

# EXECUTING A DOE: A FEW WAYS TO KILL AN EXPERIMENT

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# Why Should You Care About DOE's?

- An academic reason
  - ▣ Better than COST approach
- 4 other compelling reasons
  - ▣ Directly applicable to your career
  - ▣ Can make you a superstar
  - ▣ Theory not difficult
  - ▣ Takes creativity and imagination

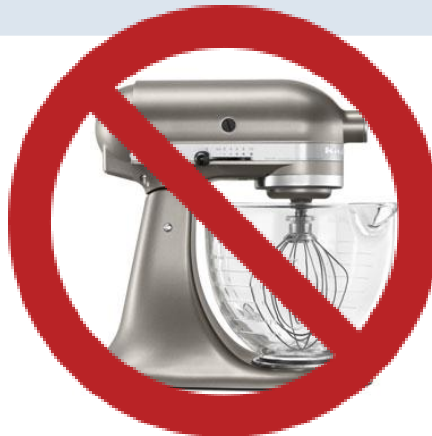
# Let's Talk Muffins

- Non-trivial topic: chemistry is involved
- Ingredients are easily available, low cost
- Can be done in your kitchen
- Lots of  $y$ -variables
- Lots of potential disturbances



# Choosing a Good Recipe

Dry Ingredients	Wet Ingredients	Directions
<p>1 1/3 C flour 3 tsp. baking powder 1/4 tsp salt 1/2 C chocolate chips</p>	<p>1/2 C sugar 1 egg 1 C milk 1/3 C vegetable oil</p>	<p>Mix dry ingredients and chocolate chips. Combine sugar with oil. Then add egg &amp; milk. Stir wet ingredients into flour mixture. Do not beat. Bake @ 375° for 20-25 min.</p>



# A Few Good Factors

- Flour type



- Baking powder amount

- Vegetable oil amount



- Mixing time



# Make it Feasible, Make it Work

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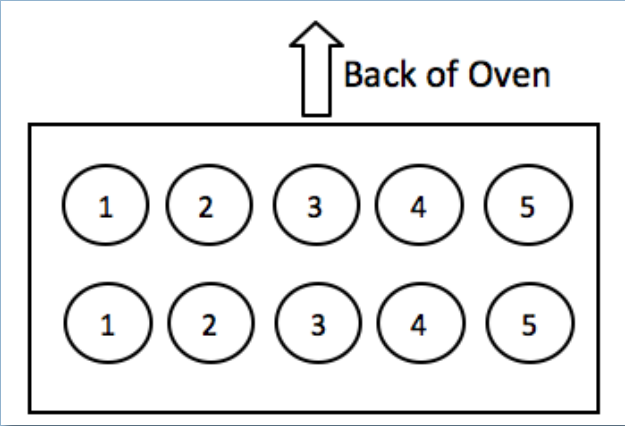


# Consider Disturbances

## □ Pour Order & Pan Location



# Randomize!

Run	Flour Type	Baking Power	Mixing Time	Operator	Egg Size	Oven Location		P1	P2	P3	P4	P5
1						Front	<b>Pour Order</b>	3	5	1	2	4
2						Back	<b>Pour Order</b>	4	1	2	3	5
3						Back	<b>Pour Order</b>	2	3	5	1	4
4						Front	<b>Pour Order</b>	1	4	5	2	3
5						Back	<b>Pour Order</b>	4	2	5	1	3
6						Front	<b>Pour Order</b>	3	5	4	1	2
7						Back	<b>Pour Order</b>	5	3	2	1	4
8						Front	<b>Pour Order</b>	5	2	4	3	1

# Make it Foolproof (or you'll feel like a fool later)



# Luck is the Residue of Preparation

- ❑ Make a test batch first if you can – this will highlight disturbances you haven't thought of, and any organizational issues.
- ❑ Pre-measure as many ingredients as possible.

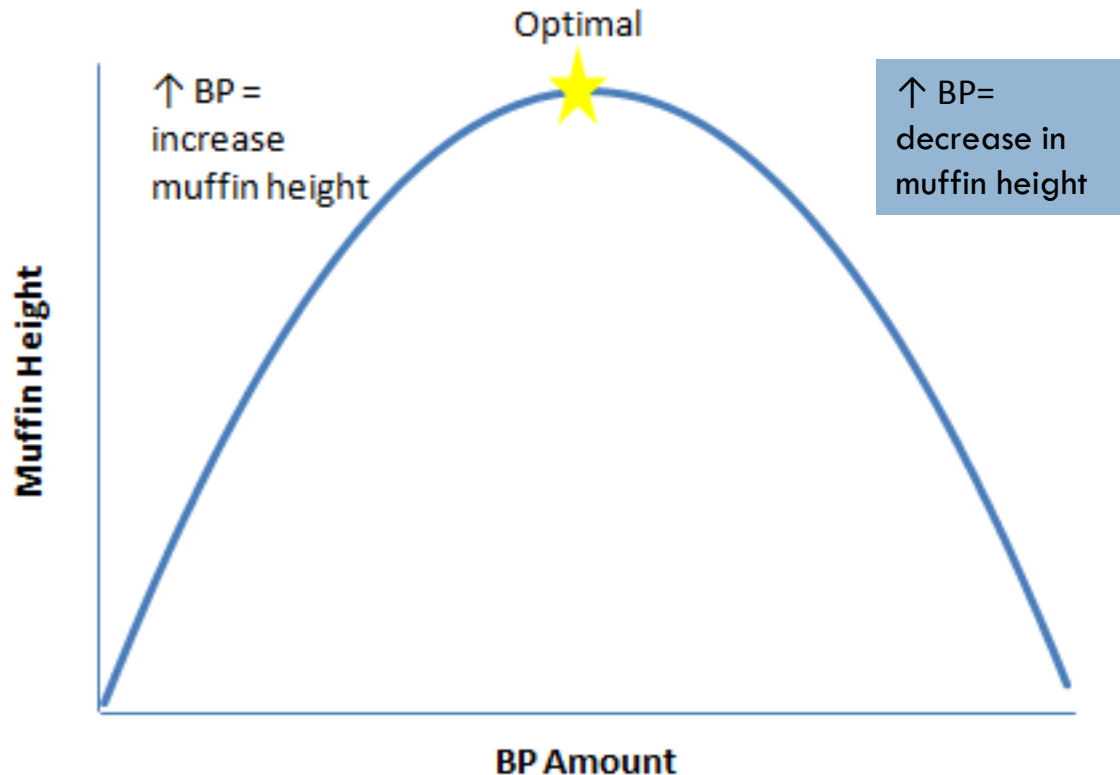


# Surviving Murphy's Law

- What else could go wrong?
- If your data collection methods are well organized, you'll be able to keep track of the unexpected.
- Final Thought: Make it fun!



# Surprises in the Data



$$y_H = 72.54 + 2.50x_A - 2.95x_B - 1.76x_Bx_D$$

↑ muffin height = use bread flour + ↓ baking powder + ↑ mixing time