Lab B Test Plan Tyler Forrester

1 TESTING OVERVIEW

The testing plan is to verify that the descriptive functions are working appropriately, then verify that dice rolls are returning the appropriate range of numbers. We can then uses multiple rolls to see if the descriptive statistics converge to their theoretical levels. If the dice rolls are close to these theoretical levels it is very likely that the program is working appropriately.

2 TESTING PLAN

Test Case	Input Values	Driver Functions	Expected Outcomes	Actual Outcomes
Sort in ascending order	Array{2,5,8,3,5}	bubbleSort()	Print to console 2 3 5 5 8	Print to console 2 3 5 5 8
Average	Array{2,5,8,3,5}	Average	Print to console "4.6 "	Print to console "4.6 "
Standard deviation	Array{2,5,8,3,5}	standDev()	Print to console 2.30217	Print to console 2.30217
Mode	Array{2,5, 8, 3,5}	mode()	5	5
Mode	Array{2,5, 8, 3,5, 3}	mode()	5 3	5 3
Median	Array{2,5, 8, 3,5}	Median()	5	5
Median	Array{2,5, 8, 3,5, 3}	Median()	4	4
Roll Dice 10 Times	Dice1	rollDie()	Numbers between 1 and 6	Numbers between 1 and 6
Roll Dice 10 Times	Dice4	rollDie()	Number between 1 and 4	Number between 1 and 4
Roll two 6- dice 1000 Times then analyze. Tests Dice Class	Dice1 and Dice2	arrRolls()	Average: 7 Standard Deviation: 2.45 Mode: 7 Median: 7	Average: 6.975 Standard Deviation 2.45 Median: 7 Modes(s): 7
Roll two 4-sided dice 1000 times then analyze	Please see analysis			

Roll two loaded 6-sided dice 1000 times then analyze	Please see analysis			
Roll two loaded 4-sided dice 1000 times then analyze	Please see analysis			

3 STATISTICAL ANALYSIS

In this section of the paper we are going to review the results of rolling both two die and adding the sum together and also the distribution of a single die roll. The descriptive statistics used will be mean, median, standard deviation and mode. Since its know what the distributions should like we can compare our statistics to the baseline to present an argument of fair dice rolls.

6-sided Unloaded Dice

Adding two 6 sided die together gives a distribution of 2 through 12 there is only 1 combination to get 2 (1,1) and only 1 combination to get 12 (6,6). Others vary in likelihood: 2 combos for 3 and 11 , 3 combos for 4 and 10, 4 combos for 5 and 9 and 5 combos for 6 8 and 6 combos for 7. From these numbers we can determine the mean, standard deviation, most likely mode, and most likely median for the distribution.

Theoretical distribution for two unloaded six side dice rolls is:

Average: 7

Standard Deviation: 2.45

Mode: 7

Median: 7

The actual results for the experiment were:

For 10 sums of two die rolls :

Average: 6.1

Standard Deviation: 1.64

Median: 7

Mode(s): 7

For 1000 sums of two die rolls:

Average: 6.975

Standard Deviation 2.45

Median: 7

Modes(s): 7

We can see through rolling the die 1000 times that we have correctly set up the dice class. Otherwise over these numbers would have never converged. We can also see that testing of 10 rolls is too few.

We should always expect some variance in the results but as the trials move to infinity we will start to see the results converge to the theoretical results.

6-sided Loaded Dice

For the sake of brevity (a brief analysis was noted in the assignment), I am going to give the expected distribution without indepth description of production of the theoretical definition. The 6-sided loaded dice moves the distribution so that 1 is only weight at 95% and 6 is weighted at 105%. This is accomplished by moving each number lower than 6 up by 5%. (The middle number lose 5% but also gain it from the lower number). This produces a theoretical distribution which looks like this:

Theoretical distribution for two Loaded six side dice rolls is:

Average: 7.08

Standard Deviation: 2.45

Median: 7

Mode: 7

The actual results for the experiment were:

For 10 sums of two Loaded die rolls :

Average: 8.6

Standard Deviation: 2.37

Median: 8.5

Mode(s): 8 11

For 1000 sums of two Loaded die rolls:

Average: 7.01

Standard Deviation 2.5

Median: 7

Modes(s): 8

We can see that since the loaded dice slightly moves up the average that our average is slightly higher. Its uncommon to see a mode of 8 given the distribution but not implausible. I feel comfortable that my loaded die program is working appropriately.

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<u>4-sided Unloaded Dice</u>

Adding two 4 sided die together gives a distribution of 2 through 8 there is only 1 combination to get 2 (1,1) and only 1 combination to get 8 (4,4). Others vary in likelihood: 2 combos for 3 and 7. 3 combos for 4 and 6, 4 combos for 5. From these numbers we can determine the mean, standard deviation, most likely mode, and most likely median for the distribution.

Theoretical distribution for two unloaded 4 side dice rolls is:

Average: 5

Standard Deviation: 1.63

Mode: 5

Median: 5

The actual results for the experiment were:

For 10 sums of two die rolls :

Average: 5.2

Standard Deviation: 1.16

Median: 5

Mode(s): 5

For 1000 sums of two die rolls:

Average: 4.94

Standard Deviation 1.53

Median: 5

Modes(s): 5

We can see through rolling the die 1000 times that we have correctly set up the dice class. Otherwise over these numbers would have never converged. We can also see that testing of 10 rolls is too few. We should always expect some variance in the results but as the trials move to infinity we will start to see the results converge to the theoretical results.

4-sided Loaded Dice

For a loaded 4-dice, we'll see the same distribution change as the 6-sided die. The 1 will be rolled 95% of the time and the 4 will be rolled 105% of the. This is roughly what was found.

Theoretical distribution for two Loaded six side dice rolls is:

Average: 5.06675

Standard Deviation: 1.58

Median: 5

Mode: 5

The actual results for the experiment were:

For 10 sums of two Loaded die rolls :

Average: 5.1

Standard Deviation: 1.45

Median: 5

Mode(s): 5 6

For 1000 sums of two Loaded die rolls:

Average: 5.05

Standard Deviation 1.59

Median: 5

Modes(s): 5

We see again that for the sum of two loaded die that as the number of rolls increase the dice start to converge to their expected numbers. Again was that with a slightly higher average it becomes more likely that higher numbers are rolled.

100 rolls 6-sided Die

Theoretical distribution for a six side dice rolls is:

Average: 3.5

Standard Deviation: 1.87

Median: 3.5

Mode: 1,2,3,4,5,6

The actual results for the experiment were:

For 100 die rolls :

Average: 3.55

Standard Deviation: 1.687

Median: 4

Mode(s): 4

The numbers for unloaded dice rolls converged closely to what expected after 100 rolls. It was only surprising that there was only one mode given that six were possible.

Theoretical distribution for loaded six side dice roll is:

Average: 3.545

Standard Deviation: 1.87

Median: 3.5

Mode: 6

The actual results for the experiment were:

For 100 Loaded Die Rolls

Average: 3.92

Standard Deviation 1.71

Median: 4

Modes(s): 6

The mode for 6-sided loaded dice rolls was appropriate. The average was unexpectedly high and the standard deviation low.

100 rolls 4-sided Die

Theoretical distribution for 4 side dice rolls is:

Average: 2.5

Standard Deviation: 1.29

Median: 2.5

Mode: 1,2,3,4

The actual results for the experiment were:

For 100 die rolls :

Average:2.56

Standard Deviation: 1.06132

Median: 3

Mode(s): 3

The standard deviation was slightly lower than expected and the average slightly higher. Other than these small changes every looks as expected.

Theoretical distribution for loaded 4 side dice roll is:

Average: 2.53

Standard Deviation: 1.2

Median: 2.5

Mode: 4

For 100 Loaded Die Rolls

Average: 2.54

Standard Deviation 1.09

Median: 2

Modes(s): 2

The average was almost exactly on expectation. The standard deviation again was slightly low. The median was also a little low as was the mode. This is all possible through random chance.

4 SUMMARY

After evaluating these dice rolls in a variety of ways, I am confident that my program is working appropriately. There will always be some distance from the theoretical statistics due to random chance and I am comfortable that my die roll close enough that the distance is accounted by random chance.