

Do Liquids Boil at Different Rates?

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Introduction

- 3 different liquids were tested to see if they have an effect on boiling time.
- The 3 liquids were water, orange juice, and milk.
- 3 different pot sizes were used to boil the liquids
- The pot sizes were 6.75, 7.5, and 9 inches in diameter.
- The liquids being tested were boiled on the same stovetop and at the same temperature each time.
- The amount of liquid was 4 cups each time.
- Null hypothesis: The mean boiling time will be the same between all 3 liquids.
- Alternative Hypothesis: The mean boiling time will not be the same between the 3 liquids.

All 3 liquids that were used



Methods

- Independent Variables: Liquids, Pots
- Dependent Variable: Time
- A Factorial Design was used for this experiment.

Methods

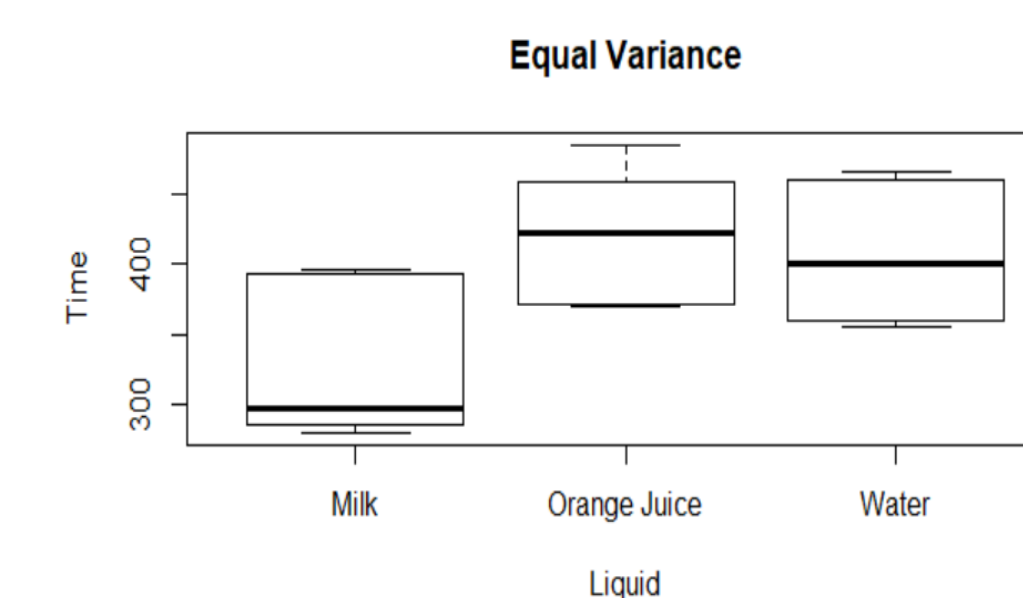
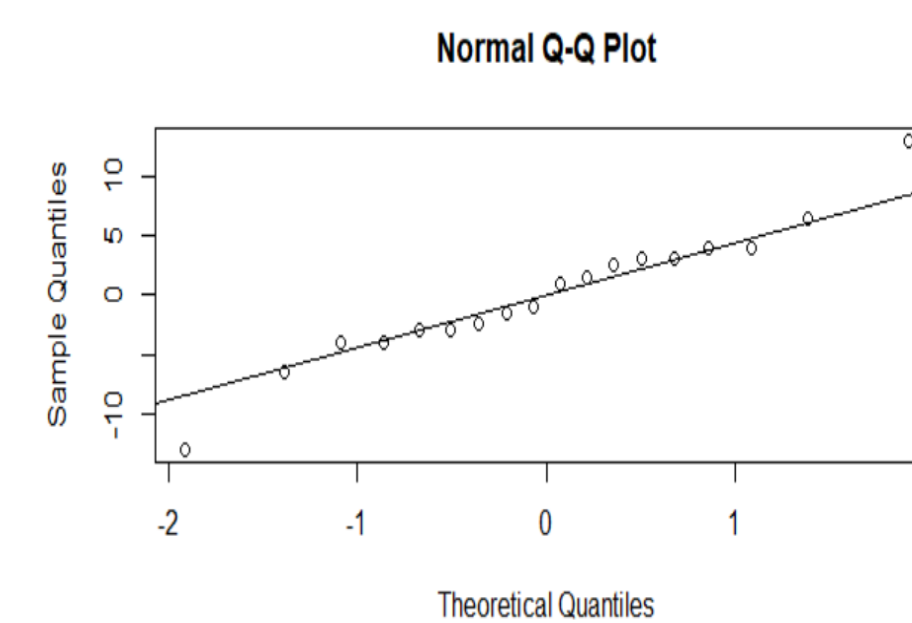
- The experiment was replicated 2 times.
- Once the liquid came to a boil the time was recorded (in seconds).
- All 18 trials were recorded and put into an Excel spreadsheet.
- R-studio was used to conduct the statistical tests, analysis, and check assumptions of the data.
- A factorial ANOVA test was used to test the null hypothesis.

Orange juice while boiling



Milk sitting before the experiment

Results



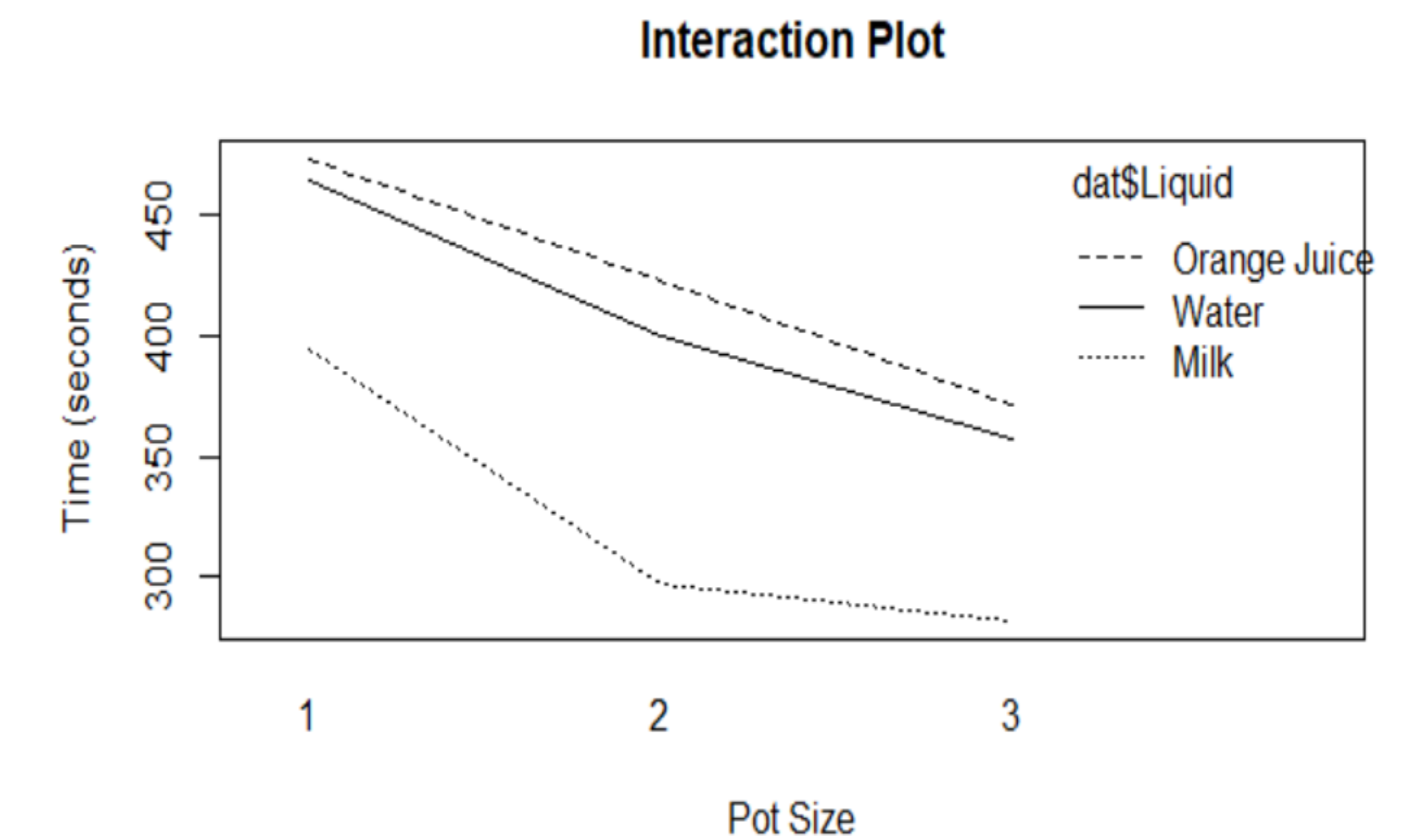
- The assumptions look fine.

Analysis

Table 1: Summary of ANOVA

Source	DF	SS	MS	F	P-value
Liquid	2	33195	16598	275.86	8.41*10 ⁻⁹
Pot Size	2	35526	17763	295.228	6.23*10 ⁻⁹
Interaction	4	1300	325	5.401	0.0169
Error	9	542	60	-----	
Total	17	70563	-----	-----	

- There is a statistically significant interaction between the factors.



- The interaction plot takes a closer look at the interaction between factors.

Conclusions

- There is evidence to reject the null hypothesis at the 0.05 level.
- There is a significant difference in mean boiling times between the 3 liquids.
- Milk boils quicker than water and orange juice.
- Water boils faster than orange juice, but it is very close.
- As the pots get bigger in size, the boiling time decreases.

Acknowledgments

I want to thank Dr. Michael Floren for giving me all the tools to design and conduct this experiment.