In [1]:
```
# Importing all necessary libraries to create prediction model
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
```

In [2]:
```
# Loading csv file with DFW Airport snowfall data and setting DATE as index
dfw_data = '/Users/ali/Downloads/snowfall-dfw-airport.csv'
snow = pd.read_csv(dfw_data, index_col="DATE")

# Converting DATE index to datetime data type
snow.index = pd.to_datetime(snow.index)
print(snow.head())
```

```
                STATION                          NAME  SNOW  SNWD  TAVG
DATE
2002-01-01  USW00003927  DAL FTW WSCMO AIRPORT, TX US   0.0   NaN  37.0
2002-01-02  USW00003927  DAL FTW WSCMO AIRPORT, TX US   0.0   NaN  28.0
2002-01-03  USW00003927  DAL FTW WSCMO AIRPORT, TX US   0.0   NaN  27.0
2002-01-04  USW00003927  DAL FTW WSCMO AIRPORT, TX US   0.0   NaN  38.0
2002-01-05  USW00003927  DAL FTW WSCMO AIRPORT, TX US   0.0   NaN  43.0
```

In [3]:
```
# Verifying the details of the dataset (data types, etc.)
print(snow.info())
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 7306 entries, 2002-01-01 to 2022-01-01
Data columns (total 5 columns):
 #   Column   Non-Null Count  Dtype
---  ------   --------------  -----
 0   STATION  7306 non-null   object
 1   NAME     7306 non-null   object
 2   SNOW     7306 non-null   float64
 3   SNWD     5997 non-null   float64
 4   TAVG     4502 non-null   float64
dtypes: float64(3), object(2)
memory usage: 342.5+ KB
None
```

In [4]:
```
# Looking for null values by percent in each column
snow.apply(pd.isnull).sum() / snow.shape[0]
```

Out[4]:
```
STATION    0.000000
NAME       0.000000
SNOW       0.000000
SNWD       0.179168
TAVG       0.383794
dtype: float64
```

In [5]:
```
# Checking for null values in Snow Depth (SNWD) and Temp Average (TAVG) col
snow[pd.isnull(snow["SNWD"])]
```

Out[5]:

DATE	STATION	NAME	SNOW	SNWD	TAVG
2002-01-01	USW00003927	DAL FTW WSCMO AIRPORT, TX US	0.0	NaN	37.0
2002-01-02	USW00003927	DAL FTW WSCMO AIRPORT, TX US	0.0	NaN	28.0
2002-01-03	USW00003927	DAL FTW WSCMO AIRPORT, TX US	0.0	NaN	27.0
2002-01-04	USW00003927	DAL FTW WSCMO AIRPORT, TX US	0.0	NaN	38.0
2002-01-05	USW00003927	DAL FTW WSCMO AIRPORT, TX US	0.0	NaN	43.0
...	...	...	...	...	...
2005-11-26	USW00003927	DAL FTW WSCMO AIRPORT, TX US	0.0	NaN	NaN
2005-11-27	USW00003927	DAL FTW WSCMO AIRPORT, TX US	0.0	NaN	NaN
2005-11-28	USW00003927	DAL FTW WSCMO AIRPORT, TX US	0.0	NaN	NaN
2005-11-29	USW00003927	DAL FTW WSCMO AIRPORT, TX US	0.0	NaN	NaN
2005-11-30	USW00003927	DAL FTW WSCMO AIRPORT, TX US	0.0	NaN	NaN

1309 rows × 5 columns

In [6]:
```
# Replacing null values in Snow Depth column with 0
snow["SNWD"] = snow["SNWD"].fillna(0.0)
```

In [7]:
```
# Making sure we have no more null values in Snow Depth column
snow[pd.isnull(snow["SNWD"])]
```

Out[7]:

DATE	STATION	NAME	SNOW	SNWD	TAVG

In [8]:
```
# Using Pandas "foward fill" feature take fill Temp Average with last non-n
snow = snow.fillna(method="ffill")
```

In [9]:
```
# Making sure we have no more null values in Temp Average column
snow[pd.isnull(snow["TAVG"])]
```

Out[9]:

DATE	STATION	NAME	SNOW	SNWD	TAVG

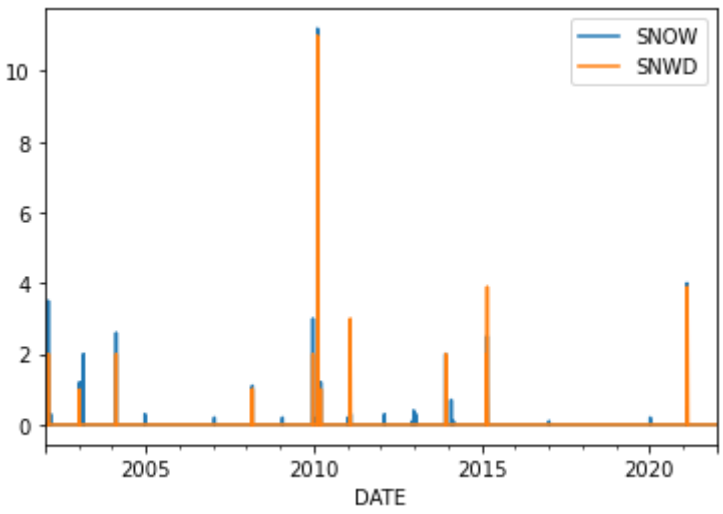
In [10]:
```
# Deleting non-numeric columns to keep the data clean
del snow["STATION"]
del snow["NAME"]
```

In [11]:
```
# Checking to see the updated number of rows in dataset
print(snow.info())
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 7306 entries, 2002-01-01 to 2022-01-01
Data columns (total 3 columns):
 #   Column  Non-Null Count  Dtype  
---  ------  --------------  -----  
 0   SNOW    7306 non-null   float64
 1   SNWD    7306 non-null   float64
 2   TAVG    7306 non-null   float64
dtypes: float64(3)
memory usage: 228.3 KB
None
```

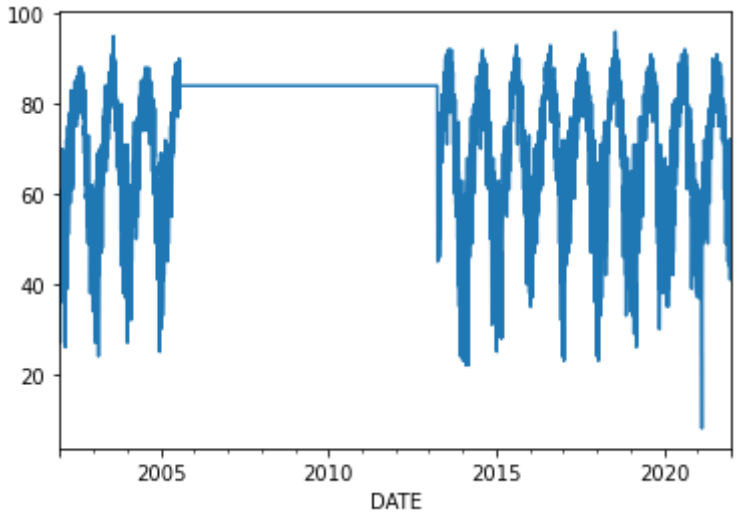
In [12]:
```
# Plotting the snow values with snow depth
snow[["SNOW", "SNWD"]].plot()
```

Out[12]: <AxesSubplot:xlabel='DATE'>



In [13]:
```
# Plotting the temp average values to see correlation with snowfall
snow["TAVG"].plot()
```

Out[13]: <AxesSubplot:xlabel='DATE'>



In [14]:
```
# Pulling the amount of snowfall by year
snow.groupby(snow.index.year).sum()["SNOW"]
```

Out[14]:
```
DATE
2002     3.8
2003     3.2
2004     2.9
2005     0.0
2006     0.0
2007     0.3
2008     2.1
2009     3.4
2010    13.9
2011     4.3
2012     0.8
2013     2.4
2014     0.8
2015     5.8
2016     0.0
2017     0.1
2018     0.0
2019     0.0
2020     0.2
2021     5.0
2022     0.0
Name: SNOW, dtype: float64
```

In [15]:
```
# Adding a prediction column for snowfall, 1 day in the future
# Using the 'shift' function to move all data back by 1 row
snow["PREDICTION"] = snow.shift(-1)["SNOW"]
```

In [16]:
```
# Copying all rows expect last one with null value in "Prediction" column
snow = snow.iloc[:-1,:].copy()
```

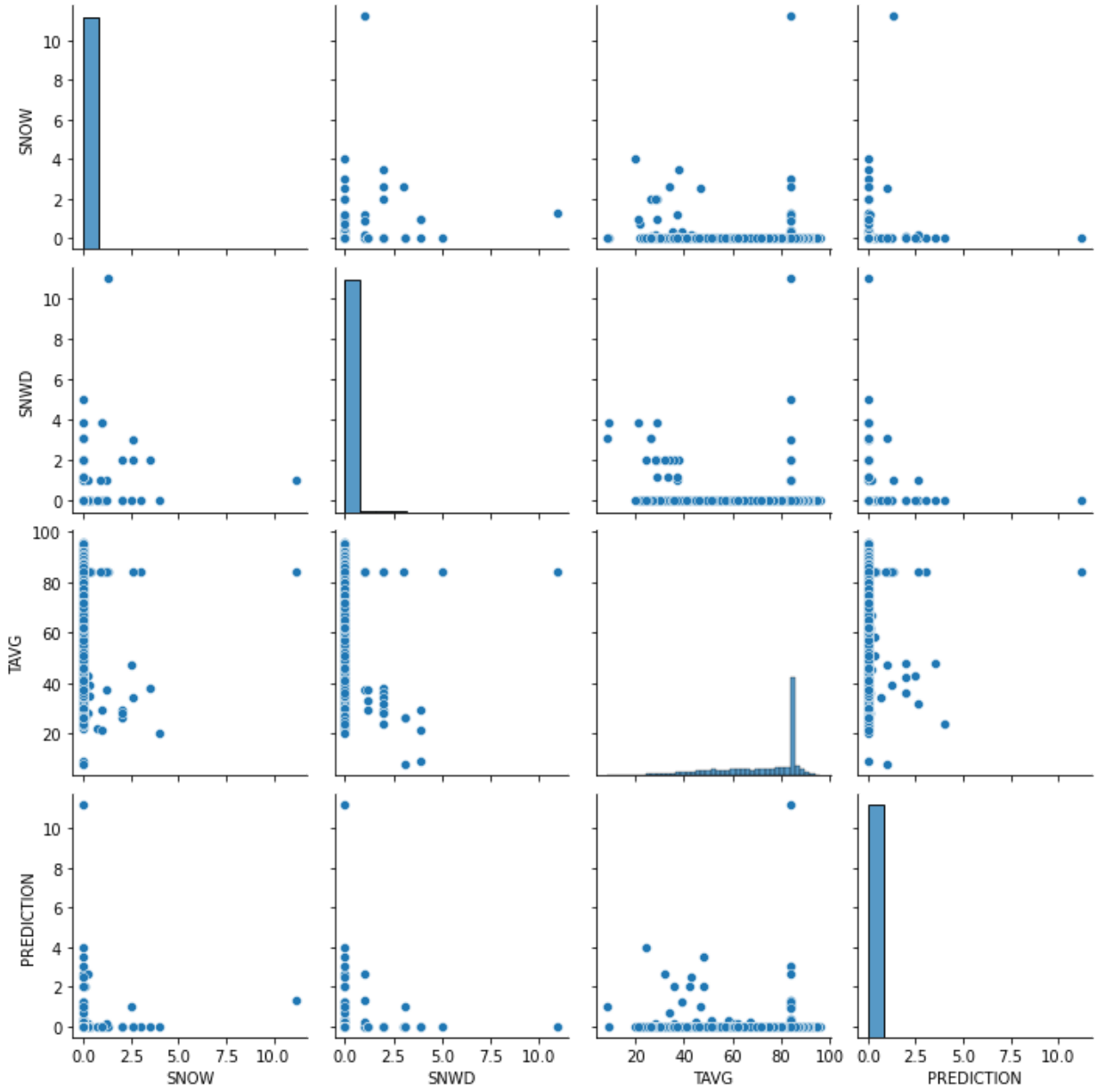
In [17]:
```
snow.describe()
```

Out[17]:

	SNOW	SNWD	TAVG	PREDICTION
count	7305.000000	7305.000000	7305.000000	7305.000000
mean	0.006708	0.009938	73.699658	0.006708
std	0.167610	0.196512	14.807791	0.167610
min	0.000000	0.000000	8.000000	0.000000
25%	0.000000	0.000000	64.000000	0.000000
50%	0.000000	0.000000	83.000000	0.000000
75%	0.000000	0.000000	84.000000	0.000000
max	11.200000	11.000000	96.000000	11.200000

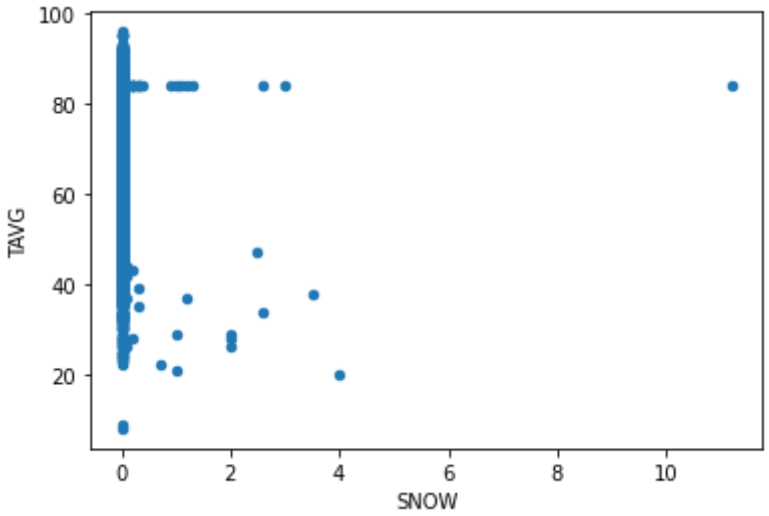
In [18]:
```
sns.pairplot(snow)
```

Out[18]:
```
<seaborn.axisgrid.PairGrid at 0x7fd4748076d0>
```



In [19]:
```
snow.plot(x='SNOW', y='TAVG', kind = 'scatter')
```

Out[19]:
```
<AxesSubplot:xlabel='SNOW', ylabel='TAVG'>
```



In [20]:
```
# Importing the Ridge regression library
from sklearn.linear_model import Ridge

# Setting up the  L2 penalty for inputs that hinder the prediction
reg_model = Ridge(alpha=.1)
```

In [21]:
```
# Setting up the predictors for next day's weather
predictors = ["SNOW", "TAVG"]
```

In [22]:
```
# Setting up our train and test sets
train = snow.loc[:"2020-12-31"]
test = snow.loc["2021-01-01":]
```

In [23]:
```
reg_model.fit(train[predictors], train["PREDICTION"])
```

Out[23]:
```
Ridge(alpha=0.1)
```

In [24]:
```
# Calculate predictions based on regression model with test set
predictions = reg_model.predict(test[predictors])
```

In [25]:
```
# Importing the mean_absolute_error library to evaluate predictions
from sklearn.metrics import mean_absolute_error
mean_absolute_error(test["PREDICTION"], predictions)
```

Out[25]: 0.02187426057605117

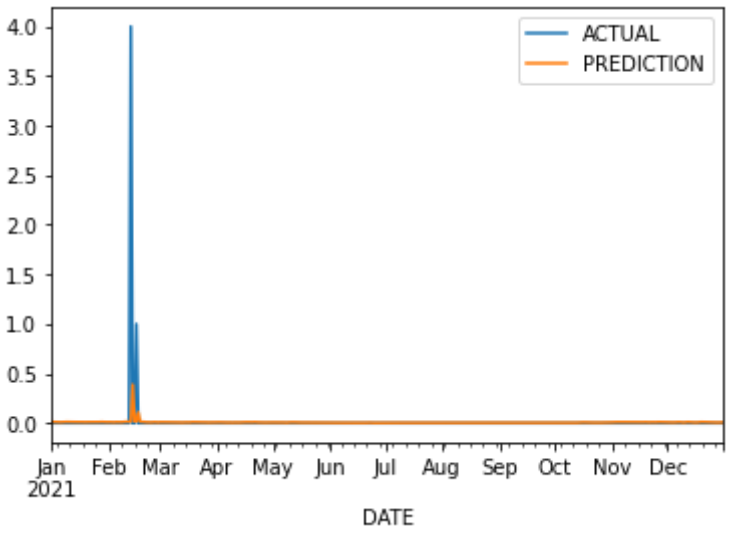
In [26]:
```
# Looking at the results based on actual snowfall vs predicted snowfall
results = pd.concat([test["PREDICTION"], pd.Series(predictions, index=test.
results.columns = ["ACTUAL", "PREDICTION"]
print(results)
```

```
            ACTUAL  PREDICTION
DATE
2021-01-01     0.0    0.013170
2021-01-02     0.0    0.012168
2021-01-03     0.0    0.011166
2021-01-04     0.0    0.010565
2021-01-05     0.0    0.010565
...            ...         ...
2021-12-27     0.0    0.006558
2021-12-28     0.0    0.006157
2021-12-29     0.0    0.007560
2021-12-30     0.0    0.008161
2021-12-31     0.0    0.008161

[365 rows x 2 columns]
```

In [27]:
```
results.plot()
```

Out[27]: <AxesSubplot:xlabel='DATE'>



In [28]:
```
# Evaluating the difference between the actual snowfall vs predicted snowfa
results["DIFFERENCE"] = (results["ACTUAL"] - results["PREDICTION"]).abs()
results.sort_values("ACTUAL", ascending=False).head(25)
```

Out[28]:

DATE	ACTUAL	PREDICTION	DIFFERENCE
2021-02-13	4.0	0.015774	3.984226
2021-02-16	1.0	0.018980	0.981020
2021-08-29	0.0	0.004154	0.004154
2021-09-07	0.0	0.004154	0.004154
2021-09-06	0.0	0.003753	0.003753
2021-09-05	0.0	0.003352	0.003352
2021-09-04	0.0	0.003152	0.003152
2021-09-03	0.0	0.003152	0.003152
2021-09-02	0.0	0.002951	0.002951
2021-09-01	0.0	0.002751	0.002751
2021-08-31	0.0	0.002951	0.002951
2021-08-30	0.0	0.003552	0.003552
2021-08-28	0.0	0.003552	0.003552
2021-08-18	0.0	0.005556	0.005556
2021-08-27	0.0	0.003552	0.003552
2021-08-26	0.0	0.002751	0.002751
2021-08-25	0.0	0.003152	0.003152
2021-08-24	0.0	0.003152	0.003152
2021-08-23	0.0	0.003152	0.003152
2021-08-22	0.0	0.003152	0.003152
2021-08-21	0.0	0.003152	0.003152
2021-08-20	0.0	0.003152	0.003152
2021-09-08	0.0	0.004154	0.004154
2021-09-09	0.0	0.004554	0.004554
2021-09-10	0.0	0.004554	0.004554