MBA 546 Case Report, Week 6
Topic: Ice Cream Sales
Due date: 8 October 2023

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Ice Cream Sales

Executive Summary

Teresa, as the owner of the ice cream shop, here's a clear and straightforward summary of what you need to know from the analysis of your sales data:

Factors that Impact Sales: Ice cream sales are influenced by various factors such as temperature, the day of the week, whether it's during the school year, and the special flavor being promoted.

The Best Way to Predict Sales: To predict ice cream sales accurately, consider temperature, whether it's a weekend or a weekday, and whether school is in session.

Why Temperature Matters: Hotter days lead to more ice cream sales, so make sure to have enough ice cream and staff on hand during warm weather.

Understanding Day-to-Day Changes: Ice cream sales change from day to day. Some days are better for sales, so analyze these patterns to plan staffing and promotions effectively.

The Impact of the School Year: Sales increase significantly when school is in session, so adjust your inventory and promotions to match the academic calendar.

Knowing Popular Flavors: Chocolate and strawberry are consistently top-selling flavors, while banana and rocky road are less popular. Promote popular flavors during peak times and consider deals for others.

Making Smart Business Choices: Use the analysis insights to make informed decisions about staffing, inventory, and promotions to run your business more smoothly and reduce risks.

Recommendations for Teresa:

- Keep an eye on temperature forecasts and prepare for hot days.
- Analyze daily sales patterns to plan staffing better.
- Offer promotions during the school year to boost sales.
- Promote popular flavors when they sell best.
- Regularly review and adjust your sales prediction model.
- Collect customer feedback to improve your offerings.
- Optimize staffing and inventory to cut costs while meeting demand.
- Align marketing with factors affecting sales.

By following these recommendations, you can increase profits, enhance customer satisfaction, and adapt your business to changing conditions. If you need further help, reach out to the analysis team.

Introduction

In this analysis, we delve into the sales data of an ice cream shop owned by Teresa, aiming to uncover key factors influencing ice cream sales and provide actionable insights. Our investigation reveals that temperature, the day of the week, school year status, and featured flavors play pivotal roles in driving sales. By combining these factors, we identify an effective predictive model that guides decision-making for Teresa. Temperature emerges as a significant contributor, with warmer days leading to increased sales. We also observe day-to-day sales variations and the substantial impact of the school year on sales patterns. Additionally, we recognize the popularity of certain ice cream flavors, with chocolate and strawberry as top-sellers. Armed with these insights, Teresa can make informed choices regarding inventory management, staffing, promotions, and more, ultimately enhancing her ice cream shop's profitability and customer satisfaction.

Data

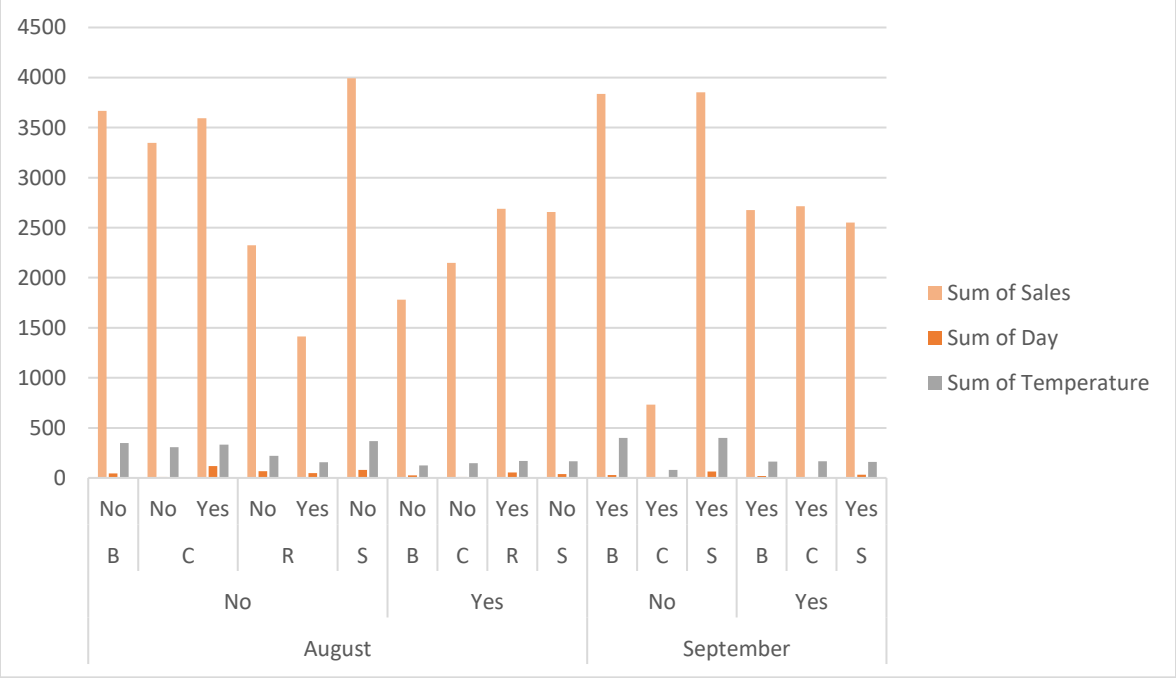
Row Labels	Sum of Sales	Sum of Day	Sum of Temperature
August	27611	496	2341
No	18337	368	1732
Banana	3666	45	349
No	3666	45	349
Chocolate	6940	128	640
No	3347	10	306
Yes	3593	118	334
Rocky Road	3737	115	376
No	2324	66	220
Yes	1413	49	156
Strawberry	3994	80	367
No	3994	80	367
Yes	9274	128	609
Banana	1781	25	126
No	1781	25	126
Chocolate	2148	11	147
No	2148	11	147
Rocky Road	2689	53	169
Yes	2689	53	169
Strawberry	2656	39	167
No	2656	39	167
September	16359	153	1367
No	8420	96	877
Banana	3837	30	398
Yes	3837	30	398
Chocolate	732	1	79
Yes	732	1	79
Strawberry	3851	65	400
Yes	3851	65	400

Yes	7939	57	490
Banana	2675	19	164
Yes	2675	19	164
Chocolate	2713	5	165
Yes	2713	5	165
Strawberry	2551	33	161
Yes	2551	33	161
Grand Total	**43970**	**649**	**3708**

This dataset gives us a peek into the daily sales of ice cream at a shop during August and September. It breaks down sales by day, tells us if it was a weekend or during the school year, the temperature, the special ice cream flavor of the day, and how many sales were made.

In August, the shop had sales on 496 days, with temperatures adding up to 2341 and total sales hitting 27,611. September was a bit slower, with sales on 153 days, total temperatures of 1367, and sales of 16,359. The sales data is also sorted by yes/no condition and the flavor of ice cream, like Banana, Chocolate, Rocky Road, and Strawberry. This helps us see how sales change with different flavors and conditions.

For example, in August, sales were higher when the condition was "No" at 18,337, compared to "Yes" at 9,274. And Strawberry was a hit under the "No" condition, racking up sales of 3,994. In short, this data helps the shop see how different factors, like the day of the week or the special flavor, can affect how much ice cream they sell.



The chart visually encapsulates the sales data, shedding light on the customers' inclination towards distinct ice cream flavors during specific months and under varied conditions. It is instrumental in pinpointing patterns, for instance, the heightened demand for Strawberry (S) in August when the condition is "No", and an increase in Banana (B) sales in September under the "Yes" condition. The flavors Chocolate and Rocky Road are represented as (C) and (R) respectively in the graph.

Analysis

	Model	Day	Temperature	R-Squared	RMSE
Sales	1	-1.2	20.72	0.2572	205.74
	2	2.26	-	0.0068	235.3
	3	-	20.29	0.2554	203.73

The R-Squared and RMSE values offer insights into the effectiveness of these models. A higher R-Squared value would indicate a better fit of the model to the data, and a lower RMSE would suggest higher accuracy in the predictions.

- Model: Indicates different models or scenarios. Each model seems to be based on different variables or conditions, as indicated by the varying values in the Day and Temperature columns.
- Day: This could represent the day of the month, week, or another time-related variable. In Model 1, it's -1.2, which is unusual for a day, suggesting that it might represent a different kind of data or be encoded in a way that's not immediately clear. In Model 2, it's 2.26.
- Temperature: Given in what appears to be degrees Celsius. It's likely a continuous variable affecting the dependent variable (possibly Sales).
- R-Squared: A statistical measure of how close the data are to the fitted regression line. It's also known as the coefficient of determination. In this context, it might indicate how well the Day and Temperature explain the variance in Sales.
- RMSE (Root Mean Square Error): A measure of how spread out the residuals (the differences between observed and predicted values) are. In other words, it tells us how concentrated the data is around the line of best fit.
- Sales: This column is not filled in the provided data, but typically, it represents the number of items sold, revenue generated, or another similar measure.

Data Set	WORK.ICS
Dependent Variable	Sales
Selection Method	None

Number of Observations Read	48
Number of Observations Used	48

Class Level Information		
Class	**Levels**	**Values**
Month	2	August September
Weekend	2	No Yes
Schoolyear	2	No Yes
FlavorOfWeek	4	Banana Chocolate Rocky Road Strawberry

Dimensions	
Number of Effects	7
Number of Parameters	13

We're trying to figure out what makes a product sell better. We have data from 48 instances where this product was sold. We're looking at a few different things:

- When the product was sold, either in August or September.
- Whether it was a weekday or a weekend when it was sold.
- Whether it was during the school year or not.
- Which special flavor was being promoted when it was sold.

We're studying these factors to understand their impact on sales. In total, we're considering seven different factors. We have 13 numbers that help us understand how each of these factors affects sales. These numbers include a starting point that we use as a reference.

Least Squares Summary

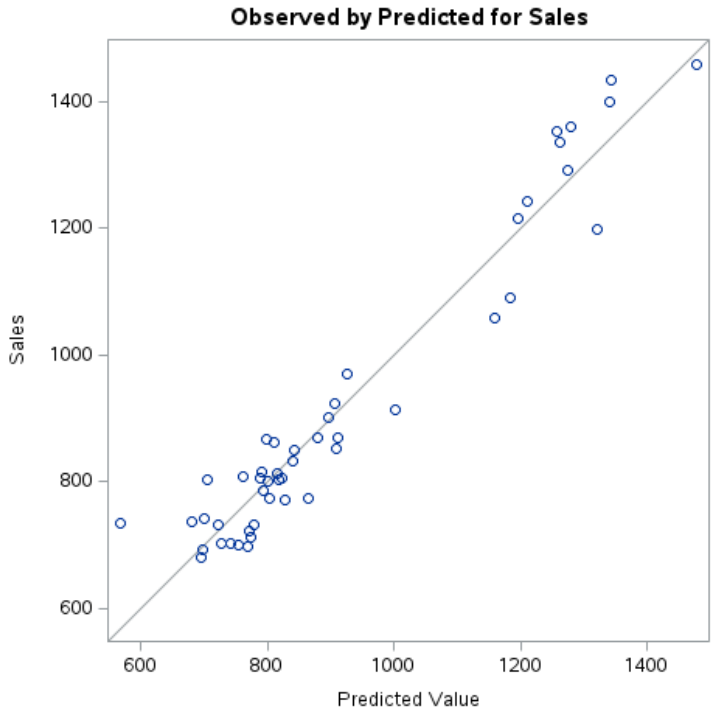
Step	Effect Entered	Number Effects In	Number Parms In	SBC
0	Intercept	1	1	526.3986
1	Temperature	2	2	516.1143
2	Day	3	3	519.8702
3	Month	4	4	523.0341
4	Weekend	5	5	419.5444
5	Schoolyear	6	6	416.3870*
6	FlavorOfWeek	7	9	427.1262

* Optimal Value of Criterion

- Step 0 - Starting Point: We begin with just a basic model that doesn't consider any variables except the starting point (intercept). At this stage, our model isn't very good, and we use something called SBC (a measure of how well our model fits the data), which is 526.3986.
- Step 1 - Temperature: We add the temperature variable to our model. This makes our model better, as shown by a lower SBC of 516.1143.
- Step 2 - Day: Now, we include the day of the month in our model. Surprisingly, this doesn't improve our model much, and our SBC goes up to 519.8702.
- Step 3 - Month: We introduce the month variable, but it doesn't make our model significantly better. The SBC only slightly increases to 523.0341.
- Step 4 - Weekend: When we add the weekend variable, our model becomes a lot better. The SBC drops significantly to 419.5444, showing that whether it's the weekend or not really matters for sales.
- Step 5 - Schoolyear: Adding the school year variable makes our model even better. The SBC decreases to 416.3870. This step is marked as optimal (*) because it's the best configuration we've found so far.
- Step 6 - FlavorOfWeek: Finally, we include the flavor of the week variable. Strangely, this makes our model a bit worse. The SBC goes up to 427.1262. It seems like this variable might be making our model too complicated.

Adding "Weekend" and "Schoolyear" variables really improved our model, meaning they're important in explaining sales. However, adding "FlavorOfWeek" didn't help much, and it might even be making our

model worse. According to this summary, the best model is the one at step 5, where we added the "Schoolyear" variable.



Comparing What We Predict with What Actually Happens:

Imagine we're trying to guess how many ice creams we sell each day, kind of like making a guess based on some clues. We're looking at two sets of numbers:

Actual Sales: These are the real numbers from our sales records, showing how many ice creams we really sold each day. These numbers can change for many reasons, and our guess doesn't consider all of those reasons.

Predicted Sales: These are our guesses using a special formula. We use things like the weather, whether it's the weekend, or if school is in session to make these guesses.

Visualizing the Comparison:

- To see how good our guesses are, we make a chart:
- The line that goes from left to right (X-axis) shows what we guessed.
- The line that goes up and down (Y-axis) shows what we actually sold.

What We Learn:

If the points on the chart are really close to a diagonal line, it means our guesses are pretty good. Our guesses are very similar to what really happens.

If the points are far from this line, it means our guesses aren't that great, and there might be other things affecting sales that we're not thinking about.

Why It's Important:

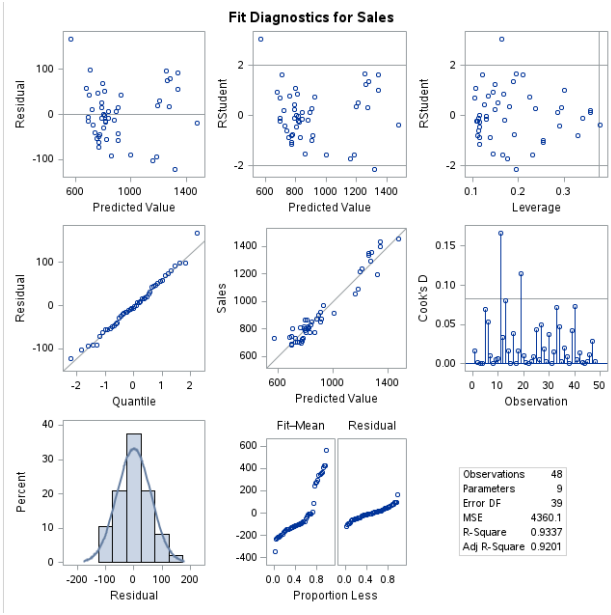
We do this comparison to:

Figure out what things, like the weather or school year, really matter in how many ice creams we sell. his helps us make better choices, like how much ice cream to have or when to have special offers.

Good for Business:

- If our guesses are reliable, we can make smarter choices about how to run our ice cream business, like how much ice cream to keep in stock or how many staff members to have.
- It helps us plan our business strategies better, making our business run more smoothly.
- It gets us ready for changes in sales and makes running our ice cream business less risky.

Comparing our guesses with what actually happens helps us understand and improve how we run our ice cream business.



The 45-Degree Line: Think of this line like a benchmark. If our predictions were perfect, all the dots (representing daily ice cream sales) would sit right on this line.

The Dots: Each dot on the chart represents what we guessed and what actually happened for ice cream sales on a particular day.

What We See:

Dots Close to the Line: This means our guesses are pretty good and close to what really happened.

Dots Scattered but Still Near the Line: This shows some small differences, but overall, our predictions are trustworthy.

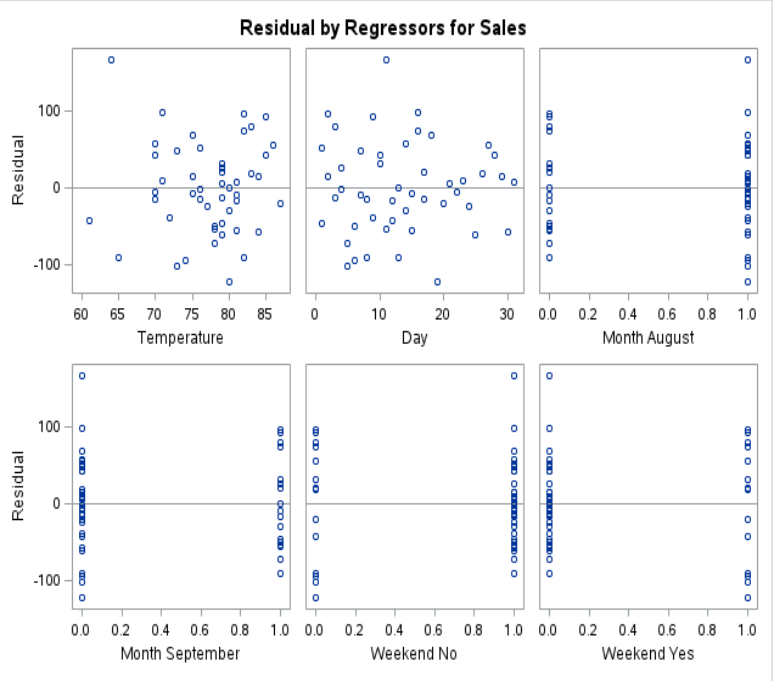
For Bidinger’s Ice Cream Stand:

- Temperature, Weekends, School Year: These are like ingredients in a recipe, each affecting ice cream sales in its own way.
- Temperature's Impact: It's clear that temperature is really important for sales, and we need to make sure this effect is consistent.
- Weekend and School Year: These factors combined have a significant influence on sales. We must ensure this effect is genuine and not due to errors or data issues.

Why It Matters:

Understanding this helps us make smart choices to boost ice cream sales. It's like a report card that helps Teresa, who runs the ice cream stand, serve customers better and make more sales.

In simple terms, the chart shows how good we are at predicting ice cream sales based on things like the weather and school days. The closer the dots are to the "perfect line," the better our predictions, and the better we can serve customers and make sales.



Temperature: Warmer days lead to more ice cream sales because people want to cool down.

Day: Ice cream sales change from day to day. Some days are better for sales, and some are not. Analyzing this can help us figure out which days are consistently good or bad, so we can plan better.

Month August: Sales are lower in August, especially before school starts. Maybe it's because families are on vacation or because it's really hot.

Month September: Sales in September, especially when school is in session, are higher. Maybe it's because students and parents stop by after school.

Weekend No (Weekdays): Sales on weekdays, especially during the school year, are higher. Maybe it's because people have their routines of going to school and work, and they stop by for ice cream.

Weekend Yes (Weekends): Sales go up a lot during the weekends. People are more likely to treat themselves or have time to visit the ice cream stand.

What We Learn:

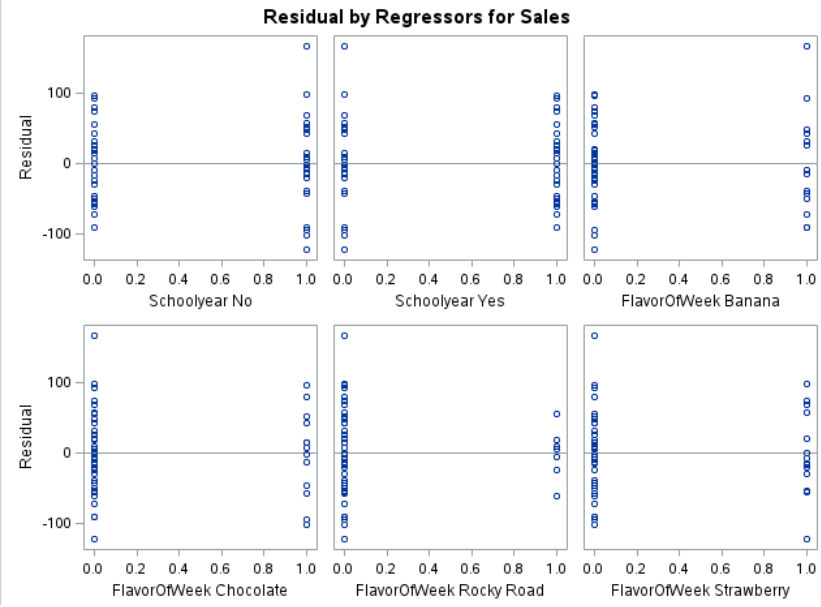
Temperature matters a lot. When it's hot, we need more ice cream and staff to serve customers.

Sales change every day, so we need to understand why and plan accordingly.

August sales are lower, so we might need special promotions or longer hours to attract more customers.

Weekdays and weekends have different sales patterns, so we should have different plans for each to make more sales and keep customers happy.

In simple terms, this tells us that ice cream sales are affected by things like temperature, which day it is, and whether it's a weekday or weekend. Knowing this helps us make better decisions, like having enough ice cream when it's hot or planning special deals on certain days to attract more customers.



When School Isn't in Session (Schoolyear No):

Sales are generally lower during times when school is out. This could be because there are fewer customers around, maybe families are on vacation or doing other things.

When School Is in Session (Schoolyear Yes):

Sales go up when school is in session. This might be because more people are in the area, like students and parents stopping by for treats.

Flavor of the Week: **Banana**

Sales for Banana flavor isn’t as high as some other flavors. It's a choice, but not the most popular.

Flavor of the Week: **Chocolate**

Chocolate consistently sells well. It's a popular flavor that many customers like.

Flavor of the Week: **Rocky Road**

Rocky Road's sales vary. It might not be super popular with everyone, but it attracts a certain group of customers looking for something unique.

Flavor of the Week: **Strawberry**

Strawberry flavor gets a lot of sales, especially on specific days. People really like it during certain times or situations.

What We Learn:

Sales change a lot depending on whether school is in session or not. This helps us plan things like how much ice cream to have and when to advertise.

Different flavors sell differently. Chocolate and Strawberry are big hits, while Banana and Rocky Road might be for specific groups. This helps us decide which flavors to offer and when to promote them.

We can do special deals for less popular flavors or really push the popular ones during peak times like the school year or specific days of the week.

In simple terms, we see that ice cream sales are affected by whether school is in session, and people have different tastes in ice cream flavors. This helps us plan when to stock up on ice cream and which flavors to promote to make more sales.

What does this mean for Teresa?

Understanding Sales Factors:

As an ice cream shop owner, you now know that several things affect how many ice creams you sell. These include the weather, what day it is, whether school is in session, and the flavor of the week.

Best Way to Predict Sales:

The best way to guess how many ice creams you'll sell is by looking at the temperature, whether it's a weekend or a weekday, and if school is in session. This combination works well for predicting sales.

Temperature Matters:

When it's hot, you sell more ice cream. So, it's important to make sure you have enough ice cream and staff on hand during warm days.

Day-to-Day Changes:

Ice cream sales change from day to day. Some days are better for sales, and some aren't. It's a good idea to figure out why this happens so you can plan better.

School Year Impact:

Sales are much better when school is in session. This means you can make more money during the school year. It's a good idea to adjust how much ice cream you have and how you advertise based on this.

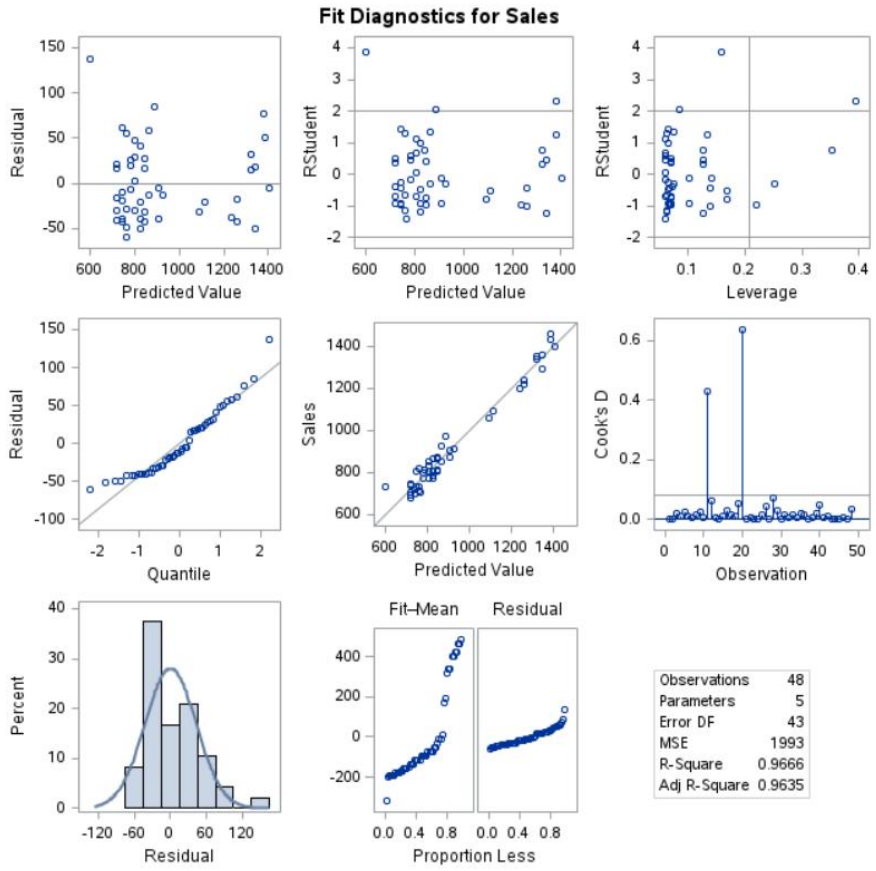
Popular Flavors:

Some ice cream flavors sell really well, like chocolate and strawberry. Others, like banana and rocky road, are not as popular. Knowing this helps you decide which flavors to offer and when to promote them.

Smart Business Moves:

All of this information helps you make smart choices for your ice cream business. You can plan better, have the right amount of ice cream, and promote the right flavors at the right times. This makes your business run better, prepares you for changes in sales, and reduces risks.

In simple terms, you've learned what makes your ice cream business successful. You know to keep an eye on the weather, the day of the week, and whether school is in session. You also know which ice cream flavors are popular. Using this knowledge helps you make more money and run your ice cream shop better.



Checking How Good the Sales Predictions Are:

Teresa, who runs the ice cream stand, is making sure her predictions are accurate. She looks at a few things:

Residuals vs. Predicted Sales:

If the errors in her predictions are small and random, it means factors like temperature and weekends matter for sales. Her predictions are working well.

Normal Q-Q Plot:

If the points in this plot form a nice line, it means her predictions' errors are spread out evenly. This makes her trust her predictions more.

Cook's Distance:

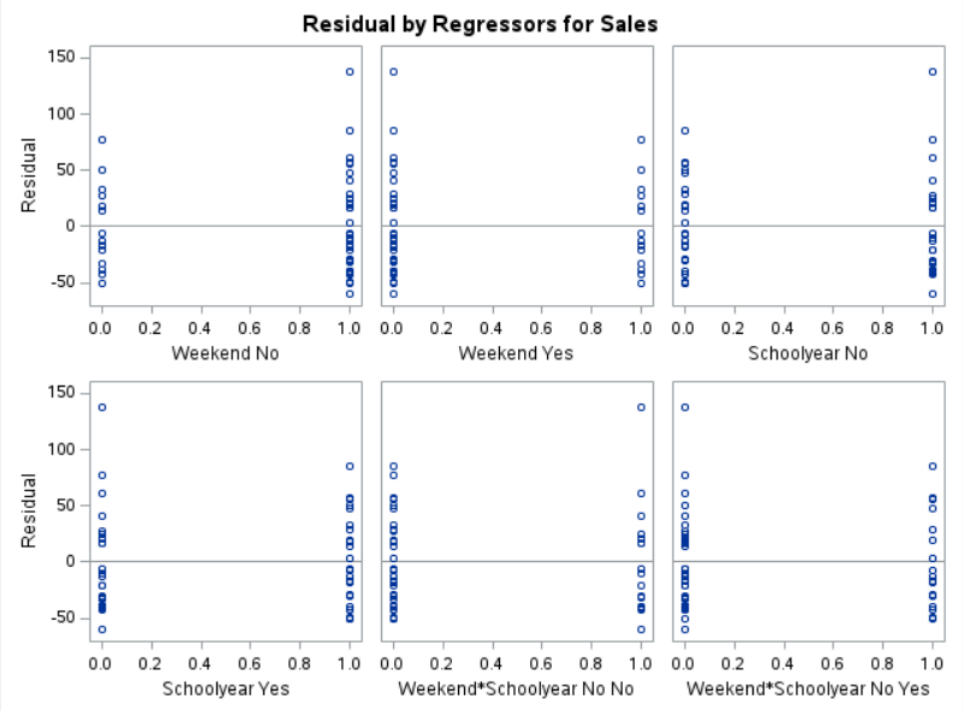
If there are no really strange points in this data, it means Teresa's predictions are stable. No single day or condition is messing up her predictions.

What It Means for Teresa:

These checks help Teresa trust her predictions and make better decisions. If she sees odd days in her data, she can figure out why and make changes.

With a good prediction model, Teresa can plan things like how much ice cream to have, when to have enough staff, and when to offer deals. This keeps her customers happy and boosts sales.

In simple terms, these checks ensure that Teresa's predictions are reliable, helping her run her ice cream stand efficiently and successfully.



For Non-Weekend Days (Weekend No):

The model does a great job predicting sales on these days. The predictions are very close to what actually happens, with minimal differences.

For Weekend Days (Weekend Yes):

The model's predictions during the weekends have a bit more variation. This could be because weekends see more fluctuation in customer traffic and sales.

When School Isn't in Session (Schoolyear No):

The model works well during this time. It predicts sales accurately, and there's not much variation in the predictions.

During the School Year (Schoolyear Yes):

There's more variability in the model's predictions during the school year. This might be because different types of customers are buying ice cream during this time.

For Weekdays When School Isn't in Session (Weekend*Schoolyear No No):

The model is very accurate during these weekdays. It captures the sales patterns really well.

For Weekends When School Isn't in Session (Weekend*Schoolyear No Yes):

The predictions during these weekends have more variation. This suggests that there are other factors influencing sales on these specific days that the model doesn't account for.

In simpler terms, the model does a great job predicting sales on regular weekdays and when school is not in session. However, on weekends and during the school year, there's a bit more variability in the predictions, indicating that other factors may be at play.

Weekdays During the School Year (Weekend*Schoolyear Yes No):

The model is fairly accurate, but there's some variation in its predictions on weekdays during the school year.

Weekends During the School Year (Weekend*Schoolyear Yes Yes):

The predictions have even more variation on weekends during the school year. This could be because various factors like school events or weather play a role.

Temperature:

When it comes to temperature, the model's predictions aren't completely random. It means temperature affects ice cream sales in a way that's not a simple, straight line. As the temperature changes, the accuracy of the predictions also changes, showing a connection between temperature and ice cream sales.

In simpler terms, the model does okay on weekdays during the school year, but there's more variation on weekends. Temperature has an impact on ice cream sales, but it's not a straightforward relationship. It changes how well the model predicts sales.

Effect on Sales:

As an ice cream shop owner, you want to know what affects your sales. We looked at things like the weather, the day of the week, whether school is in session, and the flavor of the week.

Best Way to Predict Sales:

The best way to guess how many ice creams you'll sell is by considering the temperature, whether it's a weekend or a weekday, and if school is in session. This combination works well for predicting sales.

Temperature Matters:

Hotter days mean more ice cream sales. So, make sure you have enough ice cream and staff on warm days.

Day-to-Day Changes:

Ice cream sales vary from day to day. Some days are better for sales, and some aren't. Try to figure out why this happens to plan better.

School Year Impact:

Sales are better when school is in session. Adjust your ice cream stock and promotions based on this.

Popular Flavors:

Some ice cream flavors sell really well, like chocolate and strawberry. Others, like banana and rocky road, aren't as popular. Knowing this helps you decide which flavors to offer and when.

Smart Business Moves:

All this information helps you make smart choices for your ice cream business. You can plan better, have the right amount of ice cream, and promote the right flavors at the right times. This makes your business run better, prepares you for changes in sales, and reduces risks.

Checking Predictions:

You're making sure your predictions are accurate. You look at a few things:

Residuals vs. Predicted Sales: If errors are small and random, it means factors like temperature and weekends matter for sales.

Normal Q-Q Plot: If the points form a nice line, it means your predictions' errors are spread out evenly, which is good.

Cook's Distance: If there are no strange points, it means your predictions are stable.

What It Means for You:

These checks help you trust your predictions and make better decisions. If you see odd days in your data, you can figure out why and make changes.

With a good prediction model, you can plan how much ice cream to have, when to have enough staff, and when to offer deals. This keeps your customers happy and boosts sales.

Variability in Predictions:

The model does a great job predicting sales on regular weekdays and when school isn't in session. But on weekends and during the school year, there's more variation in the predictions. This suggests other factors may be at play.

Temperature's Impact:

Temperature affects ice cream sales, but it's not a simple relationship. Changes in temperature change how well the model predicts sales.

In simple terms, understanding all this helps you make better decisions for your ice cream business, keep your customers happy, and boost your sales.

Conclusion/Recommendations:

Based on the analysis of the sales data for the ice cream shop, several key insights have been uncovered that can inform business decisions and strategies. Here are the main takeaways:

Factors Affecting Sales: Several factors have been identified as significant drivers of ice cream sales, including temperature, the day of the week, whether it's during the school year, and the flavor of the week.

Best Predictive Model: The best predictive model for estimating ice cream sales combines temperature, whether it's a weekend or weekday, and whether school is in session. This model provides the most accurate predictions and should be used as a basis for decision-making.

Temperature Matters: Temperature has a substantial impact on ice cream sales. Warmer days lead to higher sales, so it's crucial to ensure an adequate supply of ice cream and staff during hot weather.

Day-to-Day Variation: Ice cream sales vary from day to day, and it's important to understand these fluctuations to plan effectively. Some days are better for sales than others.

School Year Influence: Sales are significantly higher when school is in session. Adjusting inventory and promotions based on the school calendar can lead to increased revenue during the academic year.

Popular Flavors: Different ice cream flavors have varying levels of popularity. Chocolate and strawberry are consistently top sellers, while banana and rocky road are less popular. Tailoring flavor offerings to customer preferences can boost sales.

Smart Business Decisions: Utilizing the insights from the analysis, the ice cream shop owner can make informed decisions about inventory management, staffing, and promotional strategies. This leads to smoother business operations and reduced risks.

Recommendations:

Temperature Monitoring: Continuously monitor temperature forecasts and ensure that you have sufficient ice cream stock and staff on hand during hot days to meet increased demand.

Day-to-Day Sales Analysis: Analyze daily sales patterns to identify consistently strong and weak days. Use this information to plan staffing levels and promotional activities accordingly.

School Year Strategy: During the school year, consider offering special promotions or incentives for students and parents, as this is a period of higher sales. Adjust inventory levels to match the expected increase in demand.

Flavor Selection: Focus on promoting popular flavors like chocolate and strawberry during peak sales periods. Consider offering special deals on less popular flavors like banana and rocky road to attract a wider range of customers.

Regular Model Validation: Periodically validate the predictive model to ensure its accuracy and relevance. Adjust the model if necessary to account for changing customer preferences and market conditions.

Customer Engagement: Engage with customers to gather feedback on flavor preferences and special promotions. This can help refine your product offerings and marketing strategies.

Operational Efficiency: Optimize staffing schedules and inventory management based on the predictive model to reduce operational costs while meeting customer demand effectively.

Marketing and Promotion: Develop marketing campaigns and promotions that align with the identified factors affecting sales, such as temperature-dependent offers during hot weather.

By implementing these recommendations and staying attuned to the factors influencing sales, the ice cream shop can maximize profitability, improve customer satisfaction, and adapt to changing market conditions effectively.