**Conclusion**

Our project is to find out the factors that will affect the length of departure delay time of flights and try to build a model that can explain its variation as much as possible so that people can have a general idea of impactful factors on flight departure delay time and schedule their trips accordingly.

We pick two airports in two cities with significantly different weather conditions, DFW from Dallas and MSP from twin cities, develop separate models on both two airports and try to compare factors affecting delays in each of the locations.

Weather Factor:

Minimum sea level pressure is an important factor positively affecting departure delay time for DFW but not for MSP. One possible reason may be DFW is in the south and closer to the sea, thus more influenced by the sea level pressure. Precipitation is the second important weather factor that will positively affects departure delay for DWF but the most important one for MSP. Factors like humidity, visibility, wind speed, gust speed and cloud cover all contribute marginally to departure delay time for both cities, but they are not important factors that we should consider when making trip decisions in terms of delays.

Distance:

For both airports, the longer the flight is, the longer the delay time is at departure. This implies that international flight, such as from Asia to America, may have a longer departure time than domestic flight if all others are the same. However, the distance factor will only slightly affect departure delay time, so it is not a big concern.

Weather Event:

We all know that if there is rain, snow, fog or thunderstorm on a particular day, the flight will definitely delay for a really long time, even a day, to wait for the end of the severe weather condition. However, our project just find that it is not the worst case if you just meet with rain or snow when flying from DFW, because if there are thunderstorm, rain and snow at the same time, the delay time will be much longer than just rain or snow. Likewise, snow will certainly increase the departure delay for MSP but not as much as DFW because snow is common in twin cities, MSP airport is already experienced in dealing with such weather condition. However, if there is fog as well, things will be different. Snow and fog together will make the delay much longer than just snow for MSP.

Major Airlines VS Minor Airlines:

Some airlines are really famous for frequent and long delay. Here we just classify airlines to major airlines and minor airlines and get different results for MSP and DFW. Major airlines seem to be better at handling delays compared to minor airlines for DFW but worse than minor airlines in MSP. This is a really interesting point that is worth further research.

Weekends VS Weekdays:

Another surprising point is that, for MSP, weekends are found to have shorter delay time than weekdays by 5%, which is inconsistent with our common sense, while for DFW, the opposite is true.

Seasonality:

For both cities, in summer months like June and July, delay time is the longest, and in winter months like November, December and January, departure delay time hits the minimum. Though seasonality is a major factor affecting delays for both cities, DFW is more affected by it than MSP.

Time of the day:

For both cities, we can see that in the morning and afternoon, the departure delay is not as severe as the delay in the evening and at night. For MSP, night is the worst.

So, if you plan to take a flight, in order to reduce you waiting time due to delay, you need to consider major factors like weather event, seasonality, takeoff time in a day and so on. If you are going to fly from MSP, try to fly on a weekday in winter and choose a flight taking off in the morning or afternoon from a minor airline when there is no fog, snow, rain or thunderstorm and low precipitation. If you are going to fly from DFW, try to fly on a weekend in winter and pick a flight that takes off in the morning or afternoon from a major airline when there is no rain, snow or thunderstorm and low sea level pressure.

Although each of our two models only captures less than 10% of the total variation of departure delay time for flights taking off from MSP and DFW, far from enough to do prediction, our models certainly give us many interesting insights that can help us schedule our trips wisely. If more predictors like the number of flights taking off at the same time from an airport can be captured in our model, its prediction accuracy will be better.