,9,2), (1,9,3), (1,9,4), (1,9,5), (1,9,6), (1,9,7), (1,9,8), (1,9,9), (1,9,10), (1,9,11), (1,9,12),(1,9,13), (1,9,14), (1,9,15), (1,9,16), (1,9,17), (1,9,18), (1,9,19), (1,9,20), (1,10,1), (1,10,2), (1,10,3), (1,10,4), (1,10,5), (1,10,6), (1,10,7), (1,10,8), (1,10,9), (1,10,10),(1,10,11), (1,10,12), (1,10,13), (1,10,14), (1,10,15), (1,10,16), (1,10,17), (1,10,18), (1,10,19), (1,10,20), (1,11,1), (1,11,2), (1,11,3), (1,11,4), (1,11,5), (1,11,6), (1,11,7),(1,11,8), (1,11,9), (1,11,10), (1,11,11), (1,11,12), (1,11,13), (1,11,14), (1,11,15),(1,11,16), (1,11,17), (1,11,18), (1,11,19), (1,11,20), (1,12,1), (1,12,2), (1,12,3), (1,12,4),(1,12,5), (1,12,6), (1,12,7), (1,12,8), (1,12,9), (1,12,10), (1,12,11), (1,12,12), (1,12,13),(1,12,14), (1,12,15), (1,12,16), (1,12,17), (1,12,18), (1,12,19), (1,12,20), (1,13,1),

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(20,3,13), (20,3,14), (20,3,15), (20,3,16), (20,3,17), (20,3,18), (20,3,19), (20,3,20),(20,4,1), (20,4,2), (20,4,3), (20,4,4), (20,4,5), (20,4,6), (20,4,7), (20,4,8), (20,4,9),(20,4,10), (20,4,11), (20,4,12), (20,4,13), (20,4,14), (20,4,15), (20,4,16), (20,4,17),(20,4,18), (20,4,19), (20,4,20), (20,5,1), (20,5,2), (20,5,3), (20,5,4), (20,5,5), (20,5,6),(20,5,7), (20,5,8), (20,5,9), (20,5,10), (20,5,11), (20,5,12), (20,5,13), (20,5,14), (20,5,15),(20,5,16), (20,5,17), (20,5,18), (20,5,19), (20,5,20), (20,6,1), (20,6,2), (20,6,3), (20,6,4),(20,6,5), (20,6,6), (20,6,7), (20,6,8), (20,6,9), (20,6,10), (20,6,11), (20,6,12), (20,6,13),(20,6,14), (20,6,15), (20,6,16), (20,6,17), (20,6,18), (20,6,19), (20,6,20), (20,7,1),(20,7,2), (20,7,3), (20,7,4), (20,7,5), (20,7,6), (20,7,7), (20,7,8), (20,7,9), (20,7,10),(20,7,11), (20,7,12), (20,7,13), (20,7,14), (20,7,15), (20,7,16), (20,7,17), (20,7,18),(20,7,19), (20,7,20), (20,8,1), (20,8,2), (20,8,3), (20,8,4), (20,8,5), (20,8,6), (20,8,7),(20,8,8), (20,8,9), (20,8,10), (20,8,11), (20,8,12), (20,8,13), (20,8,14), (20,8,15),(20,8,16), (20,8,17), (20,8,18), (20,8,19), (20,8,20), (20,9,1), (20,9,2), (20,9,3), (20,9,4),(20,9,5), (20,9,6), (20,9,7), (20,9,8), (20,9,9), (20,9,10), (20,9,11), (20,9,12), (20,9,13),(20,9,14), (20,9,15), (20,9,16), (20,9,17), (20,9,18), (20,9,19), (20,9,20), (20,10,1),(20,10,2), (20,10,3), (20,10,4), (20,10,5), (20,10,6), (20,10,7), (20,10,8), (20,10,9),(20,10,10), (20,10,11), (20,10,12), (20,10,13), (20,10,14), (20,10,15), (20,10,16),(20,10,17), (20,10,18), (20,10,19), (20,10,20), (20,11,1), (20,11,2), (20,11,3), (20,11,4),(20,11,5), (20,11,6), (20,11,7), (20,11,8), (20,11,9), (20,11,10), (20,11,11), (20,11,12),(20,11,13), (20,11,14), (20,11,15), (20,11,16), (20,11,17), (20,11,18), (20,11,19),(20,11,20), (20,12,1), (20,12,2), (20,12,3), (20,12,4), (20,12,5), (20,12,6), (20,12,7),(20,12,8), (20,12,9), (20,12,10), (20,12,11), (20,12,12), (20,12,13), (20,12,14),(20,12,15), (20,12,16), (20,12,17), (20,12,18), (20,12,19), (20,12,20), (20,13,1),(20,13,2), (20,13,3), (20,13,4), (20,13,5), (20,13,6), (20,13,7), (20,13,8), (20,13,9),(20,13,10), (20,13,11), (20,13,12), (20,13,13), (20,13,14), (20,13,15), (20,13,16),(20,13,17), (20,13,18), (20,13,19), (20,13,20), (20,14,1), (20,14,2), (20,14,3), (20,14,4),(20,14,5), (20,14,6), (20,14,7), (20,14,8), (20,14,9), (20,14,10), (20,14,11), (20,14,12),(20,14,13), (20,14,14), (20,14,15), (20,14,16), (20,14,17), (20,14,18), (20,14,19),(20,14,20), (20,15,1), (20,15,2), (20,15,3), (20,15,4), (20,15,5), (20,15,6), (20,15,7),(20,15,8), (20,15,9), (20,15,10), (20,15,11), (20,15,12), (20,15,13), (20,15,14),(20,15,15), (20,15,16), (20,15,17), (20,15,18), (20,15,19), (20,15,20), (20,16,1),(20,16,2), (20,16,3), (20,16,4), (20,16,5), (20,16,6), (20,16,7), (20,16,8), (20,16,9),(20,16,10), (20,16,11), (20,16,12), (20,16,13), (20,16,14), (20,16,15), (20,16,16),(20,16,17), (20,16,18), (20,16,19), (20,16,20), (20,17,1), (20,17,2), (20,17,3), (20,17,4),(20,17,5), (20,17,6), (20,17,7), (20,17,8), (20,17,9), (20,17,10), (20,17,11), (20,17,12),(20,17,13), (20,17,14), (20,17,15), (20,17,16), (20,17,17), (20,17,18), (20,17,19),(20,17,20), (20,18,1), (20,18,2), (20,18,3), (20,18,4), (20,18,5), (20,18,6), (20,18,7),(20,18,8), (20,18,9), (20,18,10), (20,18,11), (20,18,12), (20,18,13), (20,18,14),

(20,18,15), (20,18,16), (20,18,17), (20,18,18), (20,18,19), (20,18,20), (20,19,1), (20,19,2), (20,19,3), (20,19,4), (20,19,5), (20,19,6), (20,19,7), (20,19,8), (20,19,9), (20,19,10), (20,19,11), (20,19,12), (20,19,13), (20,19,14), (20,19,15), (20,19,16), (20,19,17), (20,19,18), (20,19,19), (20,19,20), (20,20,1), (20,20,2), (20,20,3), (20,20,4), (20,20,5), (20,20,6), (20,20,7), (20,20,8), (20,20,9), (20,20,10), (20,20,11), (20,20,12), (20,20,13), (20,20,14), (20,20,15), (20,20,16), (20,20,17), (20,20,18), (20,20,19), (20,20,20)

#### 3. Definir la variable aleatoria X

La Variable aleatoria X se define como la suma de los valores obtenidos en los tres dados:

$$X = d_1 + d_2 + d_3$$

 $d_1$  es el número obtenido en el primer dado.

 $d_2$  es el número obtenido en el segundo dado.

 $d_3$  es el número obtenido en el tercer dado.

# 4. Calcular los valores posibles de X.

Estableciendo que el valor mínimo de X ocurre los tres dados muestran el número más bajo (1) y el valor máximo ocurre cuando los tres dados muestran el número de más alto (20).

$$X_{min} = 1 + 1 + 1 = 3$$

$$X_{max} = 20 + 20 + 20 = 60$$

X puede tomar cualquier número entero entre 3 y 60.

Dado 1	Dado 2	Dado 3	Suma (X)
1	1	1	3
1	1	2	4
1	1	3	5
1	1	4	6
1	1	5	7
1	1	6	8
1	1	7	9
1	1	8	10
1	1	9	11
1	1	10	12
1	1	11	13

1	1	12	14
1	1	13	15
1	1	14	16
1	1	15	17
1	1	16	18
1	1	17	19
1	1	18	20
1	1	19	21
1	1	20	22
1	2	1	4
1	2	2	5
1	2	3	6
1	2	4	7
1	2	5	8
1	2	6	9
1	2	7	10
1	2	8	11
1	2	9	12
1	2	10	13
1	2	11	14
1	2	12	15
1	2	13	16
1	2	14	17
1	2	15	18
1	2	16	19
1	2	17	20
1	2	18	21
1	2	19	22
1	2	20	23
1	3	1	5
1	3	2	6
1	3	3	7
1	3	4	8
1	3	5	9
1	3	6	10
1	3	7	11
1	3	8	12
1	3	9	13
1	3	10	14
1	3	11	15
1	3	12	16

1	3	13	17
1	3	14	18
1	3	15	19
1	3	16	20
1	3	17	21
1	3	18	22
1	3	19	23
1	3	20	24
1	4	1	6
1	4	2	7
1	4	3	8
1	4	4	9
1	4	5	10
1	4	6	11
1	4	7	12
1	4	8	13
1	4	9	14
1	4	10	15
1	4	11	16
1	4	12	17
1	4	13	18
1	4	14	19
1	4	15	20
1	4	16	21
1	4	17	22
1	4	18	23
1	4	19	24
1	4	20	25
1	5	1	7
1	5	2	8
1	5	3	9
1	5	4	10
1	5	5	11
1	5	6	12
1	5	7	13
1	5	8	14
1	5	9	15
1	5	10	16
1	5	11	17
1	5	12	18
1	5	13	19

1	5	14	20
1	5	15	21
1	5	16	22
1	5	17	23
1	5	18	24
1	5	19	25
1	5	20	26

## Cómo varia la frecuencia de X

- El valor 3 solo ocurre en una forma: (1, 1, 1).
- El valor 4 ocurre en tres formas: (1, 1, 2), (1, 2, 1), (2, 1, 1).
- El valor 30 ocurre en muchas más formas porque hay muchas combinaciones de tres números que suman 30.
- El valor 60 solo ocurre en una forma: (20, 20, 20).

Se recorren todas las combinaciones y ponemos un registró de cuantas veces ocurre cada suma.

Suma (X)	Frecuencia
3	1
4	3
5	6
6	10
7	15
8	21
9	28
10	36
11	45
12	55
13	66
14	78
15	91
16	105
17	120
18	136
19	153
20	171
21	190
22	210
23	228
24	244

25	258
26	270
27	280
28	288
29	294
30	298
31	300
32	300
33	298
34	294
35	288
36	280
37	270
38	258
39	244
40	228
41	210
42	190
43	171
44	153
45	136
46	120
47	105
48	91
49	78
50	66
51	55
52	45
53	36
54	28
55	21
56	15
57	10
58	6
59	3
60	1



El la gráfica y en tabla se muestra que los valores centrales cercanos al 30 son más frecuentes porque hay muchas combinaciones que los generan, mientras que los valores extremos 3 y 60 son diferentes ya que solo hay una forma de obtenerlos. A esto se le llama distribución en forma de campana, donde los valores medios tienen mayor probabilidad.