IEE 572- Design of Engineering Experiments

Final Project Report

Fall Semester 2016

Identification of the optimal ingredient mix for Pancakes

12/01/2016

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1.0 Aim:

To measure the perceived quality of pancakes given controlled variations in the ingredients used.

2.0 Motivation:

Over the past few months all of us tended to cook food on our own and whenever we made pancakes we noticed that all the pancakes looked different each and every time we made them. Upon delving into this occurrence, we noticed that for minor variations in our ingredients we ended up getting such highly perceivable differences in our end products. That's when we realised that ideally, an optimal mix of the ingredients for pancakes should exist such that for a given sample size the bulk of them would prefer them.

3.0 Selection of the Response Variables:

The pancakes prepared will be distributed evenly and randomly among 20 taste testers. The testers are given a scale of 0 to 20 to rate their preference of the pancakes in comparison to a control pancake made using a fixed recipe. All the testers won't be allowed to communicate among each other to prevent bias within the results. The mean of the scores of each pancake is taken between all the testers and they are accordingly ranked.

4.0 Factors and levels

4.1 Choice of Factors, Levels and Ranges:

We are considering multiple factors for the pancakes and have further classified into three main factors. They are:

4.2 Design Factors(Two-Level)

For this experiment the following factors are the design factors which influence the performance of a process or the system.

1. **Quantity of Baking Powder:** The quantity of baking powder being used directly affects the amount the pancake batter rises by upon heating, on the other hand an excess of baking powder may cause the pancake to form larger air pockets leading to a loss in texture and consistency overall. The corresponding High and Low factor levels considered are 1 tablespoon and ½ tablespoon baking powder.

2. **Time spent whisking batter**: Whisking of the batter causes the ingredients to mix uniformly with each other, but alongside this the protein gluten, found in flour begins bonding with each other, thereby imparting the consistency attributed to pancake batter. However over stirring the batter can make it bond more strongly with each other and gives the final pancake a very rubbery and chewy consistency often disliked. An ideal amount of stirring which mixes all the ingredients but does not over stir the batter should be used. For this reason, the high and low factor levels are taken as 5 and 3 minutes respectively.

3. **Type of Milk:** The type of milk used to depend upon the fat content of the milk could affect the viscosity of the batter which would in turn affect the thickness of the pancakes. The types of milk used are whole milk (3.5% fat) and fat free milk (1% fat) as the high and low factors respectively.

4. **Amount of Milk:** The amount of milk plays a large role in the viscosity of the batter and contributes to the fluffiness of the pancakes. In this experiment, we vary the quantity over two levels with 266.2ml being the lower and 295.8ml being the higher.

4.3 Held Constant Factors:

For this experiment the following factors shall be kept constant and controlled at the given values to prevent them from having any direct effect upon the end result:

1. Ambient temperature: 80F.
2. Amount of flour used in batter: 680 gms
3. Type of pan being used: two identical Nonstick 200mm Diameter pan
4. Amount of Eggs being used: 2
5. Pour Height: 150mm
6. Sugar: 30 gms
7. Unsalted Butter: 30 gms
8. Vegetable oil: 15 ml
9. Salt: 4.2 gms

4.4 Allowed to Vary Factors:

Factors which are allowed to vary can't be controlled easily but cause minimal variation in the process. They are tracked to identify any possible aberrations. The two such factors in our experiment are:

1. Diameter
2. Thickness

5.0 Standard Methodology:

Conventionally the preparation of pancakes is done by first stirring in all of the ingredients, which are namely 2 cups of flour, 1 cup of milk, 4 tablespoons of sugar and unsalted butter respectively, 1 teaspoon of salt, 2 tablespoon of vegetable oil and 2 eggs.

Further, Milk and Baking powder are added according to the factors and levels considered for the particular trial. Following this, 1/4th of a cup has to be poured onto a hot greased pan to make one pancake.

Then the pancake has to be cooked until the edges dry up. Finally, it has to be flipped around once to be cooked until the other side obtains a golden sheen to it.

The images below shows how the Experimental setup, ingredient mix and Preparation has been made.

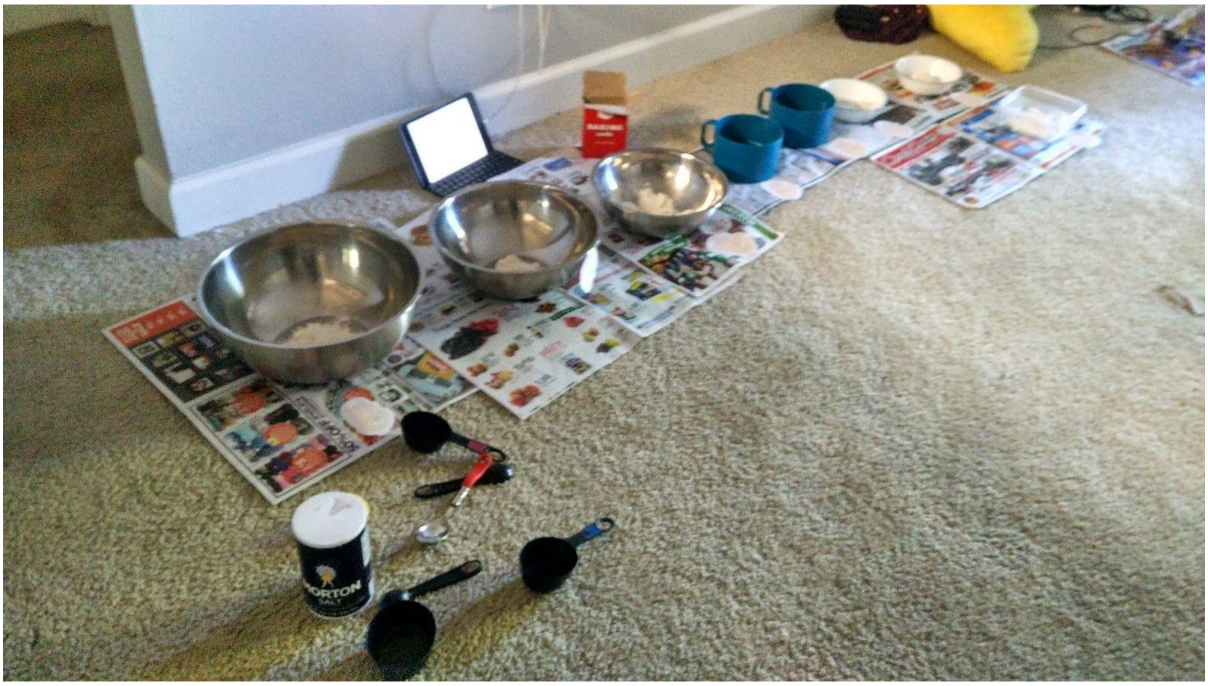

Fig.1. Experimental Setup(A)

Fig.2. Experimental Setup(B)

Fig.3. Ingredient Mixture

Fig.4. Pancake Preparation

6.0 Experimental Design of Experiment

6.1 Choice of Experimental Design:

There were four different factors selected for the conduction of the experiment at two levels. Thereby there were 16 runs in the experiment, with 16 repetitions of the result being carried out via rankings from different testers. The probability of success is recorded as the response variable and the factors are analysed based on this.

6.2 Sample Size:

The sample size for the experiment is 2^4=16 considering the factor count and levels. The Below table indicates all the runs with different all the permutations and combinations that are involved in conducting the experiment.

Baking Powder	Whisk Time	Milk Type	Milk Quantity
-1	-1	-1	-1
-1	-1	-1	1
-1	-1	1	-1
-1	-1	1	1
-1	1	-1	-1
-1	1	-1	1
-1	1	1	-1
-1	1	1	1
1	-1	-1	-1
1	-1	-1	1
1	-1	1	-1
1	-1	1	1
1	1	-1	-1
1	1	-1	1
1	1	1	-1
1	1	1	1

Table 1. 2^4 Coded Design

6.3 Design Summary:

Study Type **Factorial** **Runs 16**
Initial Design **2 Level Factorial** **Blocks No Blocks**
Centre Points 0
Design Model 4FI

There are four different factors each with two levels of responses. The type of factors are categoric

6.4 Design Matrix:

The design matrix for the 16 runs was generated using JMP to determine the test matrix for evaluating the run orders and combinations of levels and is as shown below.

	''	X1	X2	X3	X4
1	++−−	1	1	-1	-1
2	++−+	1	1	-1	1
3	+−+−	1	-1	1	-1
4	+−++	1	-1	1	1
5	+++−	1	1	1	-1
6	−+++	-1	1	1	1
7	−−+−	-1	-1	1	-1
8	−−++	-1	-1	1	1
9	++++	1	1	1	1
10	+−−+	1	-1	-1	1
11	−−−−	-1	-1	-1	-1
12	−+−+	-1	1	-1	1
13	+−−−	1	-1	-1	-1
14	−++−	-1	1	1	-1
15	−+−−	-1	1	-1	-1
16	−−−+	-1	-1	-1	1

Table.2. 2^4 Randomized order Design

The Design matrix obtained from JMP above has 4 factors X1, X2, X3 and X4 which represents Quantity of Baking Powder, whisk time, Type of Milk, and Quantity of Milk at 2 levels -1 and +1 being Low and High level. The leftmost column indicates the Randomization, which is done to ensure that no lurking nuisance variables affect the experiment, order, and the column adjacent to it describes the level pattern of each factor.

6.5 Power Analysis

We have carried out power analysis using JMP for significance level of 0.05 giving a confidence interval of 95% for all low-order interactions (up to two levels). Here we ignore the higher order effects due to the sparsity of effects principle as per which the likelihood of a third or fourth order effect being significant is minimal.

Design Evaluation

Power Analysis

Significance Level 0.05

Anticipated RMSE 1

Term	Anticipated Coefficient	Power
Intercept	1	0.887
X1	1	0.887
X2	1	0.887
X3	1	0.887
X4	1	0.887
X1*X2	1	0.887
X1*X3	1	0.887
X2*X3	1	0.887
X1*X4	1	0.887
X2*X4	1	0.887
X3*X4	1	0.887

Table.3. Design evaluation through power analysis

7.0 Statistical Analysis

JMP tool is used through the analysis process and we follow the standard analysis procedure by carrying out the following steps in our experiment, which are:

- Data Collection
- Estimate factor effects
- Form the initial model
- Perform statistical testing
- Refine Model
- Analyse residuals
- Interpret results

If Model gets refined by removing the least contributing factors and interactions, then follow the same procedure beginning from estimating the effects.

7.1 Data Collection:

The experiment starts with conducting experiment and further we obtain the data from same which have been collected in randomized order and the average ratings have been considered for the analysis. The table below shows the Ratings for different pattern designs:

Runs	1	2	3	4	5	6	7	8
Pattern	+ - + -	- - + +	+ + + -	- - - -	- - + -	+ - - +	- + + -	- - - +
Ratings								
Sampler 1	8	9	15	8	7	13	12	1
Sampler 2	11	16	14	14	13	17	15	3
Sampler 3	12	18	11	12	17	18	13	10
Sampler 4	9	15	16	15	12	12	17	12
Sampler 5	16	12	8	8	14	11	15	8
Sampler 6	18	15	17	11	12	17	16	13
Sampler 7	14	13	14	7	19	15	18	9
Sampler 8	12	17	10	9	10	16	19	11
Sum of Ratings	100	115	105	84	104	119	125	67
Average Rating	12.5	14.375	13.125	10.5	13	14.875	15.625	8.375
Runs	9	10	11	12	13	14	15	16
Pattern	+ + - +	- + + +	+ + - -	+ - - -	+ + + +	+ - + +	- + - +	- + - -
Ratings								
Sampler 1	15	10	15	13	16	13	14	13
Sampler 2	14	14	9	11	17	15	7	11
Sampler 3	16	12	13	10	15	17	9	8
Sampler 4	17	14	14	16	19	16	10	10
Sampler 5	14	13	10	14	18	19	12	12
Sampler 6	17	19	17	15	19	20	14	13
Sampler 7	16	15	12	13	15	14	6	9
Sampler 8	17	14	13	20	19	20	12	15
Sum of Ratings	126	111	103	112	138	134	84	91
Average Rating	15.75	13.875	12.875	14	17.25	16.75	10.5	11.375

Table.4. Data Table

7.1.1 Responses Table with Residuals

The average ratings obtained are our responses for the experiment. The Residual column has been saved which is shown below:

	Pattern	Baking Powder	Whisking Time	Type of Milk	Quantity of Milk	Responses	Residual Y
1	++−−	1	1	-1	-1	12.75	-0.5546875
2	++−+	1	1	-1	1	15.75	0.2578125
3	+−+−	1	-1	1	-1	12.5	-0.3046875
4	+−++	1	-1	1	1	16.75	0.0078125
5	+++−	1	1	1	-1	13.125	0.0703125
6	−+++	-1	1	1	1	13.875	-1.0546875
7	−−+−	-1	-1	1	-1	13	-0.5234375
8	−−++	-1	-1	1	1	14.375	0.8203125
9	++++	1	1	1	1	17.25	0.2265625
10	+−−+	1	-1	-1	1	14.875	-0.4921875
11	−−−−	-1	-1	-1	-1	10.5	0.0390625
12	−+−+	-1	1	-1	1	10.5	0.5703125
13	+−−−	1	-1	-1	-1	14	0.7890625
14	−++−	-1	1	1	-1	15.625	0.7578125
15	−+−−	-1	1	-1	-1	11.375	-0.2734375
16	−−−+	-1	-1	-1	1	8.375	-0.3359375

Table.5. Responses and Residuals

7.2 Factor Estimates

7.2.1 Effect Summary

As the design is with two levels and four factors it consists of four primary effects and six secondary effects. Effect estimation gives the percentage contribution of each effect and the below table shows the same:

2x2x2x2 Factorial - Fit Least Squares - JMP Pro

Response Responses

Effect Summary

Source	LogWorth	PValue
Baking Powder	2.418	0.00382
Type of Milk	2.320	0.00479
Baking Powder*Quantity of Milk	2.029	0.00934
Baking Powder*Type of Milk	1.828	0.01488
Quantity of Milk	1.172	0.06726 ^
Type of Milk*Quantity of Milk	0.919	0.12040
Whisking Time	0.736	0.18371
Baking Powder*Whisking Time	0.519	0.30279
Whisking Time*Type of Milk	0.057	0.87612
Whisking Time*Quantity of Milk	0.011	0.97510

Remove Add Edit FDR ('^' denotes effects with containing effects above them)

Table.6. Effects summary

(*Higher order interactions have been ignored based on the sparsity of effects principle)

The above Pareto graphs show us the intensity of each factor with respect to the responses. The P-Values help us assess the significance of each of these factors with a smaller P-Value denoting a higher significance. From this particular graph, we can see that the most significant factor is the Quantity of Baking Powder used in the mixture, the next most significant factor is that of the Type of Milk used which holds an almost equal significance in the output. Other notable factors include the interaction between Baking Powder & Quantity of Milk and Baking Powder & the Type of Milk used.

7.3 Formation of Initial Model

7.3.1 Cube Plot for Experimental Design and Setup

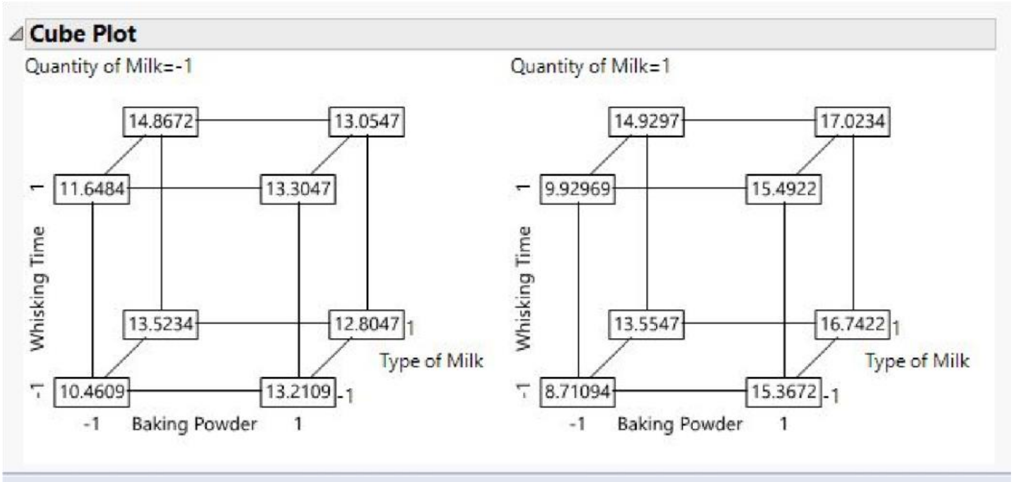

Fig.5. Cube plot with all four factors

The cube plot gives us the responses for all the possible combinations of our four factors for the experimental setup.

7.3.2 Actual vs Prediction Plot

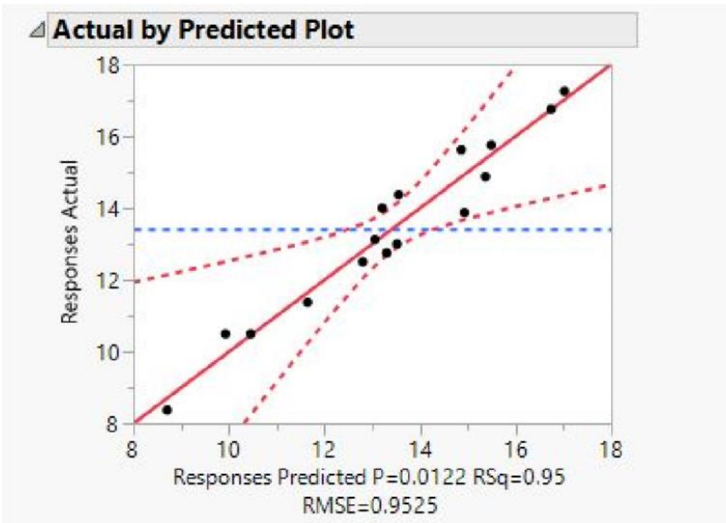

Fig.6. Actual vs Prediction Plot

This plot denotes the Expected Values of the responses vs the Actual response values obtained via experimentation. The dashed line in the graph denote the region of acceptance, only values falling within this area would be considered as acceptable values which aren't outliers. As almost all of the values we have in this graph fall either within the acceptable range or upon the demarcation line we shall consider the model to be adequate to predict further values.

7.3.3 Normal Plot

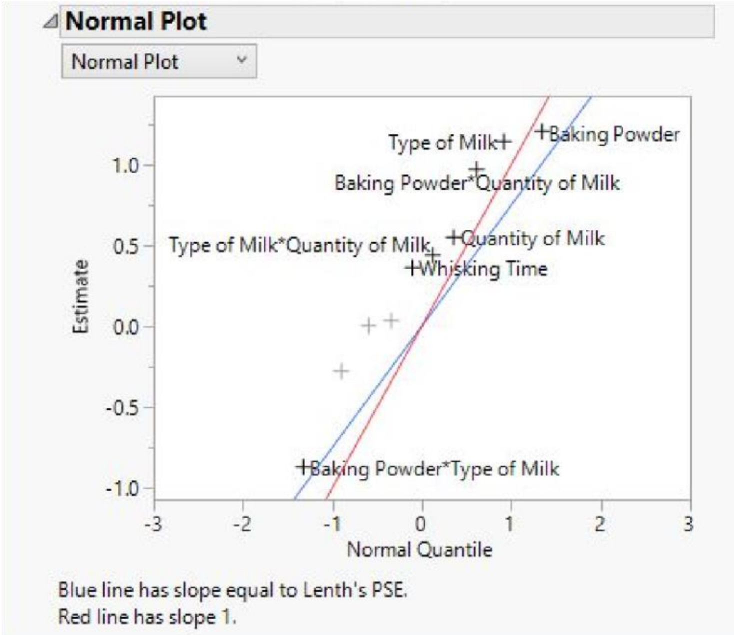

Fig.7. Normal Quantile Plot

The normality assumption states that all effect estimates must lie on the red line for them to be insignificant, therefore from here we can see the factors which display significance by lying further away from this line. This implies that the more the changes in these factors, the greater the overall change in the response variable will be.

7.3.4 Half Normal Plot

The half normal plot is a plot of the absolute value of the effect estimates against their cumulative normal probabilities. This plot is easier to interpret generally with the difference between the effect and the Lenth's PSE being the metric to gauge the significance of the factor. From both this and the Normal plot we can see that

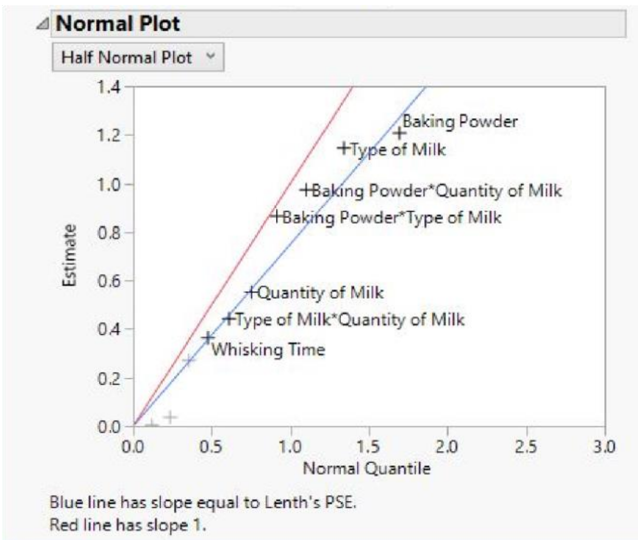

Fig.8. Half Normal Quantile Plot

7.4 Statistical Testing

7.4.1 Summary of fit

$$R^2_{\text{Adj}} = 1 - \frac{SS_E/df_E}{SS_{\text{Total}}/df_{\text{Total}}}$$

Summary of Fit

RSquare	0.948375
RSquare Adj	0.845124
Root Mean Square Error	0.952484
Mean of Response	13.41406
Observations (or Sum Wgts)	16

Fig.9. Summary of Fit

The summary of fit gives us our R- Square and R-Square adjusted values. The R-square value gives us the percentage effect contribution of all the effects to the model.

The adjusted R-Square in comparison only shows the contribution of the significant effects to the model. Here we can see that 94.8% of the effects contribute to the model which means the effect of error here is low whereas the significant factors contribute to 84.5% of the model.

The RMS Error is the square root of the variance of the residuals. It indicates the absolute fit of the model to the data–how close the observed data points are to the model's predicted values. Whereas R-squared is a relative measure of fit, RMSE is an absolute measure of fit.

$$RMSErrors = \sqrt{\frac{\sum_{i=1}^{n}(\hat{y}_i - y_i)^2}{n}}$$

The mean of Response tells us the mean of all the values in our experiment. Here we can see that the mean is 13.41. This value is further used to calculate residuals for the responses of the model.

7.4.2 ANOVA Table

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	10	83.330078	8.33301	9.1851
Error	5	4.536133	0.90723	Prob > F
C. Total	15	87.866211		0.0122*

Table.7. Analysis of Variance

The Analysis of Variance of our model helps determine the significance of the overall model vs the error inherent in the model. As can be seen here both the Sum of Squares and the Mean Squares of the model is way more significant than the error thereby making the ANOVA test results of the model highly accurate.

7.4.3 Effects Tests

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Baking Powder	1	1	23.461914	25.8611	0.0038*
Whisking Time	1	1	2.157227	2.3778	0.1837
Type of Milk	1	1	21.102539	23.2605	0.0048*
Quantity of Milk	1	1	4.922852	5.4263	0.0673
Baking Powder*Whisking Time	1	1	1.196289	1.3186	0.3028
Baking Powder*Type of Milk	1	1	12.032227	13.2626	0.0149*
Whisking Time*Type of Milk	1	1	0.024414	0.0269	0.8761
Baking Powder*Quantity of Milk	1	1	15.258789	16.8192	0.0093*
Whisking Time*Quantity of Milk	1	1	0.000977	0.0011	0.9751
Type of Milk*Quantity of Milk	1	1	3.172852	3.4973	0.1204

Table.8. Effects tests

The effects test gives us a more detailed analysis of the ANOVA test carried out on the model and helps corroborate the inference we derived from the effect summary. The F-ratio which is calculated from the ratio of the sum of squares with the Mean Square of errors. The p-values in orange denote the very significant factors, the one in red denotes a moderately significant factor while the ones in black can be ignored.

7.4.4 Sorted Parameter Estimates

Sorted Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Baking Powder	1.2109375	0.238121	5.09	0.0038*
Type of Milk	1.1484375	0.238121	4.82	0.0048*
Baking Powder*Quantity of Milk	0.9765625	0.238121	4.10	0.0093*
Baking Powder*Type of Milk	-0.867188	0.238121	-3.64	0.0149*
Quantity of Milk	0.5546875	0.238121	2.33	0.0673
Type of Milk*Quantity of Milk	0.4453125	0.238121	1.87	0.1204
Whisking Time	0.3671875	0.238121	1.54	0.1837
Baking Powder*Whisking Time	-0.273438	0.238121	-1.15	0.3028
Whisking Time*Type of Milk	0.0390625	0.238121	0.16	0.8761
Whisking Time*Quantity of Milk	0.0078125	0.238121	0.03	0.9751

Table.10. Sorted parameter Estimates

These are in continuation to the analysis of variance. Here we can see that we have significant t-test results for the factors baking powder, type of milk, the interaction between baking powder and quantity of milk, and the interaction between baking powder and the type of milk. While most of the factors contribute to the overall response value the interaction between baking powder and the type of milk reduces the response value upon increasing.

7.5 Refine Model

From the statistical testing we see that the whisking time factor and the interactions associated with it are highly negligible and for the model to be refined we neglect the same. Further, we have carried out the statistical analysis for the refined model which will be discussed later in this report.

7.6 Analysis of Residuals

7.6.1 Normal Quantile plot vs Residuals

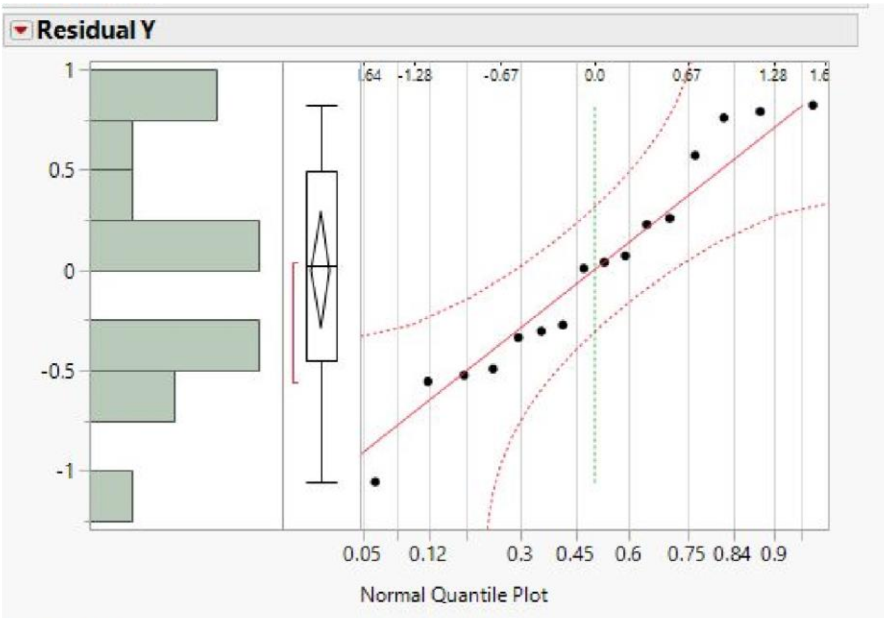

Fig.10. Residual vs Normal Quantile Plot

As can be seen here since all of points fall within the acceptable area the normality assumption for the experiment holds true throughout. The normality assumption holds true as long as the values of the residuals stay close to the centerline.

7.6.2 Response vs Time

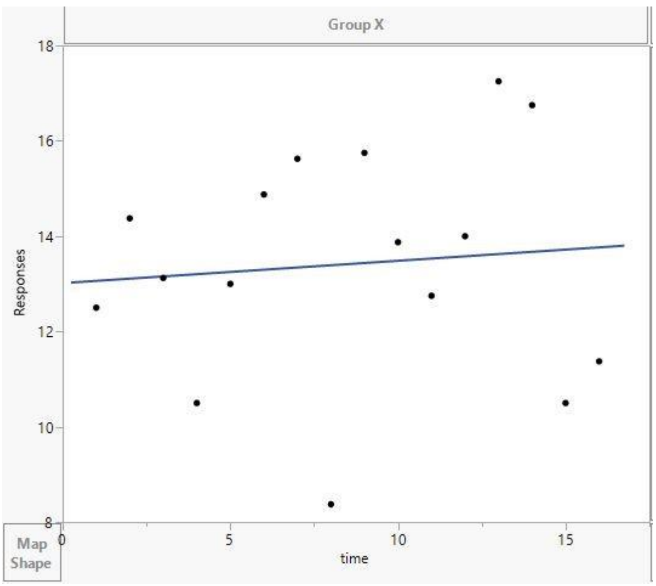

Fig.8. Response Vs Time

Here we can see that the responses are scattered randomly with the progression of time which confirms the independence assumption of the model.

7.7 Interpretation of Results

7.7.1 Prediction Profiler

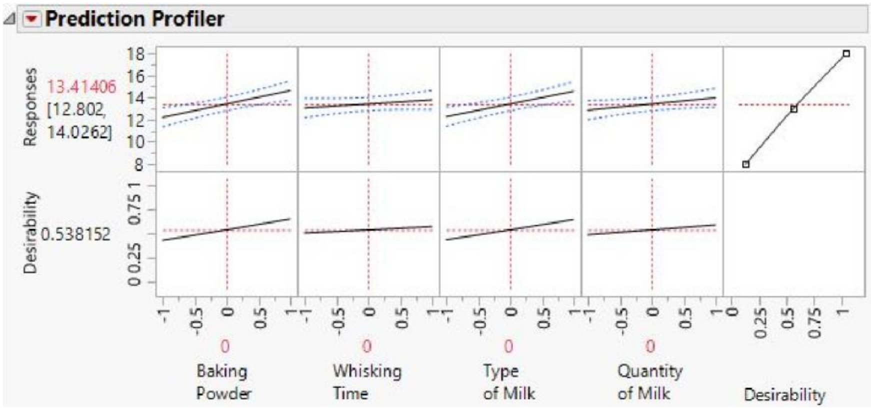

Fig.12. Prediction Profiler

The prediction profiler gives us the marginal distribution for each factor. This helps us find the effect of each individual factor and its contribution to the overall desirability. As we can see here the steep slopes for baking powder and type of milk show that these two factors have a significant effect on the overall response.

7.7.2 Prediction Profiler Maxima

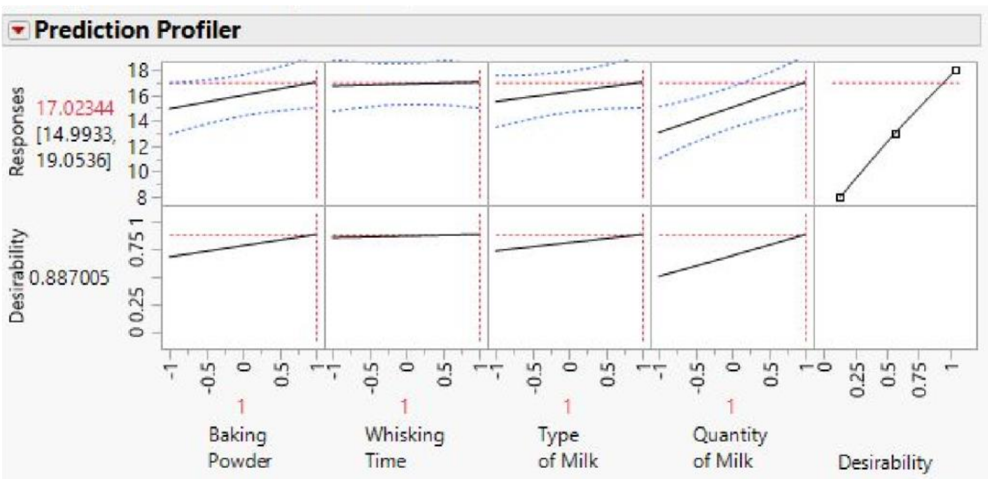

Fig.13. Prediction profiler at maxima

Here with the assistance of JMP we find the optimal combination of all the individual factors such that we get the maximum response variable. In this case it is found to be at the setting 1, 1, 1, 1

7.7.3 Prediction Expression

Prediction Expression

13.4140625
+ 1.2109375 * Baking Powder
+ 0.3671875 * Whisking Time
+ 1.1484375 * Type of Milk
+ 0.5546875 * Quantity of Milk
+ Baking Powder * (Whisking Time * -0.2734375)
+ Baking Powder * (Type of Milk * -0.8671875)
+ Whisking Time * (Type of Milk * 0.0390625)
+ Baking Powder * (Quantity of Milk * 0.9765625)
+ Whisking Time * (Quantity of Milk * 0.0078125)
+ Type of Milk * (Quantity of Milk * 0.4453125)

Fig.14. Regression Equation

The prediction expression generated above is the regression equation derived from the response values of the model. This equation implies that due to its linearly increasing nature the response variable would constantly keep rising for any corresponding increase in the factor levels.

8 . Refined Model Statistical Analysis (Contd. from 7.5)

8.1 Refined Model

8.1.1 Cube Plot

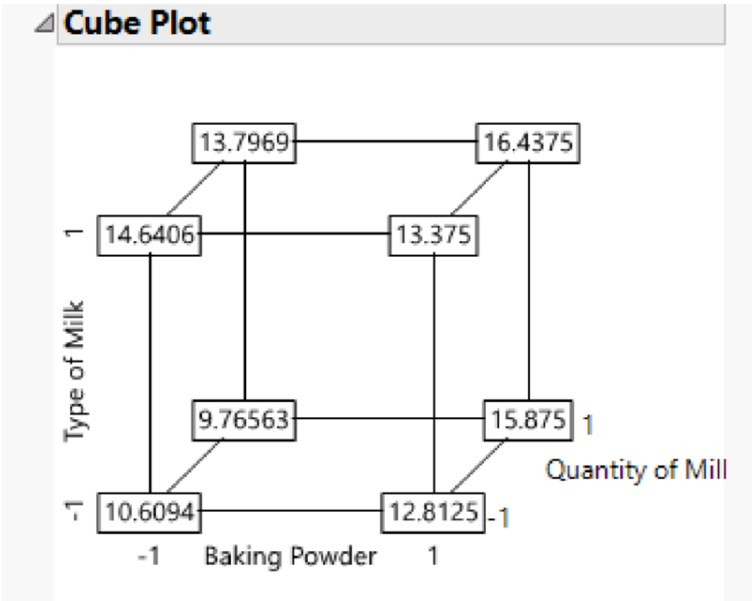

Fig.15. Revised cube Plot 8.1.2

Actual vs Predicted Plot

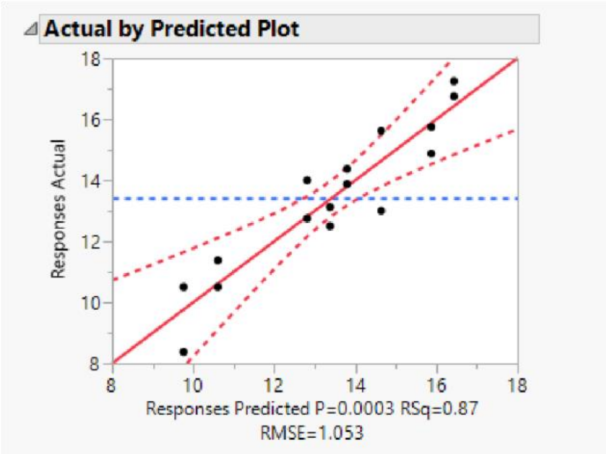

Fig.16. Actual vs predicted for refined model 8.1.3

Normal Plot

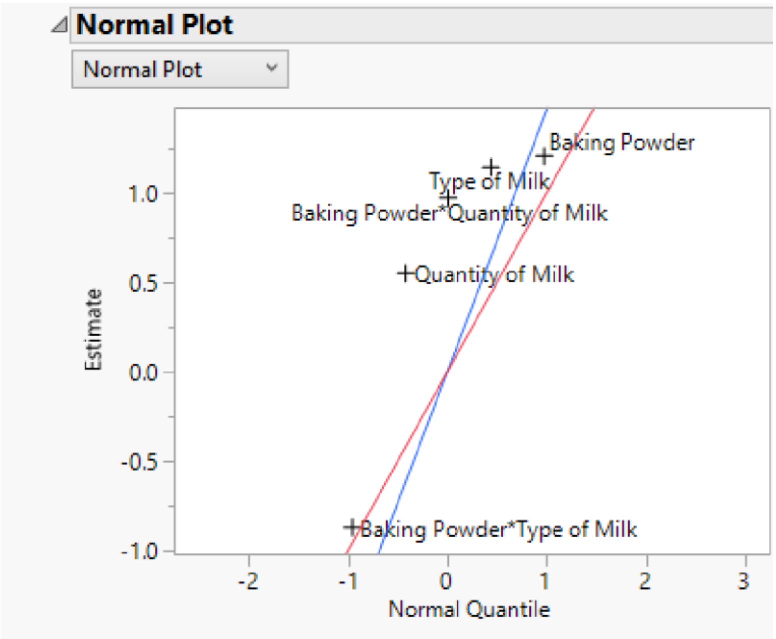

Fig.17. Normal Quantile plot For refined Model

8.1.4 Half Normal Plot

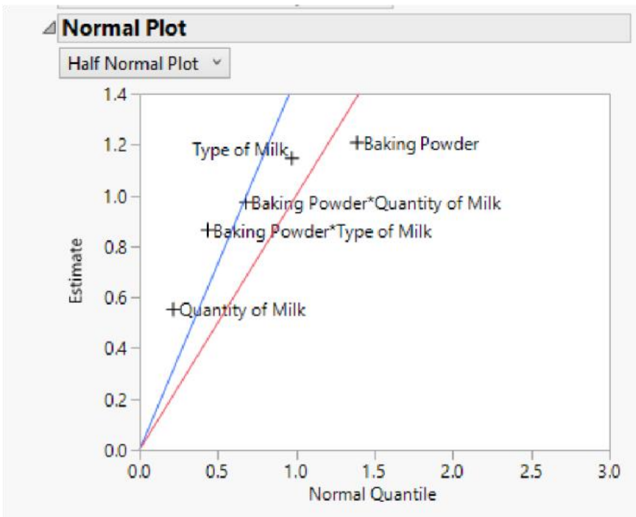

Fig.18. Half Normal Quantile Plot for Revised plot

In this refined model we have removed the factor Whisking Time and now only consider the remaining three factors.

8.2 Statistical Testing

8.2.1 Summary of Fit

Actual by Predicted Plot

Summary of Fit

RSquare	0.873809
RSquare Adj	0.810714
Root Mean Square Error	1.052991
Mean of Response	13.41406
Observations (or Sum Wgts)	16

Table.10. Summary of Fit

8.2.2 Analysis of variance

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	76.778320	15.3557	13.8490
Error	10	11.087891	1.1088	Prob > F
C. Total	15	87.866211		0.0003*

Table.11. Analysis Of Variance for revised model

8.2.3 Effects Tests

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Baking Powder	1	1	23.461914	21.1599	0.0010*
Type of Milk	1	1	21.102539	19.0321	0.0014*
Quantity of Milk	1	1	4.922852	4.4398	0.0613
Baking Powder*Type of Milk	1	1	12.032227	10.8517	0.0081*
Baking Powder*Quantity of Milk	1	1	15.258789	13.7617	0.0040*

Table.12. Effects Test For Revised Model

8.2.4 Sorted Parameter Estimates

Sorted Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Baking Powder	1.2109375	0.263248	4.60	0.0010*
Type of Milk	1.1484375	0.263248	4.36	0.0014*
Baking Powder*Quantity of Milk	0.9765625	0.263248	3.71	0.0040*
Baking Powder*Type of Milk	-0.867188	0.263248	-3.29	0.0081*
Quantity of Milk	0.5546875	0.263248	2.11	0.0613

Table.13. Sorted Parameter Estimates For revised model

In this refined model the ANOVA test would reassign the sum of squares associated with the factor Whisking Time to the Error. As the MSE of error increase this causes the R-Squared Value to go down while the R-Square Adjusted values don't do so as significantly. This is because the R-Square Adjusted value already aims to neglect the insignificant factors.

There are minor changes in the ANOVA and the Student's T-Test analysis values which in this case which doesn't significantly change the effect significances as compared to the original model.

8.3 Interpretation of Results

8.3.1 Prediction Profile

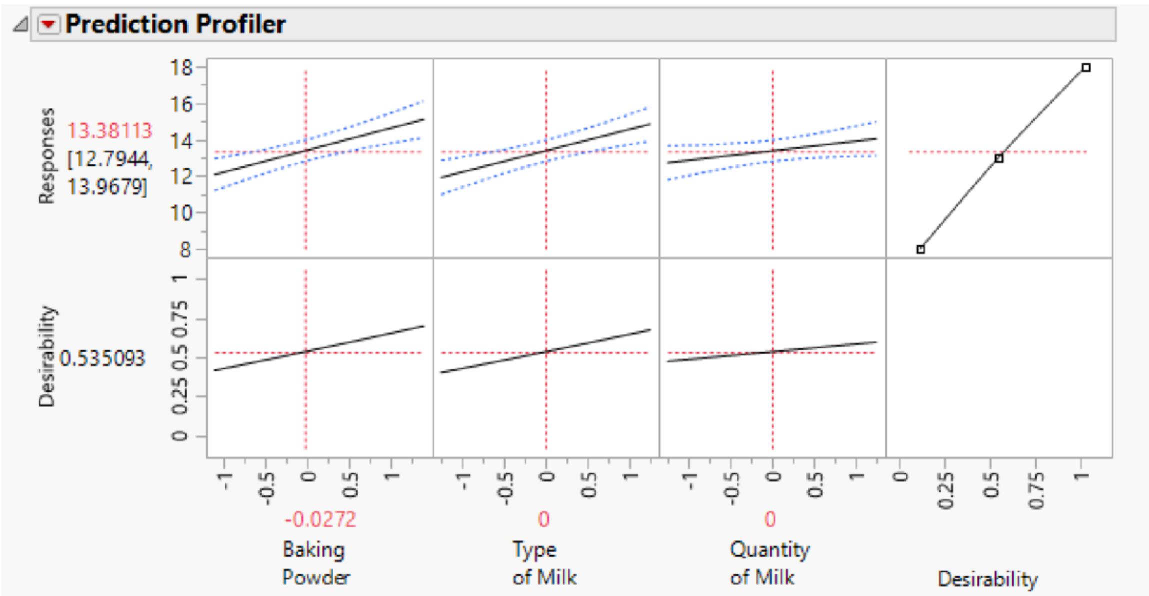

Fig.19. Prediction Profiler For revised Model

8.3.2 Maximum Prediction Profile

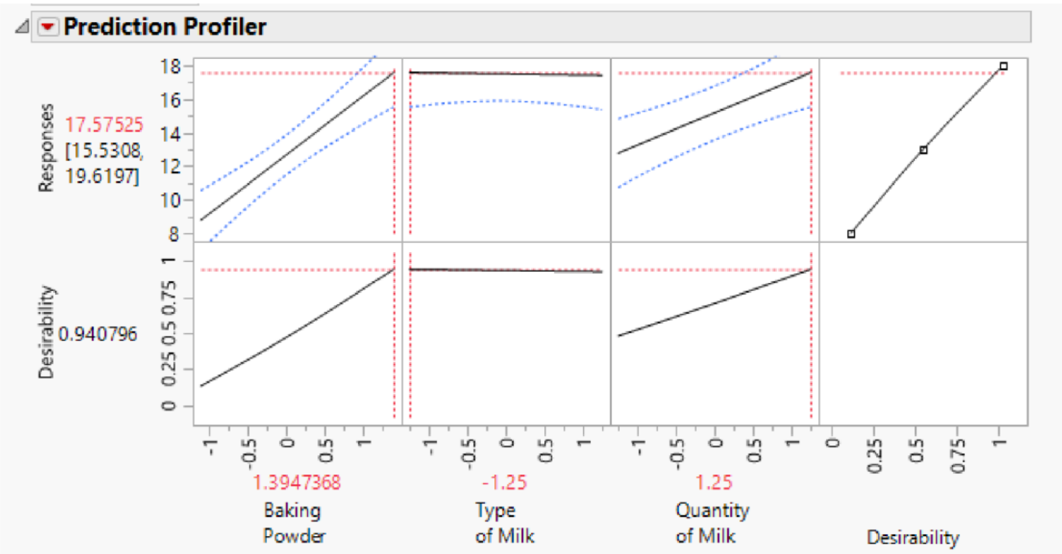

Fig.20. Prediction Profiler Maxima for Revised Model 8.3.3

Prediction Expression

Prediction Expression

13.4140625
+ 1.2109375 * Baking Powder
+ 1.1484375 * Type of Milk
+ 0.5546875 * Quantity of Milk
+ Baking Powder * (Type of Milk * -0.8671875)
+ Baking Powder * (Quantity of Milk * 0.9765625)

Fig.21.Regression equation for Revised Model

8.3.4 Interaction Plot

Fig.22. Interaction Profiles

8.3.5 Response Surfaces

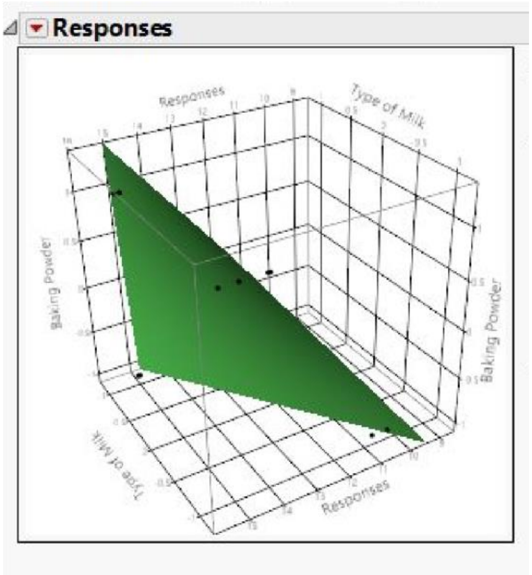

Fig.23. Response Surface baking powder vs type of milk

Response surface baking powder vs Quantity of milk

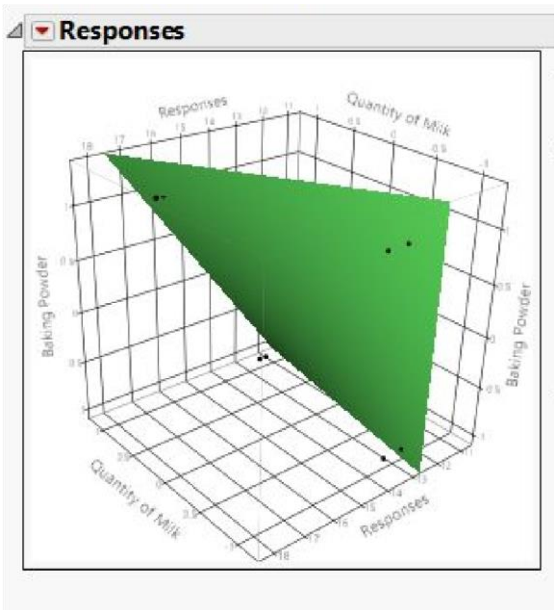

Fig.24. Response Surface Baking Powder Vs Quality Of milk

From all the interpretation results of the refined model we see that the Baking powder and the type of milk plays a major role. Further with the Prediction profile and Response surfaces we infer that the effect of Quantity of Milk starts increasing when the Baking powder level increases but the Quantity of milk effect becomes negligible when the baking powder is at the lower level. Whereas in the case of the interaction between the Type of Milk and the Quantity of baking powder the Type of Milk has a significant effect at lower quantities of Baking Soda but becomes less significant when we increase the amount of baking soda. The reverse happens to the effect estimates while vice versa.

9. Conclusion and Inferences

From the above model and its refinement, we can see that the most significant factors are

A. The quantity of Baking Powder added
B. The type of milk used
C. The quantity of milk used (only when the quantity of baking powder is high enough due to significant interaction between them)

The most significant second order interactions which actively contribute to the overall model are the interactions between

A. The quantity of Baking Powder and the type of milk
B. The quantity of Baking Powder and the quantity of milk

Most of these conclusions from the experiment are in line with standard convention which dictates that the fluffiness of a pancake is dictates how good or bad it is.

From this we can see that the most optimal combination for making a desirable pancake would be to increase all the factors to their respective high levels.

Further experimentation can be carried out by increasing the high level for baking powder to see if there is a limit to the amount it can be increased to before the increase stops becoming linear.

10. References

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