

Combining Datasets & Data Cleaning

In [1]:	<pre>import numpy as np import pandas as pd</pre>
In [2]:	<pre>pip install holidays</pre> <p>Requirement already satisfied: holidays in c:\users\on3\anaconda3\lib\site-packages (0.13)</p> <p>Requirement already satisfied: pytz&gt;=2.0.0 in c:\users\on3\anaconda3\lib\site-packages (from holidays) (2.8.2)</p> <p>Requirement already satisfied: korean-lunar-calendar in c:\users\on3\anaconda3\lib\site-packages (from holidays) (0.2.1)</p> <p>Requirement already satisfied: coretextdateutil==2.3.0 in c:\users\on3\anaconda3\lib\site-packages (from holidays) (2.4.0)</p> <p>Requirement already satisfied: hijri-converter in c:\users\on3\anaconda3\lib\site-packages (from holidays) (2.2.3)</p> <p>Requirement already satisfied: pymeeus<1.0,=>0.3.13 in c:\users\on3\anaconda3\lib\site-packages (from convertdate==2.3.0-holidays) (0.3.11)</p> <p>Requirement already satisfied: kstz==1.5 in c:\users\on3\anaconda3\lib\site-packages (from python-dateutil>=holidays) (1.16.0)</p> <p>Note: you may need to restart the kernel to use updated packages.</p>
In [3]:	<pre>from datetime import date import holidays</pre>

Bike Share Toronto Data (2018)

2605025		1666	7000	4/1/2018 0:01	Fort York Blvd / Capreol Ct	4/1/2018 0:29	7150	Sylvan Ave (Dufferin Grove Park)	Annual Member
# Bike Share - 2018 Q3 b18_q3.head(1)									
	trip_id	trip_duration_seconds	from_station_id	trip_start_time	from_station_name	trip_stop_time	to_station_id	to_station_name	user_type
0	3244396	528	7254	7/1/2018 0:00	Borden St / Bloor St W - SMART	7/1/2018 0:08	7140	Macpherson Ave / Spadina Rd	Annual Member
# Bike Share - 2018 Q4 b18_q4.head(1)									
	trip_id	trip_duration_seconds	from_station_id	trip_start_time	from_station_name	trip_stop_time	to_station_id	to_station_name	user_type
0	4158592	749	7061	10/1/2018 0:01	Dalton Rd / Bloor St W	10/1/2018 0:14	7042	Sherbourne St / Wellesley St E	Annual Member
# Combine quarterly datasets toronto = [b18_q1, b18_q2, b18_q3, b18_q4] bike_share = pd.concat(toronto).reset_index(drop=True) bike_share.head()									
	trip_id	trip_duration_seconds	from_station_id	trip_start_time	from_station_name	trip_stop_time	to_station_id	to_station_name	user_type
0	2383648	393	7018	1/1/2018 0:47	Bremner Blvd / Rees St	1/1/2018 0:54	7176	Bathurst St / Fort York Blvd	Annual Member
1	2383649	625	7184	1/1/2018 0:52	Ossington Ave / College St	1/1/2018 1:03	7191	Central Tech (Harbord St)	Annual Member
2	2383650	233	7235	1/1/2018 0:55	Bay St / College St (West Side) - SMART	1/1/2018 0:59	7021	Bay St / Albert St	Annual Member
3	2383651	1138	7202	1/1/2018 0:57	Queen St W / York St (City Hall)	1/1/2018 1:16	7020	Phoebe St / Spadina Ave	Annual Member
4	2383652	703	7004	1/1/2018 1:00	University Ave / Elm St	1/1/2018 1:12	7060	Princess St / Adelaide St E	Annual Member
bike_share.tail()									
	trip_id	trip_duration_seconds	from_station_id	trip_start_time	from_station_name	trip_stop_time	to_station_id	to_station_name	user_type
1922950	4581273	379	7088	12/31/2018 23:43	Dorforth Ave / Cowell Ave	12/31/2018 23:49	7091	Dorlands Station	Annual Member
1922951	4581274	306	7030	12/31/2018 23:45	Bay St / Wellesley St W	12/31/2018 23:50	7031	Jarvis St / Isabella St	Annual Member
1922952	4581275	340	7020	12/31/2018 23:49	Phoebe St / Spadina Ave	12/31/2018 23:55	7000	Fort York Blvd / Capreol Ct	Annual Member
1922953	4581276	1466	7014	12/31/2018 23:52	Sherbourne St / Carlton St (Allan Gardens)	1/1/2019 0:17	7269	Toronto Eaton Centre (Yonge St)	Annual Member
1922954	4581277	333	7299	12/31/2018 23:58	Mill St / Parliament St	1/1/2019 0:04	7013	Scott St / The Esplanade	Annual Member
# Number of observations and features bike_share.shape (1922955, 9)									
# Datatypes bike_share.info()									
<class 'pandas.core.frame.DataFrame'> RangeIndex: 1922955 entries, 0 to 1922954 Data columns (total 9 columns): # Column Dtype --- -- 0 trip_id int64 1 trip_duration_seconds int64 2 from_station_id int64 3 trip_start_time object 4 from_station_name object 5 trip_stop_time object 6 to_station_id int64 7 to_station_name object 8 user_type object dtypes: int64(4), object(5) memory usage: 132.0+ MB									
# Convert trip_start_time and trip_stop_time to DateTime Format cols = ['trip_start_time', 'trip_stop_time'] bike_share[cols] = bike_share[cols].apply(pd.to_datetime)									
bike_share.info()									
<class 'pandas.core.frame.DataFrame'> RangeIndex: 1922955 entries, 0 to 1922954 Data columns (total 9 columns): # Column Dtype									

In [11]:	<pre># Number of observations and features bike_share.shape</pre>
Out[11]:	<pre>(1922955, 9)</pre>
In [12]:	<pre># Datatypes bike_share.info()</pre> <pre><class 'pandas.core.frame.DataFrame'> RangeIndex: 1922955 entries, 0 to 1922954 Data columns (total 9 columns): # Column Dtype --- --- 0 trip_id int64 1 trip_duration_seconds int64 2 from_station_id int64 3 trip_start_time object 4 from_station_name object 5 trip_stop_time object 6 to_station_id int64 7 to_station_name object 8 user_type object dtypes: int64(4), object(5) memory usage: 132.0+ MB</pre>
In [13]:	<pre># Convert trip_start_time and trip_stop_time to DateTime Format cols = ['trip_start_time', 'trip_stop_time'] bike_share[cols] = bike_share[cols].apply(pd.to_datetime)</pre>
In [14]:	<pre>bike_share.info()</pre> <pre><class 'pandas.core.frame.DataFrame'> RangeIndex: 1922955 entries, 0 to 1922954 Data columns (total 9 columns): # Column Dtype --- --- 0 trip_id int64 1 trip_duration_seconds int64 2 from_station_id int64 3 trip_start_time datetime64[ns] 4 from_station_name object 5 trip_stop_time datetime64[ns] 6 to_station_id int64 7 to_station_name object 8 user_type object dtypes: datetime64(2), int64(4), object(3) memory usage: 132.0+ MB</pre>

min	2383648.000	60.000	7000.000	7000.000
25%	2955251.500	422.000	7042.000	7042.000
50%	3494072.000	670.000	7109.000	7107.000
75%	4027557.500	1051.000	7222.000	7222.000
max	4581277.000	55077.000	7391.000	7391.000

```
# Identify weekdays vs weekend
bike_share['trip_start_time'].dt.dayofweek
# Monday = 0, Sunday = 6

0      0
1      0
2      0
3      0
4      0
1922950  ..
1922951  0
1922952  0
1922953  0
1922954  0
Name: trip_start_time, Length: 1922955, dtype: int64

# Create boolean weekend column
bike_share['Weekend'] = bike_share['trip_start_time'].dt.dayofweek() > 5).astype(int)
# 0 = Weekday, 1 = Weekend

0      1700750
1      222205
Name: Weekend, dtype: int64

# Identify holidays
ca_holidays = holidays.CH(years=2018)

for date, occasion in ca_holidays.items():
    print(f'{date} - {occasion}')

2018-01-01 - New Year's Day
2018-02-19 - Family Day
2018-03-10 - Good Friday
2018-04-02 - Easter Monday
2018-05-21 - Victoria Day
2018-07-01 - Canada Day
2018-07-02 - Canada Day (Observed)
2018-08-06 - Civic Holiday
2018-09-03 - Labour Day
2018-10-08 - Thanksgiving
2018-12-25 - Christmas Day
2018-12-26 - Boxing Day

# Create boolean holiday column
bike_share['Holiday'] = pd.to_datetime(bike_share['trip_start_time']).dt.date.isin(ca_holidays).astype(int)

bike_share['Holiday'].value_counts()

0      1874748
1       48207
Name: Holiday, dtype: int64
```

Toronto Weather Data (2018)

```
# Load Toronto weather data
w1 = pd.read_csv(r'C:\Users\von3_a\Documents\Data Analytics, Big Data & Predictive Analytics\Data\Weather 2018/4
w2 = pd.read_csv(r'C:\Users\von3_a\Documents\Data Analytics, Big Data & Predictive Analytics\Data\Weather 2018/4
w3 = pd.read_csv(r'C:\Users\von3_a\Documents\Data Analytics, Big Data & Predictive Analytics\Data\Weather 2018/4
w4 = pd.read_csv(r'C:\Users\von3_a\Documents\Data Analytics, Big Data & Predictive Analytics\Data\Weather 2018/4
w5 = pd.read_csv(r'C:\Users\von3_a\Documents\Data Analytics, Big Data & Predictive Analytics\Data\Weather 2018/4
w6 = pd.read_csv(r'C:\Users\von3_a\Documents\Data Analytics, Big Data & Predictive Analytics\Data\Weather 2018/4
```

In [18]:	<pre># Identify weekday vs weekend bike_share['trip_start_time'].dt.dayofweek # Monday = 0, Sunday = 6</pre>
Out[18]:	<pre>0 0 1 0 2 0 3 0 4 0 .. 1922950 0 1922951 0 1922952 0 1922953 0 1922954 0 Name: trip_start_time, Length: 1922955, dtype: int64</pre>
In [19]:	<pre># Create boolean weekend column bike_share['Weekend'] = (bike_share['trip_start_time'].dt.dayofweek > 5).astype(int) bike_share['Weekend'].value_counts() # 0 = Weekday, 1 = Weekend</pre>
Out[19]:	<pre>0 1700750 1 222205 Name: Weekend, dtype: int64</pre>
In [20]:	<pre># Identify holidays ca_holidays = holidays.CA(years=2018)</pre>
In [21]:	<pre>for date, occasion in ca_holidays.items(): print(f'{date} = {occasion}')</pre> <p>2018-01-01 = New Year's Day 2018-02-19 = Family Day 2018-03-10 = Good Friday 2018-04-02 = Easter Monday 2018-05-21 = Victoria Day 2018-07-01 = Canada Day 2018-07-02 = Canada Day (Observed) 2018-08-06 = Civic Holiday 2018-09-03 = Labour Day 2018-10-08 = Thanksgiving 2018-12-25 = Christmas Day 2018-12-26 = Boxing Day</p>

In [22]:	<pre># Create boolean holiday column bike_share['Holiday'] = pd.to_datetime(bike_share['trip_start_time']).dt.date.isin(ca_holidays).astype(int)</pre>
In [23]:	<pre>bike_share['Holiday'].value_counts()</pre>
Out[23]:	<pre>0 1874748 1 45207 Name: Holiday, dtype: int64</pre>

Toronto Weather Data (2018)

```
'Year',
'Month',
'Month',
'Day',
'Time',
'Temp Flag',
'Dew Point Temp Flag',
'Rel Hum Flag',
'Wind Dir (l0s deg)',
'Wind Dir Flag',
'Wind Spd (km/h)',
'Wind Spd Flag',
'Visibility Flag',
'Stn Press Flag',
'Hmdx Flag',
'Wind Chill Flag', axis=1, inplace=True)
```

```
weather.head()
```

	Date/Time	Temp (°C)	Dew Point Temp (°C)	Rel Hum (%)	Visibility (km)	Stn Press (kPa)	Hmdx	Wind Chill	Weather	Strong Wind
0	2018-01-01 00:00	-16.200	-20.500	70.000	16.100	102.130	NaN	-22.000	NaN	0
1	2018-01-01 01:00	-16.800	-21.100	70.000	16.100	102.100	NaN	-20.000	NaN	0
2	2018-01-01 02:00	-17.300	-20.800	75.000	16.100	102.150	NaN	-26.000	NaN	0
3	2018-01-01 03:00	-17.900	-21.600	73.000	16.100	102.130	NaN	-24.000	NaN	0
4	2018-01-01 04:00	-17.200	-21.100	72.000	16.100	102.090	NaN	-21.000	NaN	0

```
weather.Weather.unique()
```

```
array([nan, 'Snow', 'Fog', 'Rain', 'Rain,Fog', 'Haze',
       'Freezing Rain,Snow', 'Moderate Snow', 'Freezing Rain,Fog',
       'Rain,Snow', 'Moderate Rain', 'Moderate Rain', 'Freezing Rain',
       'Thunderstorms,Rain', 'Thunderstorms,Moderate Rain,Fog',
       'Thunderstorms', 'Thunderstorms,Heavy Rain,Fog', 'Heavy Rain,Fog'],
      dtype=object)
```

```
# Try to simplify weather feature. Convert weather into a sparse matrix
```

```
weather['Weather'].fillna(value='clear', inplace=True) # fill in null values with stand in value
```

```
weather_code = CountVectorizer(token_pattern='(?u) [a-zA-Z] [a-z ]+')
weather_code.fit = weather_code.transform(weather['Weather'])
print(weather_code.get_feature_names())
```

```
['clear', 'fog', 'freezing rain', 'haze', 'heavy rain', 'moderate rain', 'moderate snow', 'rain', 'snow', 'thin
drizzle']
```

```
# Instantiate into dataframe and drop stand in value
weather_code_df = pd.DataFrame(columns=weather_code.get_feature_names(),
                               data=weather_code.fit.transform())
weather_code_df.drop(['clear'], axis=1, inplace=True)
weather_code_df.columns = map(str.title, weather_code_df.columns)
```

```
# Overwrite pervious weather with weather code and drop weather feature
weather = pd.concat([weather, weather_code_df], join='inner', axis=1)
weather.drop(['Weather'], axis=1, inplace=True)
```

```
weather.head()
```

	Date/Time	Temp (°C)	Dew Point Temp (°C)	Rel Hum (%)	Visibility (km)	Stn Press (kPa)	Hmdx	Wind Chill	Strong Wind	Fog	Freezing Rain	Haze	Heavy Rain	Moderate Rain	Moderate Snow	Rain	S
0	2018-01-01 00:00	-16.200	-20.500	70.000	16.100	102.130	NaN	-22.000	0	0	0	0	0	0	0	0	0
1	2018-01-01 01:00	-16.800	-21.100	70.000	16.100	102.100	NaN	-20.000	0	0	0	0	0	0	0	0	0
2	2018-01-01 02:00	-17.300	-20.800	75.000	16.100	102.150	NaN	-26.000	0	0	0	0	0	0	0	0	0
3	2018-01-01 03:00	-17.900	-21.600	73.000	16.100	102.130	NaN	-24.000	0	0	0	0	0	0	0	0	0

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In [38]:	<pre>bike_share.info()</pre> <pre><class 'pandas.core.frame.DataFrame'> RangeIndex: 8760 entries, 0 to 8759 Data columns (total 18 columns): # Column Non-Null Count Dtype --- --- 0 Date/Time 8760 non-null datetime64[ns] 1 Temp (°C) 8756 non-null float64 2 Dew Point Temp (°C) 8756 non-null float64 3 Rel Hum (%) 8758 non-null float64 4 Visibility (km) 8752 non-null float64 5 Stn Press (kPa) 8755 non-null float64 6 Hmdx 1781 non-null float64 7 Wind Chill 1676 non-null float64 8 Strong Wind 8760 non-null int64 9 Fog 8760 non-null int64 10 Freezing Rain 8760 non-null int64 11 Haze 8760 non-null int64 12 Heavy Rain 8760 non-null int64 13 Moderate Rain 8760 non-null int64 14 Moderate Snow 8760 non-null int64 15 Rain 8760 non-null int64 16 Snow 8760 non-null int64 17 Thunderstorms 8760 non-null int64 dtypes: float64(7), int32(1), int64(9), object(1) memory usage: 1.2+ MB</pre>
In [39]:	<pre># Check for duplicates bike_share.duplicated().sum()</pre>
Out[39]:	<pre>0</pre>
In [40]:	<pre># Check for null values bike_share.isna().sum()</pre>
Out[40]:	<pre>Date/Time 0 Temp (°C) 4 Dew Point Temp (°C) 4 Rel Hum (%) 2 Visibility (km) 4 Stn Press (kPa) 5 Hmdx 6979 Wind Chill 7084 Strong Wind 0 Fog 0 Freezing Rain 0 Haze 0 Heavy Rain 0 Moderate Rain 0 Moderate Snow 0 Rain 0 Snow 0 Thunderstorms 0 dtypes: int64</pre>
In [41]:	<pre># Handle missing values. Impute hmdx and wind chill with 0. Forwardfill any remaining null values weather.fillna({'Hmdx': 0, 'Wind Chill': 0}, inplace=True) weather.fillna(method='ffill', inplace=True)</pre>
In [42]:	<pre>weather.isna().sum()</pre>
Out[42]:	<pre>Date/Time 0 Temp (°C) 0 Dew Point Temp (°C) 0 Rel Hum (%) 0 Visibility (km) 0 Stn Press (kPa) 0 Hmdx 0 Wind Chill 0 Strong Wind 0 Fog 0 Freezing Rain 0 Haze 0 Heavy Rain 0 Moderate Rain 0 Moderate Snow 0 Rain 0 Snow 0 Thunderstorms 0 dtypes: int64</pre>

```
# Convert Date/Time to DateTime Format
weather['Date/Time'] = pd.to_datetime(weather['Date/Time'], yearfirst=True, infer_datetime_format=True)

weather.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8760 entries, 0 to 8759
Data columns (total 18 columns):
 #   Column      Non-Null Count  Dtype
---  ---
0   Date/Time  8760 non-null    datetime64[ns]
1   Temp (°C)   8760 non-null    float64
2   Dew Point Temp (°C)  8760 non-null    float64
3   Rel Hum (%)  8760 non-null    float64
4   Visibility (km)  8760 non-null    float64
5   Stn Press (kPa)  8760 non-null    float64
6   Hmdx        8760 non-null    float64
7   Wind Chill  8760 non-null    float64
8   Strong Wind  8760 non-null    int32
9   Fog         8760 non-null    int64
10  Freezing Rain  8760 non-null    int64
11  Haze        8760 non-null    int64
12  Heavy Rain  8760 non-null    int64
13  Moderate Rain  8760 non-null    int64
14  Moderate Snow  8760 non-null    int64
15  Rain        8760 non-null    int64
16  Snow        8760 non-null    int64
17  Thunderstorms  8760 non-null    int64
dtypes: datetime64[ns](1), float64(7), int32(1), int64(9)
memory usage: 1.2 MB

weather.head()
```