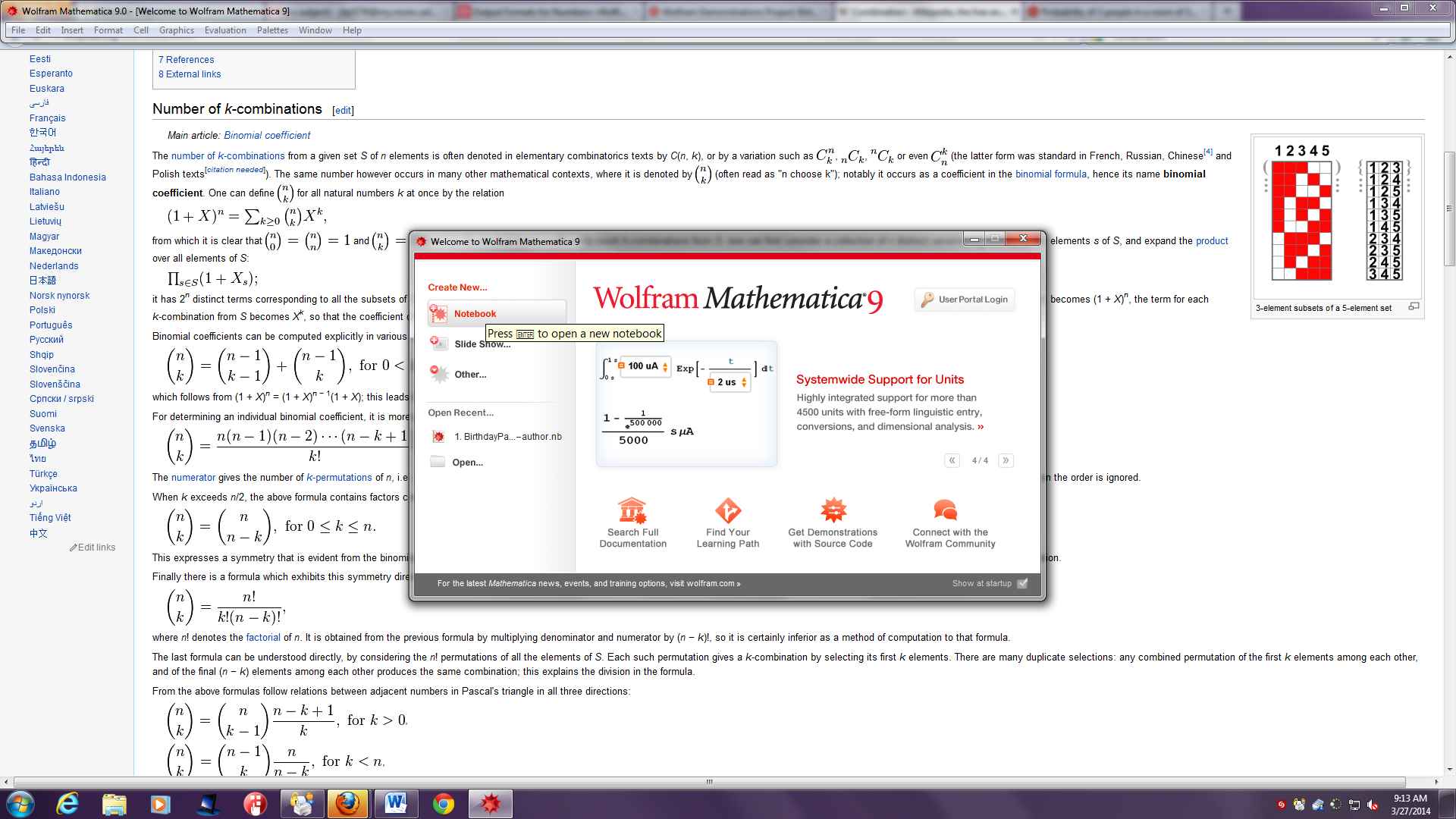
Mathematica Lesson: Using Mathematica to model the Birthday Problem as a Poisson distribution

Problem: In a set of *n* randomly chosen people, some pair of them will have the same birthday.1

Vocabulary: *Poisson Distribution*-is a discrete probability distribution that expresses the probability of a given number of events occurring in a fixed interval of time and/or space if these events occur with a known average rate and independently of the time since the last event2

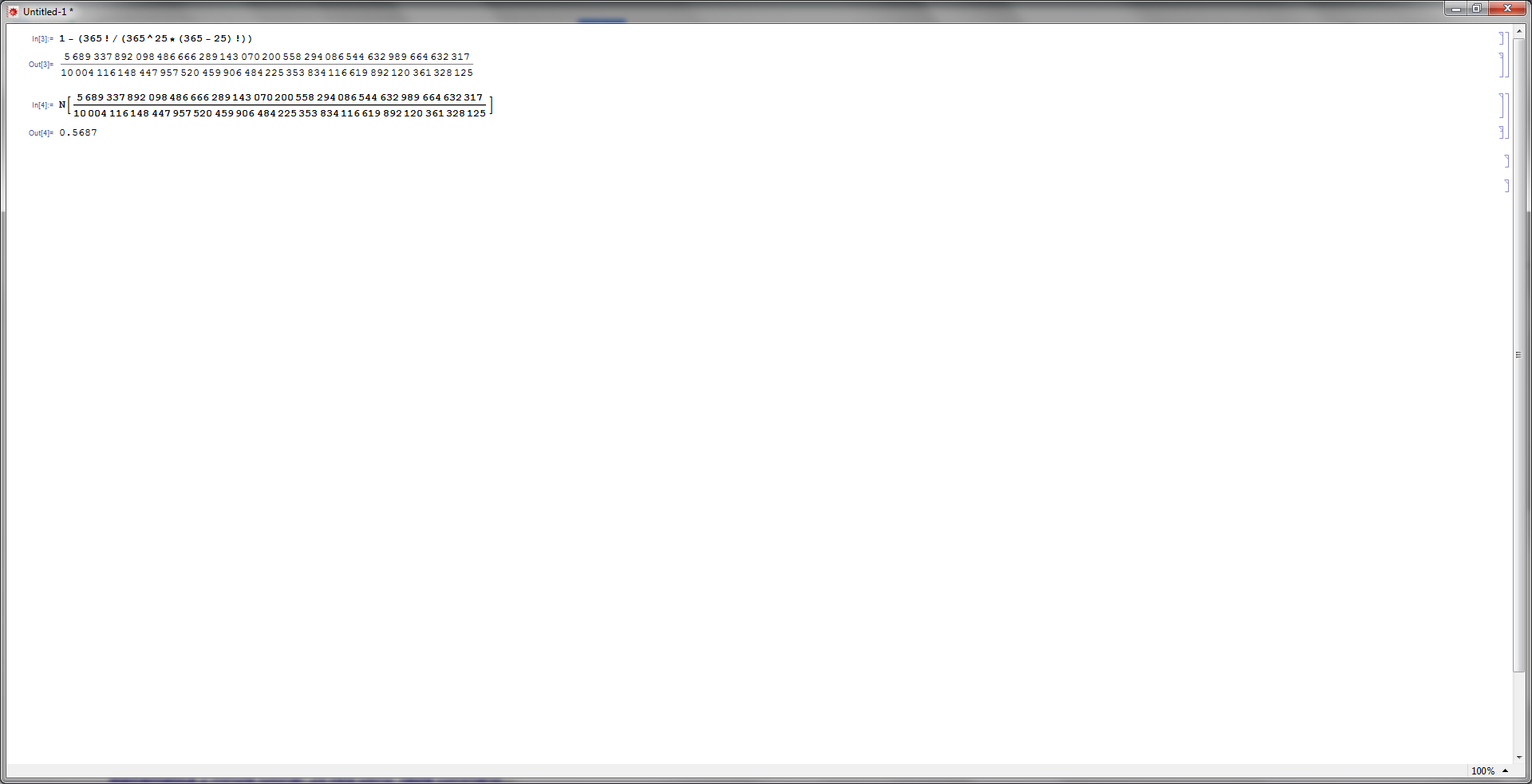
1. You may be sitting in a classroom right now with about 25 other students. Do you think that you have the same birthday as anyone else? Write down your guess (as a percentage) of what you think the probability would be.
2. Open Mathematica and create a new notebook.



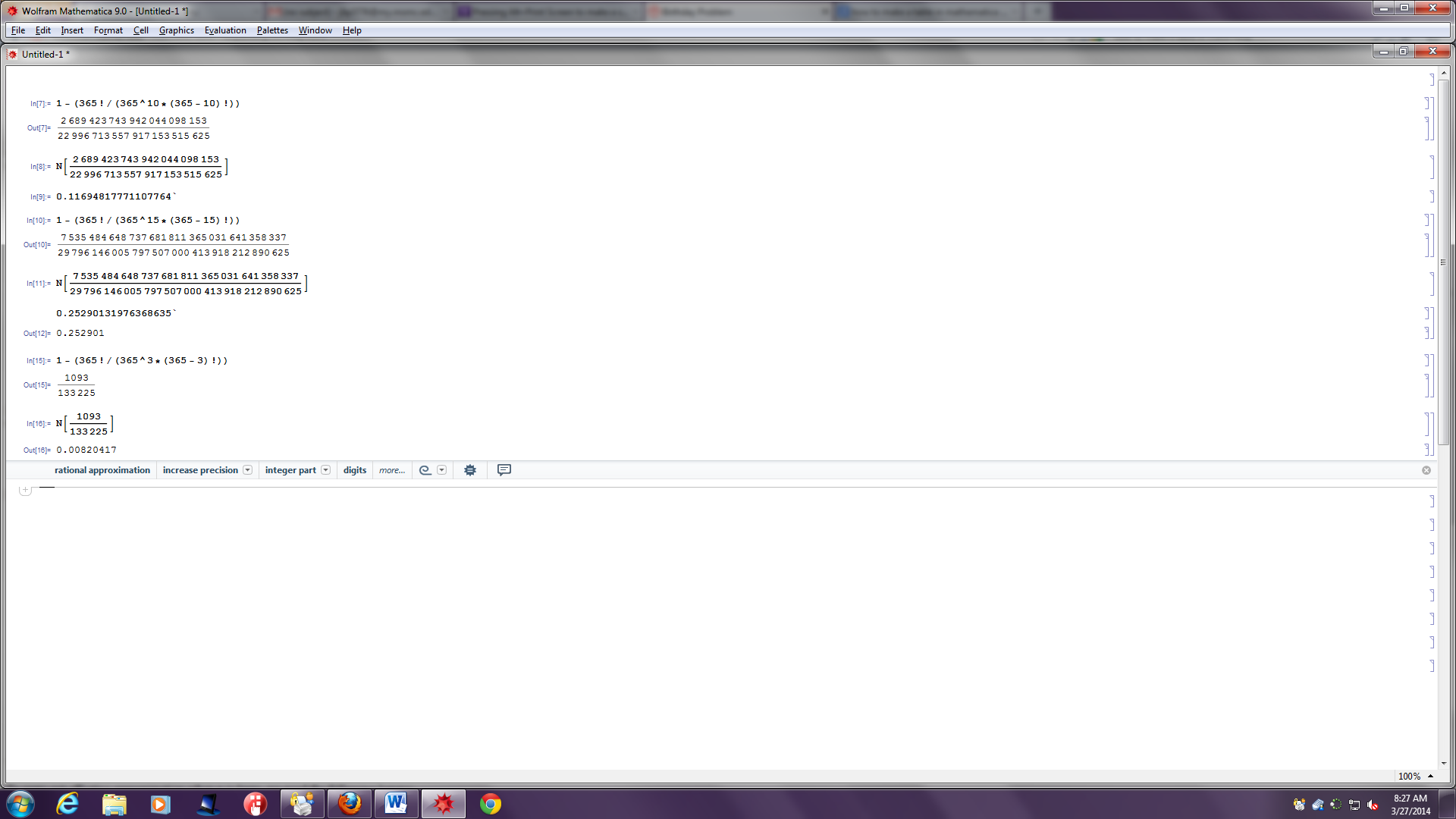
1. If we assume that everyone has an equal chance of being born on the same day, the probability of being born on any given day is. The probability of *n* number of people not being born on the same day is :

image

1. Using Mathematica we can enter as follows. To find the answer to our problem. (Remember the original formula is for people not sharing the same birthday)Press numerical value to convert the fraction into a decimal. Press Shift Enter to enter the formula.

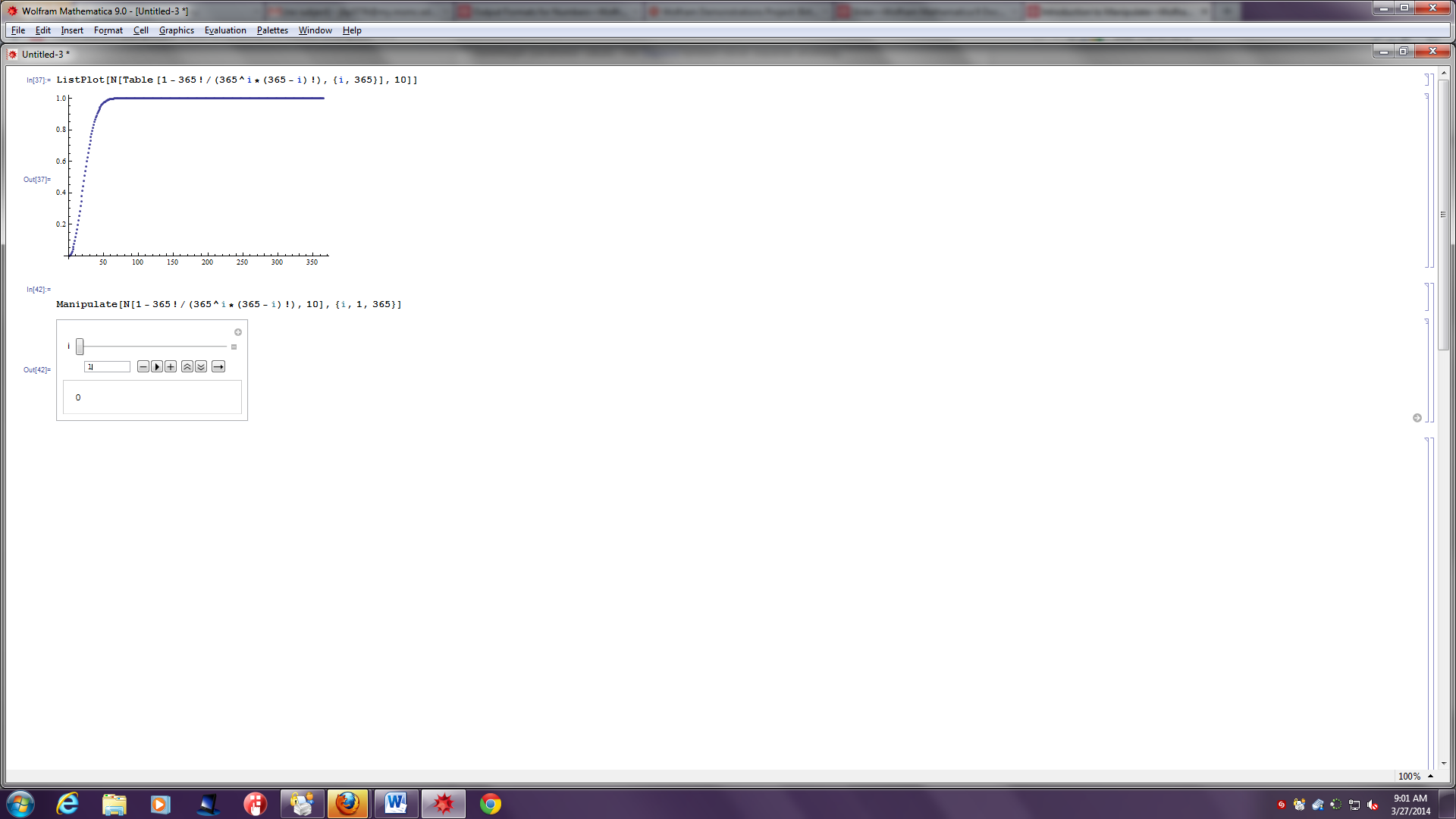


1. Was your answer close to the actual value of 56.87%?
2. Manipulate the formula to find the percentage of find a match with
   1. 10 people
   2. 15 people
   3. 3 people



1. Find how many people have to be in a room in order to get a 50% chance of two people having the same birthday? How about 99% chance? Write your answer below. Make a logical guess.

1. We can use Mathematica to help us model this by createing a Possion distrabution

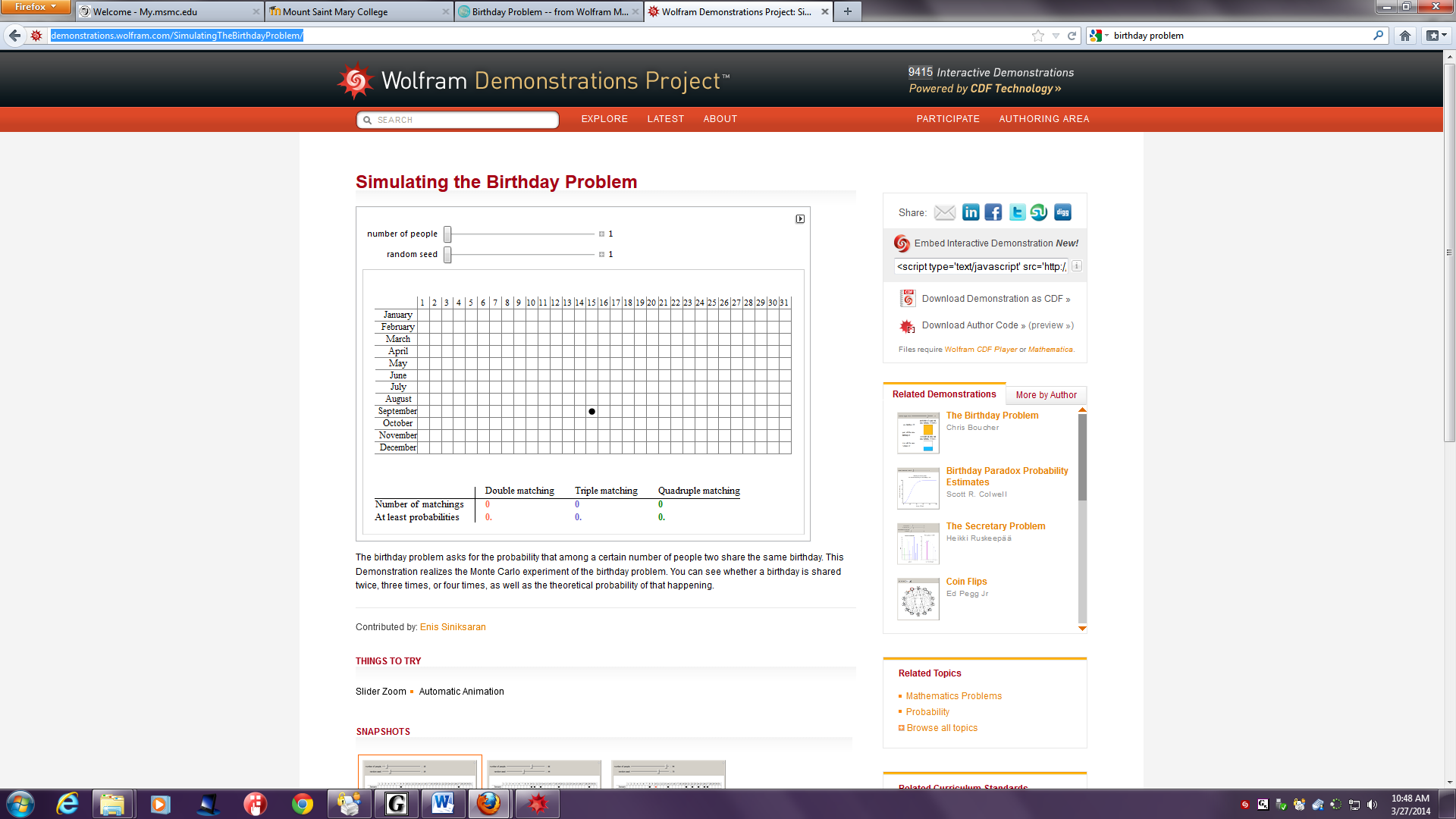


1. Use the sliders and the graph to answer the following questions
   1. How many people are needed to reach 50%?
   2. How many people are needed to reach 99%?

* 1. Is this number smaller than what you originally thought?
  2. How would we change our formula if we wanted to find if 3 people had the same birthday?

**Real World Application-** The math behind the birthday problem is used in cryptographic attack. This attack can be used to abuse communication between two or more parties. The attack depends on the higher likelihood of collisions found between random attack attempts and a fixed degree of permutations as described in the birthday problem.3

**Helpful link:** http://demonstrations.wolfram.com/SimulatingTheBirthdayProblem



\*You can import the code to have a more realistic slider for a demonstration.

**Citations:**

1. Weisstein, Eric W. "Poisson Distribution." From MathWorld--A Wolfram Web Resource. http://mathworld.wolfram.com/PoissonDistribution.html
2. Weisstein, Eric W. "Birthday Problem." From MathWorld--A Wolfram Web Resource. http://mathworld.wolfram.com/BirthdayProblem.html
3. Weisstein, Eric W. "Birthday Attack." From MathWorld--A Wolfram Web Resource. http://mathworld.wolfram.com/BirthdayAttack.html