Stat 150 – Random Babies Name: ______________________________

Suppose that on one night at a certain hospital, four mothers give birth to baby boys. As a very sick joke, the hospital staff decides to return babies to their mothers completely at random.

a) Simulate this process by shuffling four index cards marked with the babies' first names and dealing them randomly onto a sheet marked with the mothers' last names. Do this four times, in each case recording the number of mothers who get the right baby (a "match").

Repetition #1: Repetition #2: Repetition #3: Repetition #4:

b) Combine your results with the rest of the class, filling in the "count" row of the table:

# of matches:	0	1	2	3	4
count					
proportion					

c) Determine the proportion of times that there are 0 matches, 1 match, and so on. Record these in the "proportion" row of the table above.

- A process is ___________________ if individual outcomes are uncertain but there is a regular distribution of outcomes in a large number of repetitions.
- The ____________________ of any outcome in a random process is the *proportion* of times that the outcome would occur in a very large number of repetitions (also known as *relative frequency*).
- A probability can be approximated by ________________ (artificially re-creating) the random process a large number of times and determining the relative frequency of occurrences.

d) Your instructor will now use the Random Babies applet to simulate this random process a total of 10,000 times. Record the resulting approximate probabilities in the table:

# of matches:	0	1	2	3	4
Approx prob					

e) Your instructor will click on the bar graph for 0 matches. Does this graph indicate that the relative frequency is varying less as time goes on, perhaps approaching a specific value?

A theoretical analysis of this process would consider all of the possible ways to distribute the four babies to the four mothers. All of the possibilities are listed here:

1234	1243	1324	1342	1423	1432
2134	2143	2314	2341	2413	2431
3124	3142	3214	3241	3412	3421
4123	4132	4213	4231	4312	4321

Adapted from: Investigating Statistical Concepts, Applications, and Methods – B. Chance, A. Rossman, 2015

f) How many possibilities are there for returning the four babies to their mothers?

g) For each of these possibilities, indicate how many mothers get the correct baby. Count how many ways there are to get 0 matches, 1 match, and so on. Record these in the middle row of the table below. Then, determine the probability of each event by dividing these counts by your answer to (f).

# of matches:	0	1	2	3	4
# possibilities					
probability					

h) How close are these theoretical probabilities to the ones you approximated by the simulation?

i) What is the probability that at least one mother gets the correct baby? Suggest two different ways to calculate this.

- The listing of all possible outcomes is called the __________________ of the random process.
- A _____________________________describes all possible outcomes and assigns probabilities to them.

j) Using the applet simulation results, calculate the average (mean) number of matches per repetition of the process. Multiply the number of <u>matches</u> by the <u>count</u> for each option, and add them up. Then divide by the total number of trials.

- The long-run average value achieved by a numerical random process is called its ________________________.

m) Calculate the theoretical expected number of matches from the (exact) probability distribution (g). Multiply each <u>match possibility</u> by its <u>probability</u>, and then add these up across all of the possible outcomes. Compare that to the average number of matches from the simulated data (j).