

# **Minnesota United FC Business Intelligence Interview Project**

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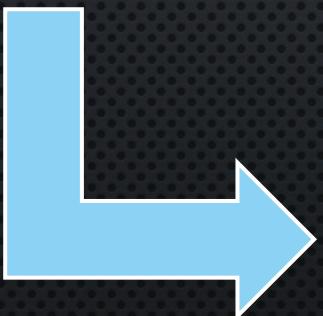


March  
2023



# INTRODUCTION AND GOALS

## Project Workflow



### Project Goals

1. Predict the number of tickets sold and subsequent revenue from ticket sales for Minnesota United's final regular season match against Vancouver.
2. Establish trends in ticket sales from the previous season to aid in pricing strategies for the upcoming season.
3. Project Minnesota United's total revenue from ticket sales (both season and single-game tickets) from the previous season.

- a) Develop a predictive model using machine learning to establish our prediction for the number of single-game tickets sold for Minnesota United's final regular season match and calculate the predicted revenue from ticket sales for this match based on our predicted value for ticket sales.
- b) Analyze the model's results and explain the features from our data that affect Minnesota United's ticket sales the most, along with showcasing trends in ticket sales from the dataset with the utilization of Tableau.
- c) Tie the entire analysis together and establish a prediction for Minnesota United's total revenue from last season's ticket sales.



# PREDICTIONS

## Predictions for Minnesota United vs Vancouver Whitecaps

Single-Game Ticket Sales ➔ 3,677

Single-Game Ticket Revenue ➔ \$239,005

Total Tickets Sold ➔ 17,177

Match Revenue ➔ \$711,505

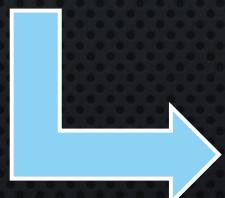
Total Revenue Projection from Single-Game Ticket Sales ➔ \$7,328,227

Total Revenue Projection from Season Ticket Sales ➔ \$8,032,500

Total Revenue Projection from Ticket Sales ➔ \$15,360,727



The Above  
Observations are  
also reflected in  
our model's  
coefficient  
values



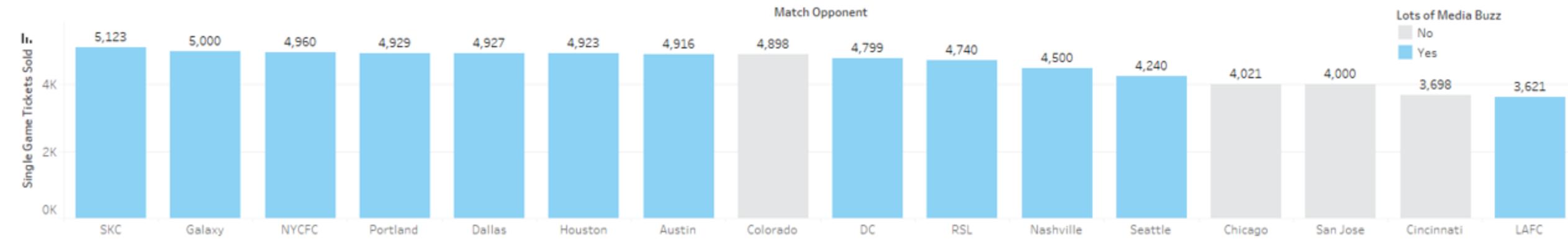
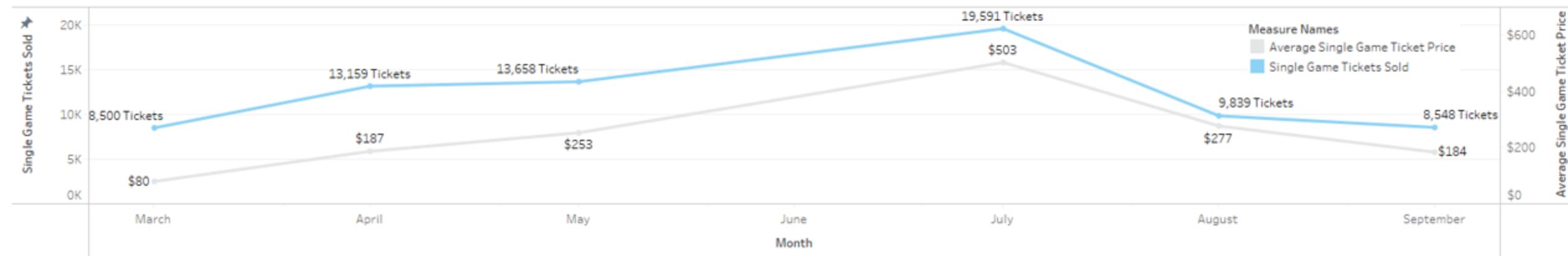
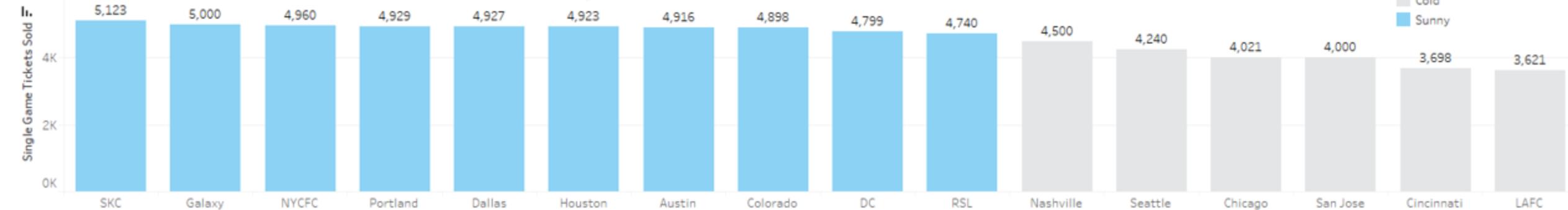
# TRENDS IN TICKET SALES

- Weather conditions make a **large** impact on ticket sales
  - Over **65%** of single-game **ticket sales** were made when the match's weather conditions were labeled as "Sunny" last season
  - The **top 10 best-selling matches** were on sunny days last season
- The most popular months to buy tickets to Minnesota United matches were **June and July** by a significant amount
  - March and September were the two least popular months
- In general, matches with "**lots of media buzz**" sold more tickets
  - 11 of the top 12 best-selling matches from last season had "lots of media buzz"

1. Home matches when the weather is labeled as "Sunny" are associated with an **average increase in ticket sales by about 968 tickets**, after accounting for all other explanatory variables.
2. Home matches that had "lots of media buzz" are associated with an **average increase in ticket sales by about 327 tickets**, after accounting for all other explanatory variables.
3. For every month closer we get to the end of the season there is an **average associated decrease in ticket sales by about 94 tickets**, after accounting for all other explanatory variables.



# Trends in Ticket Sales





# Possible Improvements in Pricing Strategy

1. Scheduling more home matches during late spring and summer
  - I. Increased sales in summer months historically
  - II. More "Sunny" days
2. Look to schedule more matches with high-market teams
  - I. Increased media buzz
3. Look to schedule more matches with teams that have notoriously good records and large fanbases
  - I. Increased media buzz - similar to high-market teams, but could also include teams that generally have great records and/or just had a very successful season beforehand
4. Look to schedule more matches with midwestern/teams close to Minnesota
  - I. More opposing fans attending in MN due to less travel time (Cincinnati, Chicago, Columbus, etc.)
5. Look to sign high-level players that will attract more media attention
  - I. Obviously not easy, but would be highly influential in terms of ticket sales if possible



# REVENUE CALCULATION PROCESS

13,500 season tickets were sold for each home match at \$35 a ticket on average → Minnesota United made \$472,500 per game in season tickets sales ( $35 * 13,500 = 472,500$ ) → \$8,032,500 total from season tickets last season over 17 home matches

Minnesota United made \$599,235 in ticket sales revenue from the LAFC match

\$599,235 – \$472,500 → \$126,735 in single-game ticket revenue at \$35 a ticket on average

$126,735 / 35 \rightarrow 3621$  single-game tickets sold for the LAFC match

Therefore, the prediction of 3,677 single-game tickets sold at an average price of \$65 ( $3,677 * 65$ ) for the Vancouver match → \$239,005 in single-game ticket revenue

\$239,005 + \$472,500 → \$711,505 in total ticket revenue and a total number of 17,177 tickets sold for the Vancouver match

Single-game ticket revenue for each game was calculated and summed along with the total revenue from ticket sales for the final match against Vancouver for a total single-game ticket revenue → \$7,328,227

**Total revenue from ticket sales from the previous season:**

\$7,328,227 + \$8,032,500 → \$15,360,727



# DATA MANIPULATION FOR MODEL CREATION

## Conversion to Binary Variables

# Change "Weather" and "Lots of Media Buzz" to binary variables

```
mn_united$Weather <- ifelse(mn_united$Weather == "Sunny", 1, 0)
```

```
mn_united`Lots of Media Buzz` <- ifelse(mn_united`Lots of Media Buzz` == "Yes", 1, 0)
```

## Creation of our Training Dataset

Rows: 16

Columns: 8

\$ Weather

\$ media\_buzz

\$ `Single Game Tickets Sold`

\$ `Average Single Game Ticket Price`

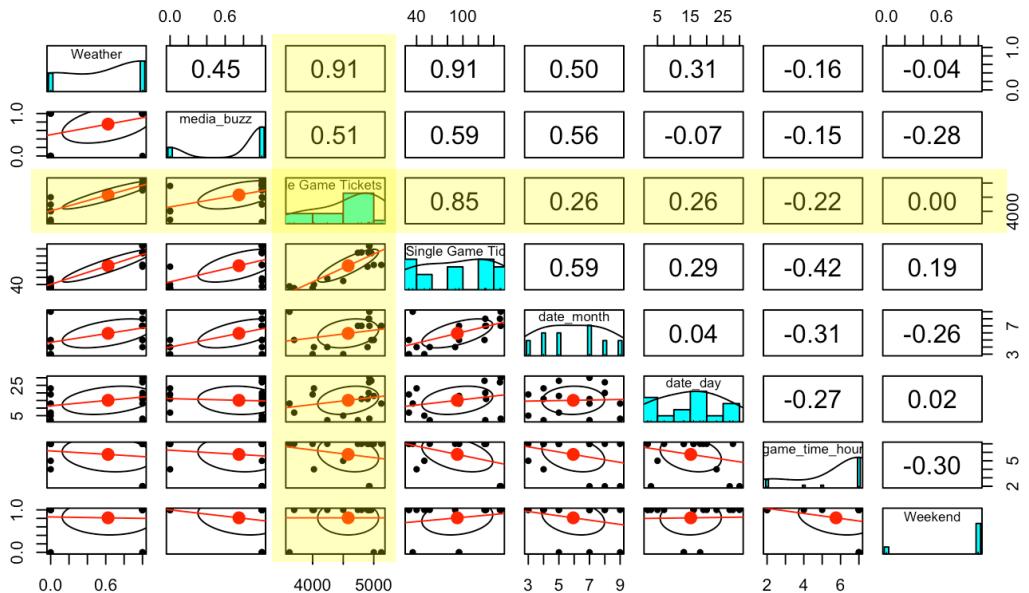
\$ date\_month

\$ date\_day

\$ game\_time\_hour

\$ Weekend

## Variable Correlations and Relationships





# MODEL CREATION

$H_0$ : The linear model is not statistically significant for predicting the number of single-game tickets sold for Minnesota United's final match against Vancouver

$H_a$ : The linear model is statistically significant for predicting the number of single-game tickets sold for Minnesota United's final match against Vancouver

**Response Variable:** The number of single-game tickets sold by Minnesota United (no season tickets)

## Initial Model: Use of All Variables in the Training Dataset

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	4839.52633	252.57520	19.161	5.7e-08 ***
Weather	2171.10563	673.27654	3.225	0.0122 *
media_buzz	784.61452	290.57677	2.700	0.0271 *
`Average Single Game Ticket Price`	-17.83020	10.20578	-1.747	0.1188
date_month	-64.43953	34.63035	-1.861	0.0998 .
date_day	-0.06378	4.35058	-0.015	0.9887
game_time_hour	-100.13341	35.72992	-2.803	0.0231 *
Weekend	503.51030	342.13437	1.472	0.1793
---				

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 120 on 8 degrees of freedom  
Multiple R-squared: 0.9691, Adjusted R-squared: 0.9421  
F-statistic: 35.85 on 7 and 8 DF, p-value: 2.008e-05

## Model Revision: Removal of Multiple Explanatory Variables

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	4773.832	243.991	19.566	2.66e-09 ***
Weather	1198.280	216.640	5.531	0.000251 ***
media_buzz	399.520	106.381	3.756	0.003749 **
`Average Single Game Ticket Price`	-3.287	2.844	-1.156	0.274714
date_month	-103.936	21.017	-4.945	0.000583 ***
game_time_hour	-55.568	23.553	-2.359	0.040005 *
---				

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 125.5 on 10 degrees of freedom  
Multiple R-squared: 0.9578, Adjusted R-squared: 0.9367  
F-statistic: 45.36 on 5 and 10 DF, p-value: 1.493e-06



# FINAL MODEL REVISIONS

## Final Revised Model

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	4287.02	115.09	37.249	9.00e-14 ***
Weather	967.86	88.95	10.881	1.43e-07 ***
media_buzz	327.01	104.55	3.128	0.00873 **
date_month	-93.68	23.52	-3.984	0.00181 **

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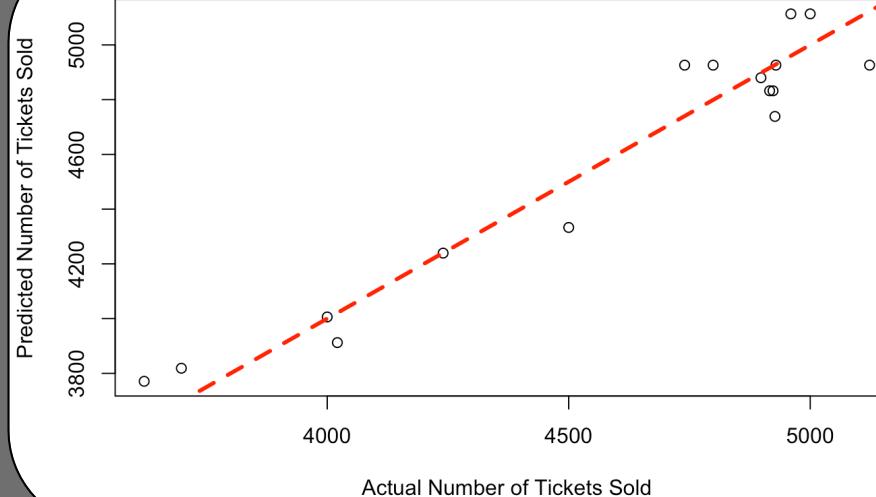
Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 145.4 on 12 degrees of freedom

Multiple R-squared: 0.932, Adjusted R-squared: 0.915

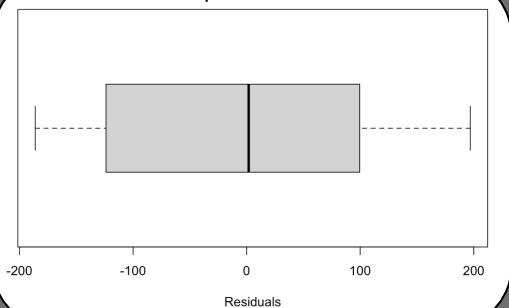
F-statistic: 54.83 on 3 and 12 DF, p-value: 2.811e-07

Plot of Predicted vs. Actual Number of Tickets Sold



$$\text{Single Game Tickets Sold} = 4287.02 + 967.86 * \text{Weather} + 327.01 * \text{media\_buzz} - 93.86 * \text{date\_month}$$

Boxplot of Residuals



Correlation of fitted values to actual values:  
[1] 0.9654069

Mean Absolute Error (MAE):

[1] 107.0703

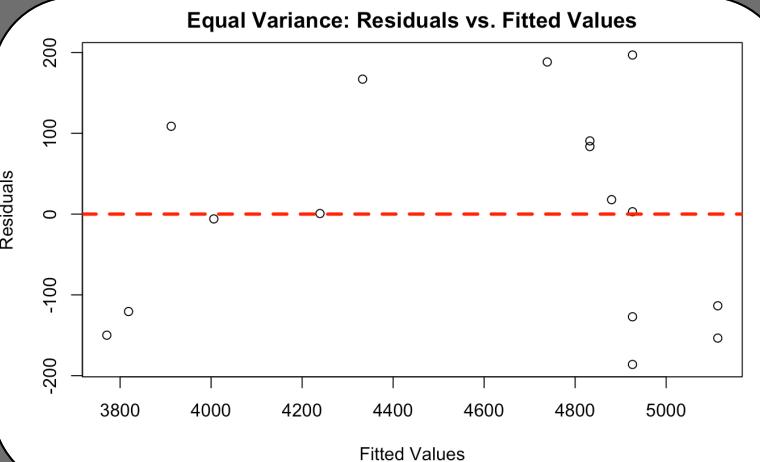
Root Mean Squared Error (RMSE):

[1] 125.9233

## Assumptions



## Equal Variance

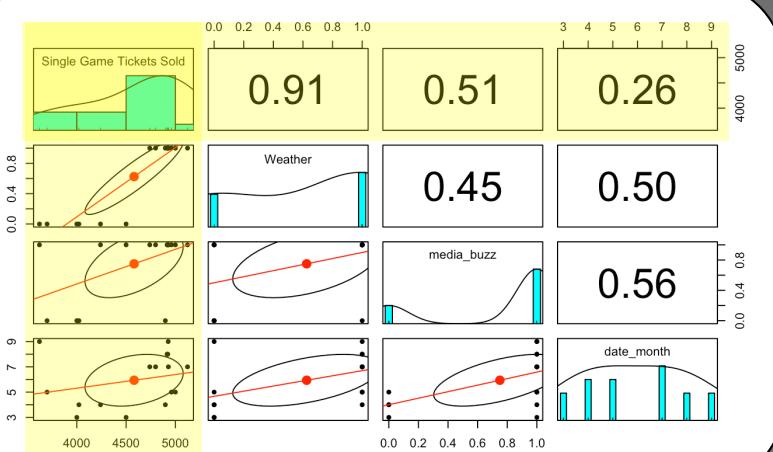


# ASSUMPTIONS

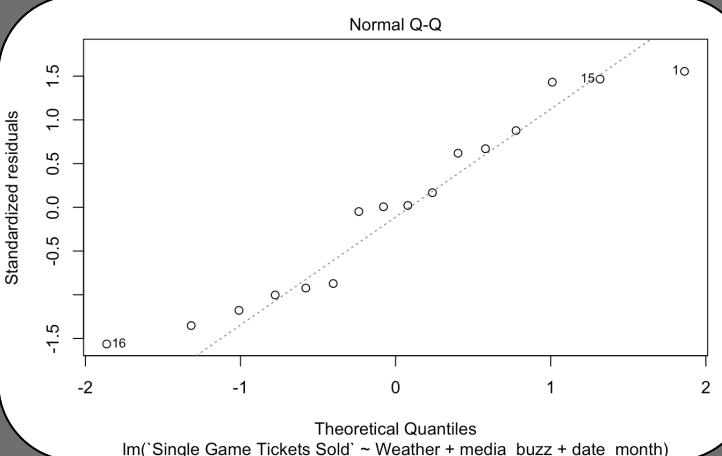
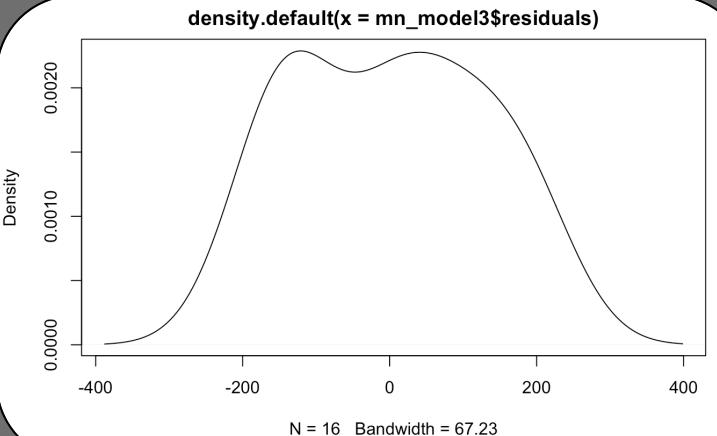
# Multicollinearity:

Weather media\_buzz date\_month  
1.403270 1.550954 1.646322

## Linearity



# Normality





# CONCLUSION

- We can **reject the null hypothesis** confirming that our linear model is statistically significant for predicting the number of single-game tickets sold for Minnesota United's final match against Vancouver based on the following;
  - Multiple R-Squared value
  - F-Statistic
  - Individual p-values
  - The model's overall p-value
  - Assumptions have been adequately met (for the most part)
  - Our prediction of 3,677 single-game tickets sold makes sense in the context of our model and its relevant circumstances
  - The mathematical interpretations of our model's coefficient values make sense in the context of our model and its relevant circumstances

## Caveats

- Small dataset
  - More difficult to make accurate predictions
  - More difficult to establish trends or patterns
  - Will lead to high variability in predictions
    - High variability can be seen with MAE, RMSE, and Standard Error values

# ADDITIONAL NOTES



## **Additional Aspects that Drive Ticket Sales in Professional Sports that I Would Pursue if Given the Time and Data**

- In-game statistics (i.e., frequency of goals/exciting plays, win-loss record, frequency of close matches, total time-with-ball, penalty totals, player suspensions, etc.)
- The true impact of individual players (i.e., the total number of "all-stars" on the team, number of high-profile players, whether we have any "fan-favorites", etc.)
- Frequency of giveaway matches/theme nights (i.e., bobblehead giveaway, fan appreciation nights, fireworks after the match, college nights, etc.)
- Individual players close to major career or season milestones
- Possibility of clinching a playoff birth/home field advantage