In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import math
```

Team

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Problem description

- A Company that sells many kinds of products requires us to replace the in-house software designed to predict retailing with an AI/ML driven method. The models that we implement should take seasonality and other additional factors into account.

Data Cleaning & Tranformation

In [11]:
```
data = pd.read_csv('forecasting.csv')
data['Price Discount (%)'] = data['Price Discount (%)'].apply(lambda
data.head()
```

Out[11]:

	Product	date	Sales	Price Discount (%)	In-Store Promo	Catalogue Promo	Store End Promo	Google_Mobility	Covid_Flag	V
0	SKU1	2/5/2017	27750	0	0	0	0	0.0	0	
1	SKU1	2/12/2017	29023	0	1	0	1	0.0	0	
2	SKU1	2/19/2017	45630	17	0	0	0	0.0	0	
3	SKU1	2/26/2017	26789	0	1	0	1	0.0	0	
4	SKU1	3/5/2017	41999	17	0	0	0	0.0	0	

In [12]:
```
data['Google_Mobility'] = data['Google_Mobility'].apply(lambda x: in
data.head()
```

Out[12]:

	Product	date	Sales	Price Discount (%)	In-Store Promo	Catalogue Promo	Store End Promo	Google_Mobility	Covid_Flag	V
0	SKU1	2/5/2017	27750	0	0	0	0	0	0	
1	SKU1	2/12/2017	29023	0	1	0	1	0	0	
2	SKU1	2/19/2017	45630	17	0	0	0	0	0	
3	SKU1	2/26/2017	26789	0	1	0	1	0	0	
4	SKU1	3/5/2017	41999	17	0	0	0	0	0	

In [13]:
```
from dateutil import parser
data.date = data.date.apply(lambda x: parser.parse(x))
data.head()
```

Out[13]:

	Product	date	Sales	Price Discount (%)	In-Store Promo	Catalogue Promo	Store End Promo	Google_Mobility	Covid_Flag	V_DA
0	SKU1	2017-02-05	27750	0	0	0	0	0	0	
1	SKU1	2017-02-12	29023	0	1	0	1	0	0	
2	SKU1	2017-02-19	45630	17	0	0	0	0	0	
3	SKU1	2017-02-26	26789	0	1	0	1	0	0	
4	SKU1	2017-03-05	41999	17	0	0	0	0	0	

In [14]:
```
data.Sales = data.Sales.apply(lambda x:  math.log(x) if x!=0 else x)
data.head()
```

Out[14]:

	Product	date	Sales	Price Discount (%)	In-Store Promo	Catalogue Promo	Store End Promo	Google_Mobility	Covid_Flag	V
0	SKU1	2017-02-05	10.230991	0	0	0	0	0	0	
1	SKU1	2017-02-12	10.275844	0	1	0	1	0	0	
2	SKU1	2017-02-19	10.728321	17	0	0	0	0	0	
3	SKU1	2017-02-26	10.195747	0	1	0	1	0	0	
4	SKU1	2017-03-05	10.645401	17	0	0	0	0	0	

In [15]:
```
mean_sales = data.Sales.describe().mean()
std_sales = data.Sales.describe().std()
outliers = mean_sales + 1.5*std_sales
outliers
```

Out[15]:
```
800.8543863355369
```

In [16]:
```
data = data[data.Sales <= outliers]
data
```

Out[16]:

	Product	date	Sales	Price Discount (%)	In-Store Promo	Catalogue Promo	Store End Promo	Google_Mobility	Covid_Fla
0	SKU1	2017-02-05	10.230991	0	0	0	0	0	
1	SKU1	2017-02-12	10.275844	0	1	0	1	0	
2	SKU1	2017-02-19	10.728321	17	0	0	0	0	
3	SKU1	2017-02-26	10.195747	0	1	0	1	0	
4	SKU1	2017-03-05	10.645401	17	0	0	0	0	
...	...	...	...	...	...	...	...	...	.
1213	SKU6	2020-10-18	11.478531	54	0	1	0	-7	
1214	SKU6	2020-10-25	11.659603	52	0	1	0	-8	
1215	SKU6	2020-11-01	11.932859	54	1	0	1	-7	
1216	SKU6	2020-11-08	10.182822	44	1	0	1	-5	
1217	SKU6	2020-11-15	10.181649	44	0	0	0	-7	

1218 rows × 12 columns

EDA

In [17]:
```
data.columns
```

Out[17]:
```
Index(['Product', 'date', 'Sales', 'Price Discount (%)', 'In-Store Promo',
       'Catalogue Promo', 'Store End Promo', 'Google_Mobility', 'Covid_Flag',
       'V_DAY', 'EASTER', 'CHRISTMAS'],
      dtype='object')
```

In [18]:
```
mean_discount = data.groupby('Product').agg({'Price Discount (%)': '
mean_discount
```

Out[18]:

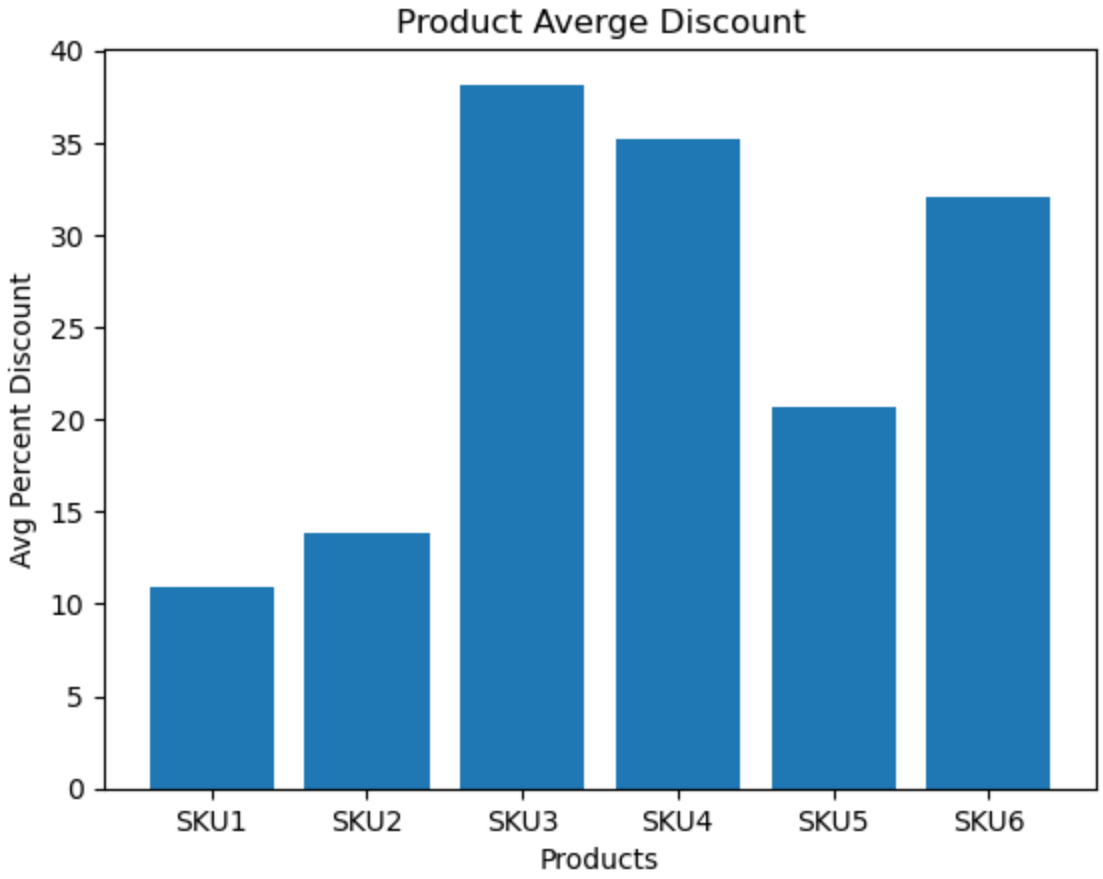
	Product	Price Discount (%)
0	SKU1	10.892157
1	SKU2	13.838235
2	SKU3	38.156863
3	SKU4	35.215686
4	SKU5	20.705882
5	SKU6	32.020202

In [19]:
```
mean_discount.Product.to_list()
mean_discount['Price Discount (%)'].to_list()
```

Out[19]:
```
[10.892156862745098,
 13.838235294117647,
 38.15686274509804,
 35.21568627450981,
 20.705882352941178,
 32.02020202020202]
```

In [20]:
```
plt.bar(mean_discount.Product.to_list(),\
          mean_discount['Price Discount (%)'].to_list())
plt.title('Product Averge Discount')
plt.xlabel("Products")
plt.ylabel("Avg Percent Discount")
```

Out[20]: Text(0, 0.5, 'Avg Percent Discount')



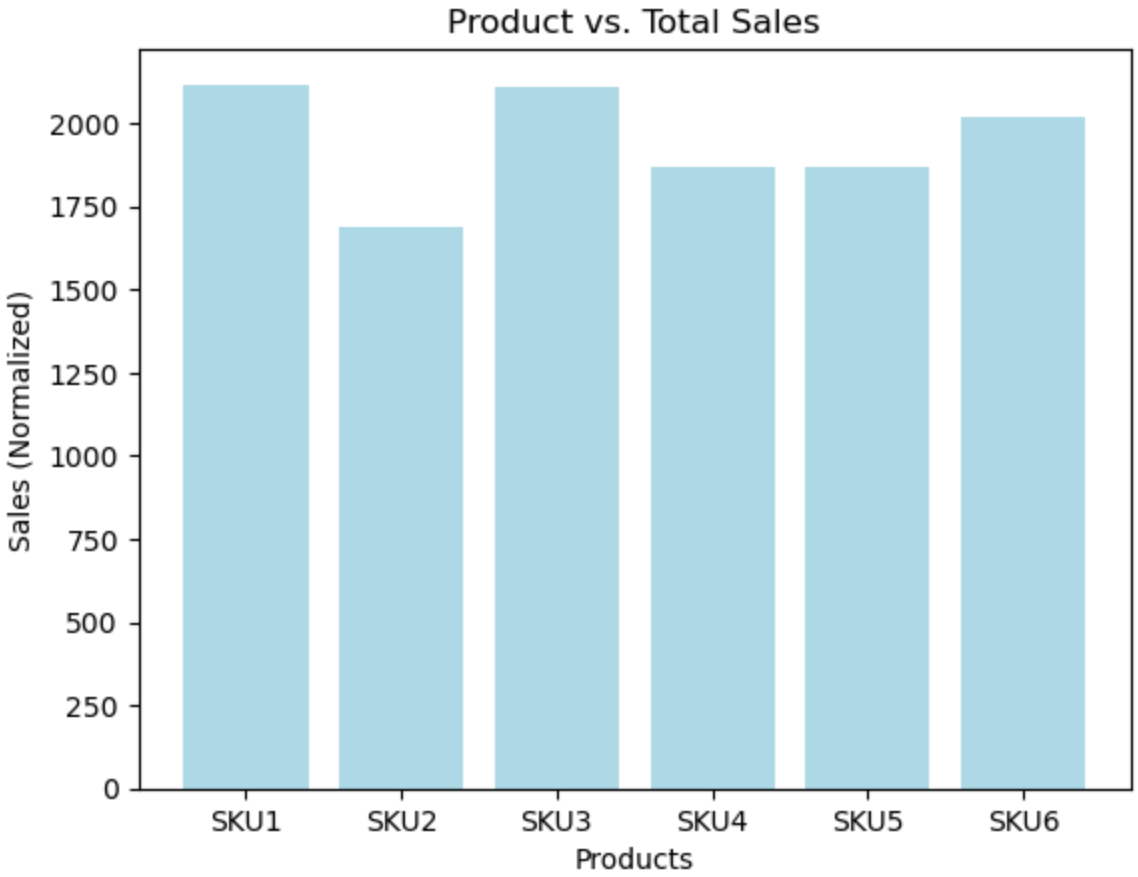
In [21]:
```
sum_sales = data.groupby('Product').agg({'Sales': 'sum'}).reset_inde
sum_sales
```

Out[21]:

	Product	Sales
0	SKU1	2116.525251
1	SKU2	1688.185204
2	SKU3	2111.827918
3	SKU4	1870.350004
4	SKU5	1868.228443
5	SKU6	2015.735406

In [22]:
```
plt.bar(sum_sales.Product.to_list(),\
           sum_sales['Sales'].to_list(),\
       color = 'lightblue')
plt.title('Product vs. Total Sales')
plt.xlabel("Products")
plt.ylabel("Sales (Normalized)")
```

Out[22]: Text(0, 0.5, 'Sales (Normalized)')



In [23]:
```
holiday_data = data[(data['V_DAY'] == 1) | (data['EASTER'] == 1) | (
holiday_data
```

Out[23]:

	Product	date	Sales	Price Discount (%)	In-Store Promo	Catalogue Promo	Store End Promo	Google_Mobility	Covid_Fla
1	SKU1	2017-02-12	10.275844	0	1	0	1	0	
9	SKU1	2017-04-09	10.908796	17	1	0	0	0	
43	SKU1	2017-12-03	11.102443	17	1	0	0	0	
53	SKU1	2018-02-11	10.422400	0	1	0	1	0	
61	SKU1	2018-04-08	10.466982	0	0	0	0	0	
...	...	...	...	...	...	...	...	...	.
1125	SKU6	2019-02-10	10.526615	38	0	0	0	0	
1133	SKU6	2019-04-07	10.432114	38	0	0	0	0	
1167	SKU6	2019-12-01	10.614622	38	0	0	0	0	
1178	SKU6	2020-02-16	9.301551	53	1	0	1	3	
1186	SKU6	2020-04-12	8.818186	53	1	0	0	-27	

71 rows × 12 columns

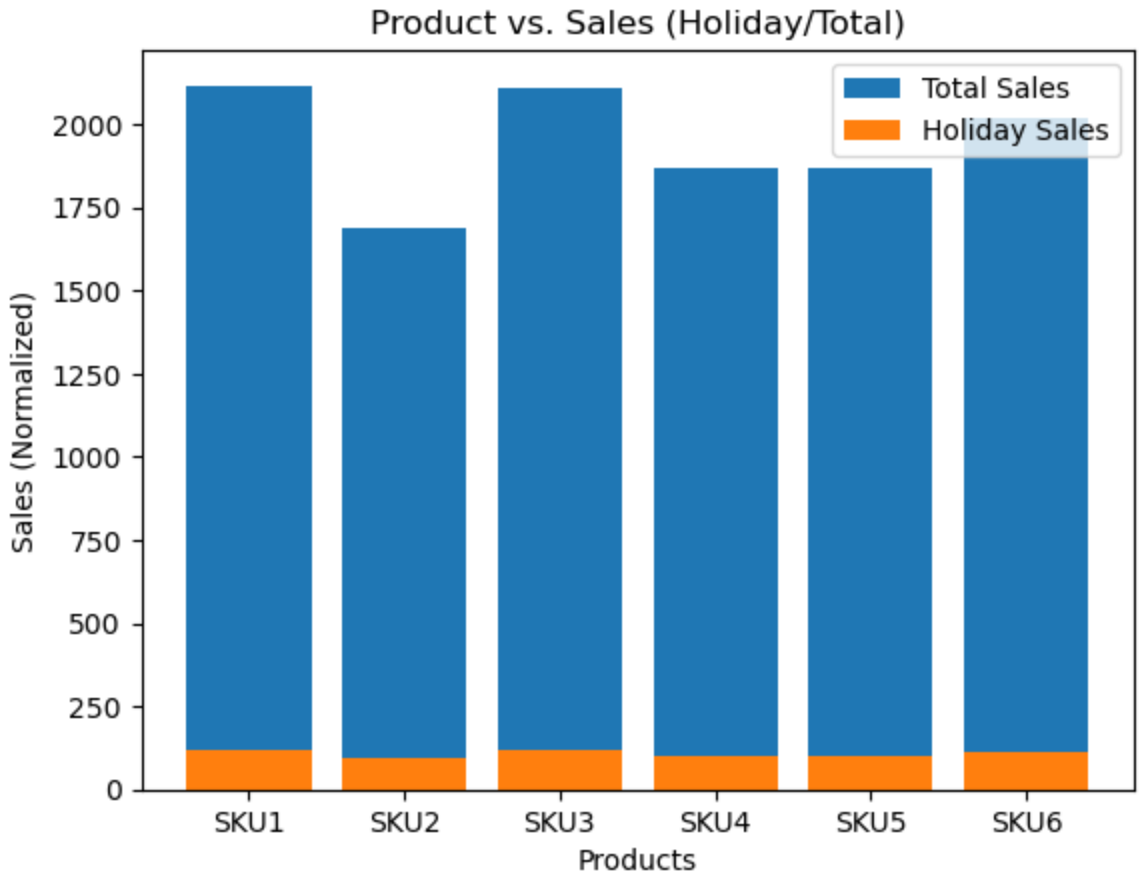
In [24]:
```
holiday = holiday_data.groupby('Product').agg({'Sales': 'sum'}).rese
holiday
```

Out[24]:

	Product	Sales
0	SKU1	118.413039
1	SKU2	94.512051
2	SKU3	116.205709
3	SKU4	102.394454
4	SKU5	99.427015
5	SKU6	110.155410

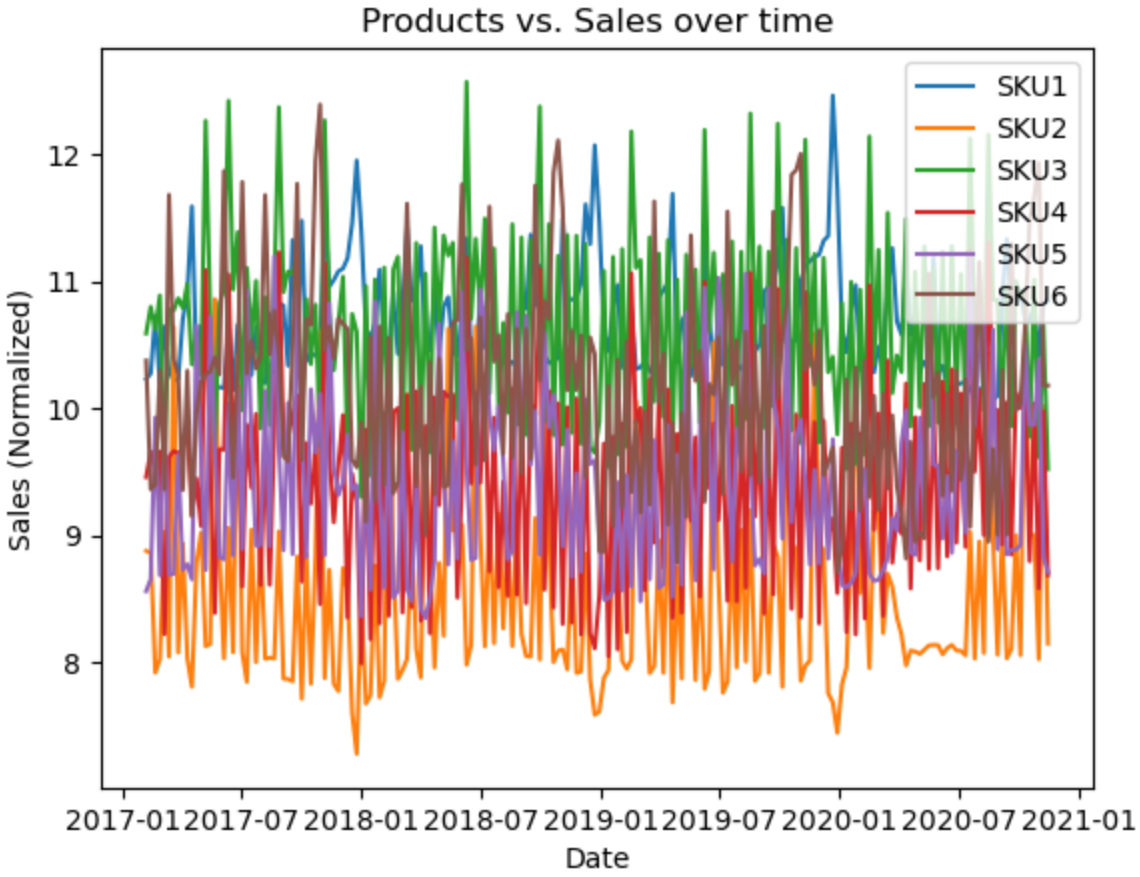
In [25]:

```
X = holiday.Product.to_list()
total = sum_sales.Sales.to_list()
holiday_count = holiday.Sales.to_list()

X_axis = np.arange(len(X))

plt.bar(X, total, label = 'Total Sales')
plt.bar(X, holiday_count, label = 'Holiday Sales')

plt.xticks(X_axis, X)
plt.xlabel("Products")
plt.ylabel("Sales (Normalized)")
plt.title("Product vs. Sales (Holiday/Total)")
plt.legend()
plt.show()
```



In [45]:
```
data = data[data.Sales > 7]
for i in data.Product.unique():
    prod = data[data['Product'] == i]
    plt.plot(prod.date, prod.Sales.to_list(),label = i)
plt.legend()
plt.title('Products vs. Sales over time')


plt.xlabel("Date")
plt.ylabel("Sales (Normalized)")
```

Out[45]: Text(0, 0.5, 'Sales (Normalized)')



In [ ]:
```
1
```