Popcorn Lab (03/28/06)

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Abstract

The object of this experiment was to determine a variety of statistical data on the "cooking" of popcorn. We determined the distribution of pops, resulting from the explosion of the kernels due to excess heat. The rate of the pops was determined through construction of a histogram and the progress of pops throughout the cooking time was shown accurately on a bell curve.

After careful analysis and observation of the data, we determined the first pop to be at 37:165357 seconds and the last pop to be at 1:36:407845 min:sec. The total number of pops was 273 and the period during which popping occurred, not including the time before and after the popping, was 59:242488 seconds. The average rate of popping was 4.55 pops/second. The average number of pops was 22.75 and the standard deviation was 11.32.

Theory

The essential idea behind this idea is that there is an underlying relationship between the pops of the popcorn kernels and the time of popping. When, enough heat is absorbed by the kernels they start popping, slowly at the beginning but then the rate of popping increases. Theoretically, the popping rate should be low at the very beginning and at the very end of the popping period, but very high in the middle when several kernels pop at the same time or at very short time intervals from each other. Therefore, we predicted that the rate of popping would be slow, then fast, and then slow in the end. We predicted that the progression would be like that of a bell curve. Also, we predicted

that the first and the last pop will be 30-40 seconds after the microwave start time and before the microwave stop time, respectively.

Experimental

1. Place a popcorn bag inside the microwave.
2. Attach a microphone device to the microwave. This device, which will record the sounds inside the microwave, is attached to a computer with Audacity program which records audio waves, their time of occurrence and amplitude.
3. Start the microwave and record the sound in the Audacity program.
4. Analyze recorded data for the first and last pops.
5. Calculate the average rate of popping, mean, and standard deviation.

Data Analysis

Through adjusting and zooming in on the amplitude and time scale, we were able to determine that the first pop was at 37:165357 seconds and the last pop was at 1:36:407845 min:sec. Also, after zooming in on the recorded data, we were able to observe the waves more closely and were able to count the approximate number of pops that occurred during the popping period. Since the rate of popping changed constantly, as predicted, following the pattern of slow, fast, and then slow, we decided to take the rate of popping at every five second interval. Then we constructed a histogram and a bell curve showing the rate of popping increasing and then decreasing. The bell curve showed an accurate depiction of the varying popping rate.

Time Interval (sec)	# of Pops
0	0
5	11
10	22
15	34
20	36
25	35
30	36
35	30
40	21
45	21
50	12
55	9
60	6

Table 1 – Data table showing the five second intervals and the pops occurring during those intervals.

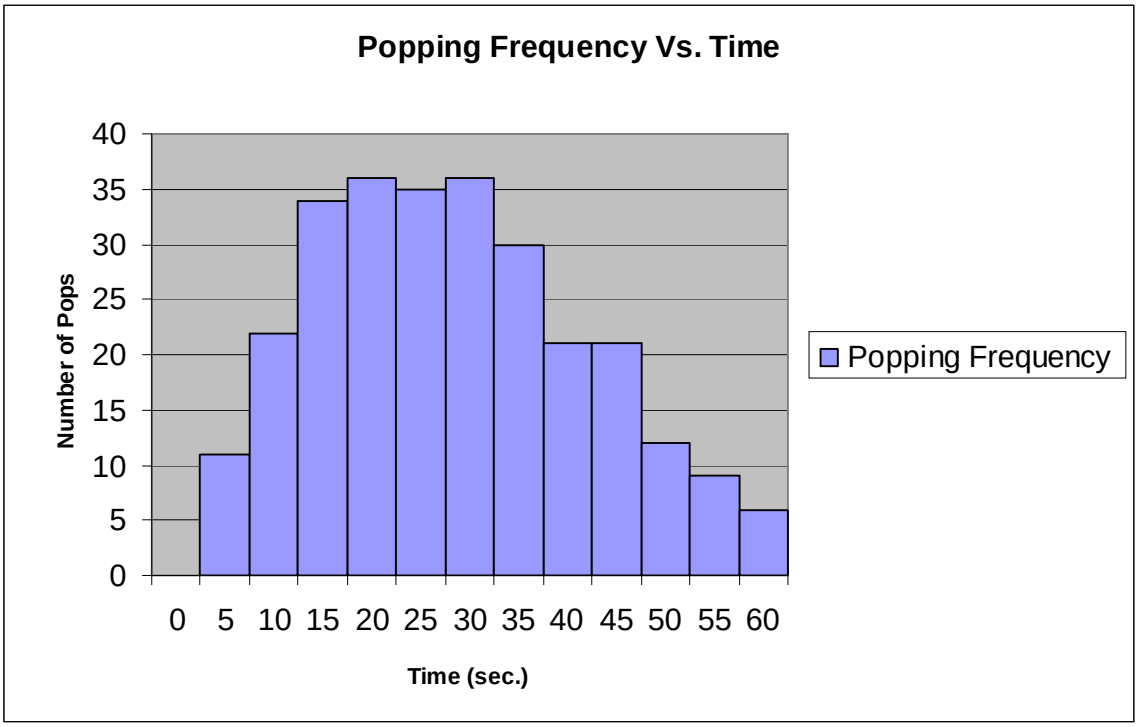

Fig.1 – A histogram showing the varying rates of popping at five second intervals. The rate increases and then after a certain time decreases.

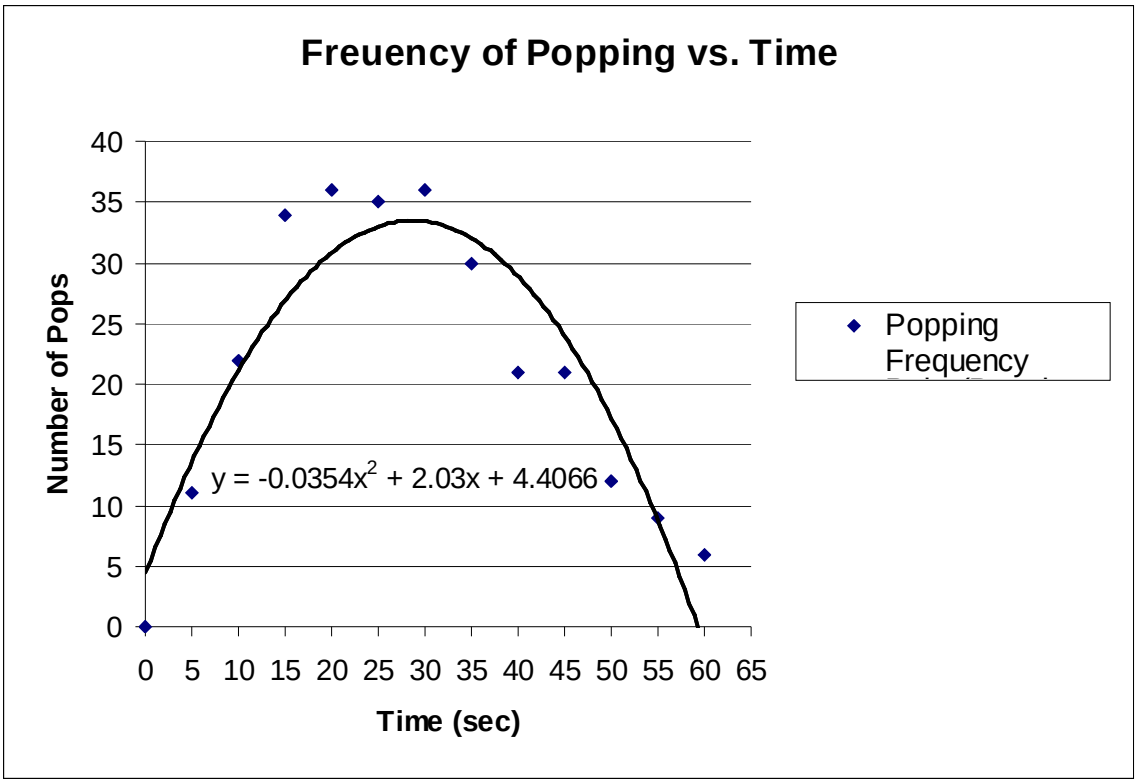

Fig.2 – A bell graph showing the continuous progression of popping during the popping period. The popping rate increases continuously until it reaches a peak and then decreases from thereon.

Mean: (Total # of pops)/ (# of five-second intervals) = 22.75

Average Rate of Popping: (Σ(popping of rate at each five-second intervals))/ (# of five-second intervals) = 4.55 pops/sec

Standard Deviation: ((Σ(pops in each interval – mean))^2)/ (# of five seconds intervals-1) = 11.32

Conclusion

The distribution of popping resulted as predicted because it increased and then decreased as shown in Fig.1. The popping rate followed the same pattern because the rate of popping in the beginning was slow, then it increased and reached a peak, and then it decreased again, shown in Fig.2. This means that in the middle of the bell curve (Fig.2) there were more pops occurring in closely timed intervals or even simultaneously. This

was expected because in order for the rate of popping to increase in the middle of the curve the number of pops occurring in a certain interval has to increase. The average rate of popping came out to be 4.55 pops/sec.

The first pop occurred on 37:165357 seconds, which is in the interval of 30-40 seconds after the start of the microwave, as predicted. The last pop occurred at 1:36:407845 min:sec, which was almost 30 seconds before the microwave turned off. Our standard deviation is 11.32, which means that our data is not too distant from being accurate. Therefore, after the accumulation of a certain amount of heat, the kernels began to pop and this occurred due to the evaporation of moisture present within the kernels.

Remarks

The experiment could have been improved with lesser background noise interference to improve the accuracy of the data.