Accident Predictor

January 20, 2022

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import cross_val_score
```

[2]:
```
df = pd.read_csv("data/accidents.csv")

# Get rid of values after 2020
df = df[df.JAHR < 2021].reset_index().drop("index", axis=1)

df.head()
```

[2]:

	MONATSZAHL	AUSPRAEGUNG	JAHR	MONAT	WERT	VORJAHRESWERT	VERAEND_VORMONAT_PROZENT	VERAEND_VORJAHRESMONAT_PROZENT	ZWOELF_MONATE_MITTELWERT
0	Alkoholunfälle	insgesamt	2020	Summe	430.0	434.0	NaN	-0.92	NaN
1	Alkoholunfälle	insgesamt	2020	202001	28.0	22.0	-20.00	27.27	37.0
2	Alkoholunfälle	insgesamt	2020	202002	40.0	28.0	42.86	42.86	38.0
3	Alkoholunfälle	insgesamt	2020	202003	27.0	34.0	-32.50	-20.59	37.0
4	Alkoholunfälle	insgesamt	2020	202004	26.0	36.0	-3.70	-27.78	36.0

1 Missing Value Analysis

There are no unexplained missing values.

[3]:
```
# Check each column for nulls

na_cols = {}
for col in df.columns:
    empty_rows = df[df[col].isna()]
    if (empty_rows.size >0):
        na_cols[col] = empty_rows.size

print(na_cols)
```

```
{'VORJAHRESWERT': 819, 'VERAEND_VORMONAT_PROZENT': 1395,
'VERAEND_VORJAHRESMONAT_PROZENT': 828, 'ZWOELF_MONATE_MITTELWERT': 1323}
```

[4]:
```
# Analyse NA values

# VORJAHRESWERT
print(df[df.VORJAHRESWERT.isna()].JAHR.unique()) # all values from 2000
print(df.JAHR.min()) # because 2000 is the first year on record

# VERAEND_VORMONAT_PROZENT
print("--------------------------------------------------------------------------------")
print(df[df.VERAEND_VORMONAT_PROZENT.isna()].MONAT.unique())
# Logical for yearly sum
# Jan. 2020 first month on record
# 2013/02 had no injured
print(df[((df.MONAT == "201303") | (df.MONAT == "201302")) & (df.AUSPRAEGUNG ==␣
 ↪"Verletzte und Getötete")& (df.MONATSZAHL == "Alkoholunfälle")])

# VERAEND_VORJAHRESMONAT_PROZENT
print("--------------------------------------------------------------------------------")
print(df[df.VERAEND_VORJAHRESMONAT_PROZENT.isna()].MONAT.unique())
# 2020 first year on record
# 2013/02 had no injured

# ZWOELF_MONATE_MITTELWERT
print("--------------------------------------------------------------------------------")
df[df.ZWOELF_MONATE_MITTELWERT.isna()].MONAT.unique() # Only for sum rows
```

```
[2000]
2000
--------------------------------------------------------------------------------
-
['Summe' '200001' '201303']
        MONATSZAHL             AUSPRAEGUNG  JAHR   MONAT  WERT  \
```

```
366  Alkoholunfälle  Verletzte und Getötete  2013  201302   0.0
367  Alkoholunfälle  Verletzte und Getötete  2013  201303   8.0

     VORJAHRESWERT  VERAEND_VORMONAT_PROZENT  VERAEND_VORJAHRESMONAT_PROZENT  \
366            5.0                    -100.0                          -100.0
367            5.0                       NaN                            60.0

     ZWOELF_MONATE_MITTELWERT
366                      17.0
367                      18.0
--------------------------------------------------------------------------------
-
['Summe' '200001' '200002' '200003' '200004' '200005' '200006' '200007'
 '200008' '200009' '200010' '200011' '200012' '201402']
--------------------------------------------------------------------------------
-
```

[4]:
```
array(['Summe'], dtype=object)
```

2 Tidy Data

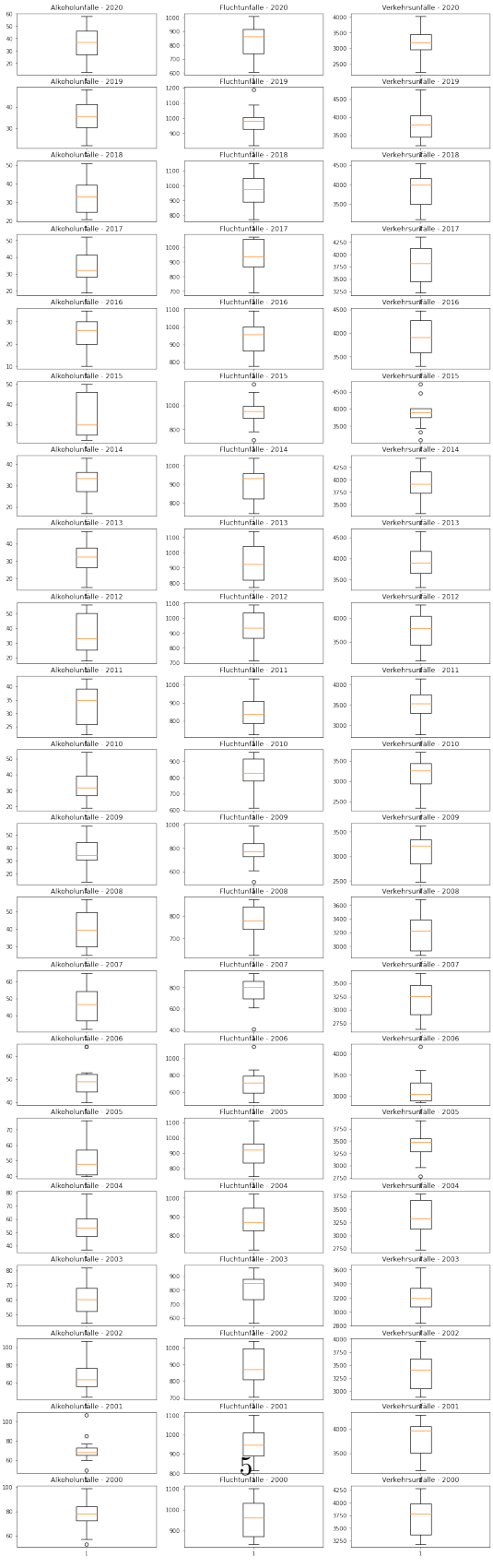
[5]:
```
def convert_months(digits):
    months = {
        "01": "January",
        "02": "February",
        "03": "March",
        "04": "April",
        "05": "May",
        "06": "June",
        "07": "July",
        "08": "August",
        "09": "September",
        "10": "October",
        "11": "November",
        "12": "December"
    }

    if(digits != "Summe"):
        return months[digits[-2:]]
    return digits

# Add a column with the month names in english
df["MONAT_EN"] = df["MONAT"].apply(convert_months)

df.head()
```

[5]:
```
        MONATSZAHL AUSPRAEGUNG  JAHR   MONAT   WERT  VORJAHRESWERT  \
0  Alkoholunfälle   insgesamt  2020   Summe  430.0          434.0
1  Alkoholunfälle   insgesamt  2020  202001   28.0           22.0
2  Alkoholunfälle   insgesamt  2020  202002   40.0           28.0
3  Alkoholunfälle   insgesamt  2020  202003   27.0           34.0
4  Alkoholunfälle   insgesamt  2020  202004   26.0           36.0

   VERAEND_VORMONAT_PROZENT  VERAEND_VORJAHRESMONAT_PROZENT  \
0                       NaN                           -0.92
1                    -20.00                           27.27
2                     42.86                           42.86
3                    -32.50                          -20.59
4                     -3.70                          -27.78

   ZWOELF_MONATE_MITTELWERT  MONAT_EN
0                       NaN     Summe
1                      37.0   January
2                      38.0  February
3                      37.0     March
4                      36.0     April
```

3 Outlier Analysis

[6]:
```
years = df.JAHR.unique()
types = df.MONATSZAHL.unique()

fig, ax = plt.subplots(nrows=len(years), ncols=len(types), figsize=(15,50))
fig.suptitle("Outlier Analysis")

for i in range(len(years)):
    for j in range(len(types)):
        ax[i,j].boxplot("WERT", data=df[(df.AUSPRAEGUNG == "insgesamt") & (df.
↪MONAT != "Summe") & (df.MONATSZAHL == types[j]) & (df.JAHR == years[i])])
        title = types[j] + " - " + str(years[i])
        ax[i,j].set_title(title)
```

Outlier Analysis

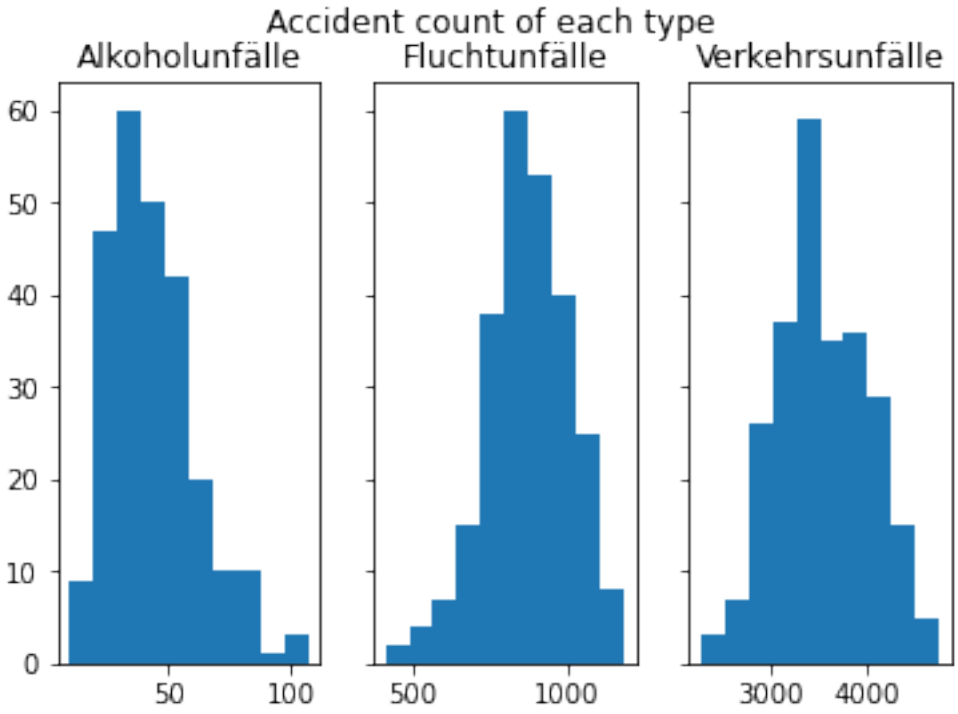


Upon analysis of the outliers, we can see that: 1. There aren't too many outliers to worry about 2. The difference from the median, in case of an outlier, is never too unrealistic

We can, therefore, move forward without any further treatment of these values necessary

4 Visualisation

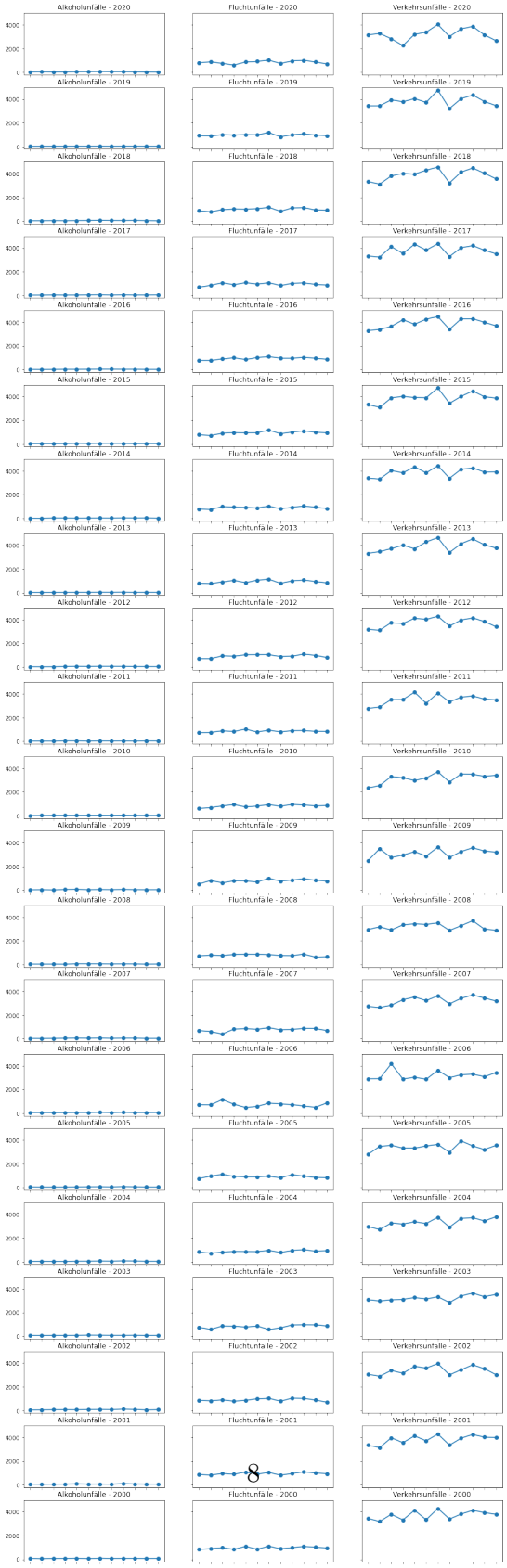
[7]:
```
fig, ax = plt.subplots(1, len(types), sharey=True)
fig.suptitle("Accident count of each type")

for i in range(len(types)):
    ax[i].hist("WERT", data=df[(df.MONAT != "Summe") & (df.MONATSZAHL ==␣
 ↪types[i]) & (df.AUSPRAEGUNG == "insgesamt")])
    ax[i].set_title(types[i])
```



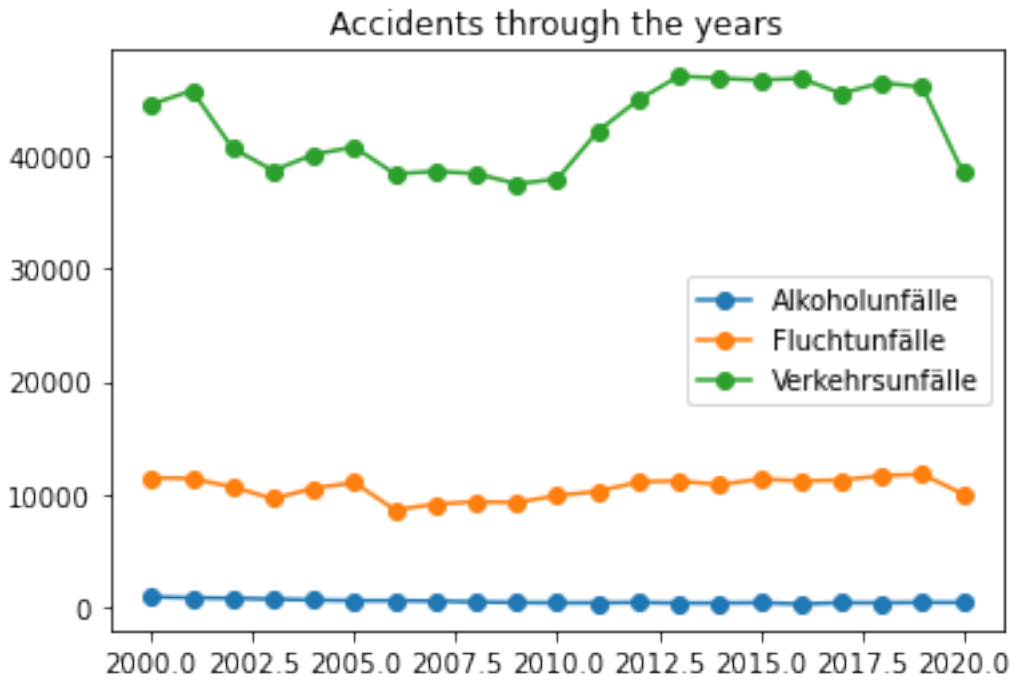
[8]:
```
fig, ax = plt.subplots(nrows=len(years), ncols=len(types), figsize=(15,50),␣
 ↪sharey=True)
fig.suptitle("Accidents through the Months")

for i in range(len(years)):
```

```
    for j in range(len(types)):
        ax[i,j].plot("MONAT_EN", "WERT", '-o', data=df[(df.AUSPRAEGUNG ==␣
↪"insgesamt") & (df.MONAT != "Summe") & (df.MONATSZAHL == types[j]) & (df.
↪JAHR == years[i])])
        title = types[j] + " - " + str(years[i])
        ax[i,j].set_title(title)
        ax[i,j].set_xticklabels([])
```

Accidents through the Months



[9]:
```
plt.title("Accidents through the years")

for typ in types:
    plt.plot("JAHR", "WERT", '-o', data=df[(df.AUSPRAEGUNG == "insgesamt") &␣
 ↪(df.MONAT == "Summe") & (df.MONATSZAHL == typ)], label=typ)

plt.legend()
plt.show()
```



5 Build the Model

5.1 Linear Regression

[10]:
```
# Build feature set
df_features = df[(df.MONAT != "Summe") & (df.AUSPRAEGUNG == "insgesamt") & (df.
 ↪MONATSZAHL == "Alkoholunfälle")][["MONAT", "WERT"]]
df_features.head()
```

[10]:

	MONAT	WERT
1	202001	28.0

```
2  202002  40.0
3  202003  27.0
4  202004  26.0
5  202005  40.0
```

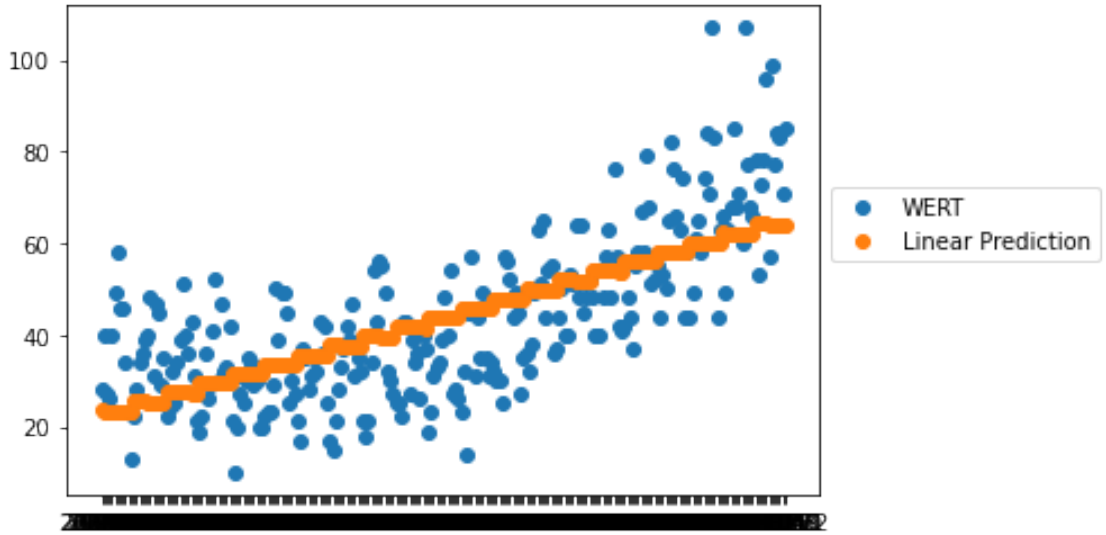
[11]:
```
X = df_features.MONAT.values.reshape(-1, 1)
y = df_features.WERT.values.reshape(-1, 1)

#X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2)

linear_model = LinearRegression()
linear_model.fit(X, y)
y_pred = linear_model.predict(X)
```

[12]:
```
df_features["Linear Prediction"] = y_pred.reshape(-1)
df_features.head()
```

[12]:

	MONAT	WERT	Linear Prediction
1	202001	28.0	23.46616
2	202002	40.0	23.44576
3	202003	27.0	23.42536
4	202004	26.0	23.40496
5	202005	40.0	23.38456

[13]:
```
plt.plot("MONAT", "WERT", "o", data=df_features)
plt.plot("MONAT", "Linear Prediction", "o", data=df_features)
plt.legend(bbox_to_anchor=(1, .65))
plt.show()
```



[14]:
```
from sklearn.metrics import mean_squared_error, mean_absolute_error,␣
↪mean_absolute_percentage_error

print("Linear Regression R2 Score:", linear_model.score(X,y))
print("Linear Regression MSE:", mean_squared_error(y, y_pred))
print("Linear Regression MAE:", mean_absolute_error(y, y_pred))
print("Linear Regression MAPE:", mean_absolute_percentage_error(y, y_pred))
```

```
Linear Regression R2 Score: 0.46922727710221923
Linear Regression MSE: 172.61223079452435
Linear Regression MAE: 10.54779982283996
Linear Regression MAPE: 0.2913832685844446
```

[15]:
```
print("Prediction for Alkoholunfälle in Jan. 2021:", linear_model.predict(np.
↪asarray([202101]).reshape(1, -1))[0][0])
```

```
Prediction for Alkoholunfälle in Jan. 2021: 21.42615950299023
```

[ ]:
```

```