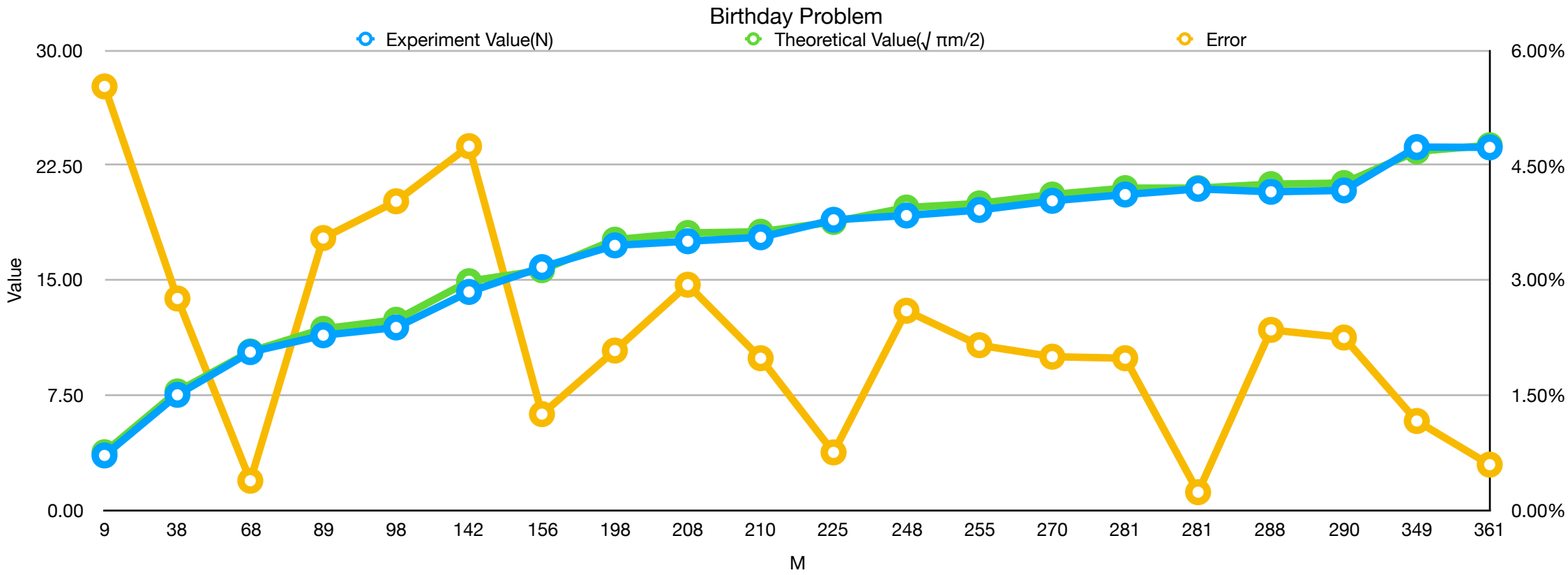
Birthday problem.

Birthday Problem

M	Experiment Value(N)	Theoretical Value(√ πm/2)	Error
9	3.55	3.76	5.53%
38	7.51	7.73	2.76%
68	10.3	10.34	0.38%
89	11.4	11.82	3.55%
98	11.91	12.41	4.03%
142	14.23	14.93	4.75%
156	15.85	15.65	1.25%
198	17.27	17.64	2.08%
208	17.54	18.08	2.94%
210	17.8	18.16	1.98%
225	18.94	18.8	0.75%
248	19.22	19.74	2.60%
255	19.58	20.01	2.15%
270	20.18	20.59	2.00%
281	20.59	21.01	1.98%
281	20.96	21.01	0.23%
288	20.77	21.27	2.35%
290	20.86	21.34	2.25%
349	23.69	23.41	1.16%
361	23.67	23.81	0.59%

```
<terminated> Birthday [Java Application] /Library/Java/Jav
 m        n        sqrt(πm/2)      Error
98       11.91      12.41      4.03%
349       23.69      23.41      1.16%
270       20.18      20.59      2.00%
89       11.40      11.82      3.55%
225       18.94      18.80      0.75%
210       17.80      18.16      1.98%
38       7.51      7.73      2.76%
281       20.59      21.01      1.98%
255       19.58      20.01      2.15%
281       20.96      21.01      0.23%
68       10.30      10.34      0.38%
198       17.27      17.64      2.08%
142       14.23      14.93      4.75%
248       19.22      19.74      2.60%
288       20.77      21.27      2.35%
361       23.67      23.81      0.59%
156       15.85      15.65      1.25%
290       20.86      21.34      2.25%
9       3.55      3.76      5.53%
208       17.54      18.08      2.94%
```



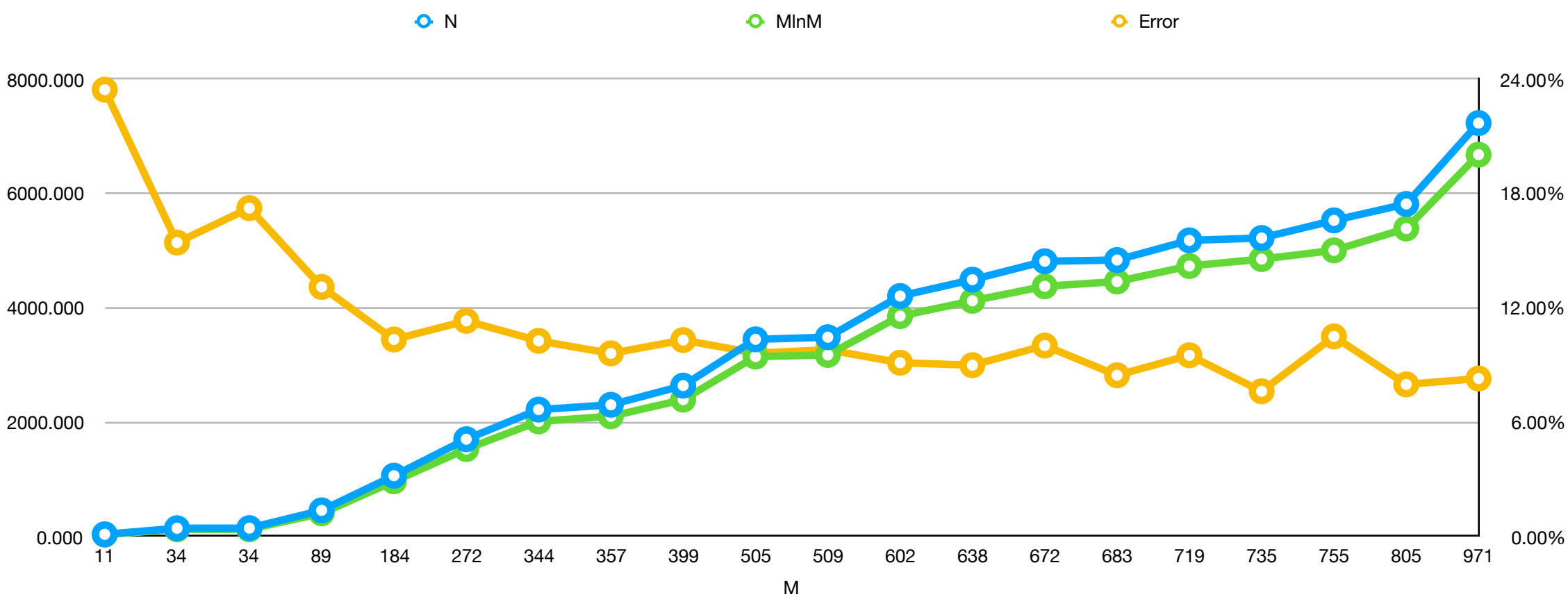
The experiment result table as well as the chart shows that the average number of hashes/throws before the first collision in encountered tends to equal to √πm/2. The Error is smaller as m getting bigger.

Coupon collector problem.

Result Table of CouponCollector

M	N	MlnM	Error
11	32.563	26.38	23.45%
34	138.389	119.9	15.42%
34	140.557	119.9	17.23%
89	451.781	399.49	13.09%
184	1058.641	959.55	10.33%
272	1697.163	1524.78	11.31%
344	2215.408	2009.18	10.26%
357	2299.855	2098.35	9.60%
399	2635.682	2389.6	10.30%
505	3445.568	3143.4	9.61%
509	3482.943	3172.32	9.79%
602	4204.038	3852.95	9.11%
638	4490.552	4120.42	8.98%
672	4812.954	4374.89	10.01%
683	4834.402	4457.6	8.45%
719	5178.75	4729.48	9.50%
735	5220.099	4850.9	7.61%
755	5528.079	5003.17	10.49%
805	5815.622	5386.13	7.97%
971	7231.585	6678.86	8.28%

m	n	mlnm	Error
505	3445.568	3143.40	9.61%
602	4204.038	3852.95	9.11%
184	1058.641	959.55	10.33%
89	451.781	399.49	13.09%
683	4834.402	4457.60	8.45%
672	4812.954	4374.89	10.01%
399	2635.682	2389.60	10.30%
357	2299.855	2098.35	9.60%
34	138.389	119.90	15.42%
638	4490.552	4120.42	8.98%
11	32.563	26.38	23.45%
344	2215.408	2009.18	10.26%
509	3482.943	3172.32	9.79%
735	5220.099	4850.90	7.61%
805	5815.622	5386.13	7.97%
272	1697.163	1524.78	11.31%
755	5528.079	5003.17	10.49%
971	7231.585	6678.86	8.28%
34	140.557	119.90	17.23%
719	5178.75	4729.48	9.50%



The experiment result table as well as the chart shows that the average number of hashes/throws before all bins/slots are filled tends to equal to mlnm. The Error is smaller as m getting bigger.