2.7 – Probability Distributions with Discrete Random Variables

– **discrete random variable** → a variable whose value is the numerical outcome of a random event

– **probability distribution** → a function that maps the Sample space to the probabilities of the outcomes in the sample space which can be visually represented by a histogram

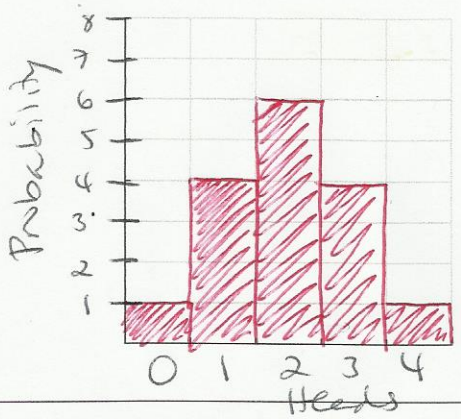
Examples: Complete each problem appropriately.

1.) The table shows the distribution of the number of heads when 4 coins are tossed.

H = Heads	0	1	2	3	4
Probability	$\frac{1}{16}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{1}{16}$
		$\frac{4}{16}$	$\frac{6}{16}$	$\frac{4}{16}$	

$= \frac{16}{16} = 1\ (100\%)$

a.) Create a probability histogram.



b.) What is the probability of getting three heads?

$\frac{4}{16} = \frac{1}{4} = 25\%$

c.) What is the probability of getting at least two heads?

$\frac{6}{16} + \frac{4}{16} + \frac{1}{16} = \frac{11}{16} = 68.8\%$

d.) What is the probability of getting no more then one head?

$\frac{1}{16} + \frac{4}{16} = \frac{5}{16} = 31.3\%$

2.) The instructor of a large class gives 15% of A's and D's, 30% of B's and C's, and 10% of F's. Let x be the random variable assigned to a student's grade on a 4-point scale, where A = 4, B = 3, etc.

a.) Create a probability table that models the information above.

x = student's grade	4 (A)	3 (B)	2 (C)	1 (D)	0 (F)
Probability	.15	.30	.30	.15	.10

b.) If a student is selected at random from this class, what grade would we expect them to have? (min 4 + add)

$4(.15) + 3(.30) + 2(.30) + 1(.15) + 0(.10) = 2.25$ (low C avg)

c.) What percent of the class is passing?

$.15 + .30 + .30 + .15 = .90 = 90\%$

d.) What percent of the class has a B or better?

$.30 + .15 = .45 = 45\%$

3.) The table shows the probabilities for the number of people who live in a typical U.S. household.

x = number of occupants	1	2	3	4	5	6	7
Probability	0.25	0.32	.17	0.15	0.07	0.03	0.01

$= 1\ (100\%)$

a.) What is the probability of people in the U.S. leaving in a household with 3 occupants?

$.25 + .32 + .15 + .07 + .03 + .01 = .83 \rightarrow 1 - .83 = .17$ or 17%

b.) If a random U. S household is selected, how many occupants would we expect to find leaving there?

$1(.25) + 2(.32) + 3(.17) + 4(.15) + 5(.07) + 6(.03) + 7(.01) = 2.6$ occupants

c.) What percent of U.S. households have at least 5 people living there?

$.07 + .03 + .01 = .11 = 11\%$

d.) What percent of U.S. households have no more than 3 people living together?

$.25 + .32 + .17 = .74 = 74\%$

Simulation Activity:

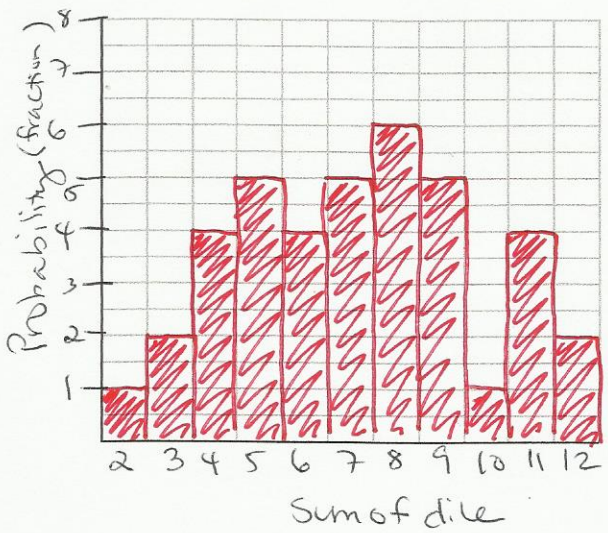
Roll a pair of dice forty times and find the sum of the dice that is rolled for each trial.
Write your information on the provided table.

Trial #	Dice # 1	Dice # 2	Sum of Dice	Trial #	Dice # 1	Dice # 2	Sum of Dice
1	3	2	5	21	3	1	4
2	5	3	8	22	3	2	5
3	2	2	4	23	2	3	5
4	1	1	2	24	3	1	4
5	6	1	7	25	5	3	8
6	4	2	6	26	6	3	9
7	5	2	7	27	6	2	8
8	5	4	9	28	6	5	11
9	2	3	5	29	6	5	11
10	6	6	12	30	6	3	9
11	4	3	7	31	3	1	4
12	5	6	11	32	5	3	8
13	6	5	11	33	2	1	3
14	4	2	6	34	6	2	8
15	4	2	6	35	6	6	12
16	4	1	5	36	6	2	8
17	6	3	9	37	5	4	9
18	5	1	6	38	5	2	7
19	6	1	7	39	6	4	10
20	5	3	8	40	2	1	3

a.) Complete the probability table from your chart above. Hint: Denominator in the probability row should be 36 (from multiplying $\frac{1}{6} \times \frac{1}{6} = \frac{1}{36}$) but each numerator should be different based on its sum from your simulated activity.

X = Sum	2	3	4	5	6	7	8	9	10	11	12
Prob as a fraction	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{1}{36}$	$\frac{4}{36}$	$\frac{2}{36}$

b.) Make a histogram of your probability table.



c.) Which sum showed up the most frequent?

the sum of 8

d.) A certain sum will show up more than any others. What sum do you think this is? EXPLAIN!!

(for me) 8 → more chances to get sum

6+2
4+4
5+3

also, ...

7 → more chances to get sum

6+1
4+3
5+2