**Rabbit Simulation**

This assignment is a complete review of your CS145 class. There should be NOTHING new to you.

This assignment will give you practice with defining a class. You are to write a class that defines a Rabbit, Rabbit.java. This class will not have a main method.

You will then write a program that will run a simulation, RabbitSimulation.java, using your Rabbit class. This class will be your driver. You will only need to turn in two java files to me in your zip file: Rabbit.java and RabbitSimulation.java

You are required to use those file names.

**What are Rabbits?**

They are small mammals with fluffy, short tails, whiskers and long distinctive ears. They are from the family Leporidae. Only females can have a litter of rabbits. The gestation period for a rabbit is 28-32 days; this can change for each pregnancy. Female rabbits can get pregnant/breed again a week (7 days) after giving birth to a litter. Rabbits will breed for the first time at 100 days old. The probability of producing a doe (female) in a litter is equal to the probability of producing a buck (male). Litter sizes can vary between 3 and 8. The litter size can be different for each pregnancy.

**What to do:**

Create a class called **Rabbit**.java to model the Rabbit. Your rabbits will need a biological sex, age, and other fields to help you determine if it is pregnant, how long its gestational period is (changes for every pregnancy), how many days of the gestation has passed, and how many days after the delivery of the last litter. You will also have to have methods to give a rabbit the ability to have 3-8 rabbits per litter. For each pregnancy the litter size can vary.

You will need to write a Client (Driver) Class called **RabbitSimulation.java** that will simulate the growth of a rabbit population that starts with a given number of does and bucks at day **zero**.

**The seed population will be read in from a file. The relative path to this file will be passed via the command line. It will be only thing passed.**

The format of the file will contain any number of rows. Each row contains an initial seed population. The first integer will be the initial population of females/does and the second integer will be the initial population of males/bucks. The numbers will be tab delimited. Example:

3 1

5 2

1 3

In the example above, there are only three initial seed populations provided. The first line has an initial population of 3 does and 1 buck. The second line has a different seed population of 5 does and 2 bucks. The last line has a seed population of 1 doe and 3 bucks. Input files can have a varying number of rows!

For each of these different seed populations, you must run trials.

**A single trial:**

Increase time by 1 day at a time and answer the questions:

How many rabbits will there be produced after 1 year (**365** days – this should be a constant) given if the initial seed population were all born on day 0?

To answer this, you must have a way of storing your rabbits as you produce them. Use an ArrayList of type Rabbit to do this. Seed this ArrayList with the initial population of rabbits and add the new litters to it as they are produced.

Report the final population of rabbits, the number of does, and the number of bucks. (You need to return an integer array you used for tallying).

**Now repeat the trial 10 times**:

Your simulation should repeat this trial **10** times (This should be a constant). Reporting the stats for each round (total rabbits, does, bucks).

Use a 2-D array to store the trial data (Example index 0 stores the array of tallies for the first trial). This organizes your data like a spreadsheet. The first column is the total rabbit population, the second column is the female population, and the third is the male population.

Given the data for the 10 trials, report the average number of rabbits with its standard deviation, the average number of does and the standard deviation, and the average number of bucks and the standard deviation. The averages and standard deviations should report only have **three places after the decimal point**.

Sample outputs below are based on the given sample input file above (remember there is randomness in determining sex, gestation period, and litter size so your output will vary):

Starting with 3 doe(s) and 1 buck(s):

Trial 0: 431 was the final population of rabbits; 201 does, 230 bucks.

Trial 1: 340 was the final population of rabbits; 173 does, 167 bucks.

Trial 2: 498 was the final population of rabbits; 256 does, 242 bucks.

Trial 3: 323 was the final population of rabbits; 162 does, 161 bucks.

Trial 4: 418 was the final population of rabbits; 209 does, 209 bucks.

Trial 5: 361 was the final population of rabbits; 179 does, 182 bucks.

Trial 6: 443 was the final population of rabbits; 235 does, 208 bucks.

Trial 7: 407 was the final population of rabbits; 212 does, 195 bucks.

Trial 8: 397 was the final population of rabbits; 204 does, 193 bucks.

Trial 9: 313 was the final population of rabbits; 159 does, 154 bucks.

Average number of rabbits: 393.100 with standard deviation of 55.623.

Average number of female rabbits: 199.000 with standard deviation of 29.813.

Average number of male rabbits: 194.100 with standard deviation of 27.541.

Starting with 5 doe(s) and 2 buck(s):

Trial 0: 695 was the final population of rabbits; 345 does, 350 bucks.

Trial 1: 627 was the final population of rabbits; 298 does, 329 bucks.

Trial 2: 775 was the final population of rabbits; 352 does, 423 bucks.

Trial 3: 803 was the final population of rabbits; 391 does, 412 bucks.

Trial 4: 684 was the final population of rabbits; 338 does, 346 bucks.

Trial 5: 720 was the final population of rabbits; 370 does, 350 bucks.

Trial 6: 627 was the final population of rabbits; 333 does, 294 bucks.

Trial 7: 690 was the final population of rabbits; 340 does, 350 bucks.

Trial 8: 783 was the final population of rabbits; 361 does, 422 bucks.

Trial 9: 743 was the final population of rabbits; 378 does, 365 bucks.

Average number of rabbits: 714.700 with standard deviation of 58.524.

Average number of female rabbits: 350.600 with standard deviation of 24.997.

Average number of male rabbits: 364.100 with standard deviation of 40.233.

Starting with 1 doe(s) and 3 buck(s):

Trial 0: 180 was the final population of rabbits; 86 does, 94 bucks.

Trial 1: 138 was the final population of rabbits; 62 does, 76 bucks.

Trial 2: 123 was the final population of rabbits; 61 does, 62 bucks.

Trial 3: 109 was the final population of rabbits; 55 does, 54 bucks.

Trial 4: 183 was the final population of rabbits; 90 does, 93 bucks.

Trial 5: 98 was the final population of rabbits; 56 does, 42 bucks.

Trial 6: 95 was the final population of rabbits; 49 does, 46 bucks.

Trial 7: 215 was the final population of rabbits; 102 does, 113 bucks.

Trial 8: 123 was the final population of rabbits; 52 does, 71 bucks.

Trial 9: 144 was the final population of rabbits; 76 does, 68 bucks.

Average number of rabbits: 140.800 with standard deviation of 37.968.

Average number of female rabbits: 68.900 with standard deviation of 17.421.

Average number of male rabbits: 71.900 with standard deviation of 21.538.

The format of your output should match the above example.

**Strategy:**

* Create your Rabbit class
  + Write your getter and setters and helper methods
* In your Driver create a Rabbit and test that your methods work correctly.

Once you have verified you Rabbit works correctly

* Write a method to run one trial of your experiment
  + Populate your ArrayList of rabbits with the correct number of seeds read from a file
  + For the number of days in your trial
    - Age each rabbit
    - If it is pregnant – add a day to its gestational period
    - If it can breed – let it breed
    - If it can give birth – let it give birth (add litter to rabbit population)
* Report/record the results of that trial int an integer array (print to verify then for final comment it out)
* Repeat this trial 10 times recording each trial data in a 2-D array (print to verify then for final comment it out)
* Report the averages and standard deviations
* To see if your numbers are correct – enter your numbers in an Excel spread sheet (use the STDEVP function)
* Make sure your output is formatted like mine before turning it in.

Give meaningful names to methods and variables, and use proper indentation and whitespace. Follow Java's naming standards. Localize variables when possible; declare them in the smallest scope needed. Include meaningful comment headers at the top of your program and at the start of each method. **You are required to use the java doc style!** You will lose points otherwise. Limit line lengths to 100 chars. Do NOT chain. Your main method should be a summary of your program.

Submit only your Rabbit.java and RabbitSimulation.java in a zip file with nothing else. No packages should be included. Make sure to turn in a readme.