Candle Height Experiment

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Introduction

The basis of our experiment was to determine whether or not different factors could affect the rate at which a candle could burn in a five minute period. The different factors tested include wax color, and ambient temperature. The levels of factor included red, white, and green colored wax as well as ambient room temperature of 65, 70, and 75 degrees fahrenheit. We performed four replications of the nine unique treatment combinations in our study. Our response variable of interest was the height of the candle after it had burned for five minutes. Overall, our goal was to see if we could get more value for our money out of different colored candles based on how long they burn in a given environment.

Methodology

The experiment was performed as a randomized complete block design through which the nine treatment combinations were replicated four times totaling to 36 trials. The four different members were the blocking factor creating four different blocks in our experiment. Each member was assigned nine different unique treatment combinations by using a random number generator. The experiment was conducted independently where each member was responsible for setting the temperature conditions and completing the timed candle burn. The member then had to measure the candle in inches after five minutes of burning the candle and record measurements in a table shown in Table 1.

Data Analysis

Data analysis was done in JMP as illustrated by the plots below.

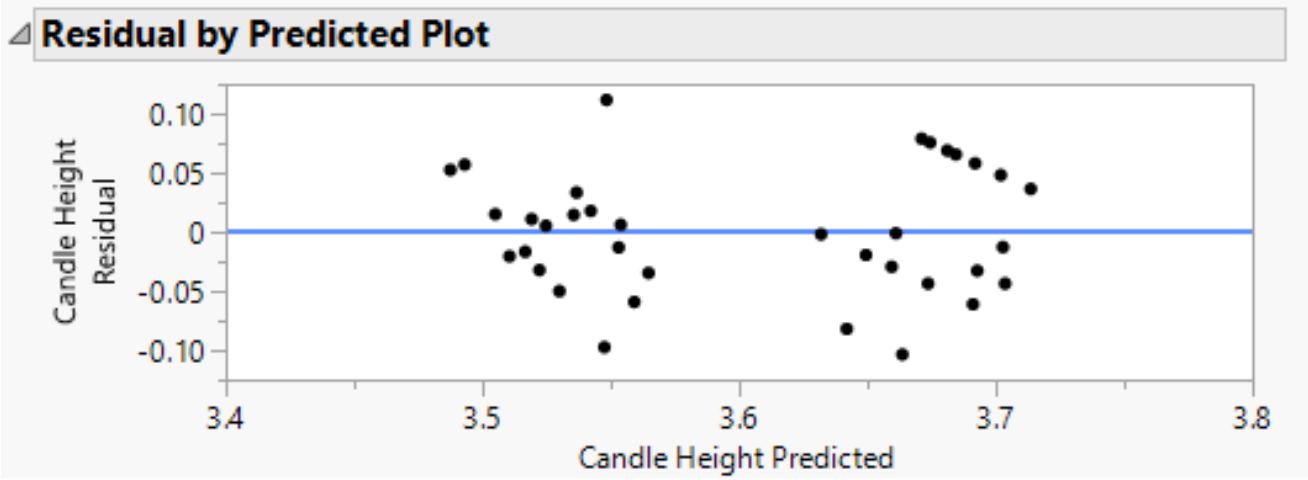

Figure has no clear pattern of residuals; thus Constant Variance Assumption is met

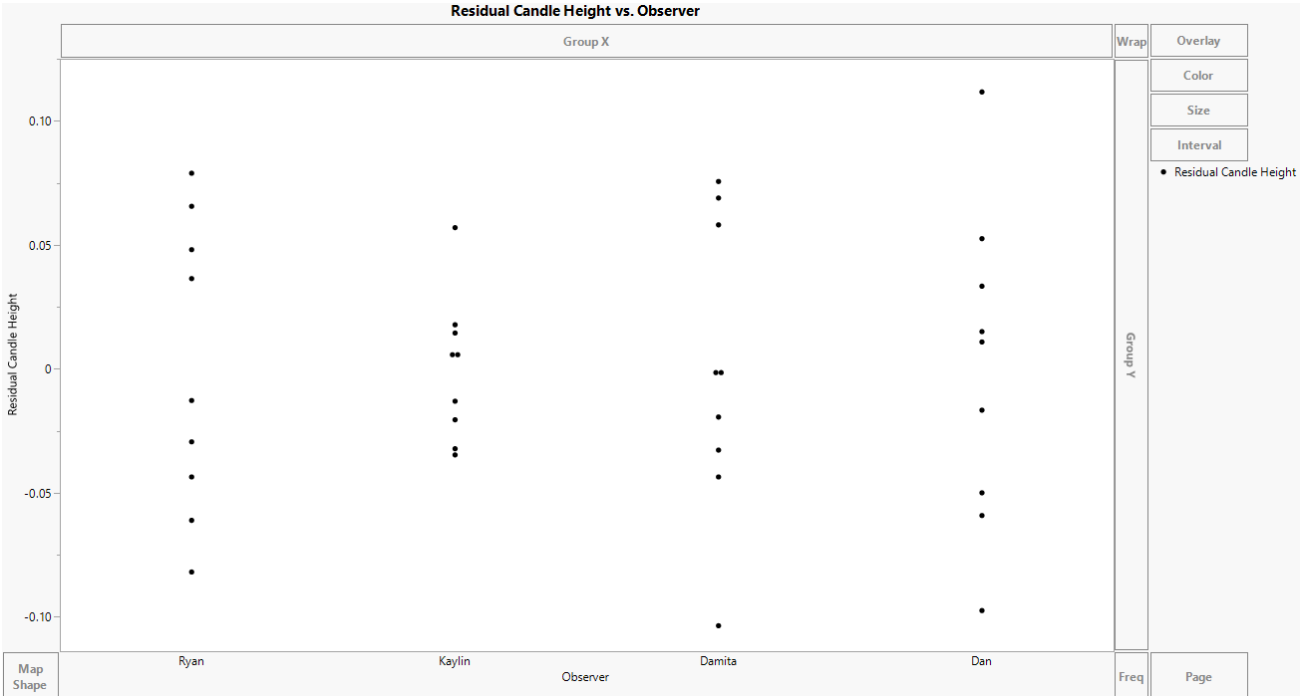

Figure has obvious variances in the residuals; the Constant Variance Assumption is violated

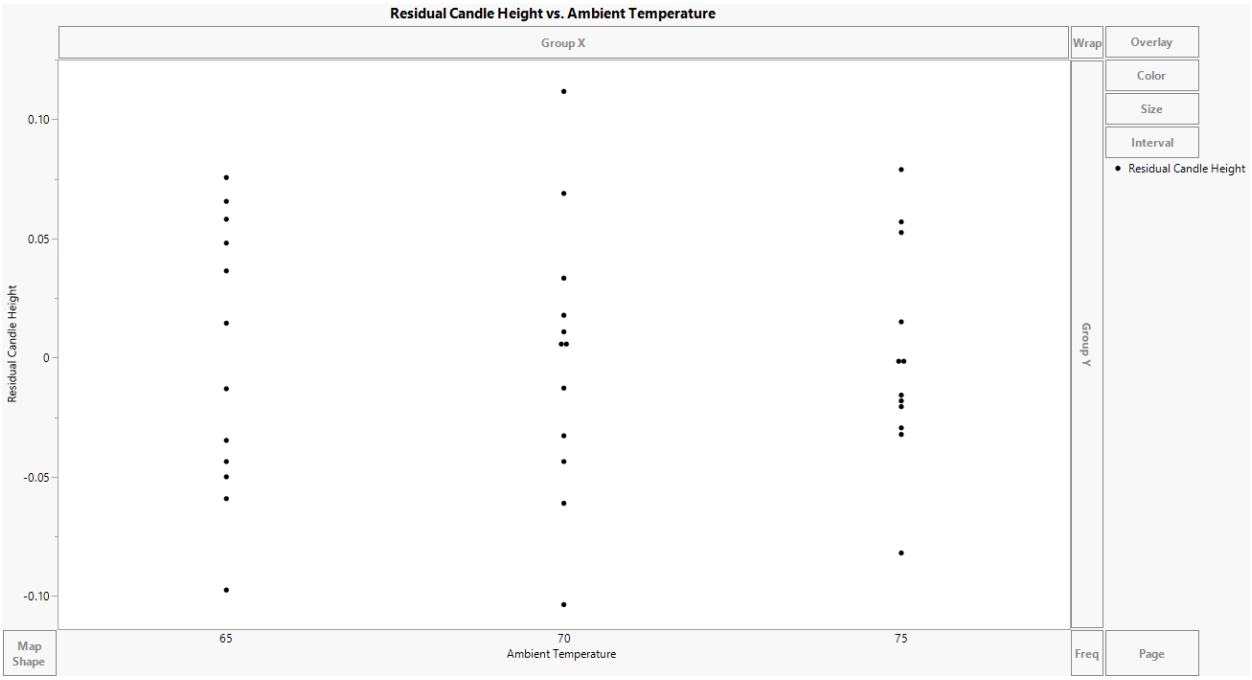

Figure indicates inequality of variance with ambient temperature 70; the Constant Variance Assumption is violated

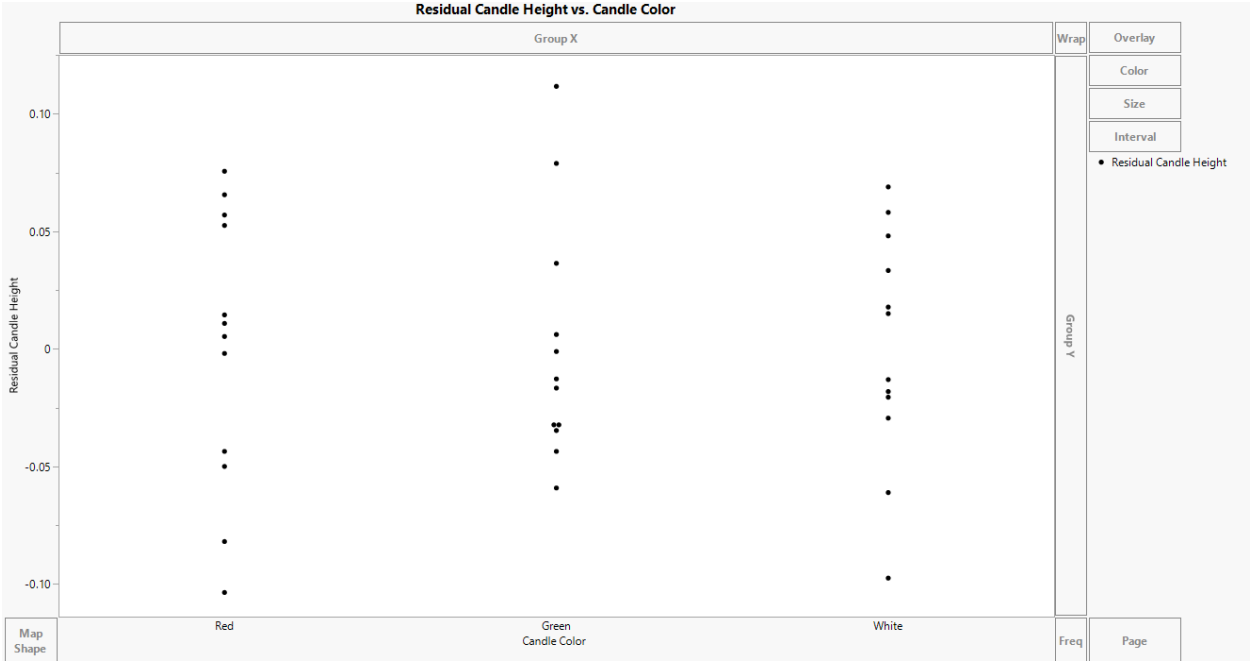

Figure indicates inequality of variance with candle color green; the Constant Variance Assumption is violated.

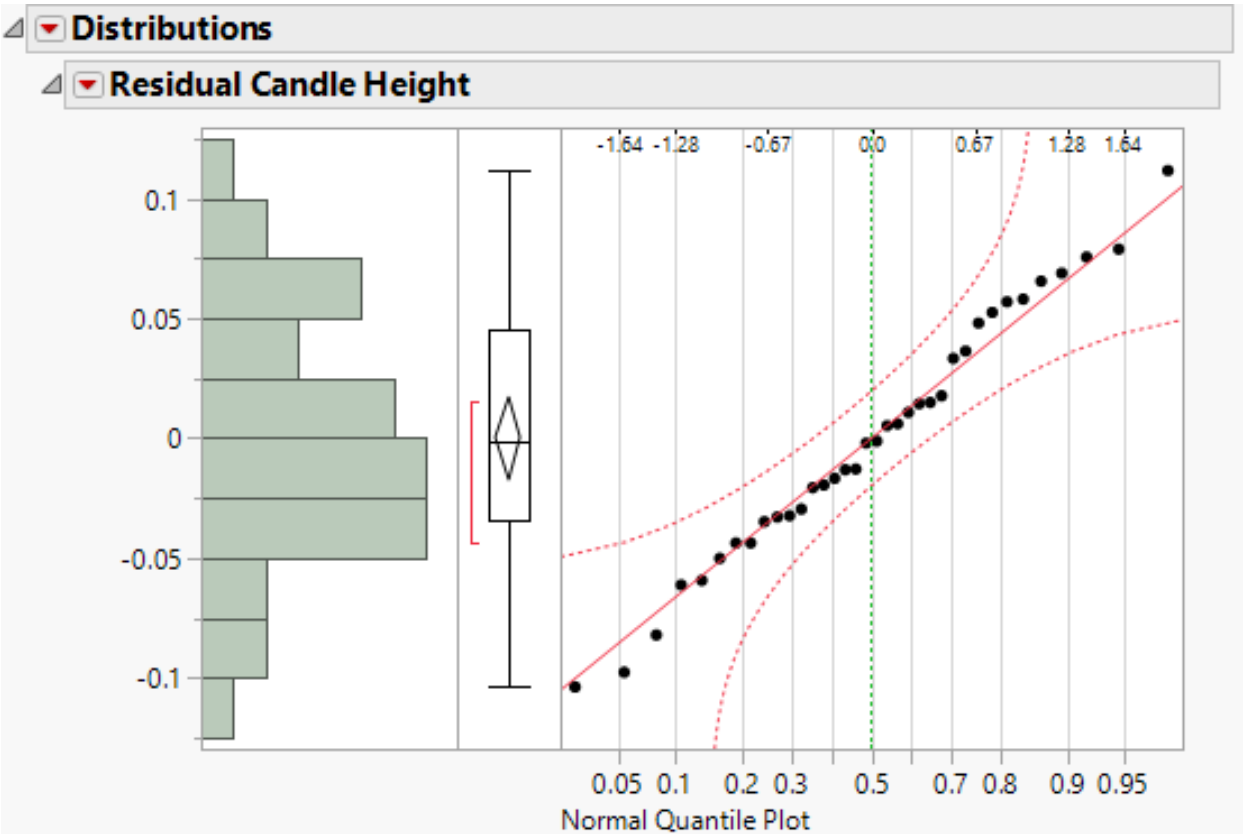

Figure has all points close to the line; Normal Distribution Assumption is met. The plot has tails that do not fall exactly along a straight line. Deviation from normality appears acceptable.

Externally studentized residuals with 95% simultaneous limits (Bonferroni) in red, individual limits in green.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	7	0.21106667	0.030152	8.9256
Error	28	0.09458889	0.003378	Prob > F
C. Total	35	0.30565556		<.0001*

Parameter Estimates

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Candle Color	2	2	0.00517222	0.7655	0.4746
Ambient Temperature	2	2	0.01170556	1.7325	0.1953
Observer	3	3	0.19418889	19.1611	<.0001*

We obtain a p-value of $.0001 < \propto 0.05$. Therefore we can reject H_0 and we find there is sufficient evidence to conclude that wax color and ambient temperature have no effect on burn rate.

Conclusions

In conclusion, it would appear color and temperature do not affect burn rate on candles. There were however noticeable external factors that played into the experiment. One external factor that could have impacted the results of the experiment was the air flow in the room. Since each member had to perform the experiment independently the environment and airflow was not consistent. This could have caused some error in measurements due to the fact that increased air flow could cause the candle to burn faster leading to imparied results. Another external factor that could have negatively impacted results is the brand from which the candles were made causing inconsistency with the wax and density of the candle. Each member independently purchased their own candles from different brands. This could cause potential error due to the candles being made from different brands and the wax consistency and formula being inconsistent between each group member. The next set of experiments to be conducted would be to try the same experiment but with wider candles to see if burn time is affected by this.

Appendices

Table 1

Factor 1	Factor 2	Blocking Variable	Response
Candle Color	Ambient Temperature	Group Member	Height of Candle after 5 mins of burning
White	75	Ryan	3.63"
Red	65	Ryan	3.75"
Green	70	Ryan	3.69"

White	65	Ryan	3.75"
Red	70	Ryan	3.63"
Green	75	Ryan	3.75"
Green	65	Ryan	3.75"
Red	75	Ryan	3.56"
White	70	Ryan	3.63"
Green	65	Damita	3.66"
Red	70	Damita	3.56"
Green	75	Damita	3.66"
Red	65	Damita	3.75"
Red	75	Damita	3.63"
White	70	Damita	3.63"
White	65	Damita	3.75"
White	75	Damita	3.63"
Green	70	Damita	3.66"
White	75	Kaylin	3.49"
Red	70	Kaylin	3.53"
Green	70	Kaylin	3.56"
White	70	Kaylin	3.56"
Green	65	Kaylin	3.53"
White	65	Kaylin	3.54"
Red	75	Kaylin	3.55"
Green	75	Kaylin	3.49"
Red	65	Kaylin	3.55"
Red	75	Daniel	3.54"
Green	65	Daniel	3.50"
Green	70	Daniel	3.51"

Red	65	Daniel	3.48"
Red	70	Daniel	3.53"
White	75	Daniel	3.52"
Green	75	Daniel	3.50"
White	70	Daniel	3.57"
White	65	Daniel	3.45"

Candle being lit by a group member