**Assignment 15: Probability (5.7)** **Name____________________**
**Please provide a handwritten response.**

Figure 5.58 gives a histogram based on probabilities for the number of heads appearing in an eight–coin toss. Using *Mathematica*'s **`Random`** command, we can simulate the repeated tossing of eight coins together and keep track of the number of heads appearing in each toss. Then we can create a histogram describing our experiment, and compare it to Figure 5.59.

**1a.** We can simulate tossing one coin with the command

```
Random[Integer]
```

which generates either 0 or 1 at random, each with probability $\frac{1}{2}$; we interpret the outcome of "1" as representing "heads" and "0" as representing "tails". Execute this command ten times and list the results below.

**1b.** By adding the **`Table`** command we can simulate tossing eight coins at once; execute

```
Table[Random[Integer], {8}]
```

three times and record the results below. Also record how many 1's ("heads") appeared in each toss.

**1c.** We are really interested only in the <u>number</u> of heads appearing in each toss of the eight coins. Because the tails are represented by "0" and the heads by "1", a convenient way to count the heads is simply to toss a coin eight times and add the results. Execute

```
Sum[Random[Integer], {n, 1, 8}]
```

three times and record the results below. (The counter **`n`** is used here simply to help the **`Sum`** command keep track of when to start and stop.) How large could this number be? How small?

**1d.** Now we are ready to generate data for our histogram. Execute

```
Table[Sum[Random[Integer], {n, 1, 8}], {25}]
```

to simulate tossing the eight coins together twenty–five times, and enter the result below.

**1e.** Enter in the table on the next page the number of occurrences in part **d** of each possible outcome, as a fraction of the total of twenty–five tosses. A sample is provided, but your specific numbers will probably be different.

| # of heads | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| Occurrences | $\frac{\_\_}{25}$ | $\frac{\_\_}{25}$ | $\frac{\_\_}{25}$ | $\frac{\_\_}{25}$ | $\frac{\_\_}{25}$ | $\frac{\_\_}{25}$ | $\frac{\_\_}{25}$ | $\frac{\_\_}{25}$ | $\frac{\_\_}{25}$ |
| (Sample) | $\frac{0}{25}$ | $\frac{0}{25}$ | $\frac{3}{25}$ | $\frac{8}{25}$ | $\frac{8}{25}$ | $\frac{5}{25}$ | $\frac{0}{25}$ | $\frac{1}{25}$ | $\frac{0}{25}$ |

**1f.** We want a list of all the possible outcomes preceded by the frequency with which each outcome actually occurred. The command below would create such a list according to the data in the sample row of the table. Execute this command after you have changed the underlined numbers 0 , 0 , 3 , etc. to the numbers you recorded in the table.

```
freq = {{0/25,0},{0/25,1},{3/25,2},{8/25,3},{8/25,4},{5/25,5},{0/25,6},{1/25,7},{0/25,8}}
```

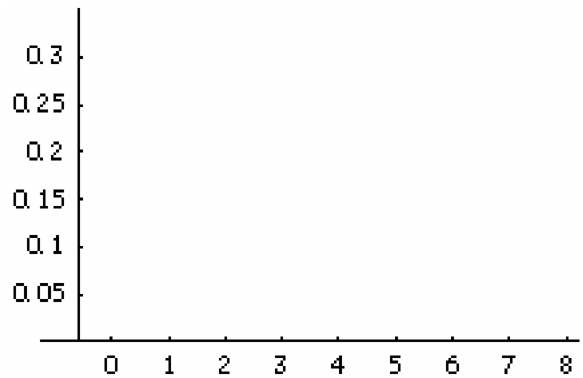
**1g.** To draw our histogram we must first load in a package; execute

```
Needs["Graphics`Graphics`"]
```

followed by

```
BarChart[freq]
```

and sketch the result on the diagram at right. How closely does your histogram resemble Figure 5.58?




**1h.** We can repeat this "experiment" using 500 tosses provided *Mathematica* counts the frequencies of occurrence for us. Load in another package by executing

```
Needs["Statistics`DataManipulation`"]
```

followed by

```
tosses = Table[Sum[Random[Integer], {n, 1, 8}], {500}];
```

(Include the semicolon! It prevents *Mathematica* from printing this long result on the screen.) Next execute

```
fr = Frequencies[tosses]
```

To divide the frequencies by 500 outcomes in our final histogram execute `Clear[freq]` followed by the (unfortunately) complicated command

```
freq = MapAt[#/500&, fr, Table[{i, 1}, {i, 1, Length[fr]}]]
```

(The `#` and `&` characters are above the "3" and "7", respectively, on your keyboard.) Record the result below, and then execute `BarChart[freq]` . Does this histogram more closely resemble Figure 5.58 than your result in part **g**?