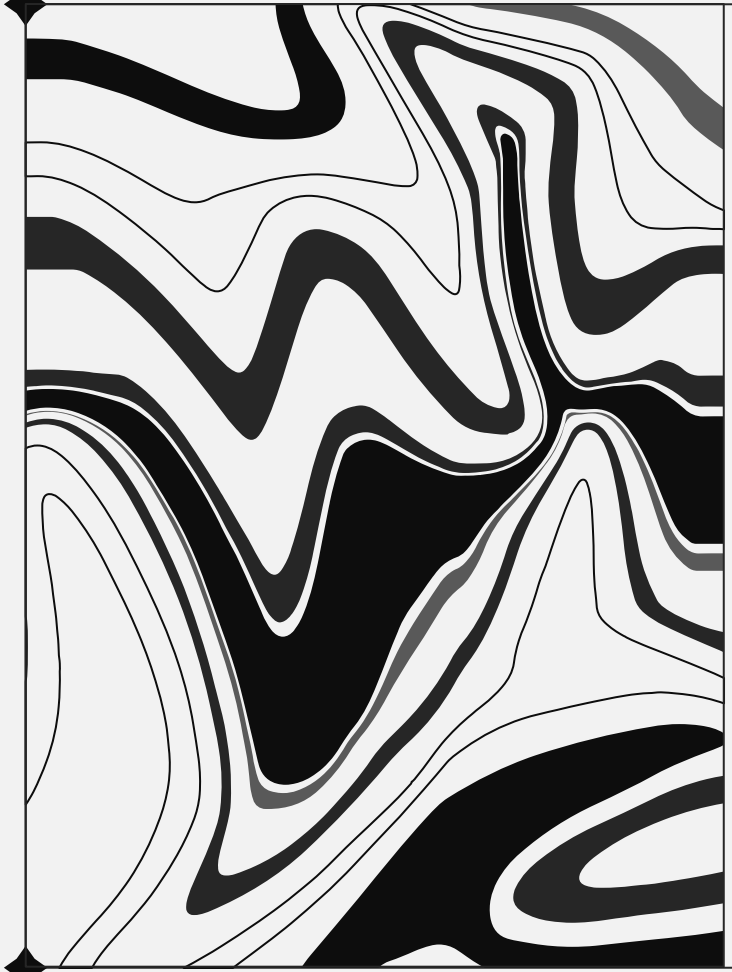


AER LINGUS

# ENHANCING WEATHER FORECASTING FOR AVIATION OPERATIONS

A time series analysis

# OVERVIEW

**Problem:**

1. Deicing an aircraft adds time to trip
2. The FAA says for all aircraft, structural icing can occur when moisture is present in the air at temperatures between 4° and -10°C.
3. Even if the plane has to go through deicing once, it adds time to trip.

**Solve:** To address additional time needed we work with the control center to create a deicing schedule. This can result in a flight delay or delayed boarding to wait for an open slot on the deicing pad.

**How:**

1. Make recommendations based on the data.
2. Build a model that can accurately forecast the weather by the hour.

# TABLE OF CONTENTS

# 01 FIRST SECTION

Business Understanding

# EQUIPMENT

## TYPE I

**DEICE**

Designed to remove ice after it begins to accumulate on the airframe.

## TYPE IV

**ANTI-ICE**

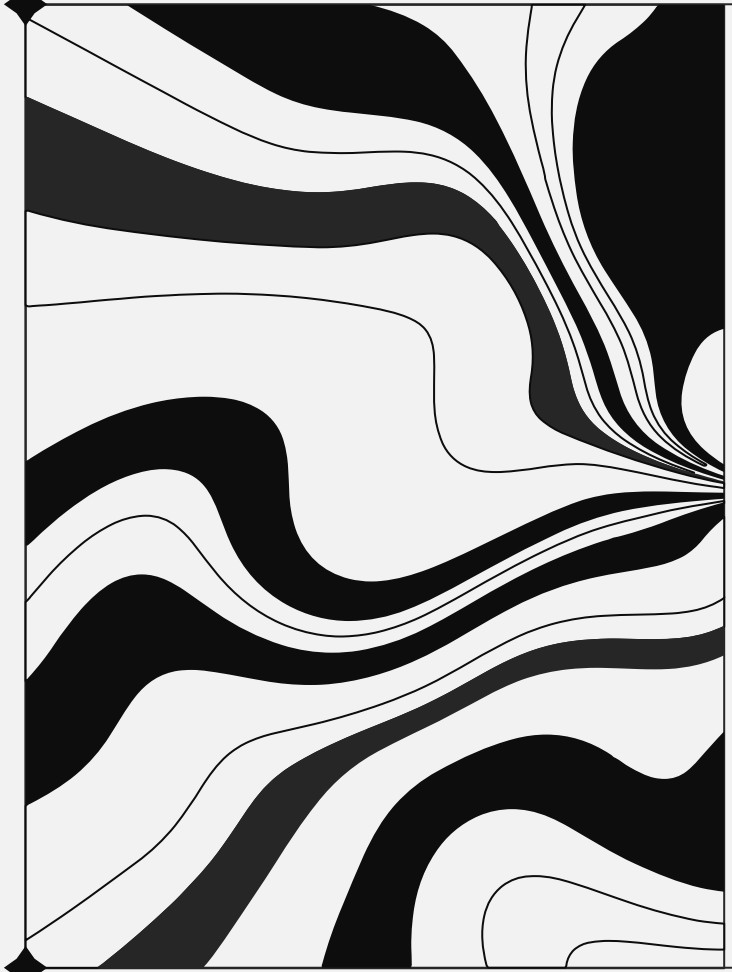
Before entering icing conditions and is designed to prevent ice from forming.

# WHEN SHOULD PILOTS DEICE OR ANTI-ICE?

- Planes will be de-iced and anti-iced as close to takeoff as possible to prevent more snow and ice from building up while plane is grounded. If it's just a buildup of frost, the process might only take 5-10 minutes to complete. During more severe weather, it can take 10-60 minutes.
- If the plane sits past its holdover time the fluid can be contaminated with snow and ice and you won't have the clean surface **AND** you have to restart the whole process over again.

# HOLDOVER TIME!

- The time from spraying to rolling down the runway
- precipitation, temperature and type of aircraft



# 02 SECOND SECTION

The Data and Exploratory Data Analysis

# The Data

Met Eirann Meteorological Service 1990-2020

## STATION

Dublin Airport

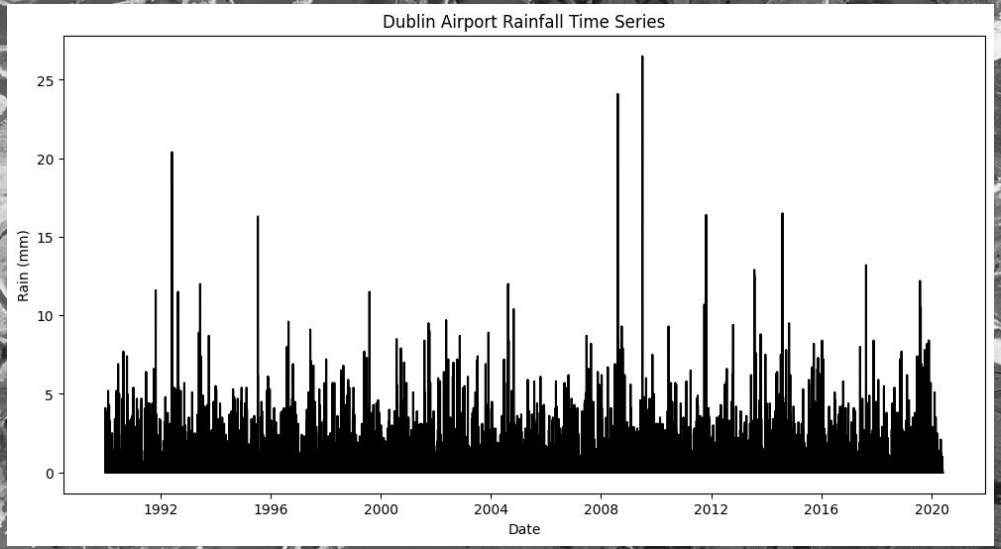
## TIME

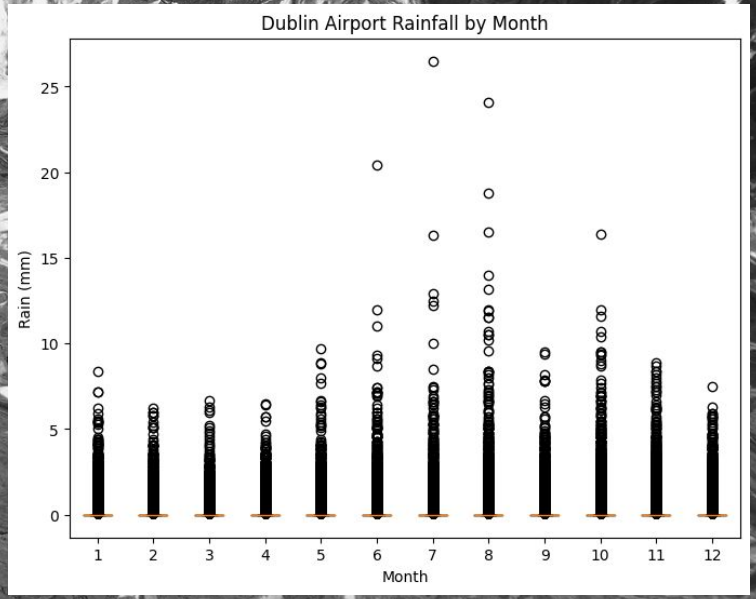
Hourly
Convert to Datetime

## Y

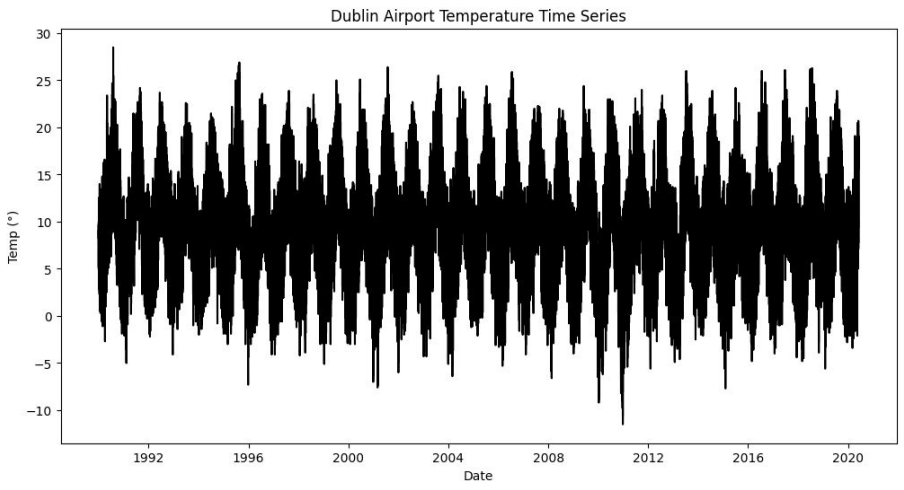
**Temperature and Rainfall**
No missing values
Convert to numerical

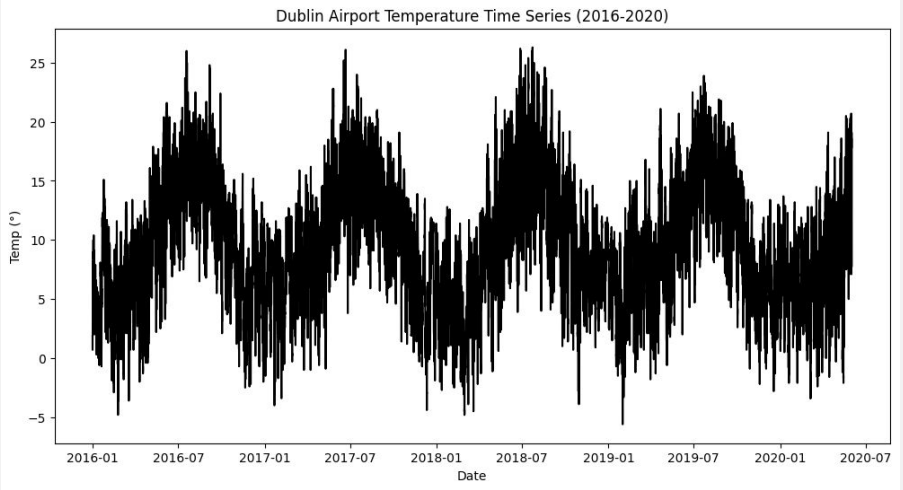
# DOES IT RAIN A LOT IN DUBLIN, IRELAND? LOL



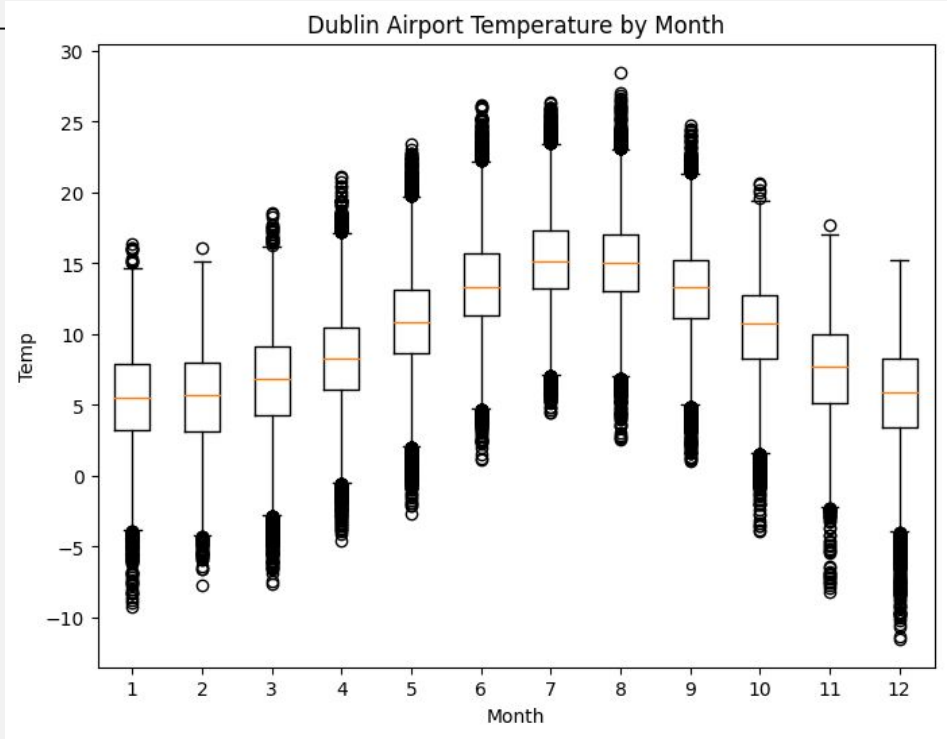



# WHAT'S THE TEMPERATURE LIKE?



# WHAT'S THE TEMPERATURE LIKE?

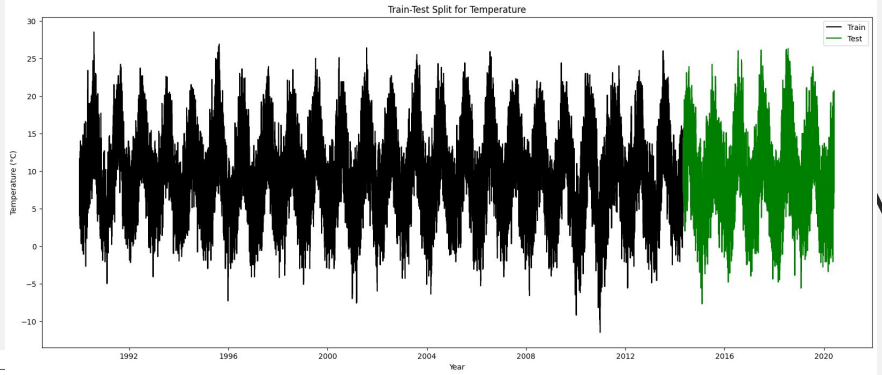


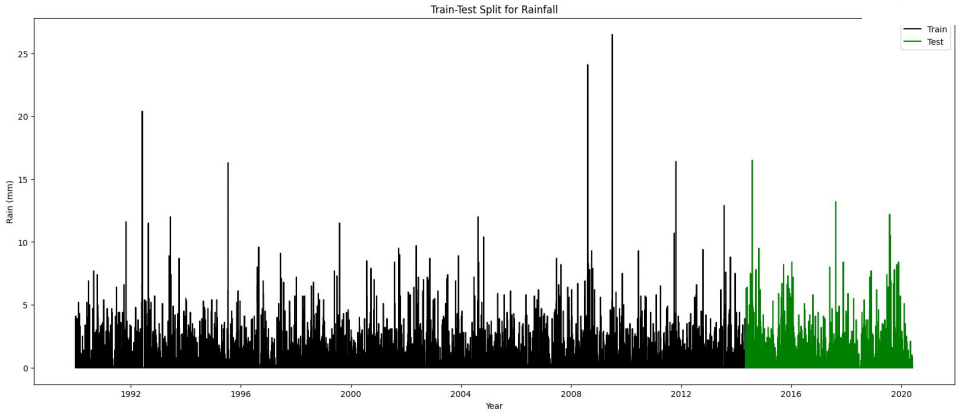
# 03 THIRD SECTION

Choosing the best model

# TRAIN-TEST SPLIT

ADF p-values
Rain = 0
Temp = -5.89



# CHOOSING THE BEST MODEL

## 01 NAIVE

Rain: .40mm
Temp: .94°C

## 02 RANDOM WALK

Rain: .44
Temp: 5.41°C

## 03 RANDOM WALK ARIMA

Rain: .44
Temp: 4.99°C

## 04 AUTOREGRESSION

Rain: .43
Temp: 4.99°C

## 05 MOVING AVERAGE

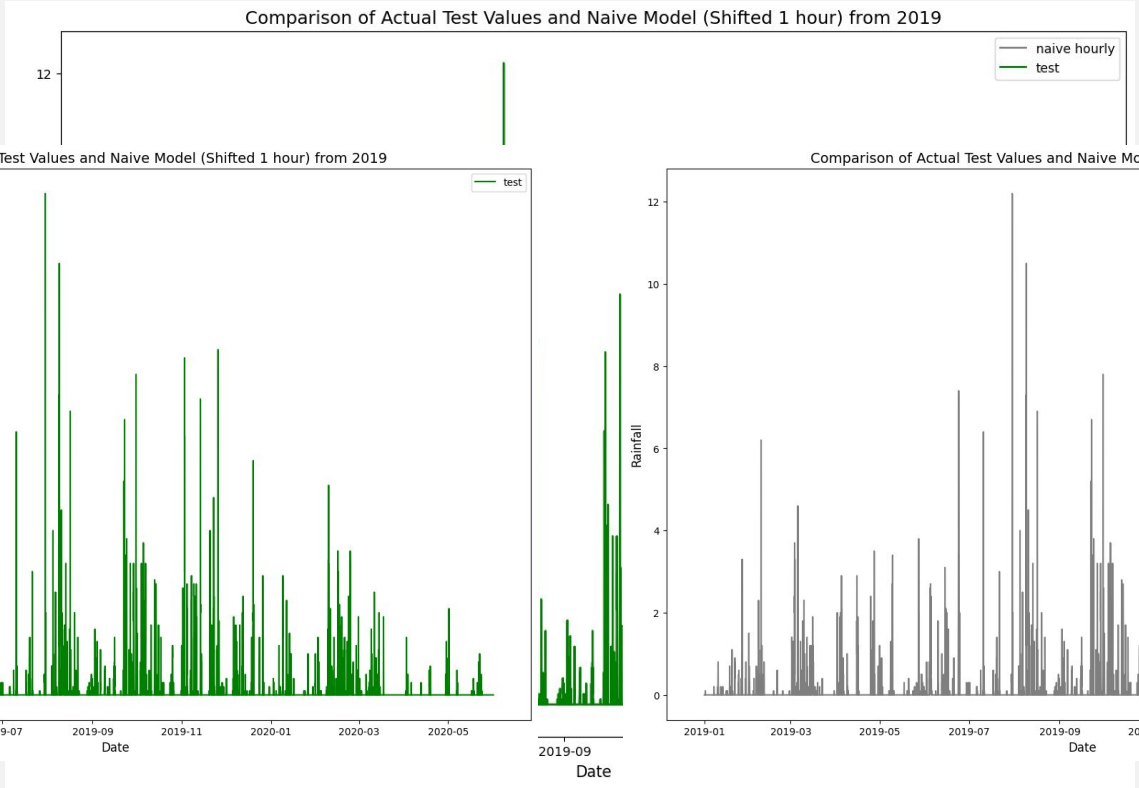
Rain: .43
Temp: 4.99°C

## 06 NEURAL PROPHET

Rain: .43
Temp: 4.11°C

“I win.”

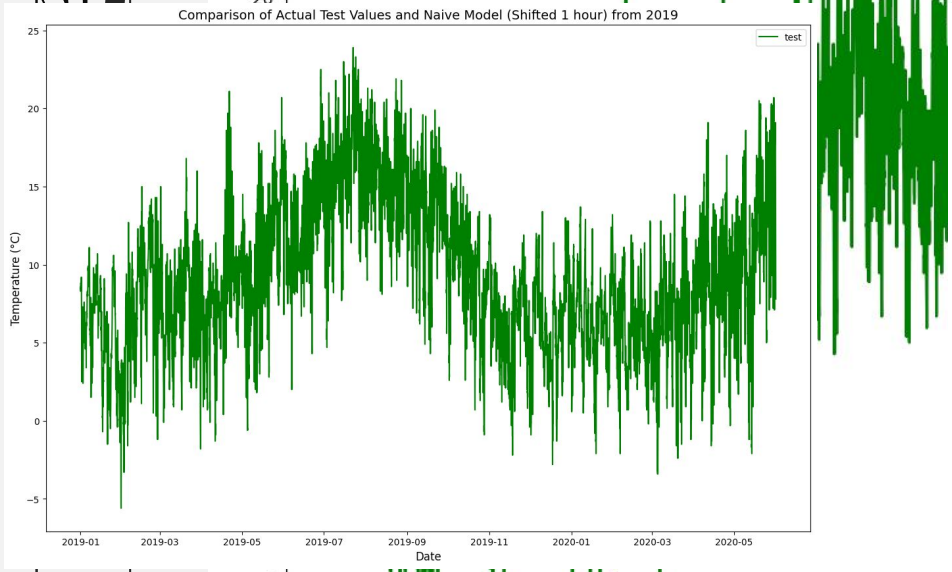
**—THOMAS BAYES**

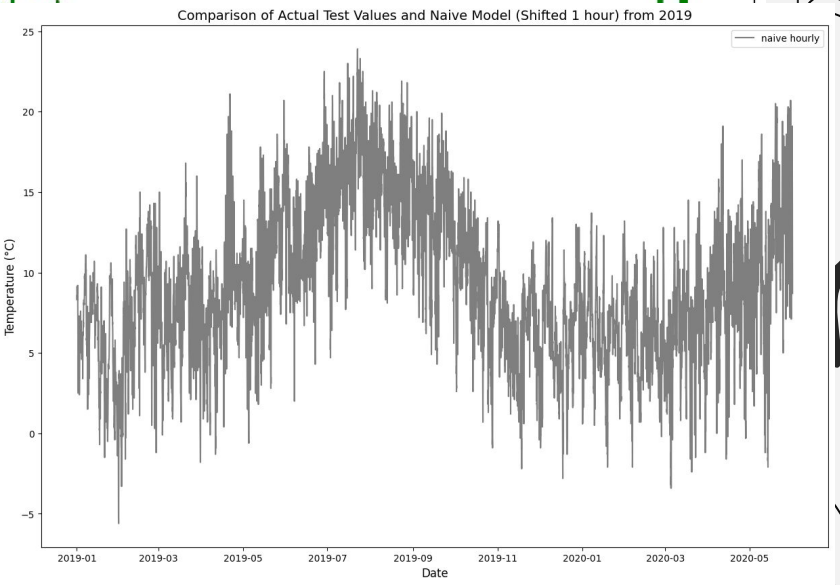

Comparison of Actual Test Values and Naive Model (Shifted 1 hour) from 2019
naive hourly
test
12
2019-09
Date


Comparison of Actual Test Values and Naive Model (Shifted 1 hour) from 2019
test
Rainfall
0
2
4
6
8
10
12
2019-01
2019-03
2019-05
2019-07
2019-09
2019-11
2020-01
2020-03
2020-05
Date

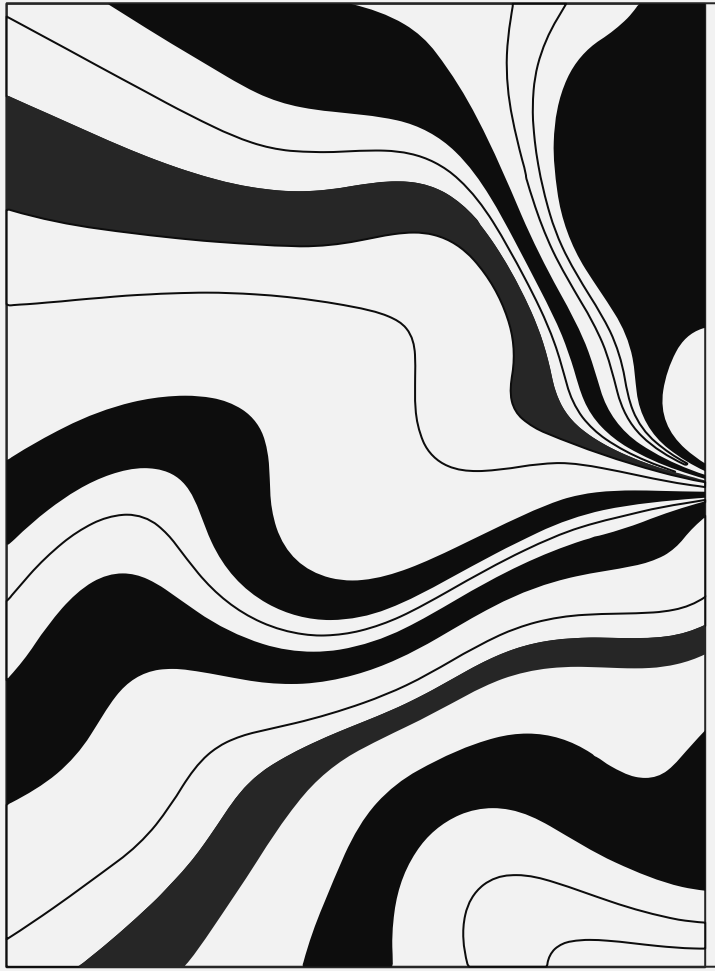

Comparison of Actual Test Values and Naive Model (Shifted 1 hour) from 2019
naive hourly
Rainfall
0
2
4
6
8
10
12
2019-01
2019-03
2019-05
2019-07
2019-09
2019-11
2020-01
2020-03
2020-05
Date

Daily = .6 mm


Comparison of Actual Test Values and Naive Model (Shifted 1 hour) from 2019
test
Temperature (°C)
Date


Comparison of Actual Test Values and Naive Model (Shifted 1 hour) from 2019
naive hourly
Temperature (°C)
Date


Comparison of Actual Test Values and Naive Model (Shifted 1 hour) from 2019
naive hourly
test
Daily = 3.09°C
Date



# 04 FOURTH SECTION

Recommendations and
Next Steps

# RECOMMENDATIONS

Light snow - you can have 2-3 hour holdover time
**Freezing rain** - you will have maybe up to 15 minutes holdtime

- Expect shorter holdover times between October and April as the temperatures are in the high risk zone for structural ice to be formed.
- Accurately predicting the rain hourly during the colder months is crucial
- Passengers should expect delays in May, October and December

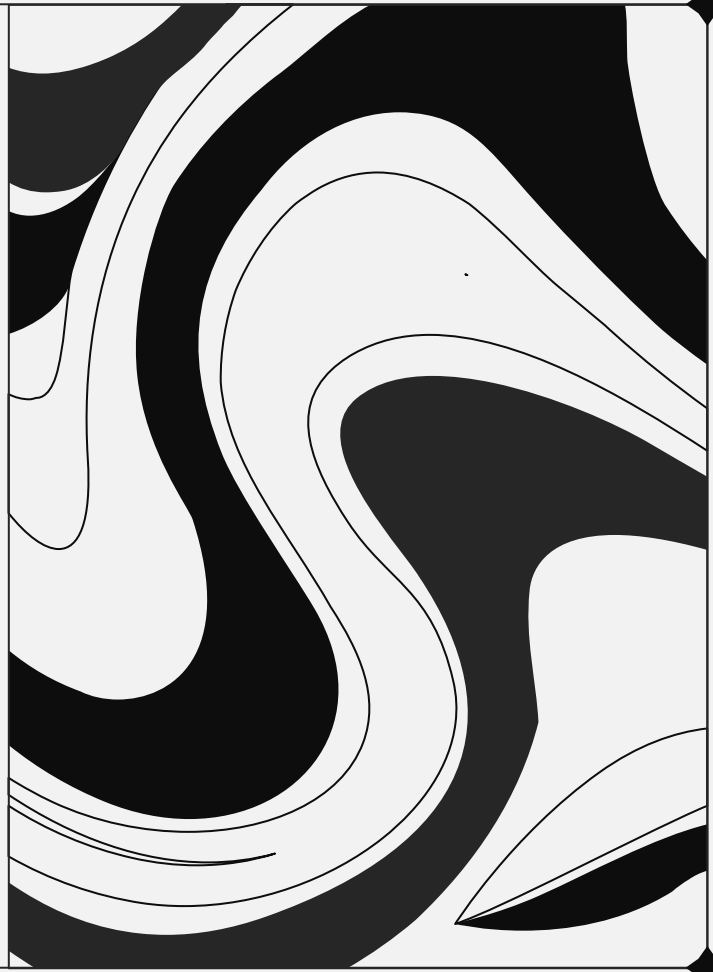
# ABOUT NEXT STEPS

## 01 TEST

Test the forecast in the next year to see if the model is accurate enough to be helpful moving forward

## 02 ADD

Add in other columns that could help forecast weather



"Aer Lingus warrants passengers if winter weather is expected to cause delays offering passengers a chance to rebook their flight before coming to the airport. Of course knowing if it's worth the potential added cost is a tough call."

# KIND OF LIKE PREDICTING THE WEATHER

# THANKS

**Do you have any questions?**
casiasjc@gmail.com