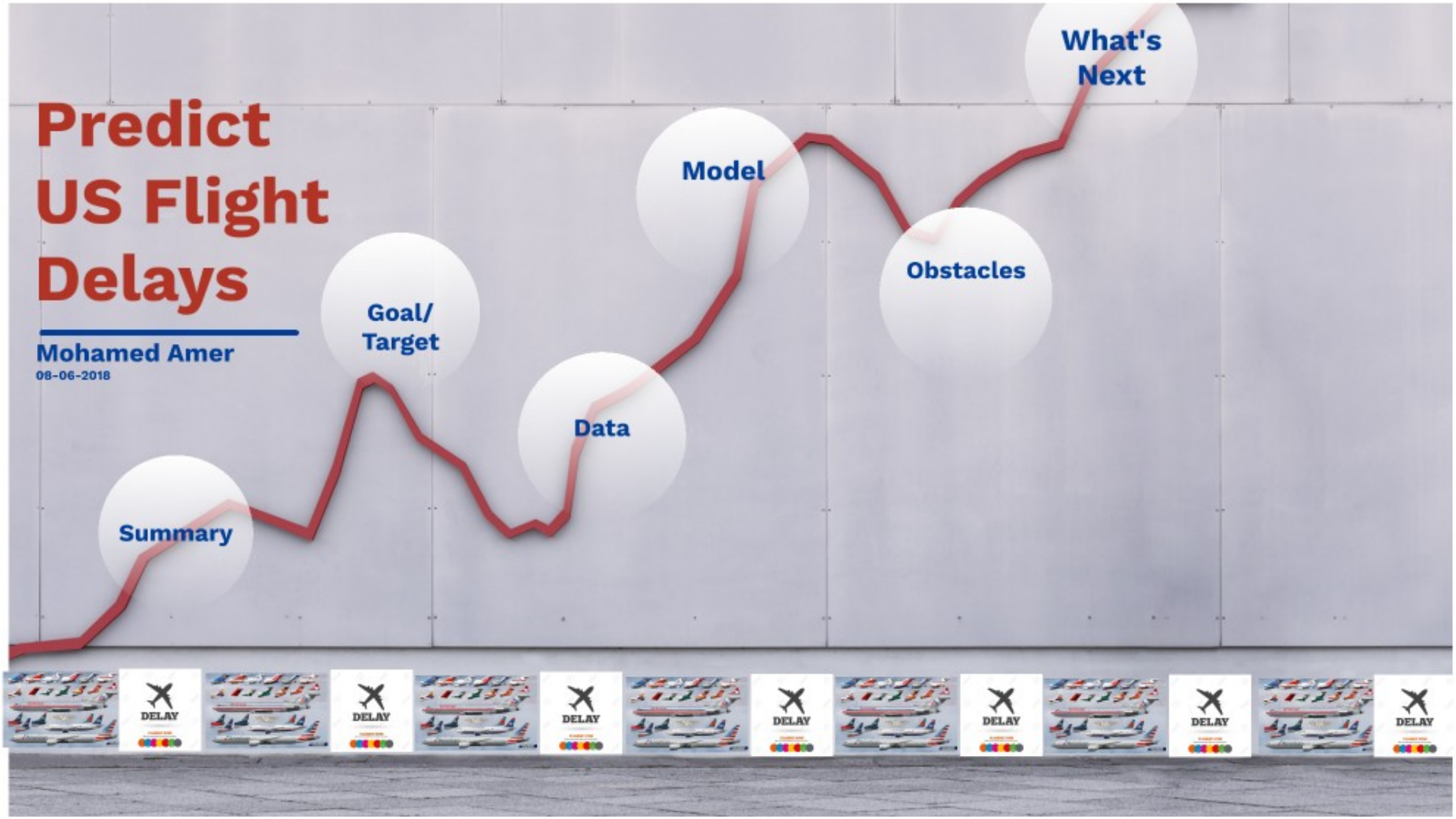

Predict
US Flight
Delays
Mohamed Amer
08-06-2018
Summary
Goal/
Target
Data
Model
Obstacles
What's
Next
DELAY

Problem Identification

~20%*

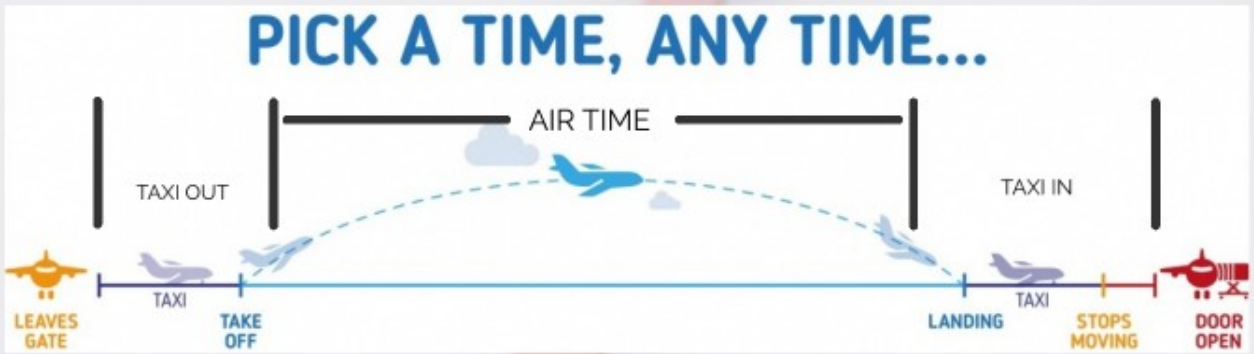
Delay mong US domestic airlines in 2015

Process

Process

* https://www.transtats.bts.gov/HomeDrillChart.asp

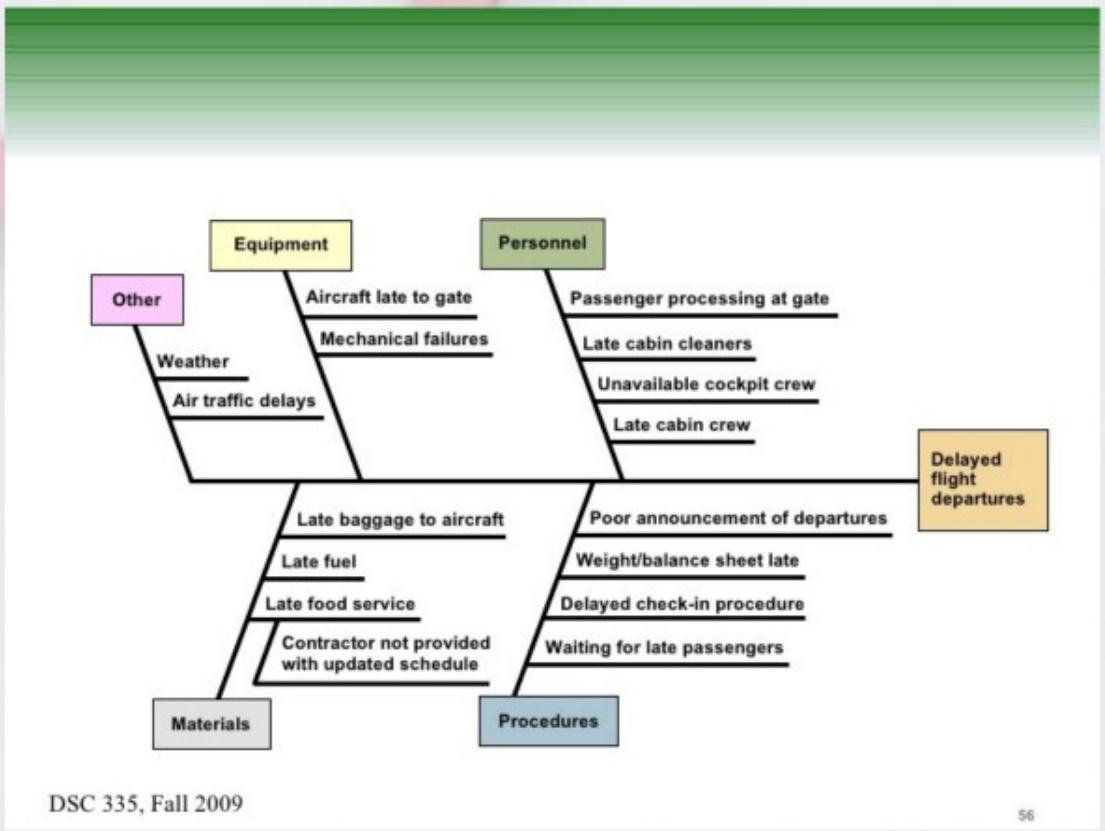
Airplane Process on Route



Marked Delays During the Route:

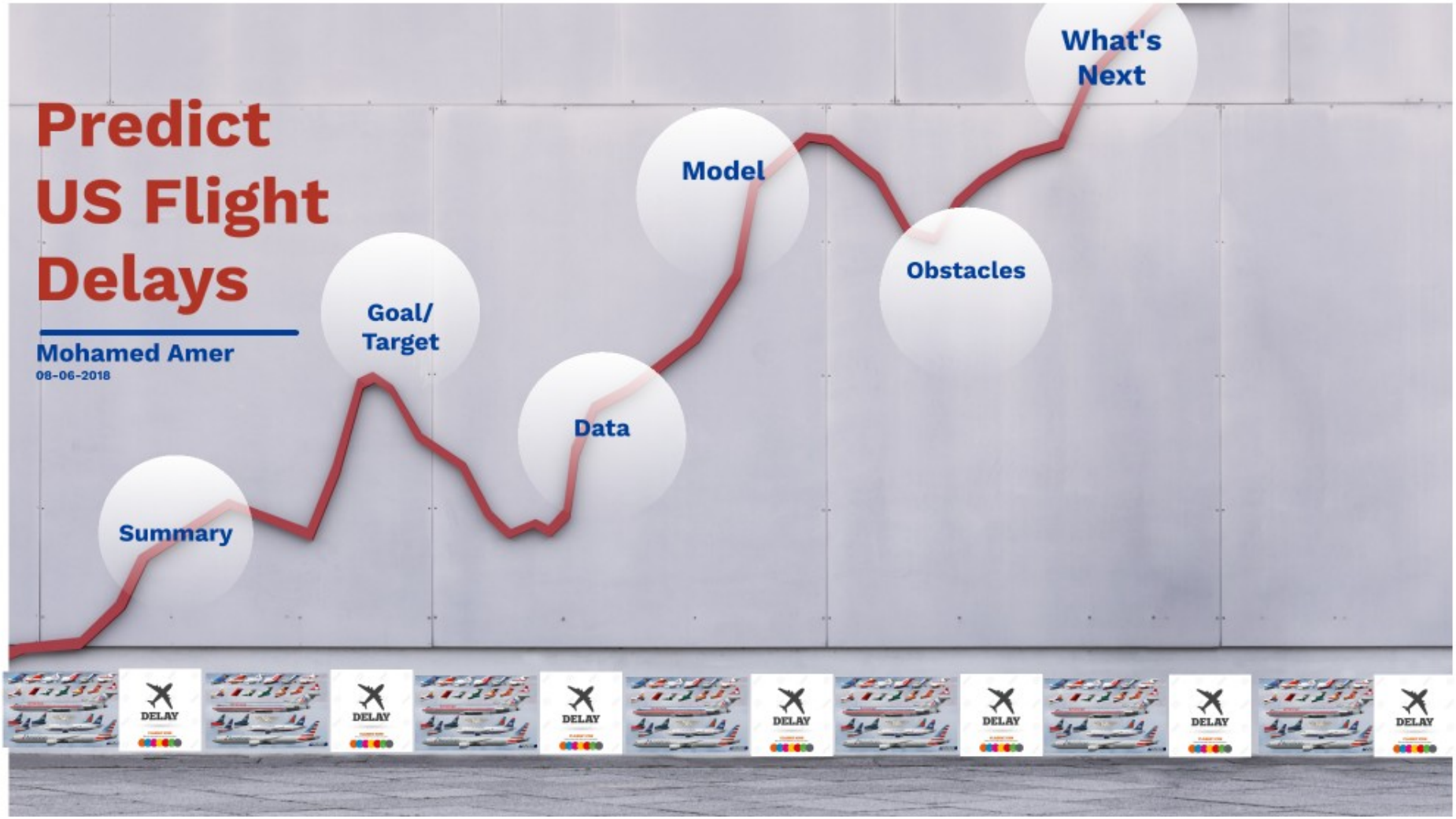
- Departure delay (Sum of All Delays at Departure)
- Air System Delay
- Security Delay
- Airline Delay
- Late Aircraft Delay
- Weather Delay
- Arrival Delay (Actual Arrival Time- Planned)

Delay Causes at Departure



DSC 335, Fall 2009

56


Predict
US Flight
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Mohamed Amer
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Summary
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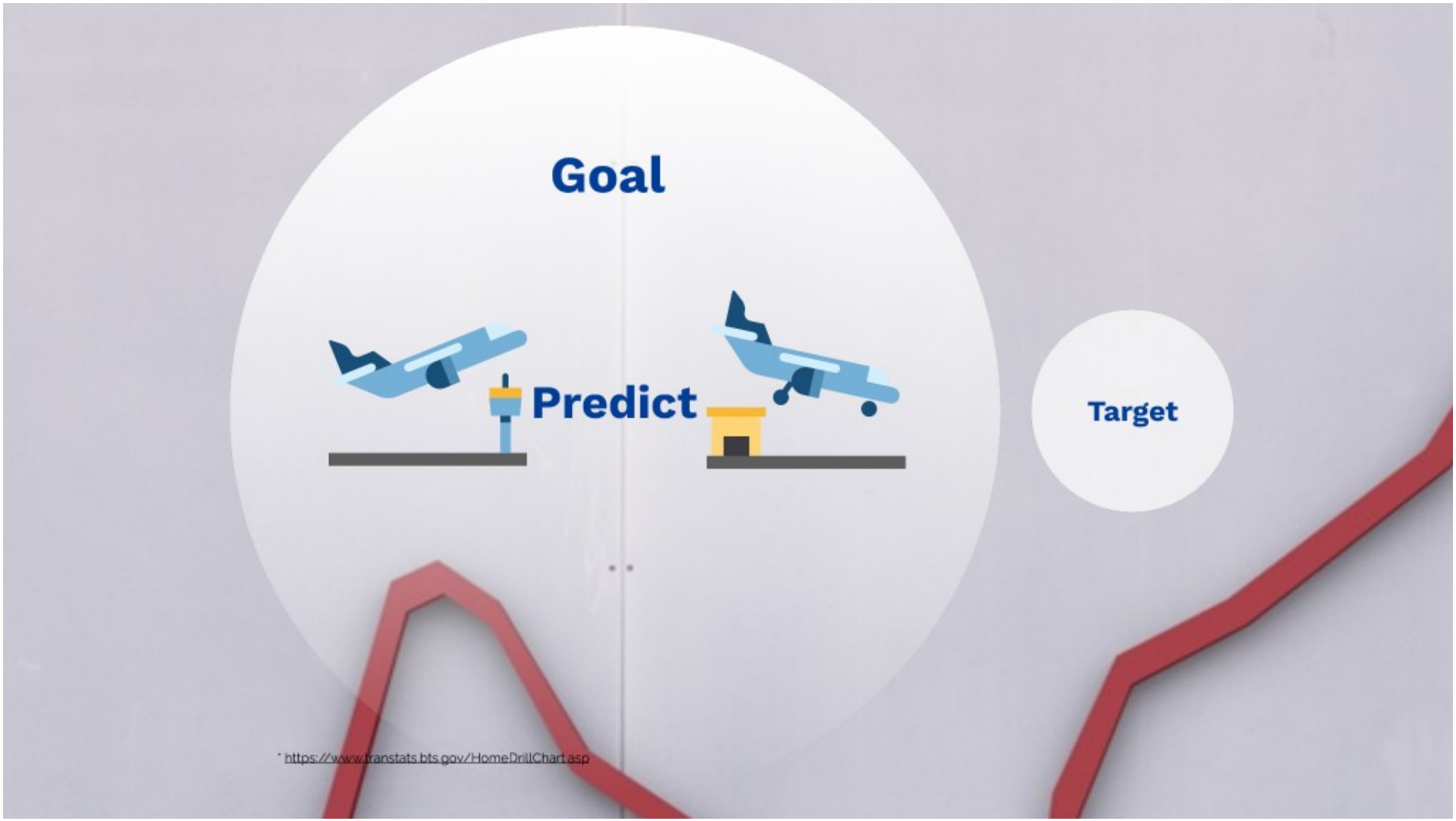
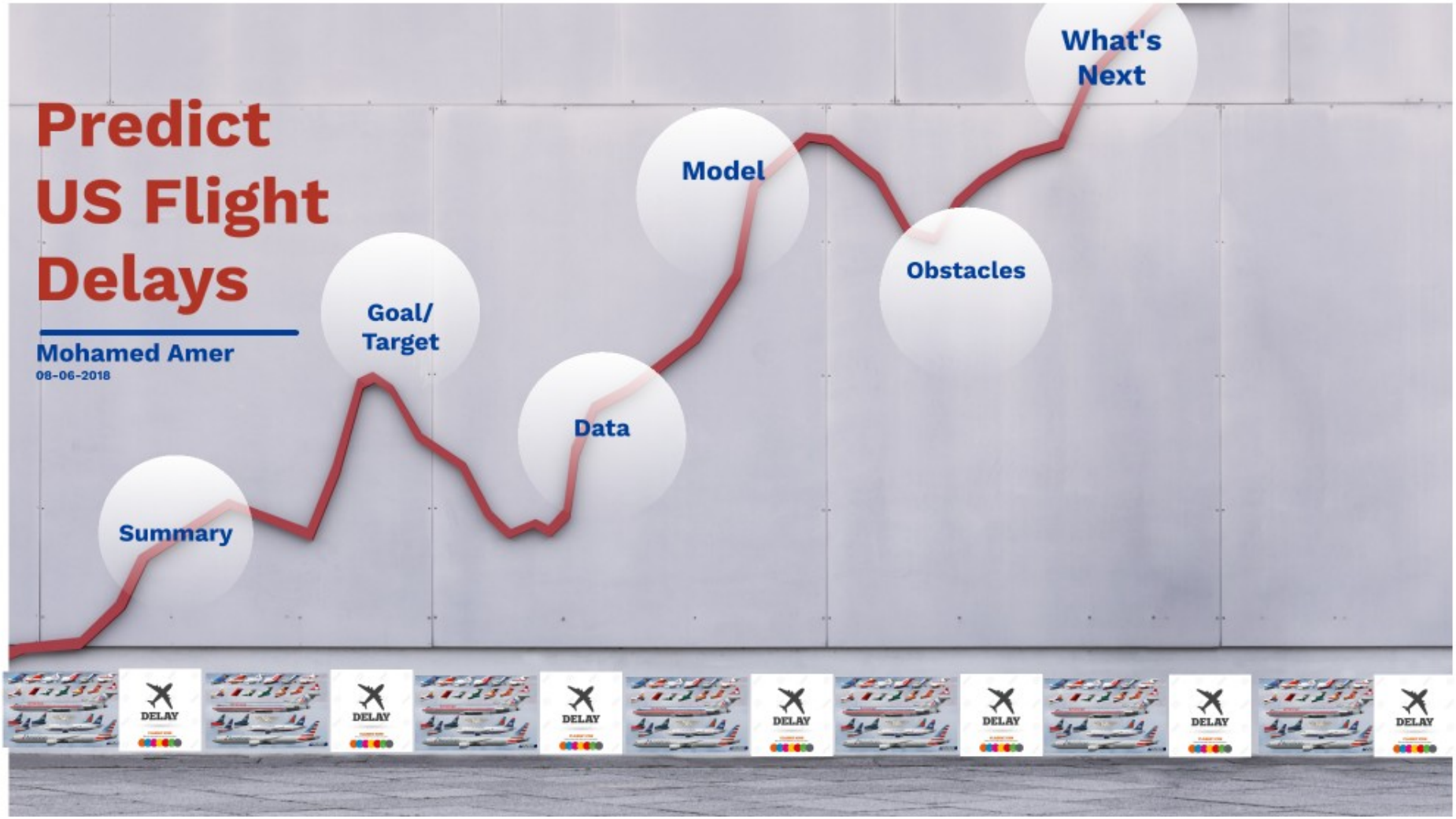
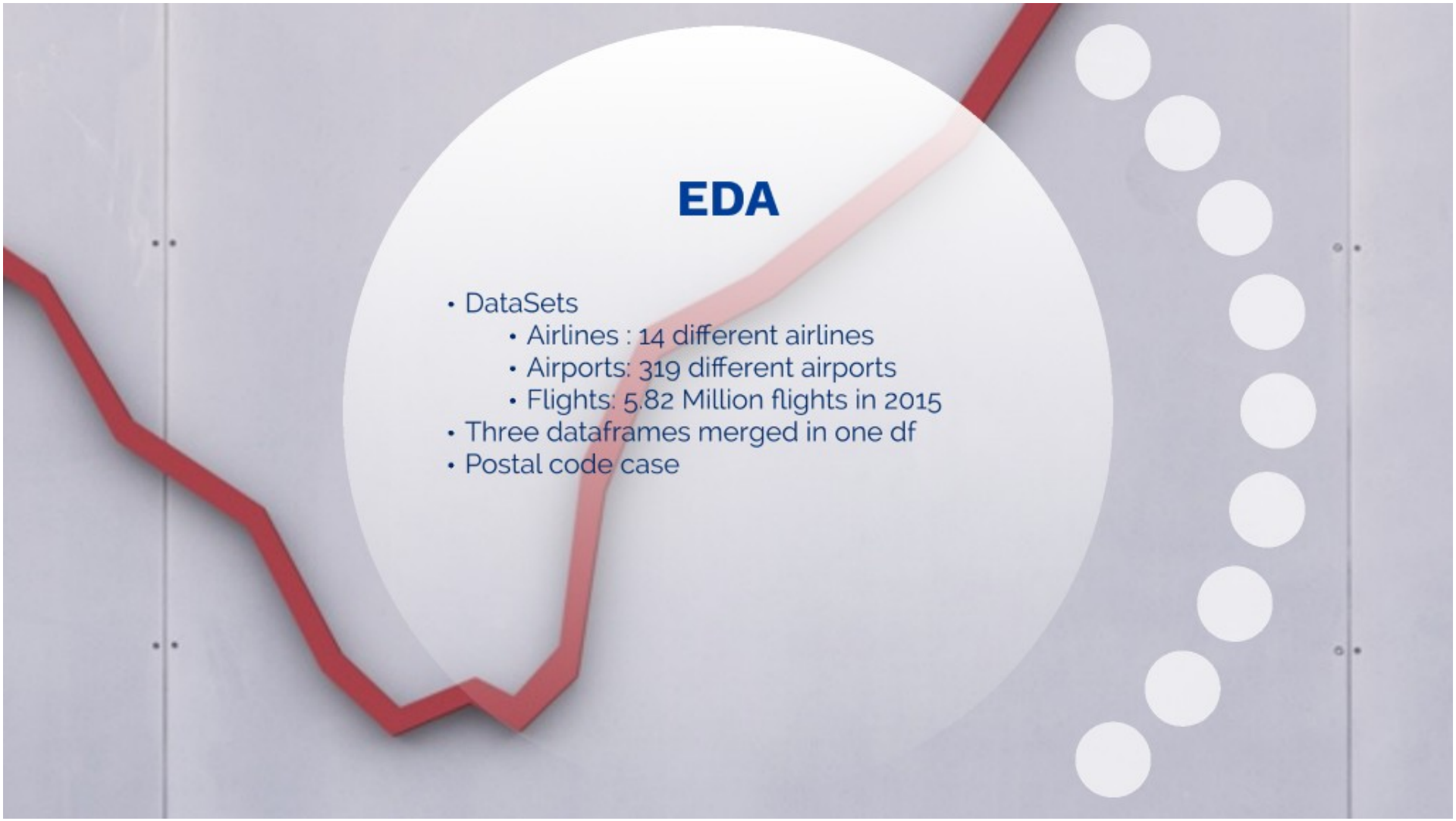
DELAY


Goal
Predict
Target
* https://www.transtats.bts.gov/HomeDrillChart.asp

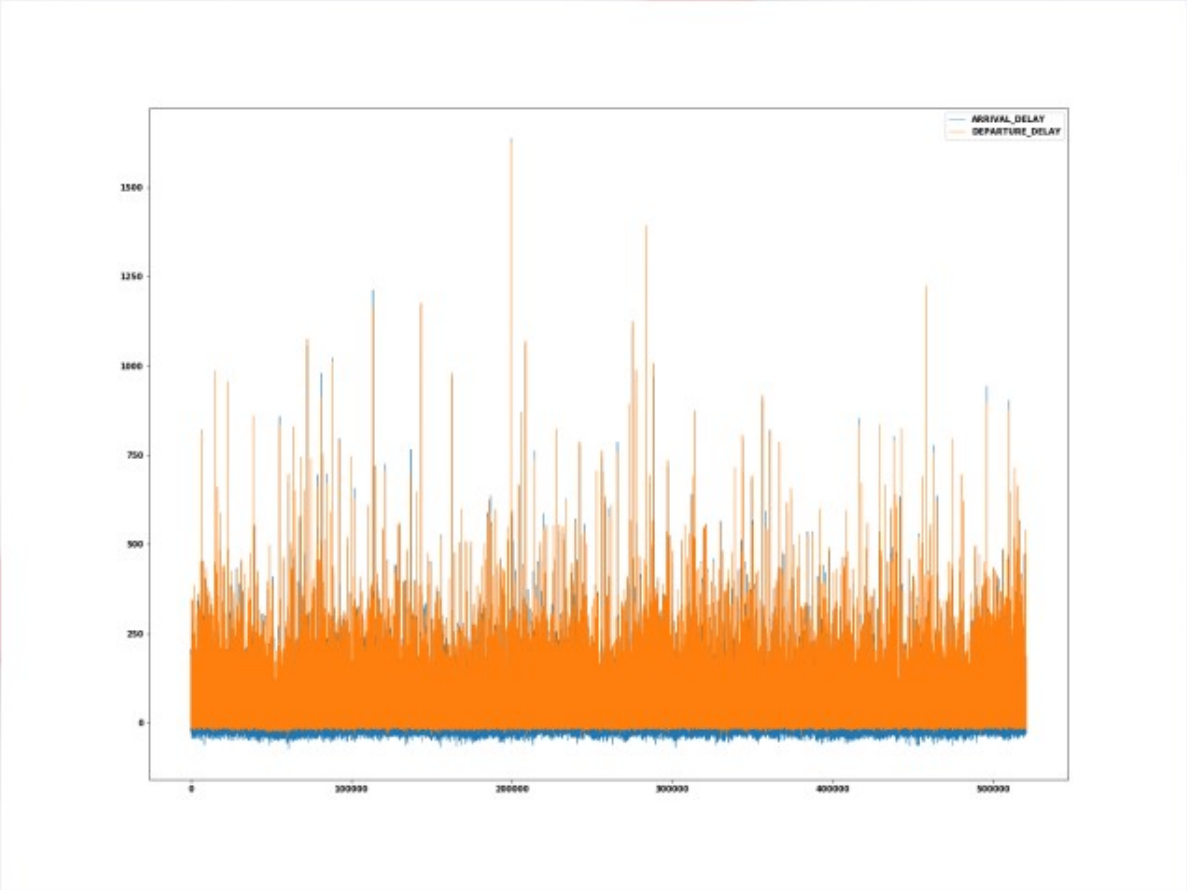
Target

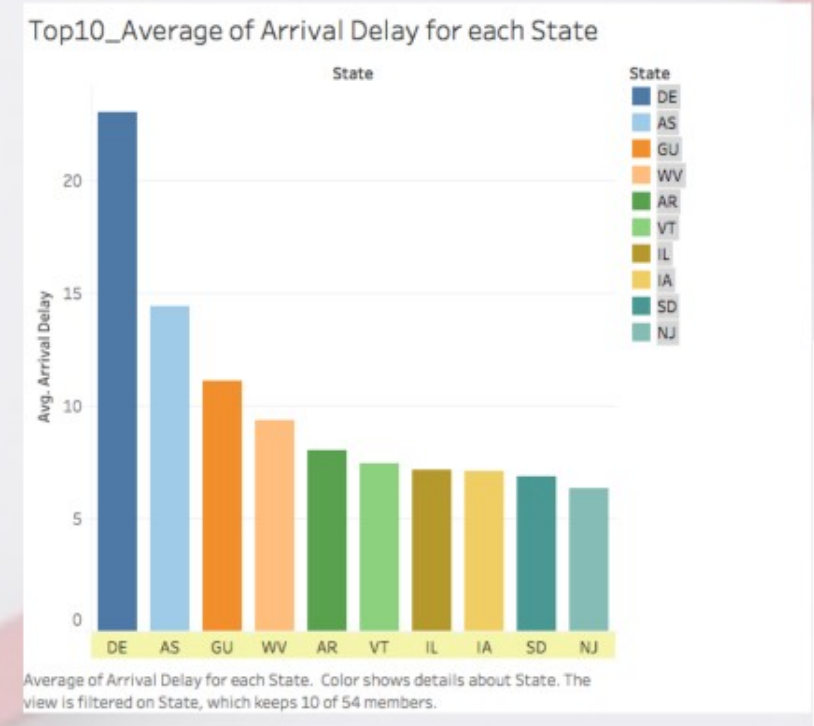

Passenger
• Save Time
• Plan well
Airline
• Cost reduction
• Customer Satisfaction
Airport
• Cost Reduction
• Space Optimization

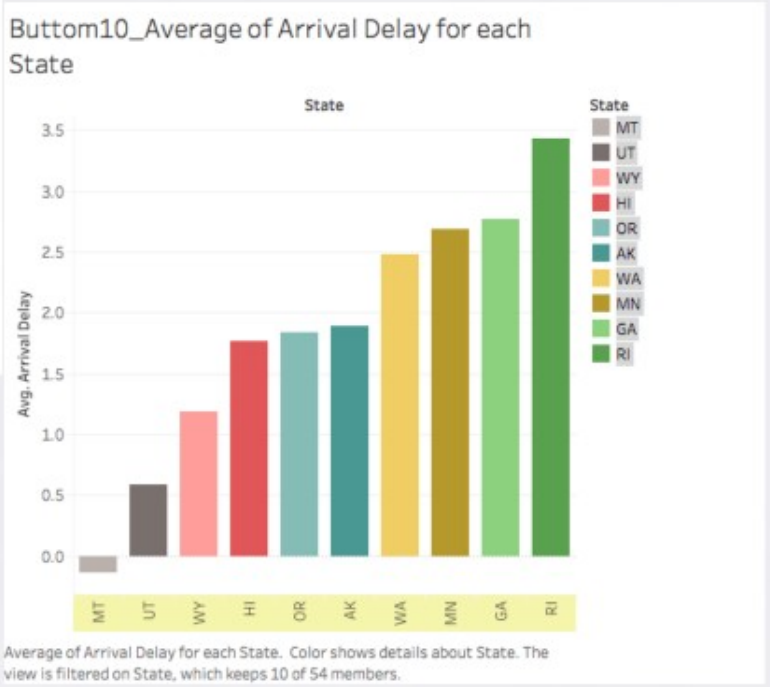

Predict
US Flight
Delays
Mohamed Amer
08-06-2018
Summary
Goal/
Target
Data
Model
Obstacles
What's
Next
DELAY

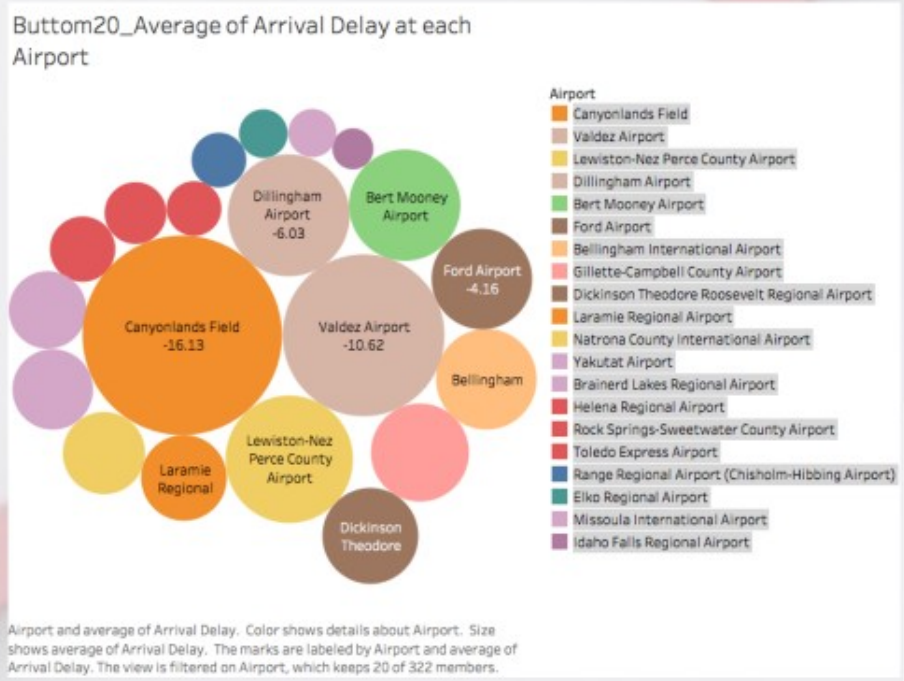

EDA
• DataSets
• Airlines : 14 different airlines
• Airports: 319 different airports
• Flights: 5.82 Million flights in 2015
• Three dataframes merged in one df
• Postal code case

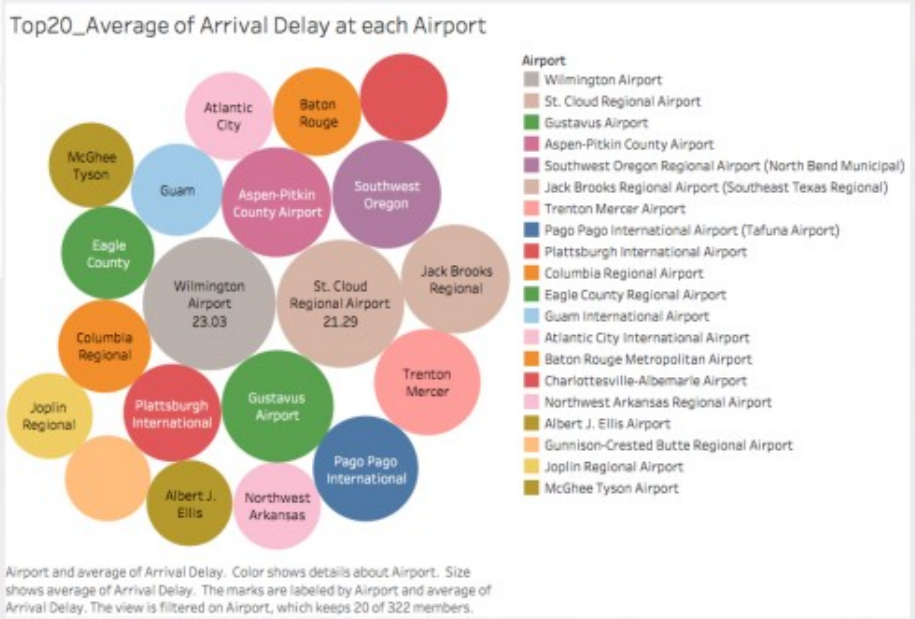
Arrival vs Departure Delay

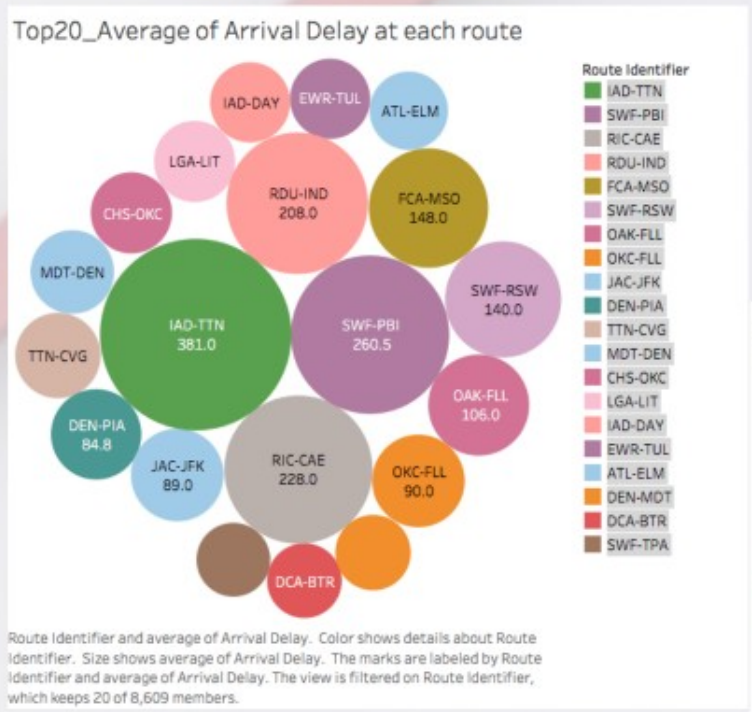


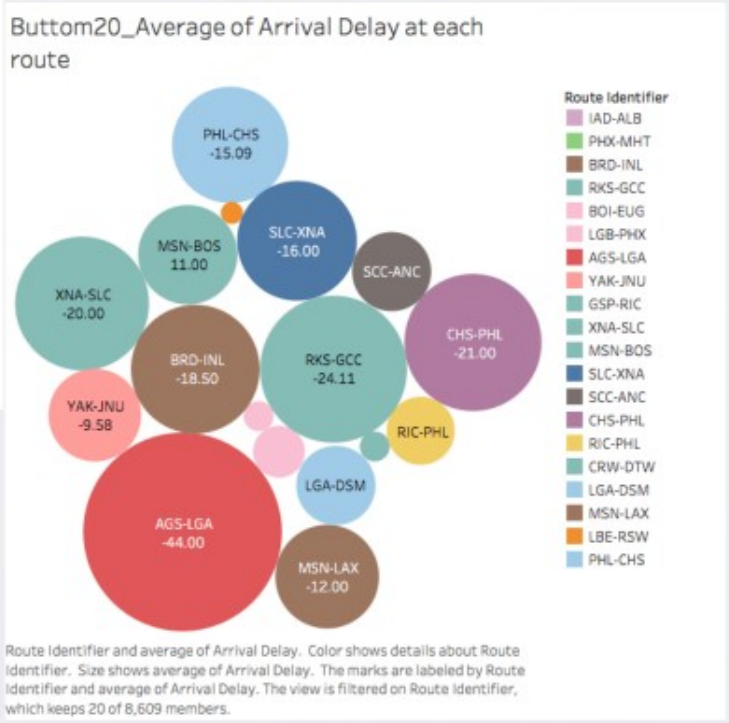

Top10_Average of Arrival Delay for each State
State
Avg. Arrival Delay
0
5
10
15
20
DE
AS
GU
WV
AR
VT
IL
IA
SD
NJ
State
DE
AS
GU
WV
AR
VT
IL
IA
SD
NJ
Average of Arrival Delay for each State. Color shows details about State. The view is filtered on State, which keeps 10 of 54 members.


Buttom10_Average of Arrival Delay for each State
State
Avg. Arrival Delay
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
MT
UT
WY
HI
OR
AK
WA
MN
GA
RI
State
MT
UT
WY
HI
OR
AK
WA
MN
GA
RI
Average of Arrival Delay for each State. Color shows details about State. The view is filtered on State, which keeps 10 of 54 members.

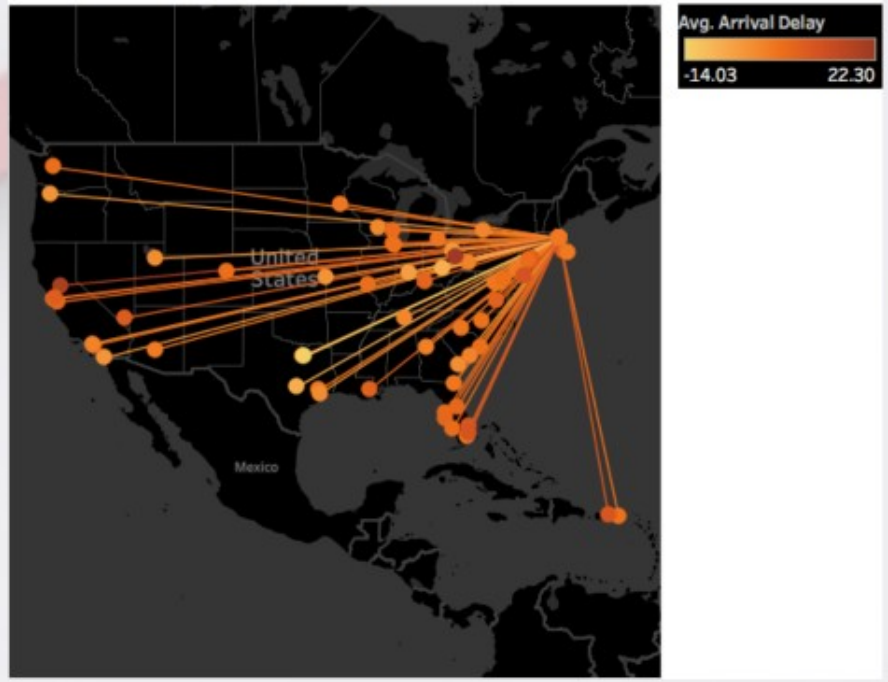

Buttom20_Average of Arrival Delay at each Airport
Dillingham Airport -6.03
Bert Mooney Airport
Ford Airport -4.16
Canyonlands Field -16.13
Valdez Airport -10.62
Bellingham
Lewiston-Nez Perce County Airport
Laramie Regional
Dickinson Theodore
Airport
Canyonlands Field
Valdez Airport
Lewiston-Nez Perce County Airport
Dillingham Airport
Bert Mooney Airport
Ford Airport
Bellingham International Airport
Gillette-Campbell County Airport
Dickinson Theodore Roosevelt Regional Airport
Laramie Regional Airport
Natrona County International Airport
Yakutat Airport
Brainerd Lakes Regional Airport
Helena Regional Airport
Rock Springs-Sweetwater County Airport
Toledo Express Airport
Range Regional Airport (Chisholm-Hibbing Airport)
Elko Regional Airport
Missoula International Airport
Idaho Falls Regional Airport
Airport and average of Arrival Delay. Color shows details about Airport. Size shows average of Arrival Delay. The marks are labeled by Airport and average of Arrival Delay. The view is filtered on Airport, which keeps 20 of 322 members.


Top20_Average of Arrival Delay at each Airport
Atlantic City
Baton Rouge
McGhee Tyson
Guam
Aspen-Pitkin County Airport
Southwest Oregon
Eagle County
Wilmington Airport 23.03
St. Cloud Regional Airport 21.29
Jack Brooks Regional
Columbia Regional
Trenton Mercer
Joplin Regional
Plattsburgh International
Gustavus Airport
Pago Pago International
Albert J. Ellis
Northwest Arkansas
Airport
Wilmington Airport
St. Cloud Regional Airport
Gustavus Airport
Aspen-Pitkin County Airport
Southwest Oregon Regional Airport (North Bend Municipal)
Jack Brooks Regional Airport (Southeast Texas Regional)
Trenton Mercer Airport
Pago Pago International Airport (Tafuna Airport)
Plattsburgh International Airport
Columbia Regional Airport
Eagle County Regional Airport
Guam International Airport
Atlantic City International Airport
Baton Rouge Metropolitan Airport
Charlottesville-Albemarle Airport
Northwest Arkansas Regional Airport
Albert J. Ellis Airport
Gunnison-Crested Butte Regional Airport
Joplin Regional Airport
McGhee Tyson Airport
Airport and average of Arrival Delay. Color shows details about Airport. Size shows average of Arrival Delay. The marks are labeled by Airport and average of Arrival Delay. The view is filtered on Airport, which keeps 20 of 322 members.

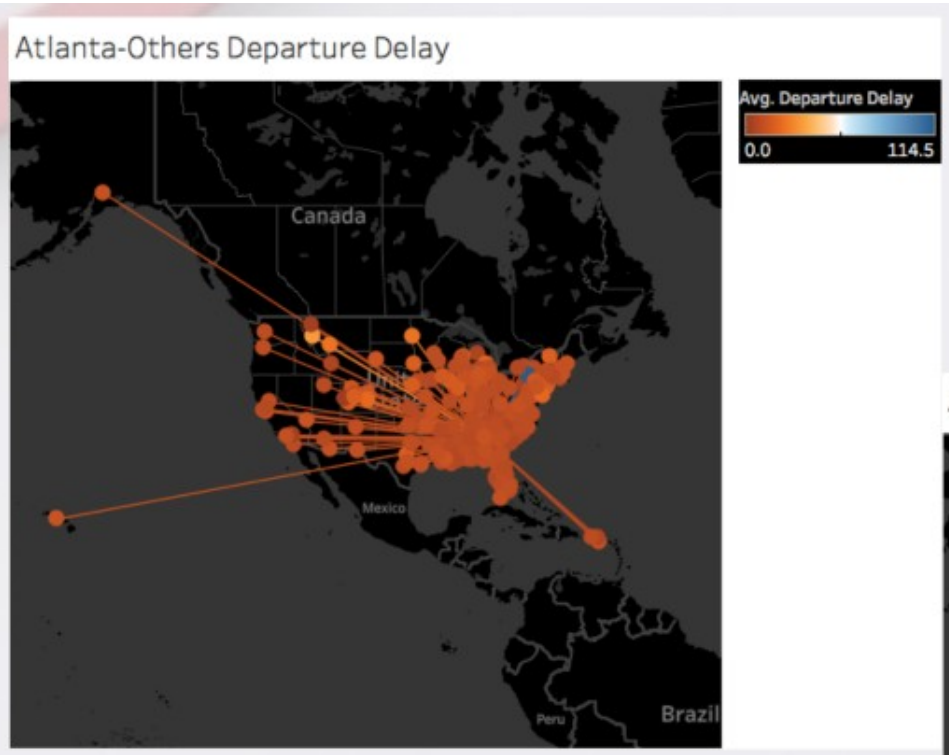

Top20_Average of Arrival Delay at each route
IAD-DAY
EWR-TUL
ATL-ELM
LGA-LIT
RDU-IND
208.0
FCA-MSO
148.0
CHS-OKC
MDT-DEN
IAD-TTN
381.0
SWF-PBI
260.5
SWF-RSW
140.0
TTN-CVG
OAK-FLL
106.0
DEN-PIA
84.8
JAC-JFK
89.0
RIC-CAE
228.0
OKC-FLL
90.0
DCA-BTR
Route Identifier
IAD-TTN
SWF-PBI
RIC-CAE
RDU-IND
FCA-MSO
SWF-RSW
OAK-FLL
OKC-FLL
JAC-JFK
DEN-PIA
TTN-CVG
MDT-DEN
CHS-OKC
LGA-LIT
IAD-DAY
EWR-TUL
ATL-ELM
DEN-MDT
DCA-BTR
SWF-TPA
Route Identifier and average of Arrival Delay. Color shows details about Route Identifier. Size shows average of Arrival Delay. The marks are labeled by Route Identifier and average of Arrival Delay. The view is filtered on Route Identifier, which keeps 20 of 8,609 members.

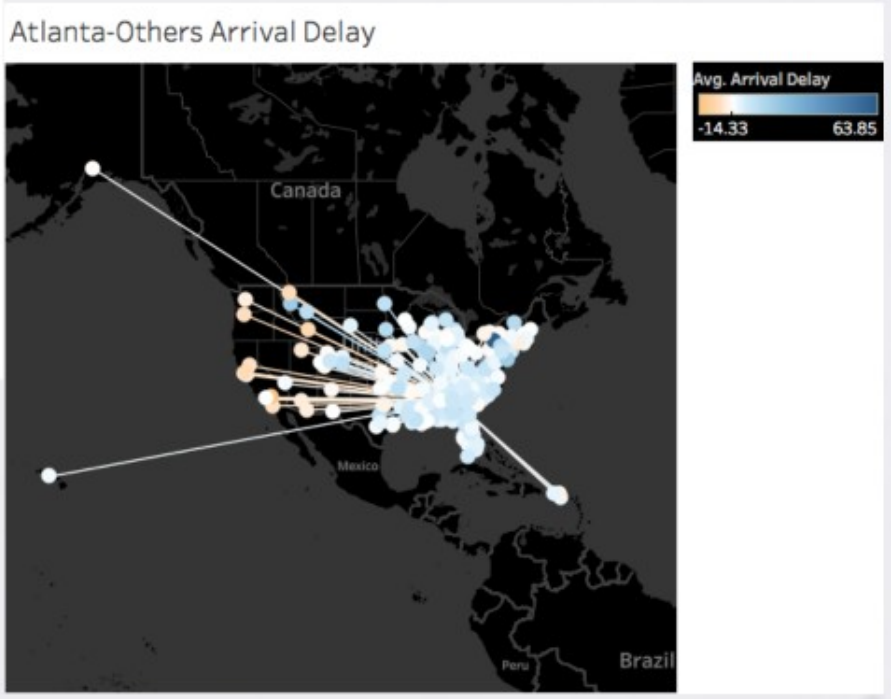

Buttom20_Average of Arrival Delay at each route
PHL-CHS
-15.09
SLC-XNA
-16.00
MSN-BOS
11.00
SCC-ANC
XNA-SLC
-20.00
CHS-PHL
-21.00
BRD-INL
-18.50
RKS-GCC
-24.11
YAK-JNU
-9.58
RIC-PHL
LGA-DSM
AGS-LGA
-44.00
MSN-LAX
-12.00
Route Identifier
IAD-ALB
PHX-MHT
BRD-INL
RKS-GCC
BOI-EUG
LGB-PHX
AGS-LGA
YAK-JNU
GSP-RIC
XNA-SLC
MSN-BOS
SLC-XNA
SCC-ANC
CHS-PHL
RIC-PHL
CRW-DTW
LGA-DSM
MSN-LAX
LBE-RSW
PHL-CHS
Route Identifier and average of Arrival Delay. Color shows details about Route Identifier. Size shows average of Arrival Delay. The marks are labeled by Route Identifier and average of Arrival Delay. The view is filtered on Route Identifier, which keeps 20 of 8,609 members.

Boston-Others Arrival Delay



Boston-Others Departure Delay


Atlanta-Others Departure Delay
Avg. Departure Delay
0.0
114.5
Canada
Mexico
Peru
Brazil

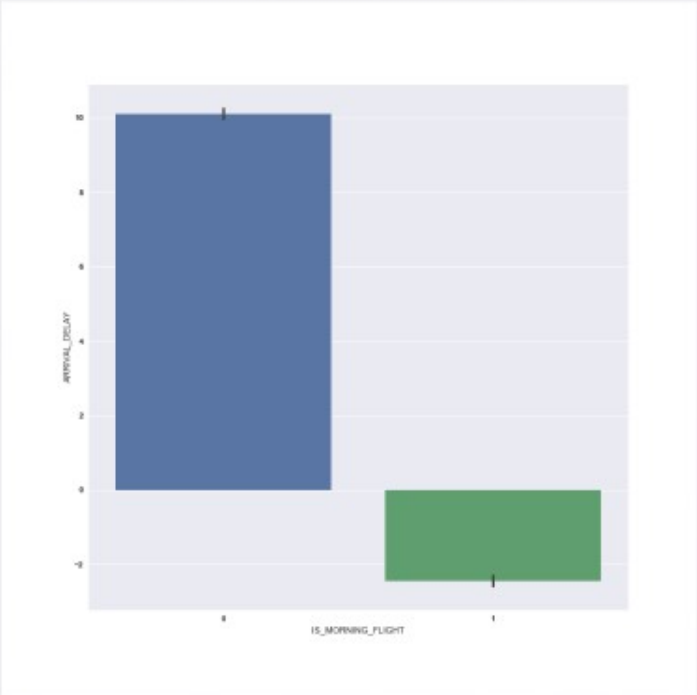

Atlanta-Others Arrival Delay
Avg. Arrival Delay
-14.33
63.85
Canada
Mexico
Peru
Brazil

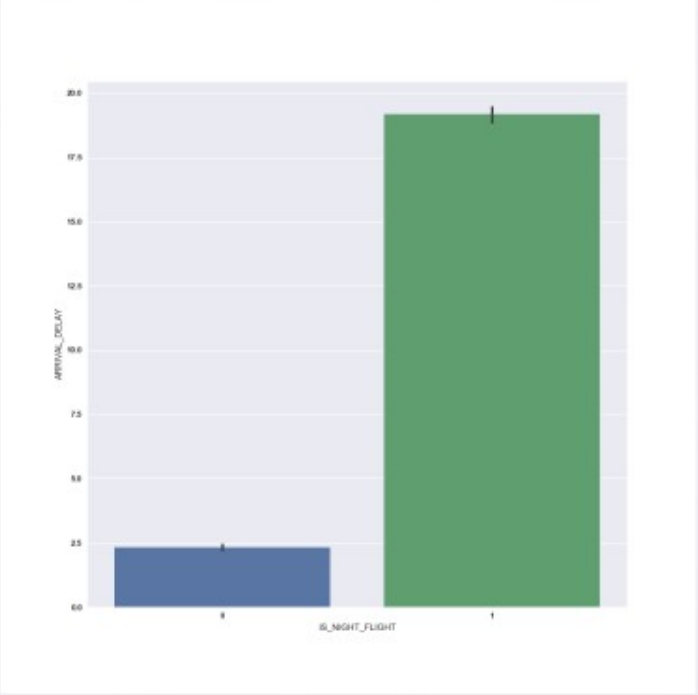

Number of Flights per City - Alaska Airlines
Count of Flight Number
52
100,003
1,326
3,752
1,324
920
4,407
192
25,731
1,174
669
792
694
668
668
668
Canada


Number of Flights per City - American Airline
Count of Flight Number
19
268,550
544
5,446
2,718
7,588
2,902
9,407
Canada


Number of Flights per City - Delta Airlines
Count of Flight Number
8
443,378
464
4,032
279
10,862
1,399
5,990
6,070
Canada

Arrival Delay Moring vs Night



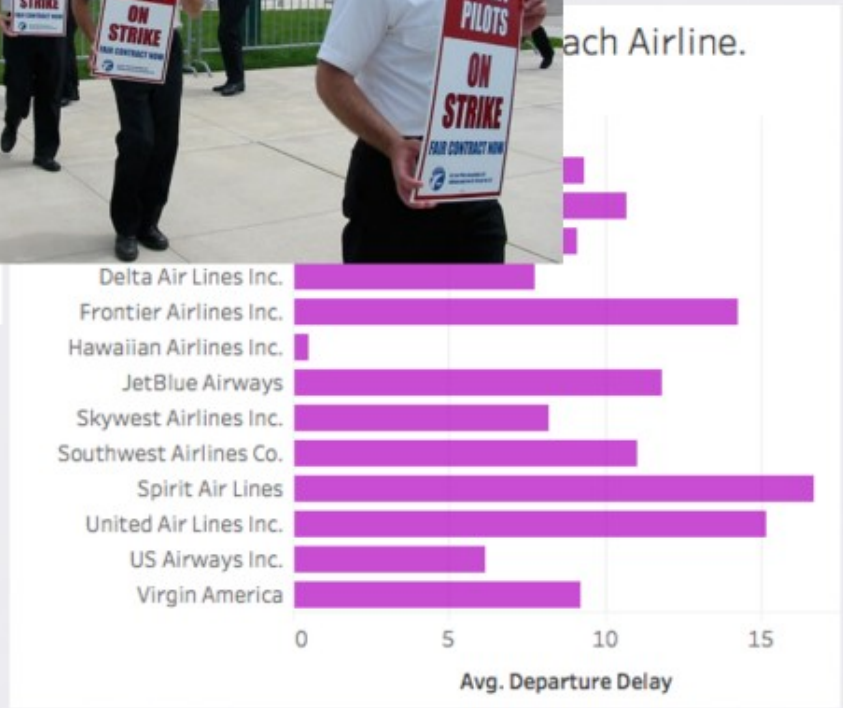



Average of Arrival Delay for each Airline
Airline Name
Alaska Airlines Inc.
American Airlines Inc.
American Eagle Airlines In..
Atlantic Southeast Airlines
Delta Air Lines Inc.
Frontier Airlines Inc.
Hawaiian Airlines Inc.
JetBlue Airways
Skywest Airlines Inc.
Southwest Airlines Co.
Spirit Air Lines
United Air Lines Inc.
US Airways Inc.
Virgin America
0
5
10
15
Avg. Arrival Delay
Airline
AA
AS
B6
DL
EV
F9
HA
MQ
NK
OO
UA
US
VX
WN


Average of Departure Delay for each Airline.
Airline Name
Alaska Airlines Inc.
American Airlines Inc.
American Eagle Airlines In..
Atlantic Southeast Airlines
Delta Air Lines Inc.
Frontier Airlines Inc.
Hawaiian Airlines Inc.
JetBlue Airways
Skywest Airlines Inc.
Southwest Airlines Co.
Spirit Air Lines
United Air Lines Inc.
US Airways Inc.
Virgin America
0
5
10
15
Avg. Departure Delay


Average of Arrival Delay for each Airline
Airline Name
Alaska Airlines Inc.
American Airlines Inc.
American Eagle Airlines In..
Atlantic Southeast Airlines
Delta Air Lines Inc.
Frontier Airlines Inc.
Hawaiian Airlines Inc.
JetBlue Airways
Skywest Airlines Inc.
Southwest Airlines Co.
Spirit Air Lines
United Air Lines Inc.
US Airways Inc.
Virgin America
0
5
10
15
Avg. Arrival Delay
Airline
AA
AS
B6
DL
EV
F9
HA
MQ
NK
OO
UA
US
VX
WN

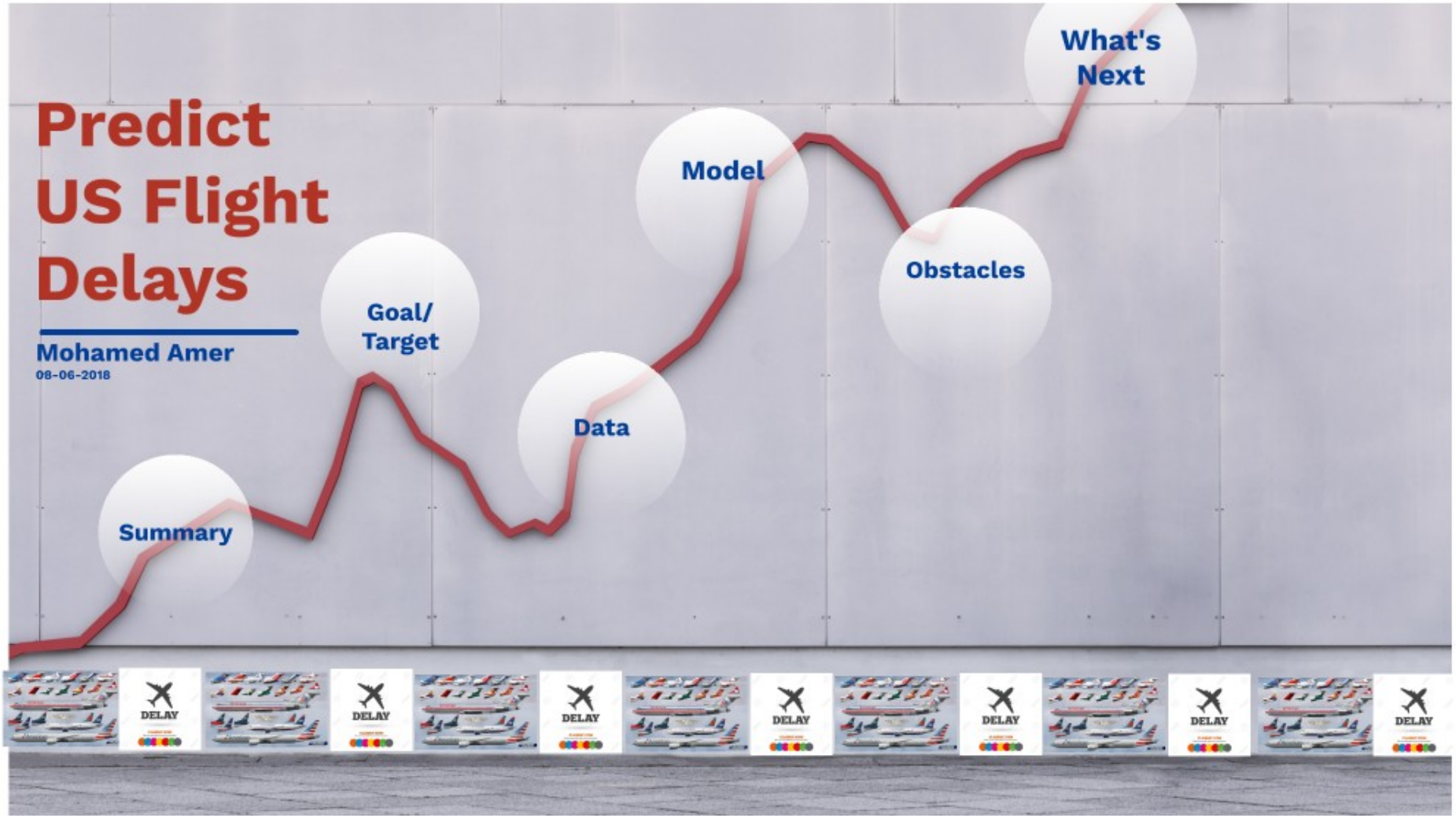

SPIRIT PILOTS
ON STRIKE
FAIR CONTRACT NOW


ach Airline.
Delta Air Lines Inc.
Frontier Airlines Inc.
Hawaiian Airlines Inc.
JetBlue Airways
Skywest Airlines Inc.
Southwest Airlines Co.
Spirit Air Lines
United Air Lines Inc.
US Airways Inc.
Virgin America
0
5
10
15
Avg. Departure Delay


Average of Arrival Delay for each Airline
Airline Name
Alaska Airlines Inc.
American Airlines Inc.
American Eagle Airlines In..
Atlantic Southeast Airlines
Delta Air Lines Inc.
Frontier Airlines Inc.
Hawaiian Airlines Inc.
JetBlue Airways
Skywest Airlines Inc.
Southwest Airlines Co.
Spirit Air Lines
United Air Lines Inc.
US Airways Inc.
Virgin America
0
5
10
15
Avg. Arrival Delay
Airline
AA
AS
B6
DL
EV
F9
HA
MQ
NK
OO
UA
US
VX
WN
SPIRIT PILOTS ON STRIKE
SPIRIT AIRLINES JUNE 12: STRIKE DEADLINE
THE CLOCK IS TICKING CONTRACT OR STRIKE
ach Airline.
Spirit Air Lines
United Air Lines Inc.
US Airways Inc.
Virgin America
0
5
10
15
Avg. Departure Delay


Average of Arrival Delay for each Airline
Airline Name
Alaska Airlines Inc.
American Airlines Inc.
American Eagle Airlines In..
Atlantic Southeast Airlines
Delta Air Lines Inc.
Frontier Airlines Inc.
Hawaiian Airlines Inc.
JetBlue Airways
Skywest Airlines Inc.
Southwest Airlines Co.
Spirit Air Lines
United Air Lines Inc.
US Airways Inc.
Virgin America
0
5
Airline
AA
AS
B6
DL
EV
F9
SPIRIT PILOTS
ON STRIKE
SPIRIT PILOTS
WHAT'S YOUR PILOT WORTH?
THE CLOCK IS TICKING
CONTRACT OR STRIKE
ach Airline.
Spirit Air Lines
United Air Lines Inc.
US Airways Inc.
Virgin America
0
5
10
15
Avg. Departure Delay


Average of Arrival Delay for each Airline
Airline Name
Alaska Airlines Inc.
American Airlines Inc.
American Eagle Airlines In..
Atlantic Southeast Airlines
Delta Air Lines Inc.
Frontier Airlines Inc.
Hawaiian Airlines Inc.
JetBlue Airways
Skywest Airlines Inc.
Southwest Airlines Co.
Spirit Air Lines
United Air Lines Inc.
US Airways Inc.
Virgin America
0
5
Airline
AA
AS
my airline sucks... a lot!
spirit
SPIRIT PILOTS
THE CLOCK IS TICKING
CONTRACT OR STRIKE
ach Airline.
Spirit Air Lines
United Air Lines Inc.
US Airways Inc.
Virgin America
0
5
10
15
Avg. Departure Delay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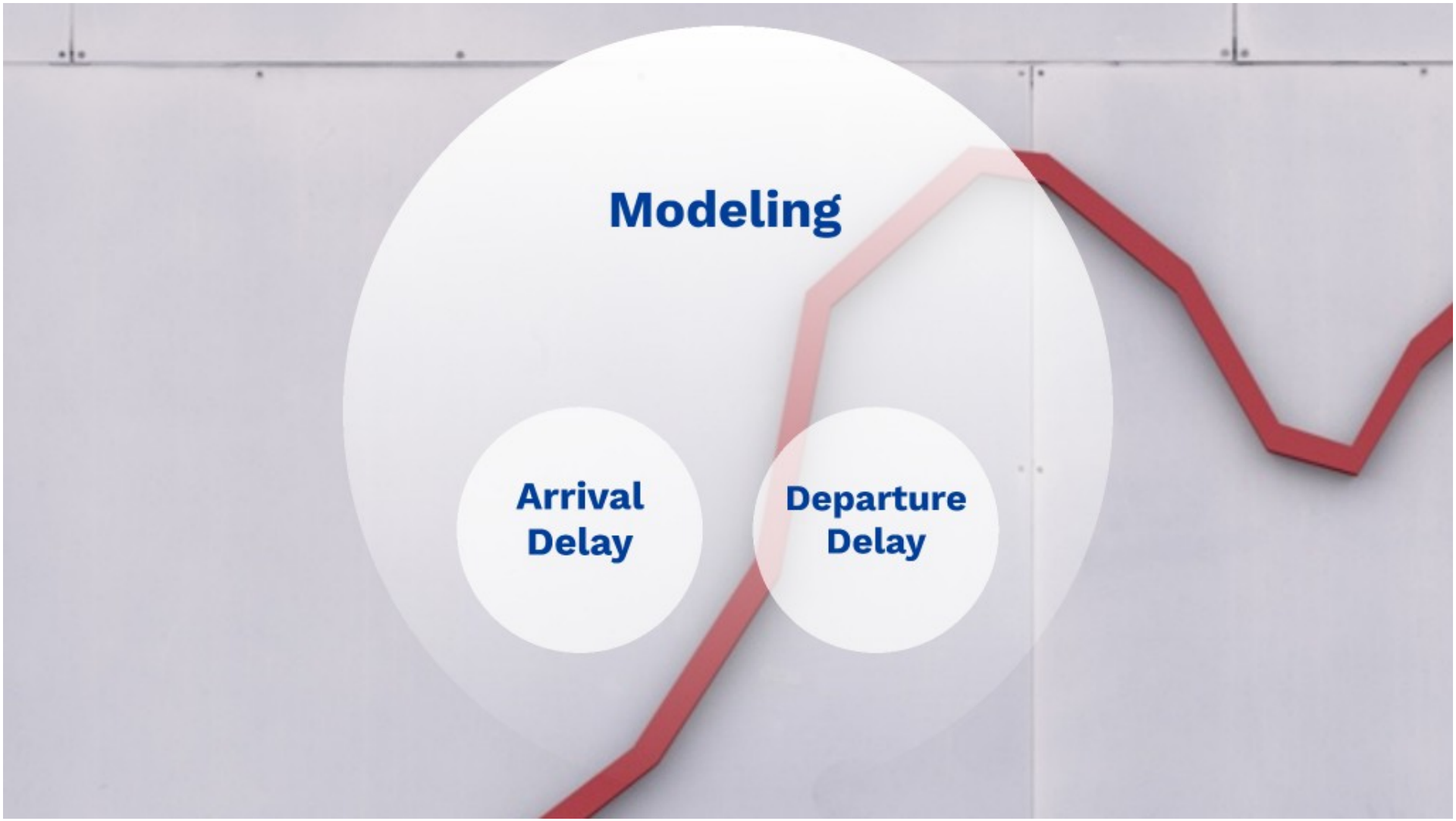

Modeling
Arrival Delay
Departure Delay

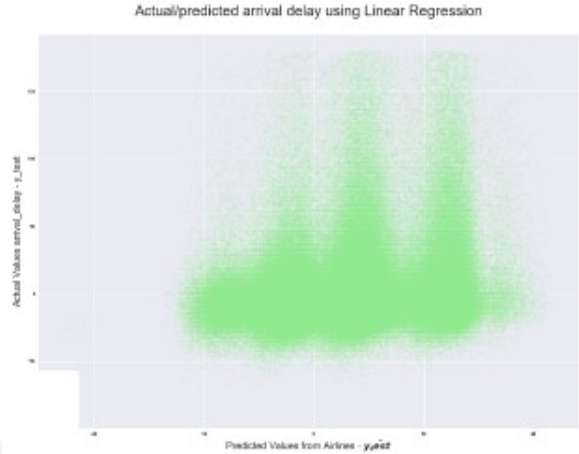
Predicting Delay in Minuets

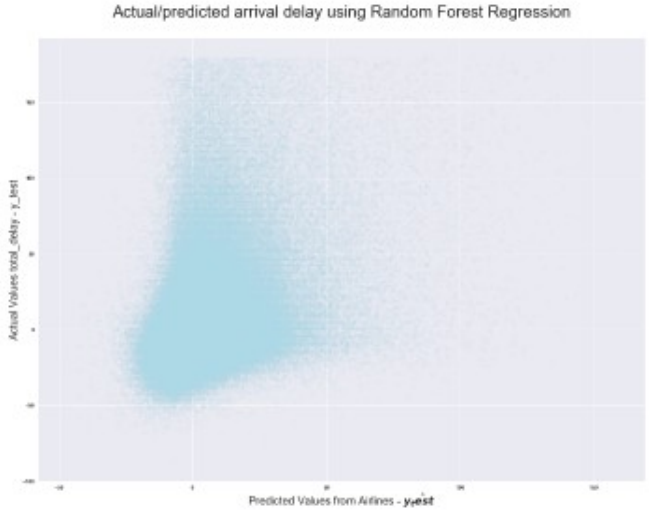
Baseline: ~3
ML used :

- Linear, RF, ADA Boost, KNN
- w/o (pipeline)

Best results

Random Forest (score of 0.14)





Predicting Significant Delay

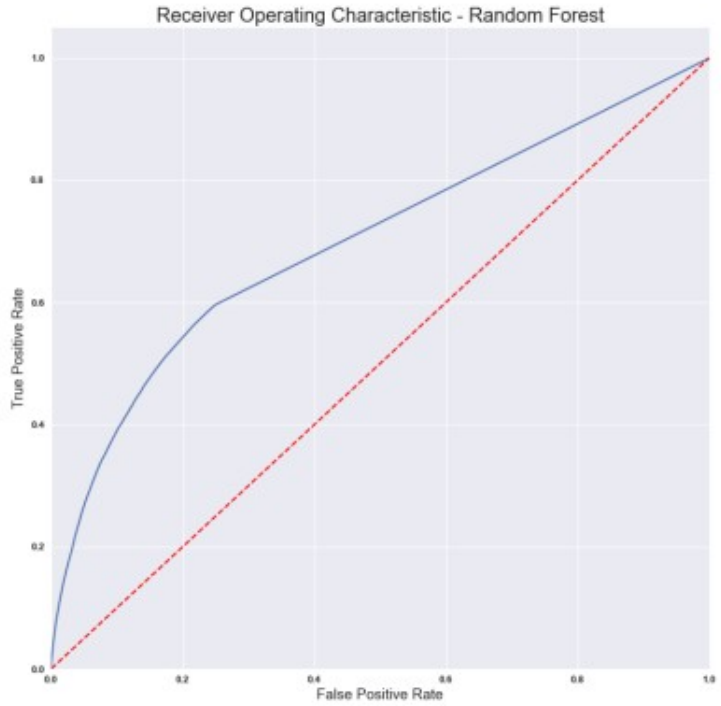
Criteria : >60min significantly delayed
ML used :

- Logistic, RF, ADA Boost
- w/o (pipeline)

Best results

Random Forest

	precision	recall	f1-score	support
0	0.95	0.97	0.96	542417
1	0.27	0.16	0.20	30198
avg / total	0.92	0.93	0.92	572615



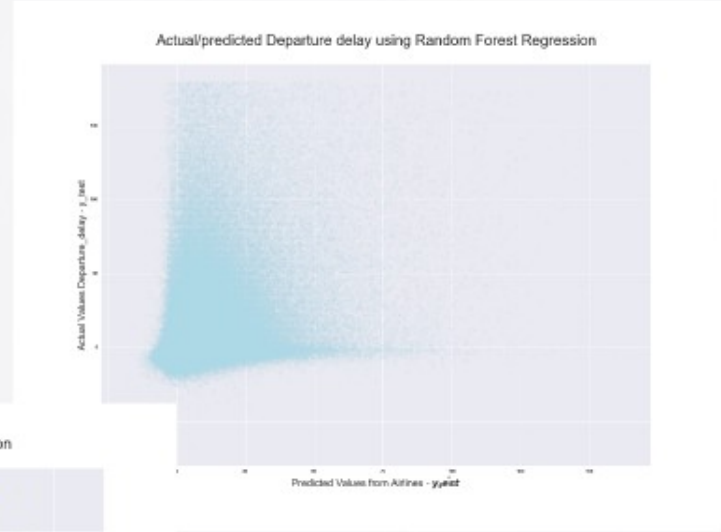
Predicting Delay in Minuets

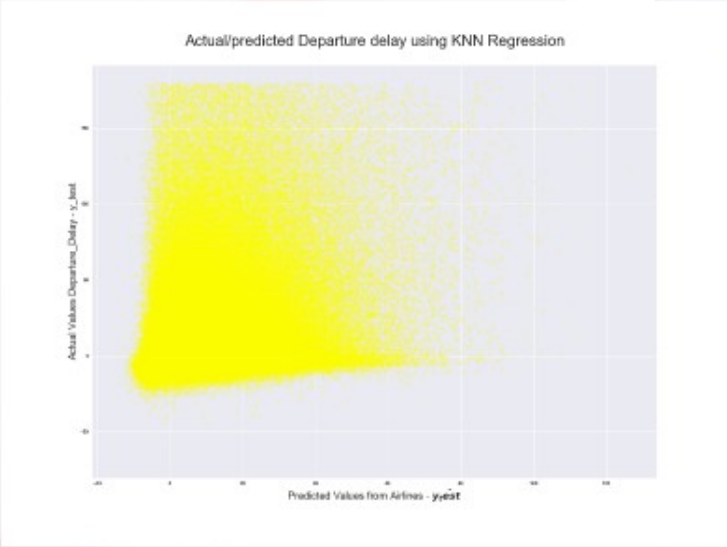
Baseline: ~7.8
ML used :

- Linear, RF, ADA Boost, KNN
- w/o (pipeline)

Best results

Random Forest (score of 0.13)





Predicting Significant Delay

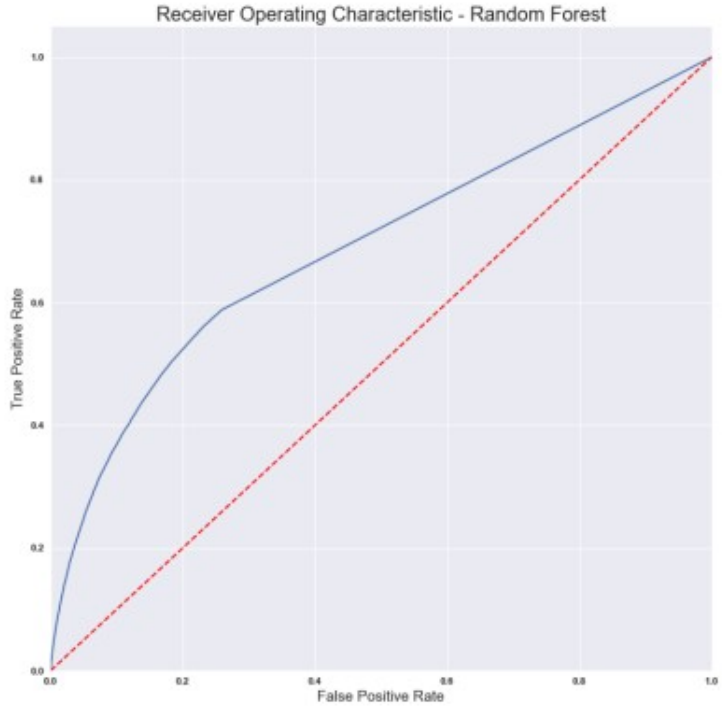
Criteria : >60min significantly delayed
ML used :

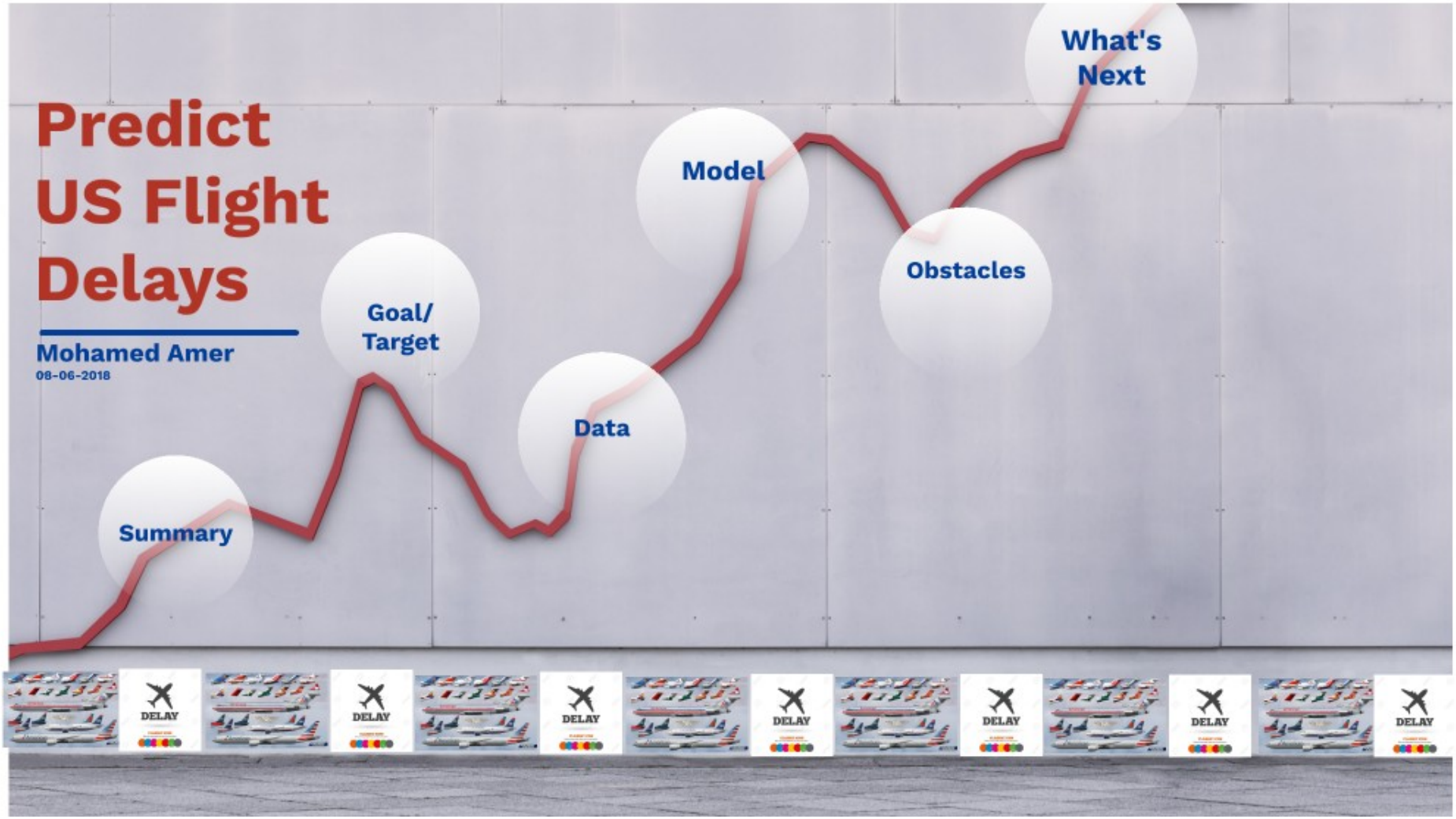
- Logistic, RF, ADA Boost
- w/o (pipeline)

Best results

Random Forest

	precision	recall	f1-score	support
0	0.95	0.97	0.96	542040
1	0.26	0.16	0.20	30509
avg / total	0.92	0.93	0.92	572549




Predict
US Flight
Delays
Mohamed Amer
08-06-2018
Summary
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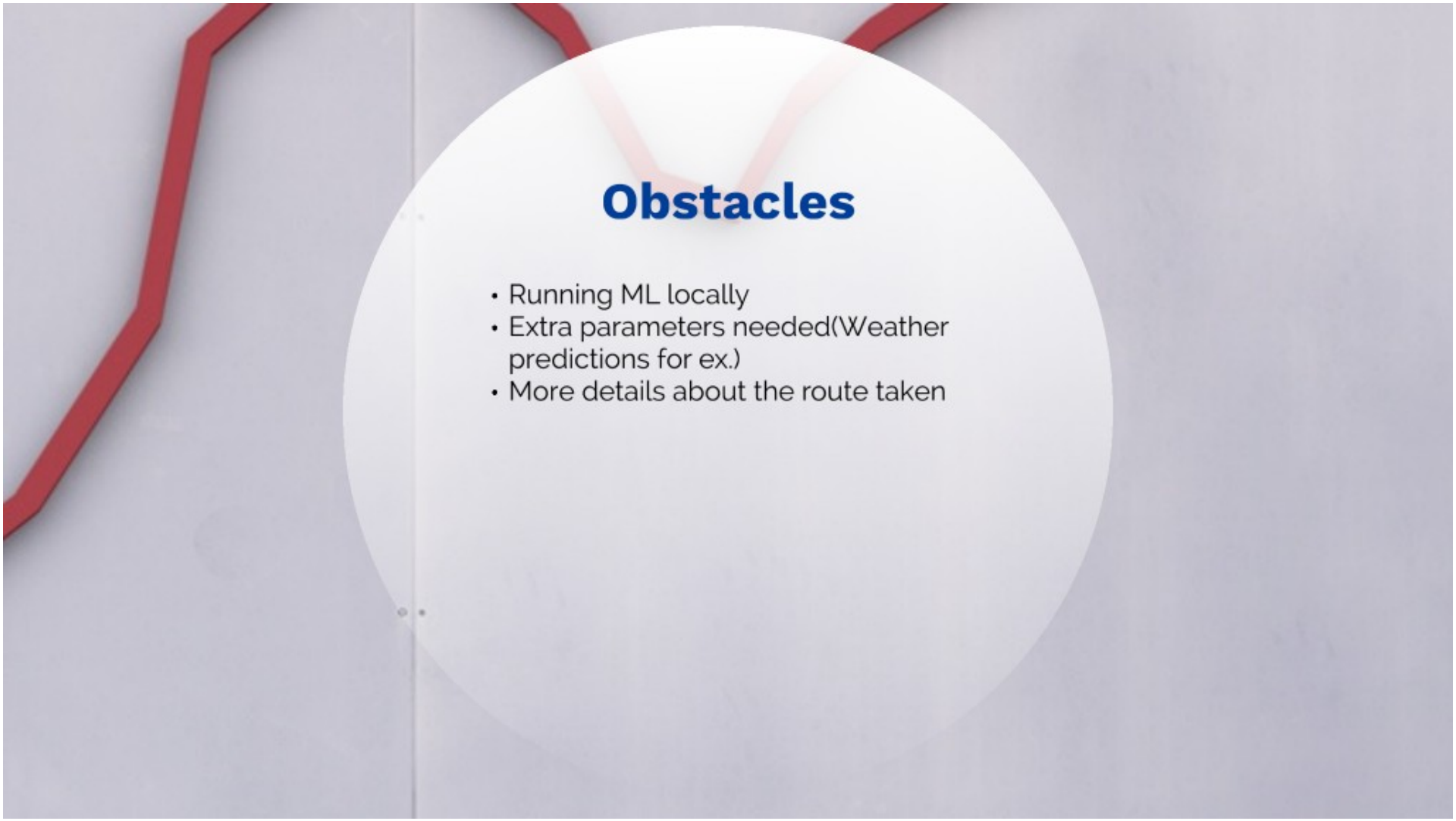
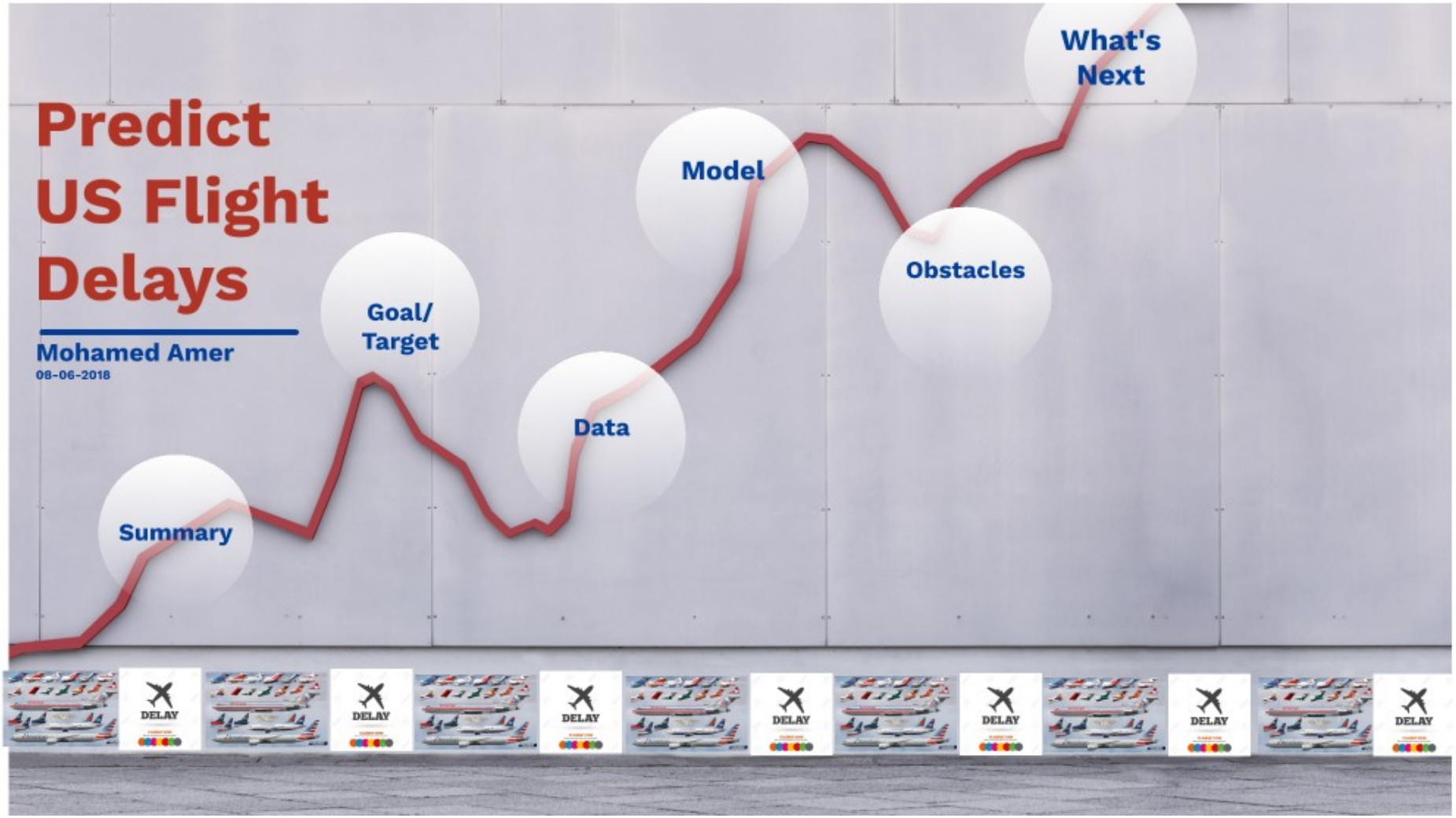
Target
Data
Model
Obstacles
What's
Next
DELAY


Obstacles
• Running ML locally
• Extra parameters needed(Weather predictions for ex.)
• More details about the route taken


Predict
US Flight
Delays
Mohamed Amer
08-06-2018
Summary
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Data
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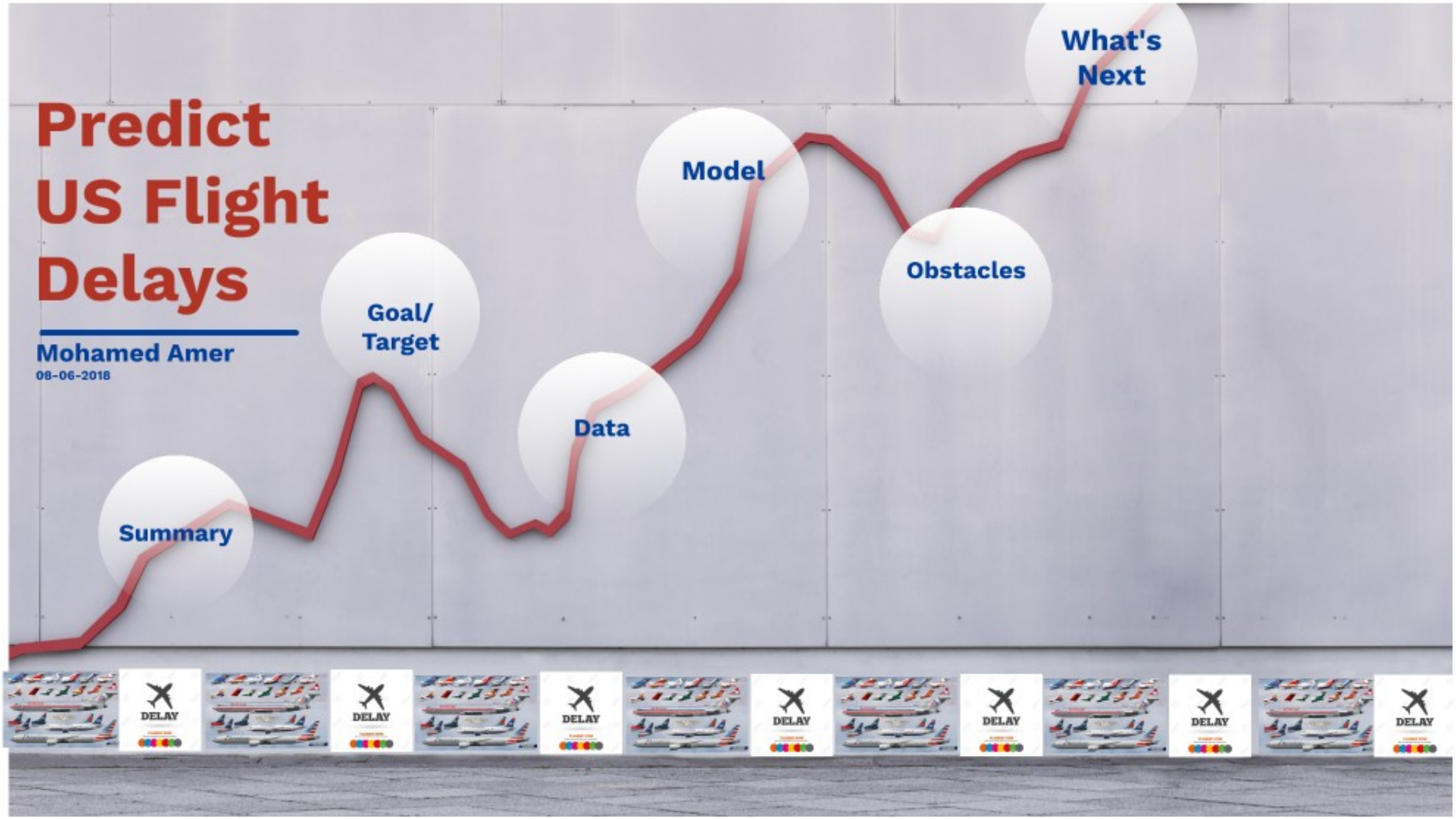
Obstacles
What's
Next
DELAY


Next Steps
• Flask
• Include Weather forecast
• Check for October Data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