lx_statistiek

September 27, 2019

In [21]:
```
from datetime import datetime

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

%matplotlib inline
plt.style.use('fivethirtyeight')
```

In [2]:
```
lx_file = "./data/201909_lx_events.csv"

objects = ("XAZR_LX_12_4","XAZR_LX_7_0","XR_LX_10_1","XR_LX_11_7","XR_LX_12_1t1","XR_LX
           "XR_LX_12_6","XR_LX_13_7","XR_LX_14_9","XR_LX_15_6","XR_LX_21_3","XR_LX_23
           "XR_LX_23_2_1","XR_LX_23_2_2","XR_LX_5_3","XR_LX_5_4","XR_LX_5_5t1","XR_LX
           "XR_LX_7_0","XR_LX_7_7t1","XR_LX_7_7t2","XCPR_LX_10_1","XCPR_LX_11_7","XCPR
           "XCPR_LX_12_4","XCPR_LX_12_6","XCPR_LX_13_7","XCPR_LX_14_9","XCPR_LX_15_6"
           "XCPR_LX_23_1_2","XCPR_LX_23_2_1","XCPR_LX_23_2_2","XCPR_LX_5_3","XCPR_LX_5
           "XCPR_LX_6_0","XCPR_LX_7_0","XCPR_LX_7_7t1","XCPR_LX_7_7t2","XKTEPR_LX_10_1
           "XKTEPR_LX_12_1t2","XKTEPR_LX_12_4","XKTEPR_LX_12_6","XKTEPR_LX_13_7","XKTE
           "XKTEPR_LX_21_3","XKTEPR_LX_23_1_1","XKTEPR_LX_23_1_2","XKTEPR_LX_23_2_1","
           "XKTEPR_LX_5_4","XKTEPR_LX_5_5t1","XKTEPR_LX_5_5t2","XKTEPR_LX_6_0","XKTEPR
```

In [3]:
```
datecol = ['datetime']
df = pd.read_csv(lx_file, sep=';', parse_dates=datecol, dayfirst=True, infer_datetime_f
```

In [4]:
```
df.drop(columns=['logfile','type','event'], inplace=True)
```

In [5]:
```
df.sort_values(by='datetime', inplace=True)
df.reset_index(drop=True, inplace=True)
df[['func','lx']] = df.object.str.split('_',1, expand=True)
```

In [6]:
```
df['lx_closed_time'] = ""
df['lx_closed_time'] = pd.to_numeric(df.lx_closed_time)
df['lx_alarm_time'] = ""
df['lx_alarm_time'] = pd.to_numeric(df.lx_alarm_time)
df['deltaT_func'] = ""
df['deltaT0_1'] = ""
```

```
        df['deltaT0_2'] = ""
        df['deltaT0_L'] = ""
        df['deltaT_lx'] = ""
        df['lx_open_error'] = ""
        df['lx_passage'] = ""
        df['lx_other_error'] = ""
        df['lx_input_error'] = ""
        df['lx_closed_long'] = ""
        df['lx_xcpr_repeat'] = ""
        df['lx_xktepr_repeat'] = ""
        df['lx_note'] = ""

        tmin = df.datetime.min()
        tmax = df.datetime.max()
        maxsec = int((tmax-tmin)/np.timedelta64(1,'s'))
        lx_name = set(df.lx)

In [7]: new_df = pd.DataFrame()

        for lx in objects:
            new_df = df[df.object==lx]
            new_df = new_df.assign(deltaT_func = lambda x: (x.datetime - x.datetime.shift(1, ax
            new_df = new_df.assign(deltaT0_1 = lambda x: (x.datetime - tmin)/np.timedelta64(1,
            new_df = new_df.assign(deltaT0_2 = lambda x: x.deltaT0_1.shift(-1, axis = 0))
            new_df.loc[new_df.deltaT0_2.isnull(), 'deltaT0_2'] = maxsec
            new_df = new_df.assign(deltaT0_L = lambda x: x.deltaT0_2 - x.deltaT0_1)
            df.update(new_df)

In [8]: df.sort_values(by='datetime', inplace=True)

        for lx in lx_name:
            new_df = df[df.lx==lx]
            new_df = new_df.assign(deltaT_lx = lambda x: (x.datetime - x.datetime.shift(1, axis
            df.update(new_df)

In [9]: functions = ['XR','XCPR']
        for lx in lx_name:
            new_df = df[df.lx==lx]
            new_df = new_df.sort_values(by='datetime')
            new_df = new_df[new_df.func.isin(functions)] # maak een dataframe met alleen xr en
            new_df.loc[(((new_df['func']=='XCPR') & (new_df['value']==1)) &
                        ((new_df['func'].shift(1)=='XR') & (new_df['value'].shift(1)>=1)) &
                        ((new_df['func'].shift(2)=='XR') & (new_df['value'].shift(2)>=1)) &
                        ((new_df['func'].shift(3)=='XR') & (new_df['value'].shift(3)==1))),
                        ['lx_passage','lx_note']] = ["LX double passage"]*2

            new_df.loc[(((new_df['func']=='XCPR') & (new_df['value']==1)) &
                        ((new_df['func'].shift(1)=='XR') & (new_df['value'].shift(1)==2)) &
```

```
                        ((new_df['func'].shift(2)=='XR') & (new_df['value'].shift(2)==1)) &
                        ((new_df['func'].shift(3)=='XCPR') & (new_df['value'].shift(3)==2)) &
                        ((new_df['func'].shift(4)=='XR') & (new_df['value'].shift(4)==1))),
                        ['lx_passage','lx_note']] = ["LX single passage"]*2

            new_df.loc[(((new_df['func']=='XCPR') & (new_df['value']==1)) &
                        ((new_df['func'].shift(1)!='XR'))),
                        ['lx_open_error','lx_note']] = ["XCPR off and no XR on before"]*2
            df.update(new_df)
```

In [10]:
```
functions = ['XR','XCPR','XKTEPR']
for lx in lx_name:
    new_df = df[df.lx==lx]
    new_df = new_df.sort_values(by='datetime')
    new_df = new_df[new_df.func.isin(functions)] # maak een dataframe met alleen xr e

    new_df.loc[((new_df.value.isin([0,3])) & (new_df.func.isin(functions[1:]))),
                ['lx_input_error','lx_note']] = ["Short/OOC on input"]*2

    new_df.loc[(((new_df.func=='XKTEPR') & (new_df.value==1)) &
                ((new_df.func.shift(1)=='XR') & (new_df.value.shift(1)==2))),
                ['lx_other_error','lx_note']] = ["XKTEPR off after XR on"]*2

    new_df.loc[(((new_df.func=='XKTEPR') & (new_df.value==1)) &
                ((new_df.func.shift(1)=='XCPR') & (new_df.value.shift(1)>=1))),
                ['lx_closed_long','lx_note']] = ["LX closed too long"]*2

    new_df.loc[(((new_df.func=='XKTEPR') & (new_df.value==1)) &
                ((new_df.func.shift(1)=='XR') & (new_df.value.shift(1)==1))),
                ['lx_closed_long','lx_note']] = ["LX closed too long"]*2

    new_df.loc[(((new_df.func=='XKTEPR') & (new_df.value==1)) &
                ((new_df.func.shift(-1)=='XKTEPR') & (new_df.value.shift(-1)==2))),
                ['lx_xktepr_repeat','lx_note']] = ["XKTEPR repeat"]*2

    new_df.loc[(((new_df.func=='XCPR') & (new_df.value==2)) &
                ((new_df.func.shift(1)=='XCPR') & (new_df.value.shift(1)==1)) &
                ((new_df.func.shift(2)=='XCPR'))),
                ['lx_xcpr_repeat','lx_note']] =   ["XCPR repeat"]*2
    df.update(new_df)
```

In [11]:
```
# bepaal de lx_closed_time
for lx in lx_name:
    new_df = df[df.lx==lx]
    new_df = new_df[new_df.func=='XCPR']
    new_df = new_df.sort_values(by='datetime')

    new_df.loc[(((new_df['func']=='XCPR') & (new_df['value']==1)) &
```

```
                        ((new_df['func'].shift(1)=='XCPR') & (new_df['value'].shift(1)==2))),
                        ['lx_closed_time']] = new_df.deltaT0_1 - new_df.deltaT0_1.shift(1)

            df.update(new_df)
```

```
In [12]: #bepaal de lx_alarm_time
         for lx in lx_name:
             new_df = df[df.lx==lx]
             new_df = new_df[new_df.func=='XKTEPR']
             new_df = new_df.sort_values(by='datetime')

             new_df.loc[(((new_df['func']=='XKTEPR') & (new_df['value']==2)) &
                         ((new_df['func'].shift(1)=='XKTEPR') & (new_df['value'].shift(1)==1)))
                         ['lx_alarm_time']] = new_df.deltaT0_1 - new_df.deltaT0_1.shift(1)

             df.update(new_df)
```

0.1 Data voor de statistiek

- lx_xcpr_time
- lx_xktepr_time
- lx_passage

```
In [13]: lx_xcpr_time = df.query("func=='XCPR' & value==1")[['datetime','lx','lx_closed_time']]

         lx_xktepr_time = df.query("func=='XKTEPR' & value==2")[['datetime','lx','lx_alarm_time

         lx_passage = df.query("lx_passage !=''")[['datetime','lx','lx_passage']]
```

1 Bepaal de tijd dat de overwegbomen laag zijn:

```
In [14]: lx_passage.groupby(['lx','lx_passage']).count().unstack()
```

Out[14]:

	datetime	
lx_passage	LX double passage	LX single passage
lx		
LX_10_1	26.0	1383.0
LX_11_7	36.0	1377.0
LX_12_1t1	7.0	640.0
LX_12_4	91.0	1121.0
LX_12_6	125.0	1046.0
LX_13_7	231.0	829.0
LX_14_9	238.0	124.0
LX_15_6	18.0	657.0
LX_21_3	9.0	672.0
LX_5_3	237.0	1520.0
LX_5_4	976.0	777.0
LX_5_5t1	48.0	934.0

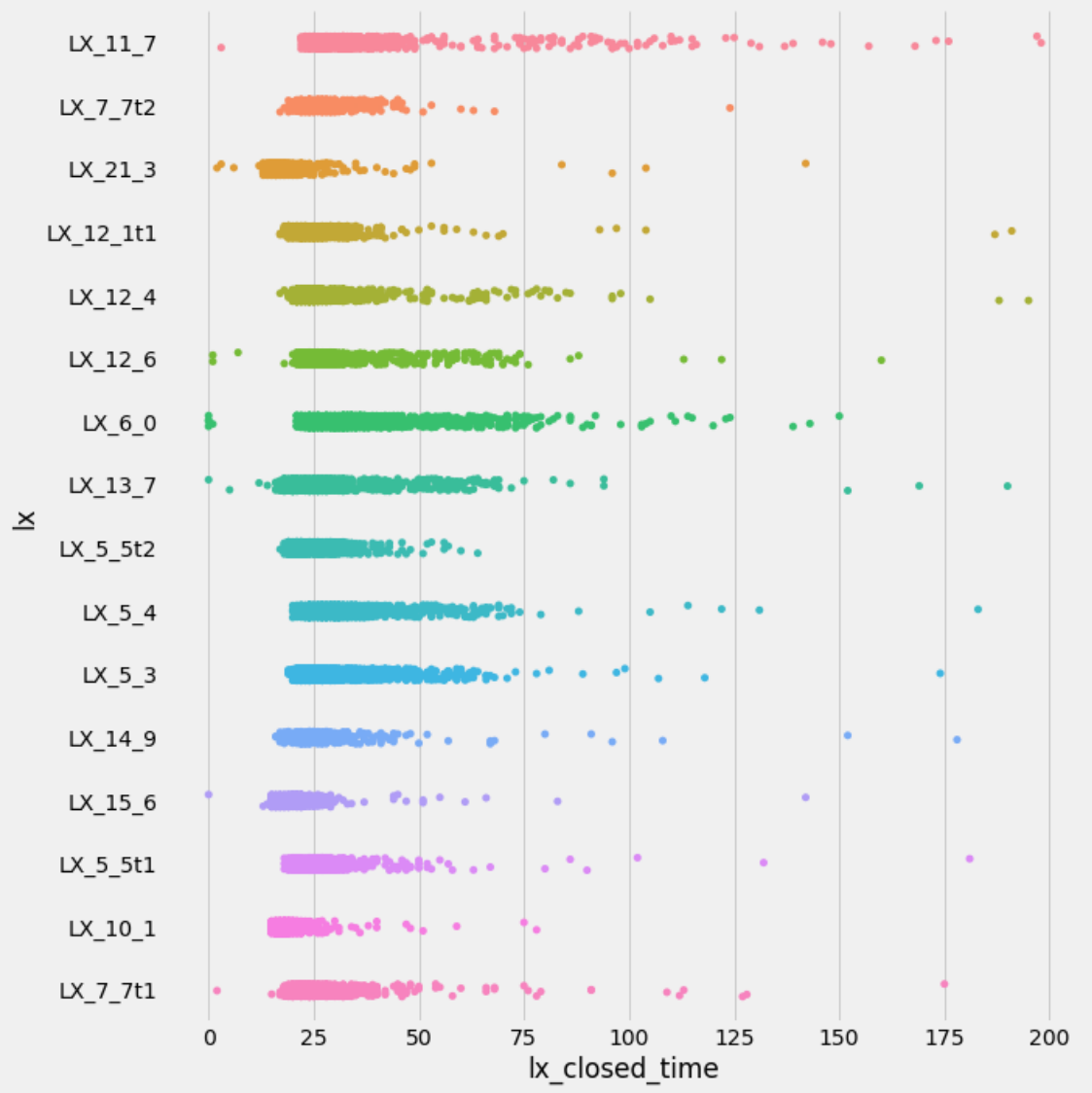
```
LX_5_5t2              637.0             345.0
LX_6_0                198.0            1608.0
LX_7_7t1               54.0             707.0
LX_7_7t2                NaN             672.0
```

In [15]:
```
lx_xcpr_time.groupby(['lx']).describe().round(1)
```

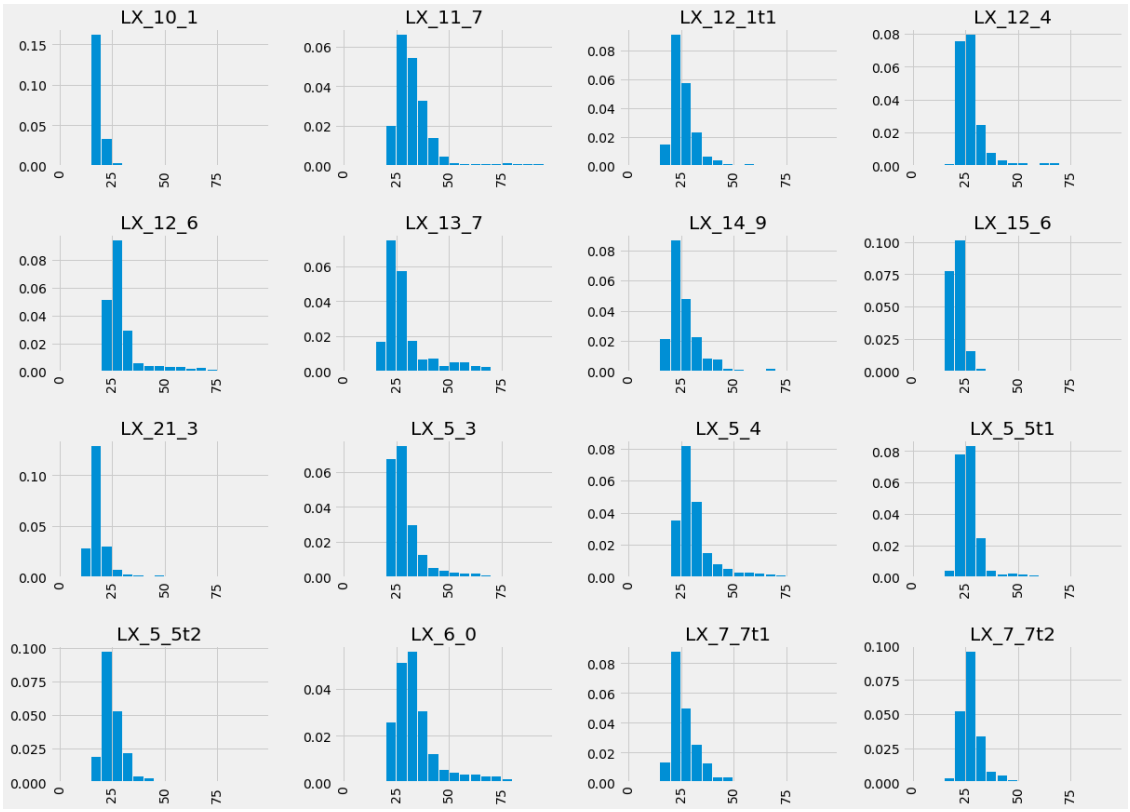
Out[15]:

	lx_closed_time							
	count	mean	std	min	25%	50%	75%	max
lx								
LX_10_1	1411.0	18.5	3.7	15.0	17.0	18.0	19.0	78.0
LX_11_7	1420.0	36.6	28.3	3.0	27.0	32.0	36.0	561.0
LX_12_1t1	650.0	27.0	16.5	17.0	22.0	24.0	28.0	311.0
LX_12_4	1216.0	28.6	14.3	17.0	23.0	26.0	29.0	312.0
LX_12_6	1185.0	30.2	13.9	1.0	24.0	27.0	30.0	244.0
LX_13_7	1089.0	39.1	152.5	0.0	22.0	25.0	30.0	4445.0
LX_14_9	364.0	28.5	22.3	16.0	22.0	24.0	28.2	350.0
LX_15_6	679.0	21.0	7.2	0.0	18.0	20.0	22.0	142.0
LX_21_3	687.0	18.2	8.5	2.0	15.0	16.0	19.0	142.0
LX_5_3	1760.0	28.9	9.6	19.0	24.0	26.0	30.2	174.0
LX_5_4	1759.0	30.9	10.1	20.0	25.0	29.0	32.0	183.0
LX_5_5t1	983.0	26.8	9.1	18.0	23.0	26.0	28.0	181.0
LX_5_5t2	983.0	25.0	5.6	17.0	21.0	24.0	27.0	64.0
LX_6_0	1820.0	35.2	17.1	0.0	27.0	32.0	37.0	317.0
LX_7_7t1	773.0	28.5	19.0	2.0	22.0	24.0	30.0	261.0
LX_7_7t2	673.0	27.7	6.6	17.0	24.0	27.0	29.0	124.0

In [22]:
```
pl1 = sns.catplot('lx_closed_time','lx', data=lx_xcpr_time[lx_xcpr_time.lx_closed_time
```




```
In [23]: pl2 = lx_xcpr_time.hist(column='lx_closed_time', bins=list(range(0,100,5)), by='lx',
                                 density=True, figsize=(20,15), rwidth=0.9, layout=(4,4))
```



1.1 Overweg dicht tijd >= 30sec

```
In [25]: lx_xcpr_time[lx_xcpr_time.lx_closed_time >= 30].groupby(['lx']).describe().round(1)
```

Out[25]:

	lx_closed_time							
	count	mean	std	min	25%	50%	75%	max
lx								
LX_10_1	16.0	43.9	15.2	30.0	33.2	39.0	48.8	78.0
LX_11_7	827.0	44.3	35.1	30.0	33.0	35.0	40.0	561.0
LX_12_1t1	124.0	42.0	33.4	30.0	31.0	33.0	38.0	311.0
LX_12_4	276.0	42.1	25.4	30.0	31.0	34.0	41.0	312.0
LX_12_6	327.0	42.6	21.7	30.0	31.0	34.0	48.5	244.0
LX_13_7	284.0	83.9	294.4	30.0	33.0	42.0	55.0	4445.0
LX_14_9	85.0	46.7	41.1	30.0	31.0	35.0	43.0	350.0
LX_15_6	19.0	49.8	26.5	30.0	32.5	44.0	53.0	142.0
LX_21_3	23.0	50.4	28.7	30.0	32.5	40.0	49.0	142.0
LX_5_3	513.0	39.0	12.8	30.0	32.0	34.0	41.0	174.0
LX_5_4	737.0	37.9	12.3	30.0	31.0	34.0	40.0	183.0
LX_5_5t1	174.0	37.6	17.0	30.0	31.0	32.0	37.0	181.0
LX_5_5t2	155.0	34.8	6.5	30.0	30.5	32.0	36.0	64.0
LX_6_0	1122.0	41.4	19.2	30.0	32.0	35.0	42.0	317.0

LX_7_7t1	196.0	43.9	32.9	30.0	32.0	35.0	40.0	261.0
LX_7_7t2	168.0	35.0	9.2	30.0	30.8	32.0	36.2	124.0

1.2 Overweg dicht tijd <= 180sec

```
In [26]: lx_xcpr_time[lx_xcpr_time.lx_closed_time <= 180].groupby(['lx']).describe().round(1)
```

Out[26]:

	lx_closed_time							
	count	mean	std	min	25%	50%	75%	max
lx								
LX_10_1	1411.0	18.5	3.7	15.0	17.0	18.0	19.0	78.0
LX_11_7	1411.0	35.0	17.0	3.0	27.0	32.0	36.0	176.0
LX_12_1t1	647.0	26.1	8.1	17.0	22.0	24.0	28.0	104.0
LX_12_4	1213.0	28.1	9.7	17.0	23.0	26.0	29.0	105.0
LX_12_6	1183.0	29.8	11.0	1.0	24.0	27.0	30.0	160.0
LX_13_7	1077.0	28.7	12.7	0.0	22.0	25.0	30.0	169.0
LX_14_9	363.0	27.7	14.6	16.0	22.0	24.0	28.0	178.0
LX_15_6	679.0	21.0	7.2	0.0	18.0	20.0	22.0	142.0
LX_21_3	687.0	18.2	8.5	2.0	15.0	16.0	19.0	142.0
LX_5_3	1760.0	28.9	9.6	19.0	24.0	26.0	30.2	174.0
LX_5_4	1758.0	30.8	9.4	20.0	25.0	28.5	32.0	131.0
LX_5_5t1	982.0	26.6	7.6	18.0	23.0	26.0	28.0	132.0
LX_5_5t2	983.0	25.0	5.6	17.0	21.0	24.0	27.0	64.0
LX_6_0	1816.0	34.8	13.9	0.0	27.0	32.0	37.0	150.0
LX_7_7t1	770.0	27.6	12.5	2.0	22.0	24.0	29.8	175.0
LX_7_7t2	673.0	27.7	6.6	17.0	24.0	27.0	29.0	124.0

2 Duur van storingsmelder actief in seconden:

```
In [27]: lx_xktepr_time.groupby(['lx']).describe().round(1)
```

Out[27]:

	lx_alarm_time						\
	count	mean	std	min	25%	50%	75%
lx							
LX_11_7	12.0	102.8	119.6	8.0	30.0	66.0	100.2
LX_12_1t1	3.0	68.3	69.9	26.0	28.0	30.0	89.5
LX_12_4	3.0	72.3	69.1	29.0	32.5	36.0	94.0
LX_12_6	2.0	75.5	12.0	67.0	71.2	75.5	79.8
LX_13_7	2.0	6266.0	8690.3	121.0	3193.5	6266.0	9338.5
LX_14_9	2.0	103.5	122.3	17.0	60.2	103.5	146.8
LX_15_6	4.0	672.8	885.7	39.0	120.8	345.5	897.5
LX_21_3	6.0	658.3	697.9	1.0	59.0	563.0	1142.0
LX_5_3	1.0	12.0	NaN	12.0	12.0	12.0	12.0
LX_5_4	1.0	22.0	NaN	22.0	22.0	22.0	22.0
LX_5_5t1	1.0	20.0	NaN	20.0	20.0	20.0	20.0
LX_6_0	4.0	83.0	50.0	47.0	59.0	64.0	88.0
LX_7_7t1	4.0	76.5	42.5	13.0	72.2	96.0	100.2

	max
lx	
LX_11_7	399.0
LX_12_1t1	149.0
LX_12_4	152.0
LX_12_6	84.0
LX_13_7	12411.0
LX_14_9	190.0
LX_15_6	1961.0
LX_21_3	1597.0
LX_5_3	12.0
LX_5_4	22.0
LX_5_5t1	20.0
LX_6_0	157.0
LX_7_7t1	101.0