Imports

In [ ]:

```
import numpy as np
import pandas as pd
import seaborn as sns
from matplotlib import pyplot as plt
from scipy import stats
```

Reading data

In [ ]:

```
data_path = "../data/lab_2/car_crashes.xlsx"
```

In [ ]:

```
df = pd.read_excel(data_path)
df
```

Out[ ]:

	ID	Source	TMC	Severity	Start_Time	End_Time	Distance(mi)	Description	Stree
0	A-1	MapQuest	201.0	3	2016-02-08 05:46:00	2016-02-08 11:00:00	0.01	Right lane blocked due to accident on I-70 Eas...	I-70
1	A-2	MapQuest	201.0	2	2016-02-08 06:07:59	2016-02-08 06:37:59	0.01	Accident on Brice Rd at Tussing Rd. Expect del...	Brice R
2	A-3	MapQuest	201.0	2	2016-02-08 06:49:27	2016-02-08 07:19:27	0.01	Accident on OH-32 State Route 32 Westbound at ...	State Rout 3
3	A-4	MapQuest	201.0	3	2016-02-08 07:23:34	2016-02-08 07:53:34	0.01	Accident on I-75 Southbound at Exits 52 52B US...	I-75
4	A-5	MapQuest	201.0	2	2016-02-08 07:39:07	2016-02-08 08:09:07	0.01	Accident on McEwen Rd at OH-725 Miamisburg Cen...	Miamisburg Centervill R
...	...	...	...	...	...	...	...	...	.
4995	A-4996	MapQuest	201.0	2	2016-08-01 11:35:41	2016-08-01 12:05:41	0.00	Accident on Cold Springs Rd at Middletown Rd.	Col Springs R
4996	A-4997	MapQuest	201.0	2	2016-08-01 11:41:23	2016-08-01 12:26:23	0.00	Accident on Travis Blvd at Holiday Ln.	Travis Blv

	ID	Source	TMC	Severity	Start_Time	End_Time	Distance(mi)	Description	Stree
4997	A-4998	MapQuest	201.0	2	2016-08-01 11:57:27	2016-08-01 12:42:27	0.00	Accident on River Rd at Orchard Rd.	River R
4998	A-4999	MapQuest	201.0	2	2016-08-01 12:00:54	2016-08-01 12:30:54	0.00	Accident on Marconi Ave at Bell St.	Bell S
4999	A-5000	MapQuest	201.0	2	2016-08-01 11:59:44	2016-08-01 12:29:44	0.00	Accident on Madison Ave Westbound at I-80.	I-80 V

5000 rows × 37 columns

Functions

In [ ]:

```python
def mean(arr):
    return momentum(arr, 1)

def median(arr):
    arr = sorted(arr)
    mid1 = len(arr) // 2
    mid2 = (len(arr) - 1) // 2
    return (arr[mid1] + arr[mid2]) / 2

def trunc_mean(arr, q):
    if q < 0 or q > 1:
        raise ValueError("Q must be between 0 and 1")
    arr = sorted(arr)
    lbound = int(len(arr) * q)
    rbound = len(arr) - lbound
    if lbound > rbound:
        raise ValueError("Too much to trunclate")
    return mean(arr[lbound:rbound])

def variance(arr):
    return momentum(arr, 2) - mean(arr) ** 2

def quantile(arr, q):
    if q < 0 or q > 1:
        raise ValueError("Q must be between 0 and 1")

    arr = sorted(arr)
    full_sum = 0
    for elem in arr:
        full_sum += elem
    left_sum = float(full_sum * q)

    i, sum = 0, 0
    while i < len(arr):
        if sum + arr[i] >= left_sum:
            break
        sum += arr[i]
        i += 1
    if i == len(arr):
        raise ValueError("Q must be between 0 and 1")
    lval = arr[i - 1] if i > 0 else arr[0]
    rval = arr[i]
    return (lval + rval) / 2

def momentum(arr, k: int):
    if k < 1:
        raise ValueError("K must be natural")
    sum = 0
    for elem in arr:
        sum += elem ** k
    return sum / len(arr)

def central_momentum(arr, k: int):
    if k < 1:
        raise ValueError("K must be natural")
    mn = mean(arr)
    sum = 0
    for elem in arr:
        sum += (elem - mn) ** k
    return sum / len(arr)

def check_equal(f1, f2, *args, eps=0.01, **kwargs):
    res1 = f1(*args, **kwargs)
    res2 = f2(*args, **kwargs)
    return abs(res1 - res2) < eps, res1, res2
```

Comparison

In [ ]:

```
data =  df["Visibility(mi)"].dropna().values
data
```

Out[ ]:

```
array([10., 10., 10., ..., 10.,  7.,  7.])
```

In [ ]:

```
check_equal(np.mean, mean, data)
```

Out[ ]:

```
(True, 9.46561113352158, 9.46561113352158)
```

In [ ]:

```
check_equal(np.median, median, data)
```

Out[ ]:

```
(True, 10.0, 10.0)
```

In [ ]:

```
check_equal(stats.trim_mean, trunc_mean, data, 0.1)
```

Out[ ]:

```
(True, 9.94077620967742, 9.94077620967742)
```

In [ ]:

```
check_equal(np.var, variance, data)
```

Out[ ]:

```
(True, 3.5586499996501475, 3.5586499996501573)
```

In [ ]:

```
check_equal(np.quantile, quantile, data, 0.25)
```

Out[ ]:

```
(True, 10.0, 10.0)
```

Не нашёл в scipy/numpy функцию для подсчёта начального момента

In [ ]:

```
check_equal(stats.moment, central_momentum, data, 2)
```

Out[ ]:

```
(True, 3.5586499996501475, 3.558649999649888)
```

Graphs

In [ ]:

```
arrs = [[], [], []]
names = ["mean", "median", "trunclated mean"]
xses = np.arange(1, 5)
for x in xses:
    loc = df.loc[df.Severity == x, "Visibility(mi)"]
    arrs[0].append(loc.mean())
    arrs[1].append(loc.median())
    arrs[2].append(stats.trim_mean(loc, 0.1))
print(arrs)
```

```
[[8.5, 9.397620689655172, 9.564372864812103, 9.2], [8.5, 10.0, 10.0, 10.0], [8.5, 9.
909013605442176, 9.971393791844188, 9.2]]
```

In [ ]:

```
fig, axs = plt.subplots(1, 3)
fig.set_size_inches(20,4)
for i in range(3):
    axs[i].set_xlabel("Severity")
    axs[i].set_ylabel(f"{names[i]} visibility")
    sns.lineplot(xses, arrs[i], ax=axs[i])
```

```
/mnt/f/Code/linux-home/miniconda3/envs/vscode_py38/lib/python3.8/site-packages/seabo
rn/_decorators.py:36: FutureWarning: Pass the following variables as keyword args:
x, y. From version 0.12, the only valid positional argument will be `data`, and pass
ing other arguments without an explicit keyword will result in an error or misinterp
retation.
  warnings.warn(
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```

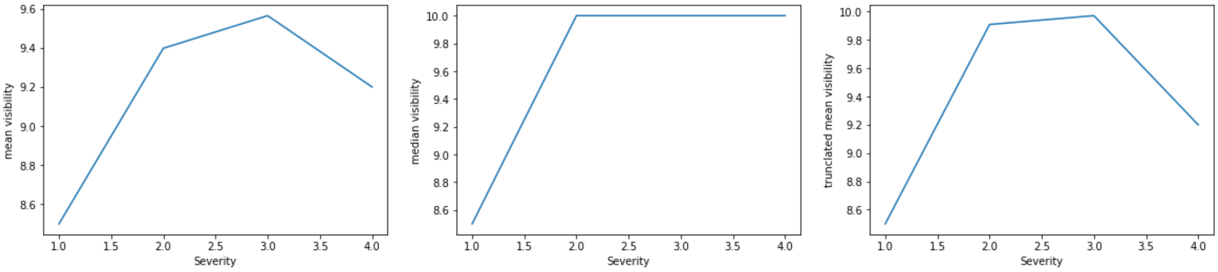

Усеченное среднее отличается от среднего, значит в данных присутствуют выбросы

По графикам видно, что в целом видимость дороги не сильно влияет на тяжесть ДТП, но в происшествиях с наибольшей тяжестью средняя видимость дороги меньше. Если видимоть очень маленькая, водители, вероятно, сбавляют скорость и тяжесть аварий уменьшается

In [ ]:

```
quantiles = np.array([0.05, 0.1, 0.25, 0.5, 0.75, 0.9, 0.95])
severeties = np.arange(1, 5)
data = np.empty((severeties.shape[0], quantiles.shape[0]))
for i in range(severeties.shape[0]):
    loc = df.loc[df.Severity == severeties[i], "Wind_Speed(mph)"]
    data[i] = loc.quantile(quantiles)
print(data)
```

```
[[ 5.91   6.02   6.35   6.9    9.2   10.58  11.04]
 [ 3.5    4.6    5.8    8.1   11.5   15.    17.3 ]
 [ 3.5    4.6    6.9    9.2   12.7   15.    18.4 ]
 [ 5.8    5.8    5.8    6.9   10.4   13.16  14.08]]
```

In [ ]:

```
fig, axs = plt.subplots(1, 4)
fig.set_size_inches(20,4)
for i in range(4):
    axs[i].set_xlabel("Wind speed")
    axs[i].set_ylabel("Dist")
    axs[i].set_ylim(0, 1)
    axs[i].set_title(f"Wind speed distribution for crashes of severity = {i + 1}")
    sns.lineplot(data[i], quantiles, ax=axs[i])
```

```
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  warnings.warn(
```
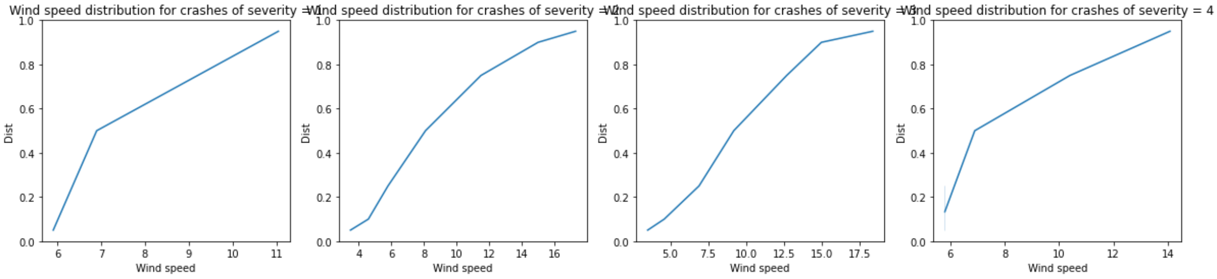



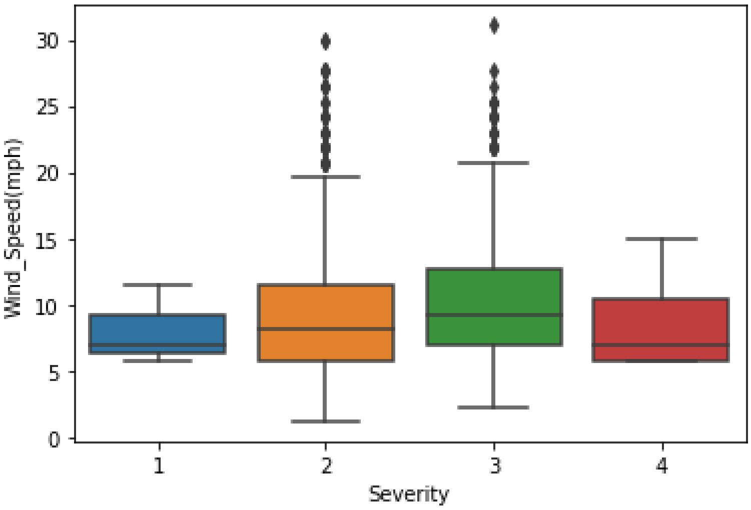
Boxplots

In [ ]:

```
sns.boxplot(x="Severity", y="Wind_Speed(mph)", data=df)
```

Out[ ]:

```
<AxesSubplot:xlabel='Severity', ylabel='Wind_Speed(mph)'>
```



Modes

In [ ]:

```
modes = [df.loc[df.Severity == i, "Wind_Speed(mph)"].mode() for i in range(1, 5)]
modes
```

Out[ ]:

```
[0     5.8
 1     6.9
 2    11.5
 dtype: float64,
 0    5.8
 dtype: float64,
 0    8.1
 dtype: float64,
 0    5.8
 dtype: float64]
```

In [ ]: