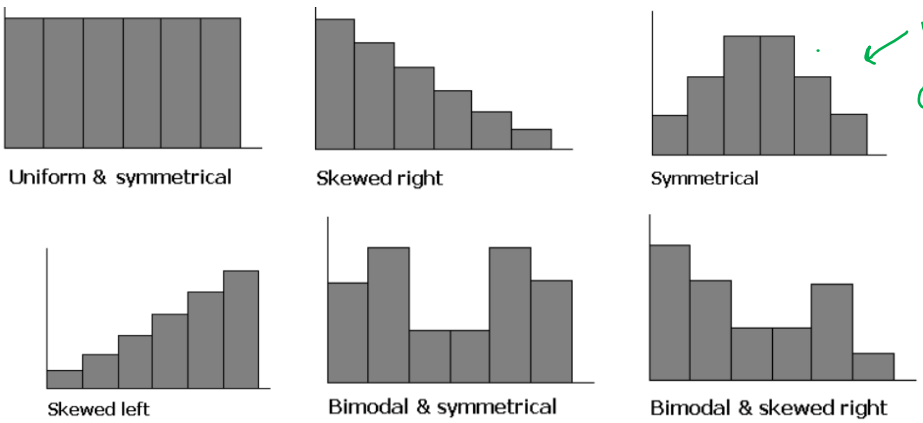
9.D – Probability Distributions and Shapes of Distributions

- **Probability distribution:** a function that gives the probability of each outcome in a sample space.
- **Uniform distribution:** a probability distribution that is equal for each event in the sample space.
- **Cumulative frequency:** the number of times events with values that are less than or equal to a given value occur. It's the probability of events occurring with values that are less than or equal to a given value.
- **Distribution shapes:** Distributions may come in many shapes. Examples are distribution shapes are uniform, symmetrical, bimodal, skewed left, skewed, right, and normal (bell shaped). The distributions are modeled below:



Activity 1

Roll a pair of standard number cubes 36 times. Record the sum for each roll.

Do the experiment in a "lists and spreadsheets" page.

Column A → = randint (1, 6, 36)

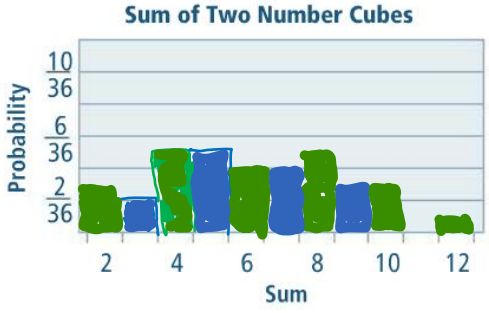
Column B → = randint (1, 6, 36)

Column C → = a+b

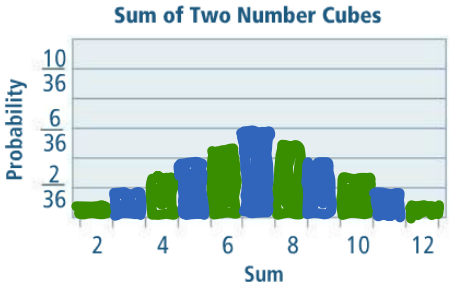
1. Use the frequency table below. Complete the table using your data.

Event: Sum	2	3	4	5	6	7	8	9	10	11	12
Frequency	III	II	~~HHT~~	~~HHT~~	IIII	IIII	~~HHT~~	III	III		I
Probability	.083	.056	.139	.139	.111	.111	.139	.083	.083	.000	.028
	3/36	2/36	5/36	5/36	4/36	4/36	5/36	3/36	3/36	0/36	1/36

2. Complete the graph using your data.



3. Make a graph of the probability distribution for the sums of two number cubes rolled 36 times, based on the theoretical probabilities of each sum.



4. a. Reasoning Compare the graphs. Do you think the number cubes you rolled are fair? Explain. Both graphs seem to have lower frequencies, or probabilities for the low sums and high sums. The middle sums of 5, 6, 7, 8 seem to have the larger frequencies. Because the graphs are similar, the cubes are probably fair.

b. Explain why there are differences, if any, between the theoretical model and the experimental model.

The models are different because an experiment is exactly that..... an experiment. It won't always match the theory, but it'll be similar most of the time.

Activity 2

5. Complete the table. Add the theoretical probabilities within each range to find the cumulative probabilities.

Sum	2 to 4	2 to 6	2 to 8	2 to 10	2 to 12
Cumulative Probability	$\frac{1}{6}$	$\frac{5}{12}$	$\frac{13}{18}$	$\frac{11}{12}$	1

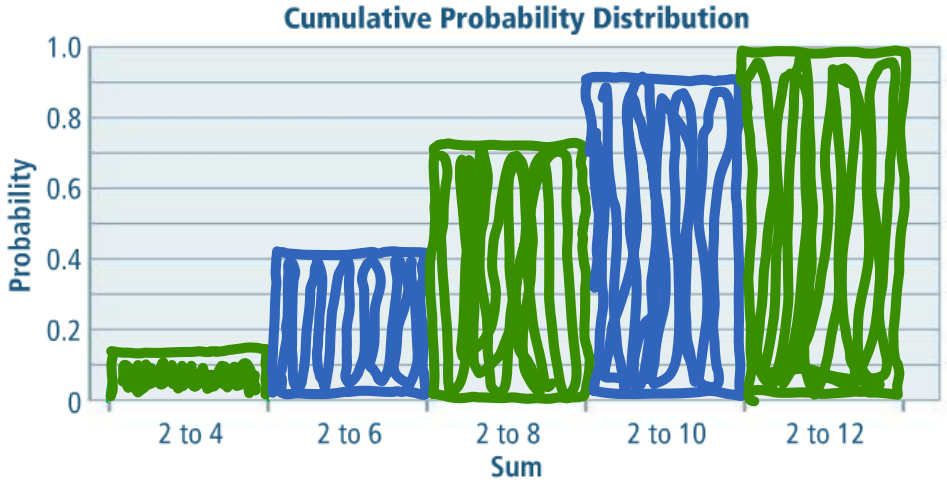
Add the probabilities for the sums of 2, 3, and 4.

Add the probabilities for sums of 5 and 6 to the previous total.

6. Reasoning Explain why the cumulative probability in the last interval is 1.

That's because it includes ALL events.

7. Complete the graph below using the cumulative probabilities you computed.



8. a. If you roll a pair of number cubes to model a situation and observe a sum of 7 four times in a row, would you question the model? Explain.

No; there are six ways of rolling a sum of 7. The probability of rolling a sum of 7 four times in a row is $\left(\frac{1}{6}\right)\left(\frac{1}{6}\right)\left(\frac{1}{6}\right)\left(\frac{1}{6}\right) = \frac{1}{1296}$. Although this is unlikely, rolling a sum of 7 four times in a row out of six different ways is possible.

b. If you observed a sum of 2 four times in a row, would you question the model? Explain.

Yes; there is only one way to roll a sum of 2. The probability of rolling a sum of 2 four times in a row is $\left(\frac{1}{36}\right)\left(\frac{1}{36}\right)\left(\frac{1}{36}\right)\left(\frac{1}{36}\right) = \frac{1}{1,679,616}$.