Experiment reveals secret to maximizing microwave popcorn

Energized by a new tool in Design-Expert® software (DX) for modeling counts, I laid out a design of experiment (DOE) aimed at reducing the number of unpopped kernels (UPK) from microwaved popcorn. I figured that counting the UPKs would be a far more precise measure of popcorn loss than weighing them, as done in this prior study by me and my son Hank.

Background and Setup

My new experiment varied the following two factors in a replicated, multilevel full-factorial, categorical design done with my General Electric (GE) Spacemaker microwave oven:

| Factor	Level 1	Level 2	Level 3
A. Preheating*	No	Yes	----
B. Timing	GE default	GE++	Popcorn Expert App

*Preheat 1 cup water for 1 minute on high power.

I tested the preheating (factor A) before and found it to be unproductive. However, after seeing it on this list of microwave 'hacks', I decided to try again. Perhaps my more precise measuring of UPK might show preheating to be of some help after all. The timing alternatives (factor B) came about when I discovered Popcorn Expert AI Cooking Assistant for systematically applying the #1 hack—the two-second rule: When this much time passes between pops, stop.

By the way, I also tried the third hack—pouring the popcorn into a covered glass bowl, but that failed completely—causing a very alarming "SENSOR ERROR". It turns out that the GE Spacemaker uses humidity to determine when your popcorn is done. The plastic cover prevented moisture from escaping. Oops! Next time I try this it will be with a perforated lid.

While researching the user manual for the first time since buying the Spacemaker 15 years ago (engineers rarely read instructions) and learning about the humidity angle for the first time, I also found out that pressing 9 twice after beginning the popcorn cook added 20 and then 10 more seconds (++) at the end.

The original experiment-design of 12 runs (2×3 replicated) was laid out in a randomized recipe sheet by DX, all of them done using 3 ounce bags of Jolly Time, Simply Popped Sea Salt microwave popcorn. Due to a few mistakes by the machine operator (me) misreading the run sheet, two extra runs got added—no harm done: more being better for statistical power.
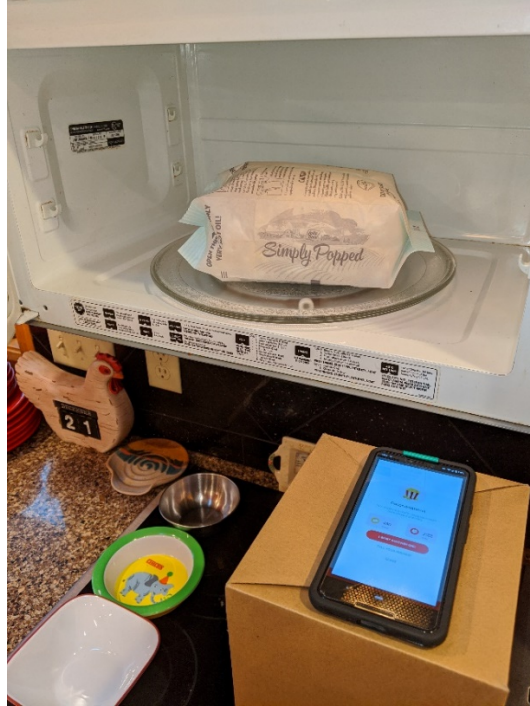
The Surprising Results

Nothing beats microwave popcorn for snacking. That's what makes unpopped kernels (UPK) so aggravating—not just for the loss of yummy yield, but also for the pain from accidentally biting down on them. The big reveal comes from the interaction plot showing that the effect of preheating depends on the timing method.

Factor Coding: Actual

UPK (Count)
● Design Points

X1 = B
X2 = A

■ A1 No
▲ A2 Yes
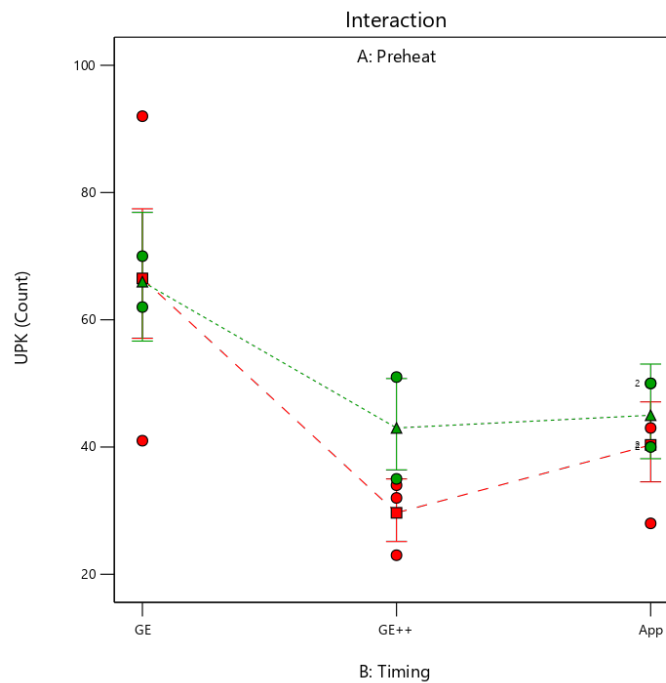
First off, look up at the upper left of the graph and notice that the default GE timing, done by a humidity sensor, creates significantly greater UPKs—the lower end of the least significant difference (LSD) bars (p<0.5) fall above the higher ends of all other LSDs. The actual results using my GE microwave popcorn button, shown by the red (no preheat) and green (yes-preheat) circles on the left, ranged from 41 to 92—far too many UPKs per bag.

Next, see how the combination of GE++ (adding time) with no preheating wins out overall. The actual counts, shown by the red circles at middle bottom, ranged from 23 to 34—far fewer UPKs than before.

Life is good: Best not bother to put in 1 cup of water and wait for a minute; also, no complications introduced by setting up my cell phone, quieting the household, and standing by to turn off the microwave when alerted by Popcorn Expert. All I need to do is press the popcorn button and then 9 twice for the extra time. Easy! And, by the way, the popcorn tastes great—no burning!

I never would have made this significant improvement without the more precise:

- measurement of UPK counts (versus weight) and
- Poisson regression (versus ordinary least squares) modeling*

  *(available in the newly released version 13 of Design-Expert® software)

I encourage you to do your own microwave popcorn experiment, ideally multifactor ones using Design-Expert version 13, now available as a free, fully functional, 14-day trial. Many factors can be tested—first and foremost being brand of popcorn and time in the microwave. Two 'hacks' posted to the question-and-answer website Quora intrigue me:

- Storing popcorn in the freezer
- Setting the bag in a bowl so it pops up better

Another hack botched by me (as confessed earlier) is pouring the popcorn into a vented microwave container. Throw one or more of these factors into your design of experiment (DOE) and please let me know the statistical outcome along with the raw data.

I remain a few dozen kernels short of the perfect microwave popcorn: Zero UPK with every exploded morsel being incredibly delicious.

> *Every once in a while, someone will mail me a single popcorn kernel that didn't pop. I'll get out a fresh kernel, tape it to a piece of paper and mail it back to them.*

Orville Redenbacher

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