Experiment 7 Statistical Mechanics

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Aim:
To discuss microstates and macrostates on throwing a die

Theory and Procedure:
This experiment consists of 2 parts:
1. Throw 2 dice and plot the histogram of the totals of all possible rolls vs the number of different ways each roll can occur. Find this multiplicity and record the actual and expected multiplicity in a table, then plot *ln w* vs the dice roll.
   Collect all the readings and compare the larger set of readings with the expected numbers to find whether there is an improvement.
2. Now consider an experiment where throwing the dice determines microstate for a collection of N molecules (N = 3). This consists of 2 sub-experiments:
   a. Exp A: If the value on the die is 1, 2, or 3 implies molecule is in state 1, and if it is 4, 5, or 6 implies it is in state 2
   This part denotes degenerate energy states where both sides are of equal energy with equal probability of occupation
   b. Exp B: If the value on the die is 1, 2, 3 or 4 implies molecule is in state 1, and if it is 5 or 6 implies it is in state 2
   This part denotes non-degenerate energy states
   We record the data after throwing the single die 100 times.

Observations and Calculations (Shrey Tripathi IMT2019084)

1a)
Histogram: Totals of all possible rolls when 2 dice are rolled (macrostates) vs number of different ways that each total can occur (microstates)
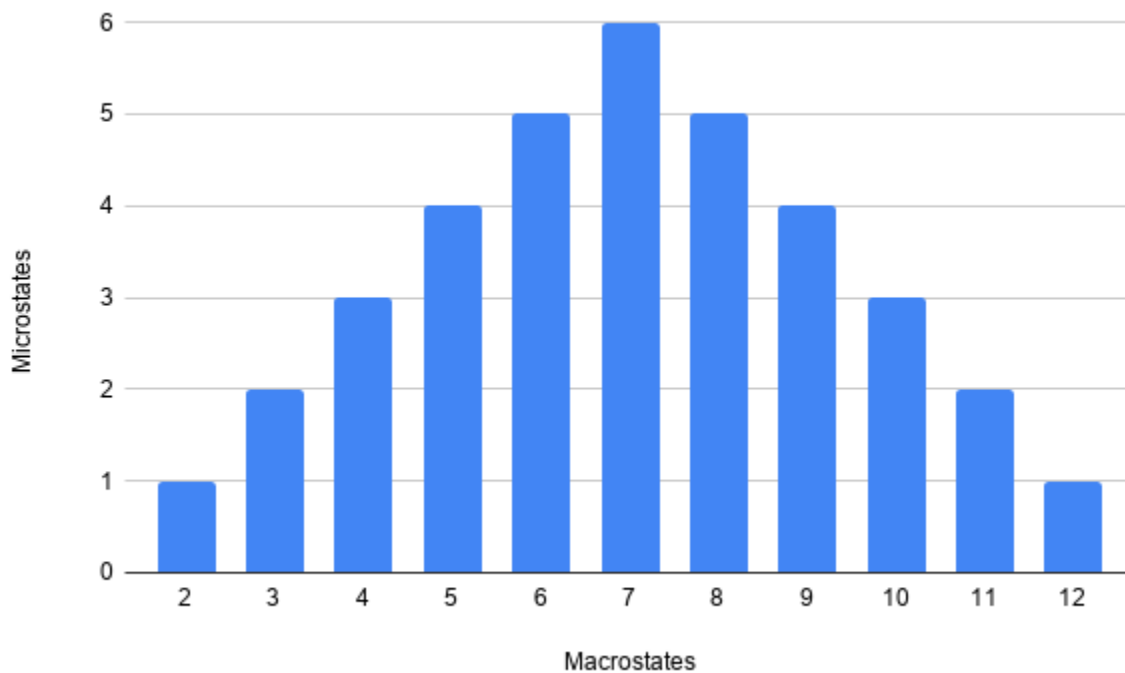

1b)
Two dice are rolled 36 times. Table of expected vs actual multiplicity:

Dice Roll	W (expected)	W (actual)	ln w(expected)	ln w(actual)
2	1	1	0.0000000000	0.0000000000
3	2	2	0.3010299957	0.3010299957
4	3	3	0.4771212547	0.4771212547
5	4	8	0.6020599913	0.9030899870
6	5	6	0.6989700043	0.7781512504
7	6	6	0.7781512504	0.7781512504
8	5	3	0.6989700043	0.4771212547
9	4	2	0.6020599913	0.3010299957
10	3	1	0.4771212547	0.0000000000
11	2	3	0.3010299957	0.4771212547
12	1	1	0.0000000000	0.0000000000

Plot of ln w (actual) and ln w (expected) vs Dice Roll is:

ln w(expected) and ln w(actual) vs Dice Roll

— ln w(expected)   — ln w(actual)
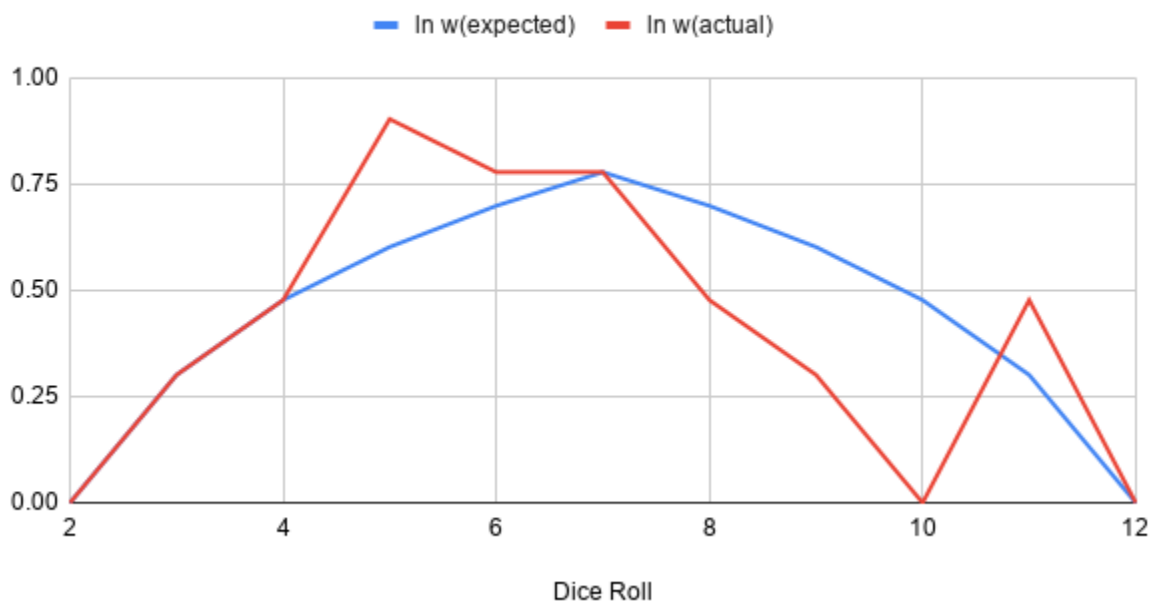
2a)
Table:

Move Number	Reading On Die	Molecular State (Exp A)	Molecular State (Exp B)
1	6	2	2
2	3	1	1
3	3	1	1
4	3	1	1
5	2	1	1
6	3	1	1
7	4	2	1
8	4	2	1
9	1	1	1
10	5	2	2
11	5	2	2

12	6	2	2
13	2	1	1
14	4	2	1
15	2	1	1
16	5	2	2
17	2	1	1
18	6	2	2
19	4	2	1
20	3	1	1
21	4	2	1
22	3	1	1
23	3	1	1
24	6	2	2
25	2	1	1
26	6	2	2
27	3	1	1
28	5	2	2
29	6	2	2
30	5	2	2
31	5	2	2
32	4	2	1
33	4	2	1
34	4	2	1
35	4	2	1
36	6	2	2
37	4	2	1
38	4	2	1
39	4	2	1
40	4	2	1
41	6	2	2
42	3	1	1
43	6	2	2
44	1	1	1
45	4	2	1
46	1	1	1

47	4	2	1
48	4	2	1
49	4	2	1
50	6	2	2
51	4	2	1
52	2	1	1
53	2	1	1
54	6	2	2
55	2	1	1
56	5	2	2
57	2	1	1
58	1	1	1
59	3	1	1
60	5	2	2
61	3	1	1
62	1	1	1
63	3	1	1
64	3	1	1
65	1	1	1
66	2	1	1
67	4	2	1
68	5	2	2
69	3	1	1
70	4	2	1
71	2	1	1
72	4	2	1
73	2	1	1
74	2	1	1
75	3	1	1
76	6	2	2
77	1	1	1
78	4	2	1
79	5	2	2
80	4	2	1
81	3	1	1

82	4	2	1
83	4	2	1
84	5	2	2
85	3	1	1
86	4	2	1
87	2	1	1
88	5	2	2
89	4	2	1
90	4	2	1
91	2	1	1
92	4	2	1
93	5	2	2
94	6	2	2
95	5	2	2
96	1	1	1
97	3	1	1
98	3	1	1
99	4	2	1
100	5	2	2

Microchart: