Data_Cleaning

July 9, 2020

1 Selection and cleaning of the Data Set

This is part of Chapter 6

The statistics shown here intend to enlighten the characteristics of the data set used to contruct the ABM.

The data was provided by the PMMG, to whom we are very thankful.

The **programmer** is Eric Araujo.

The **last update** was in 12/09/2019

[1]:
```
import pandas as pd
import matplotlib.pyplot as plt
plt.style.use('ggplot')
import geopandas
import descartes
import numpy as np

import folium
import seaborn as sns

%matplotlib inline
```

[2]:
```
xls = pd.ExcelFile('data/Lavras.xls')
registers = pd.read_excel(xls, 'OCORRENCIAS')
involved = pd.read_excel(xls, 'ENVOLVIDOS')
#materials = pd.read_excel(xls, 'MATERIAIS')
```

[6]:
```
registers.head(2)
```

[6]:
```
   Ano Fato                 Bairro  \
0      2014  ANISIO ALVES DE ABREU
1      2014  ANISIO ALVES DE ABREU

                        Desc Longa Meio Utilizado  \
0  AGRESSAO FISICA SEM EMPREGO DE INSTRUMENTOS
1                                 ARMAS DE FOGO
```

```
                 Desc Longa Subgrupo Complemento Nat  \
0  BENS / VALORES DE ESTABELECIMENTO /PESSOA JURI…
1  BENS / VALORES DE ESTABELECIMENTO /PESSOA JURI…

  Descrição Longa Local Imediato Descrição Subclasse Nat Principal  \
0           POSTO DE COMBUSTIVEL                             ROUBO
1           POSTO DE COMBUSTIVEL                             ROUBO

  Dia da Semana Fato  Dia Numérico Fato          Faixa 1 Hora Fato   Latitude  \
0       QUARTA-FEIRA                  8  De 03:00 as 03:59         -21.254166
1       QUARTA-FEIRA                 29  De 00:00 as 00:59         -21.254166

   Longitude  Mês Numérico Fato Município         Número REDS  \
0 -44.999031                  1    LAVRAS  2014-000525047-001
1 -44.999031                  1    LAVRAS  2014-002172720-001

  Tentado/Consumado Nat Principal UNIDADE_AREA   Unidade Área Militar  \
0                         TENTADO       08 BPM  54 CIA PM/8 BPM/6 RPM
1                       CONSUMADO       08 BPM  54 CIA PM/8 BPM/6 RPM

   Município - Código
0              313820
1              313820
```

[7]:

```
len(registers)
```

[7]:

```
910
```

[8]:

```
involved.head(2)
```

[8]:

```
          Número REDS                Tipo Envolvimento  Idade Aparente  Cútis  \
0  2014-000053870-001  VITIMA DE ACAO CRIMINAL / CIVEL            43.0  PARDA
1  2014-000143918-001  VITIMA DE ACAO CRIMINAL / CIVEL            22.0  NEGRA

       Deficiência Física Estado Civil            Grau Lesão  \
0  PREENCHIMENTO OPCIONAL       CASADO  SEM LESOES APARENTES
1  PREENCHIMENTO OPCIONAL     SOLTEIRO  SEM LESOES APARENTES

                                  Escolaridade      Prisão / Apreensão  \
0              ENSINO MEDIO COMPLETO (2º GRAU)  PREENCHIMENTO OPCIONAL
1  ENSINO FUNDAMENTAL COMPLETO (8 ANOS ESTUDO)  PREENCHIMENTO OPCIONAL

        Sexo Ocupação Atual Nacionalidade
0  MASCULINO            NaN    BRASILEIRA
1  MASCULINO            NaN    BRASILEIRA
```

1.1 Structuring and selecting data for registers

[9]:

```
# Renaming registers columns
translate_cols = {'Ano Fato': 'year',
                  'Mês Numérico Fato': 'month',
                  'Dia Numérico Fato': 'day',
                  'Dia da Semana Fato': 'week_day',
                  'Bairro': 'neighborhood',
                  'Desc Longa Meio Utilizado': 'violence_type',
                  'Desc Longa Subgrupo Complemento Nat': 'type_object_robbed',
                  'Descrição Longa Local Imediato': 'location_description',
                  'Descrição Subclasse Nat Principal': 'crime_type',
                  'Faixa 1 Hora Fato': 'one_h_window',
                  'Latitude': 'lat',
                  'Longitude': 'lon',
                  'Município': 'city',
                  'Número REDS': 'reds',
                  'Tentado/Consumado Nat Principal': 'committed',
                  'UNIDADE_AREA': 'pm_area',
                  'Unidade Área Militar': 'pm_unity',
                  'Município - Código': 'city_code'
                 }
registers.rename(columns=translate_cols, inplace=True)

# Removing irrelevant columns for registers
registers = registers[['year', 'neighborhood', 'violence_type',␣
 ↪'type_object_robbed',
       'location_description', 'crime_type', 'week_day', 'day',
       'one_h_window', 'lat', 'lon', 'month', 'city', 'reds', 'committed',
       ]]

# Selecting data from the years (2014-2018)
registers = registers[registers.year.isin([2014,2015,2016,2017,2018])]

# Removing white spaces in one_h_window column
registers.one_h_window = registers.one_h_window.str.rstrip()


# Changing time windows
one_h_replacement_dict = {   'De 00:00 as 00:59': '00:00 - 00:59',
                             'De 01:00 as 01:59': '01:00 - 01:59',
                             'De 02:00 as 02:59': '02:00 - 02:59',
                             'De 03:00 as 03:59': '03:00 - 03:59',
                             'De 04:00 as 04:59': '04:00 - 04:59',
                             'De 05:00 as 05:59': '05:00 - 05:59',
                             'De 06:00 as 06:59': '06:00 - 06:59',
                             'De 07:00 as 07:59': '07:00 - 07:59',
                             'De 08:00 as 08:59': '08:00 - 08:59',
                             'De 09:00 as 09:59': '09:00 - 09:59',
                             'De 10:00 as 10:59': '10:00 - 10:59',
                             'De 11:00 as 11:59': '11:00 - 11:59',
                             'De 12:00 as 12:59': '12:00 - 12:59',
                             'De 13:00 as 13:59': '13:00 - 13:59',
                             'De 14:00 as 14:59': '14:00 - 14:59',
                             'De 15:00 as 15:59': '15:00 - 15:59',
                             'De 16:00 as 16:59': '16:00 - 16:59',
                             'De 17:00 as 17:59': '17:00 - 17:59',
                             'De 18:00 as 18:59': '18:00 - 18:59',
                             'De 19:00 as 19:59': '19:00 - 19:59',
                             'De 20:00 as 20:59': '20:00 - 20:59',
                             'De 21:00 as 21:59': '21:00 - 21:59',
                             'De 22:00 as 22:59': '22:00 - 22:59',
                             'De 23:00 as 23:59': '23:00 - 23:59'}

registers.one_h_window.replace(one_h_replacement_dict, inplace=True)

# Input NaN to missing values in the data set
missing_values = ['INVÁLIDO', 'ESCOLARIDADE - IGNORADA', 'IGNORADA',␣
 ↪'PREENCHIMENTO OPCIONAL', 'INVALIDO',
                  'ESTADO CIVIL - IGNORADO', 'ESTADO CIVIL - NAO DECLARADO',␣
 ↪'PREENCHIMENTO OPCIONAL',
                  'GRAU DA LESAO - IGNORADO' ]
registers.replace(to_replace=missing_values, value=np.nan, inplace=True)
```

[11]:

```
# No duplicates
print('Number of registers in the file: \t', len(registers))
print('Number of unique REDS - IDs: \t\t', len(set(registers.reds)))
```

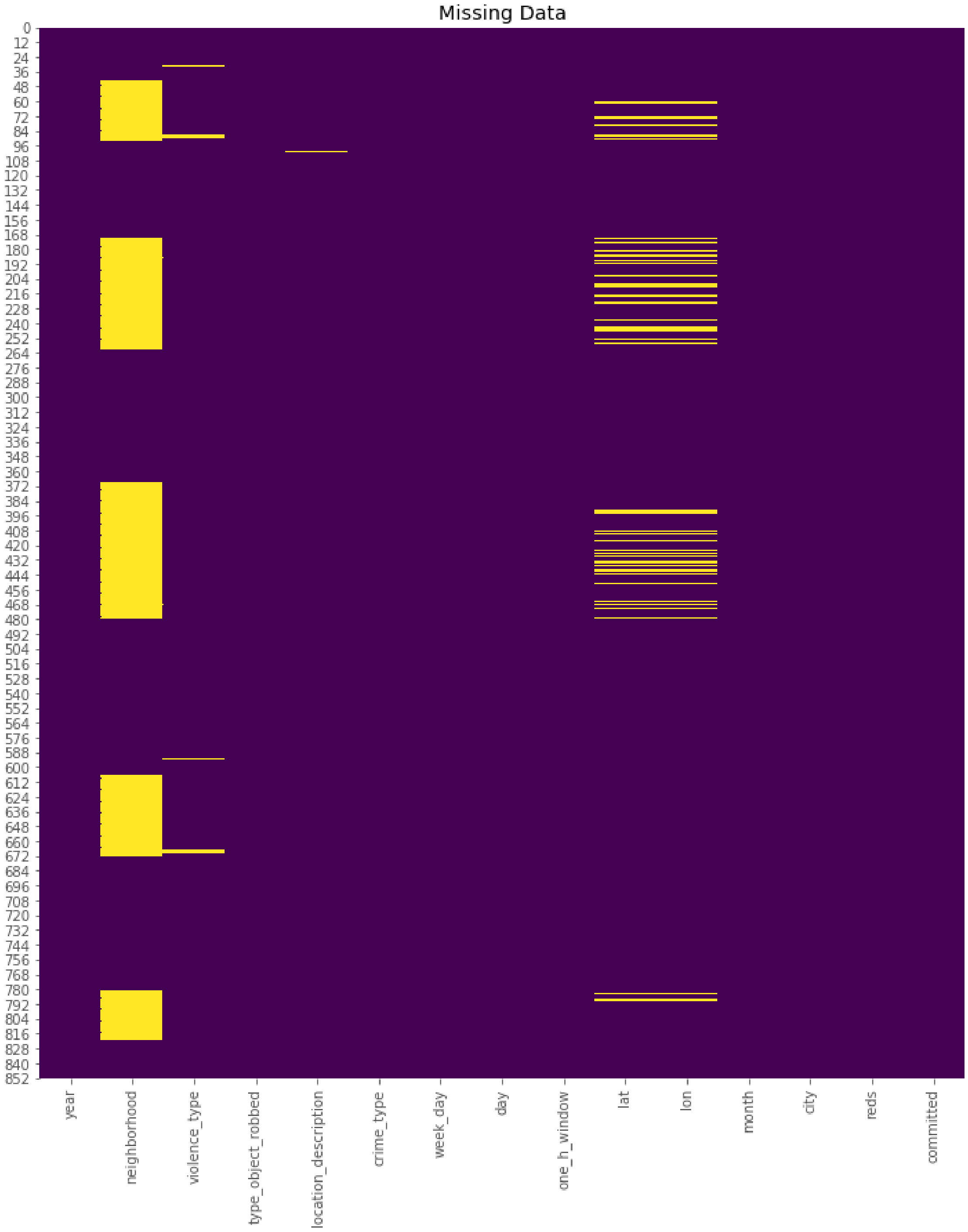
```
Number of registers in the file:         862
Number of unique REDS - IDs:             862
```

[12]:

```
plt.figure(figsize=(12,14))
sns.heatmap(registers.isnull(), cbar = False, cmap = 'viridis')
plt.title('Missing Data')
```

[12]:

```
Text(0.5, 1, 'Missing Data')
```



[13]:
```
miss_amount = len(registers[(pd.isna(registers.lat)) | (pd.isna(registers.
 ↪lon))])
print('Registers without lat or lon: \t', miss_amount)
print('Total registers: \t\t', len(registers))
print('Percentage of missing data: \t', miss_amount*100/len(registers), '%')
```

```
Registers without lat or lon:    59
Total registers:                 862
Percentage of missing data:      6.844547563805104 %
```

```
[14]: registers.dropna(axis=0, subset=['lat', 'lon'], inplace=True)
      len(registers)
```

```
[14]: 803
```

```
[10]: # Location description
      pd.value_counts(registers.location_description)[:10]
```

```
[10]: VIA DE ACESSO PUBLICA                                 407
      POSTO DE COMBUSTIVEL                                  113
      BAR / LANCHONETE / RESTAURANTE / SIMILAR               62
      OUTROS - ESTABELECIMENTOS COMERCIAIS / SERVICOS        29
      CASA                                                   29
      MERCEARIA / SACOLAO / SUPERMERCADO                     27
      CONFEITARIA / PADARIA / PANIFICADORA                   24
      LOJA DIVERSA                                           16
      SITIO                                                  12
      BOATE / CASA DE SHOW / SIMILAR                         11
      Name: location_description, dtype: int64
```

```
[11]: 407/803
```

```
[11]: 0.5068493150684932
```

```
[12]: # Select crimes on the streets and reset index
      registers_streets = registers[registers.location_description=='VIA DE ACESSO␣
       ↪PUBLICA']
      registers_streets.reset_index(drop=True, inplace=True)
```

```
[13]: location_comparison_df = pd.DataFrame([registers.year.value_counts().
       ↪sort_index(ascending=False),
                                             registers_streets.year.value_counts().
       ↪sort_index(ascending=False)],
                                             index=['Total', 'Streets']).T
```

```
[14]: location_comparison_df
```

```
[14]:       Total  Streets
      2018    121       66
      2017    187      101
      2016    221      104
```

```
2015    161       77
2014    113       59
```

[15]:

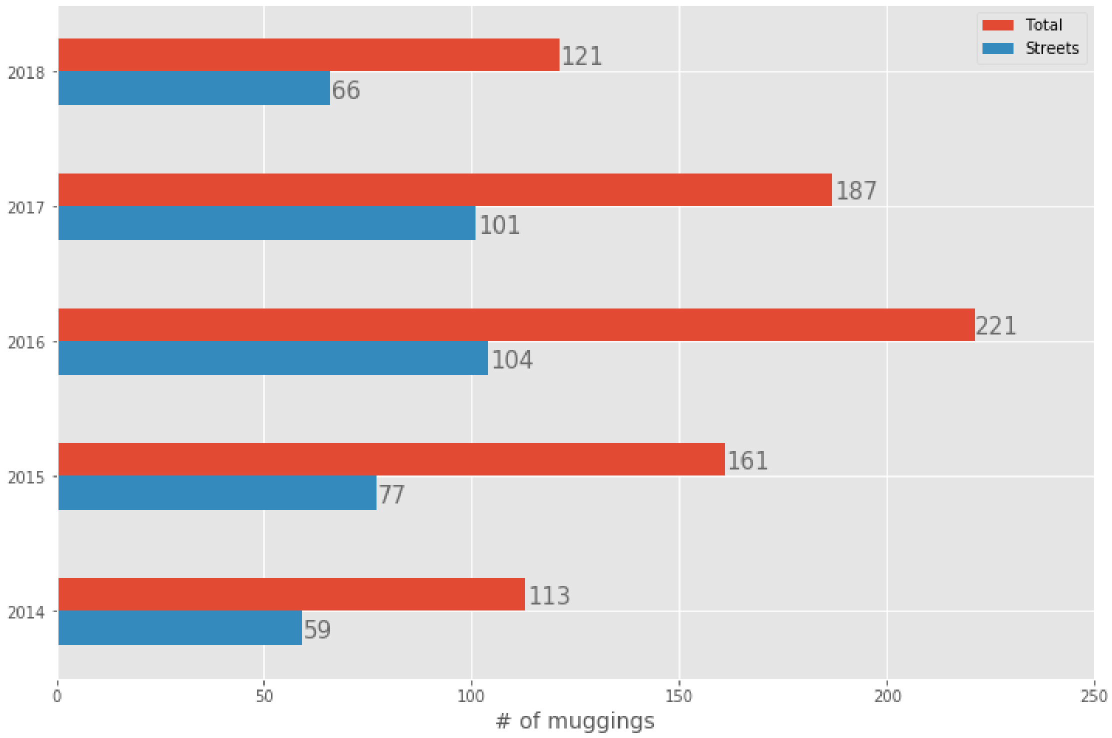
```
location_comparison_df.sum()
```

[15]:

```
Total      803
Streets    407
dtype: int64
```

[16]:

```
# Crimes per year
ax = location_comparison_df.plot(kind='barh', figsize=((12,8)))

ax.set_alpha(0.8)
#plt.title('Robberies per year in Lavras (2014-2018)', fontsize=18)
plt.xlabel('# of muggings', fontsize=14)
plt.xlim(0,250)
# create a list to collect the plt.patches data
totals = []

# find the values and append to list
for i in ax.patches:
    totals.append(i.get_width())
    #print(totals)

for i in ax.patches:
    # get_width pulls left or right; get_y pushes up or down
    ax.text(i.get_width()+.3, i.get_y()+.2, \
            str(round((i.get_width()), 2)), fontsize=15,
color='dimgrey')
# invert for largest on top
ax.invert_yaxis()
```



1.2 Selecting data within map limits

lower_x = -45.0059971

higher_x = -44.9870231

lower_y = -21.2479824

higher_y = -21.2360275

[17]:

```
# Limits for lat and lon
# x
lower_lon = -45.0059971
higher_lon = -44.9870231
# y
lower_lat = -21.2479824
higher_lat = -21.2360275
```

[18]:

```
# Selecting registers based on GIS limits
reg_streets_gis = registers_streets[(registers_streets.lat >= lower_lat) &␣
 ↪(registers_streets.lat <= higher_lat) &
                                    (registers_streets.lon >= lower_lon) &␣
 ↪(registers_streets.lon <= higher_lon)]
print('Registers of muggings in the streets within GIS limist: ',␣
 ↪len(reg_streets_gis))
```

```
Registers of muggings in the streets within GIS limist:  113
```

[19]:

```
mugggings_comparison_df = pd.DataFrame([registers.year.value_counts().
 ↪sort_index(ascending=False),
                                       registers_streets.year.value_counts().
 ↪sort_index(ascending=False),
                                       reg_streets_gis.year.value_counts().
 ↪sort_index(ascending=False)],
                                       index=['Total', 'Streets', 'Streets + GIS␣
 ↪limits']).T
```

[20]:

```
mugggings_comparison_df
```

[20]:

```
      Total  Streets  Streets + GIS limits
2018    121       66                    14
2017    187      101                    26
2016    221      104                    31
2015    161       77                    22
2014    113       59                    20
```

[21]:

```
mugggings_comparison_df.sum()
```

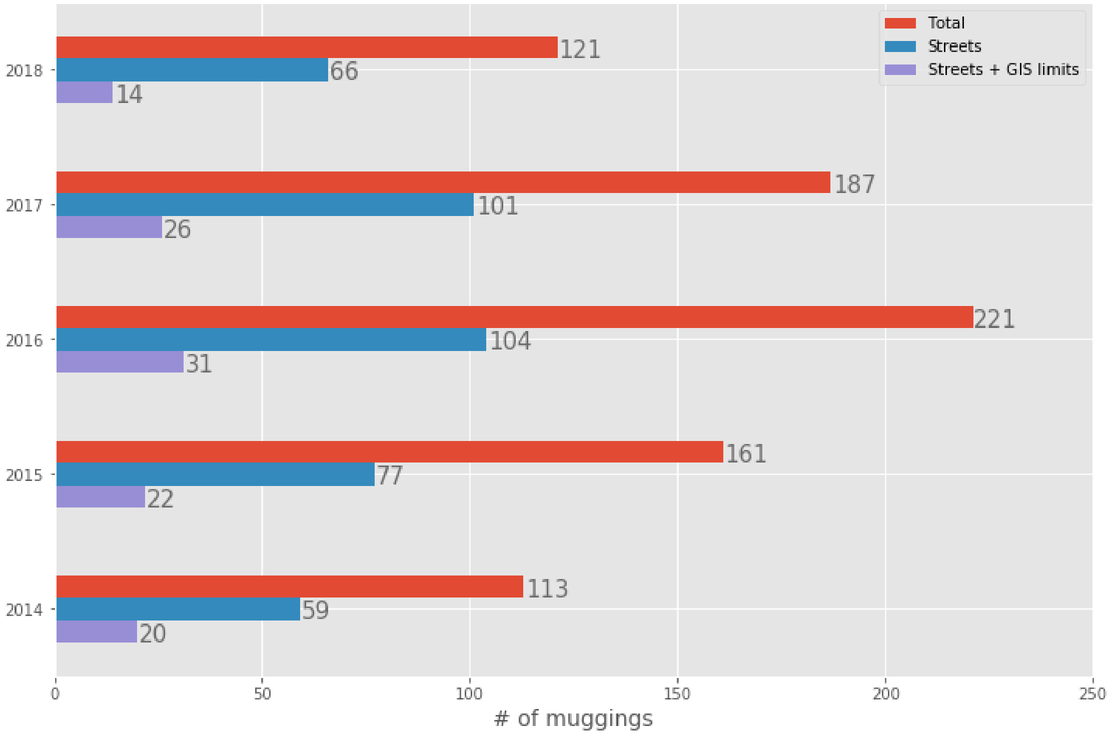
[21]:

```
Total                   803
Streets                 407
Streets + GIS limits    113
dtype: int64
```

[22]:

```
# Crimes per year
ax = mugggings_comparison_df.plot(kind='barh', figsize=((12,8)))

ax.set_alpha(0.8)
#plt.title('Robberies per year in Lavras (2014-2018)', fontsize=18)
plt.xlabel('# of muggings', fontsize=14)
plt.xlim(0,250)
# create a list to collect the plt.patches data
totals = []

# find the values and append to list
for i in ax.patches:
    totals.append(i.get_width())
    #print(totals)

for i in ax.patches:
    # get_width pulls left or right; get_y pushes up or down
    ax.text(i.get_width()+.3, i.get_y()+.16, \
            str(round((i.get_width()), 2)), fontsize=15,
color='dimgrey')
```

```
# invert for largest on top
ax.invert_yaxis()
```



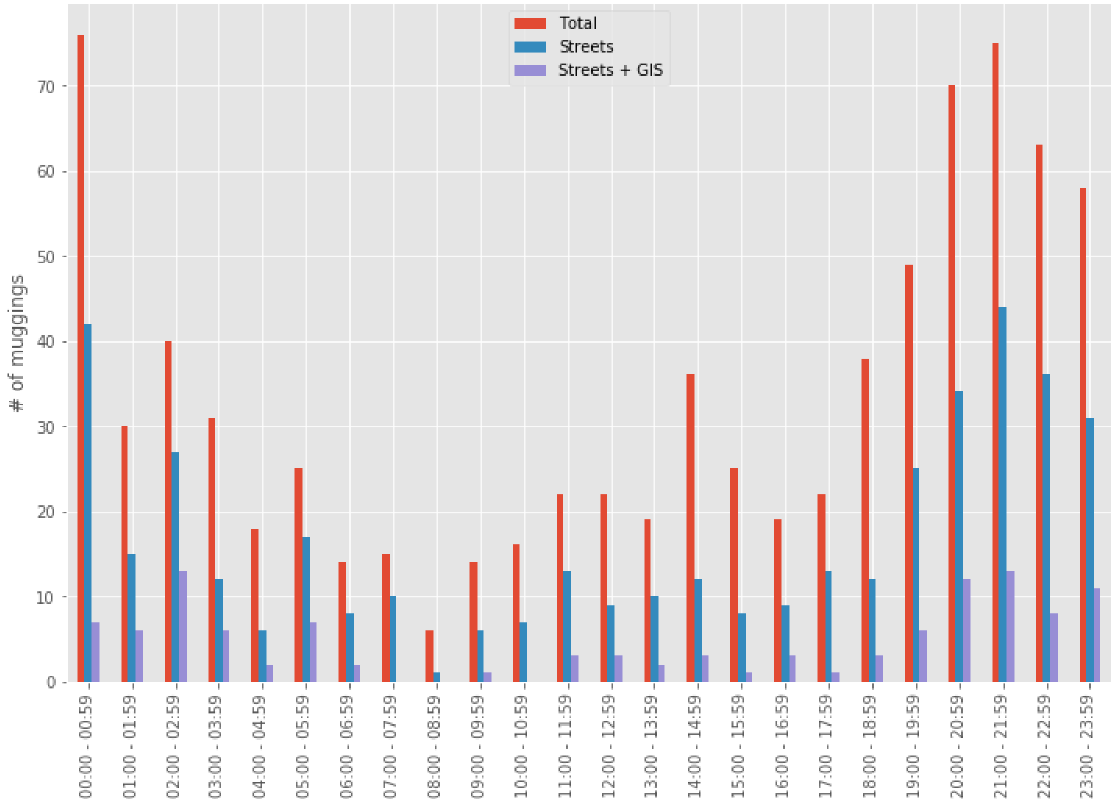
[23]:
```
reg_streets_gis.reset_index(drop=True, inplace=True)
reg_streets_gis.head(2)
```

[23]:
```
   year neighborhood                                violence_type  \
0  2014       CENTRO  AGRESSAO FISICA SEM EMPREGO DE INSTRUMENTOS
1  2014       CENTRO  AGRESSAO FISICA SEM EMPREGO DE INSTRUMENTOS

             type_object_robbed   location_description crime_type week_day  \
0  BENS / VALORES DE TRANSEUNTE  VIA DE ACESSO PUBLICA      ROUBO  DOMINGO
1  BENS / VALORES DE TRANSEUNTE  VIA DE ACESSO PUBLICA      ROUBO   SÁBADO

   day   one_h_window        lat        lon  month    city  \
0   29  22:00 - 22:59 -21.241168 -44.998860      6  LAVRAS
1    4  02:00 - 02:59 -21.246095 -45.000668      1  LAVRAS

                 reds  committed
0  2014-013823194-001    TENTADO
1  2014-000231361-001  CONSUMADO
```

```
[24]: reg_time_df = pd.DataFrame([registers.one_h_window.value_counts().sort_index(),
                     registers_streets.one_h_window.value_counts().sort_index(),
                     reg_streets_gis.one_h_window.value_counts().sort_index()],
                    index=['Total', 'Streets', 'Streets + GIS']
                   ).T.fillna(0)
```

```
[25]: ax = reg_time_df.plot(kind='bar', figsize=((12,8)))
      #ax.set_xlabel('Time of the day')
      ax.set_ylabel('# of muggings')
```

```
[25]: Text(0, 0.5, '# of muggings')
```



```
[26]: reg_time_df['Total (%)'] = reg_time_df['Total']*100 / sum(reg_time_df['Total'])
      reg_time_df['Streets (%)'] = reg_time_df['Streets']*100 /␣
       ↪sum(reg_time_df['Streets'])
      reg_time_df['Streets + GIS (%)'] = reg_time_df['Streets + GIS']*100 /␣
       ↪sum(reg_time_df['Streets + GIS'])
```

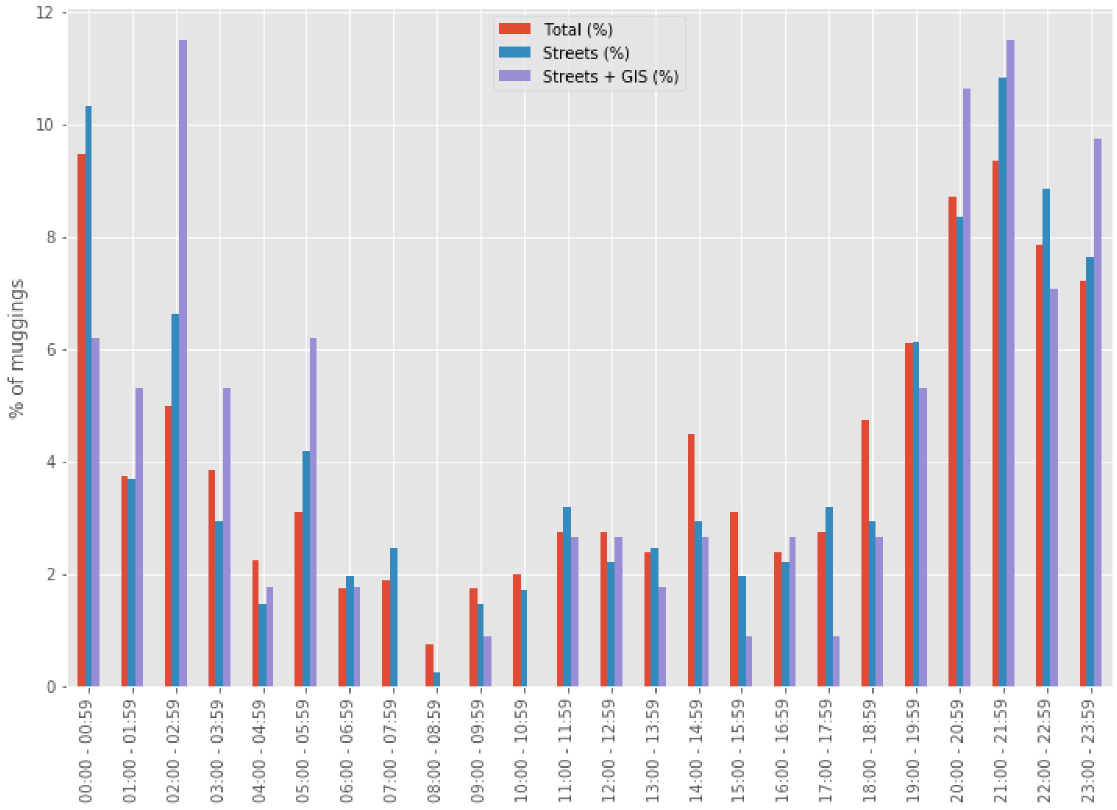
```
[27]: reg_time_df
```

```
[27]:                Total  Streets  Streets + GIS  Total (%)  Streets (%)  \
      00:00 - 00:59   76.0     42.0            7.0   9.464508    10.319410
      01:00 - 01:59   30.0     15.0            6.0   3.735990     3.685504
      02:00 - 02:59   40.0     27.0           13.0   4.981320     6.633907
      03:00 - 03:59   31.0     12.0            6.0   3.860523     2.948403
      04:00 - 04:59   18.0      6.0            2.0   2.241594     1.474201
      05:00 - 05:59   25.0     17.0            7.0   3.113325     4.176904
      06:00 - 06:59   14.0      8.0            2.0   1.743462     1.965602
      07:00 - 07:59   15.0     10.0            0.0   1.867995     2.457002
      08:00 - 08:59    6.0      1.0            0.0   0.747198     0.245700
      09:00 - 09:59   14.0      6.0            1.0   1.743462     1.474201
      10:00 - 10:59   16.0      7.0            0.0   1.992528     1.719902
      11:00 - 11:59   22.0     13.0            3.0   2.739726     3.194103
      12:00 - 12:59   22.0      9.0            3.0   2.739726     2.211302
      13:00 - 13:59   19.0     10.0            2.0   2.366127     2.457002
      14:00 - 14:59   36.0     12.0            3.0   4.483188     2.948403
      15:00 - 15:59   25.0      8.0            1.0   3.113325     1.965602
      16:00 - 16:59   19.0      9.0            3.0   2.366127     2.211302
      17:00 - 17:59   22.0     13.0            1.0   2.739726     3.194103
      18:00 - 18:59   38.0     12.0            3.0   4.732254     2.948403
      19:00 - 19:59   49.0     25.0            6.0   6.102117     6.142506
      20:00 - 20:59   70.0     34.0           12.0   8.717310     8.353808
      21:00 - 21:59   75.0     44.0           13.0   9.339975    10.810811
      22:00 - 22:59   63.0     36.0            8.0   7.845579     8.845209
      23:00 - 23:59   58.0     31.0           11.0   7.222914     7.616708

                     Streets + GIS (%)
      00:00 - 00:59           6.194690
      01:00 - 01:59           5.309735
      02:00 - 02:59          11.504425
      03:00 - 03:59           5.309735
      04:00 - 04:59           1.769912
      05:00 - 05:59           6.194690
      06:00 - 06:59           1.769912
      07:00 - 07:59           0.000000
      08:00 - 08:59           0.000000
      09:00 - 09:59           0.884956
      10:00 - 10:59           0.000000
      11:00 - 11:59           2.654867
      12:00 - 12:59           2.654867
      13:00 - 13:59           1.769912
      14:00 - 14:59           2.654867
      15:00 - 15:59           0.884956
      16:00 - 16:59           2.654867
      17:00 - 17:59           0.884956
      18:00 - 18:59           2.654867
      19:00 - 19:59           5.309735
```

```
20:00 - 20:59         10.619469
21:00 - 21:59         11.504425
22:00 - 22:59          7.079646
23:00 - 23:59          9.734513
```

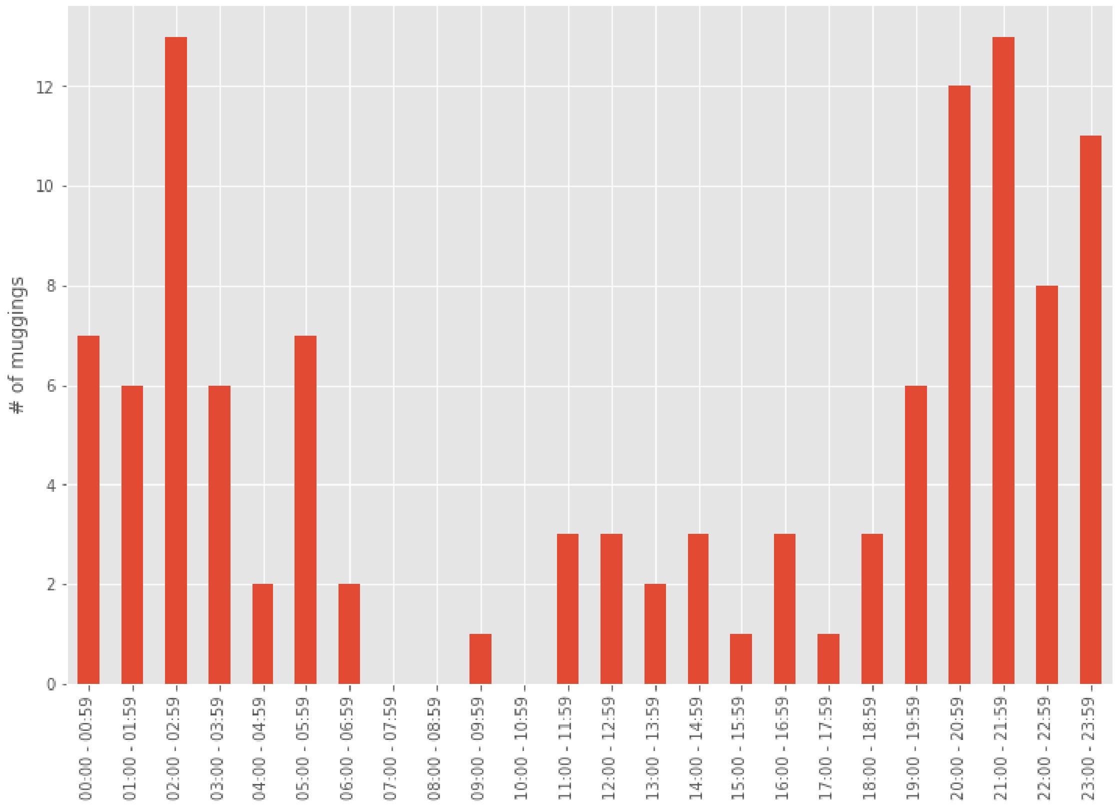
```
[28]: ax = reg_time_df[['Total (%)', 'Streets (%)', 'Streets + GIS (%)']].
       ↪plot(kind='bar', figsize=((12,8)))
      #ax.set_xlabel('Time of the day')
      ax.set_ylabel('% of muggings')
```

```
[28]: Text(0, 0.5, '% of muggings')
```



```
[29]: ax = reg_time_df['Streets + GIS'].plot(kind='bar', figsize=((12,8)))
      #ax.set_xlabel('Time of the day')
      ax.set_ylabel('# of muggings')
```

```
[29]: Text(0, 0.5, '# of muggings')
```

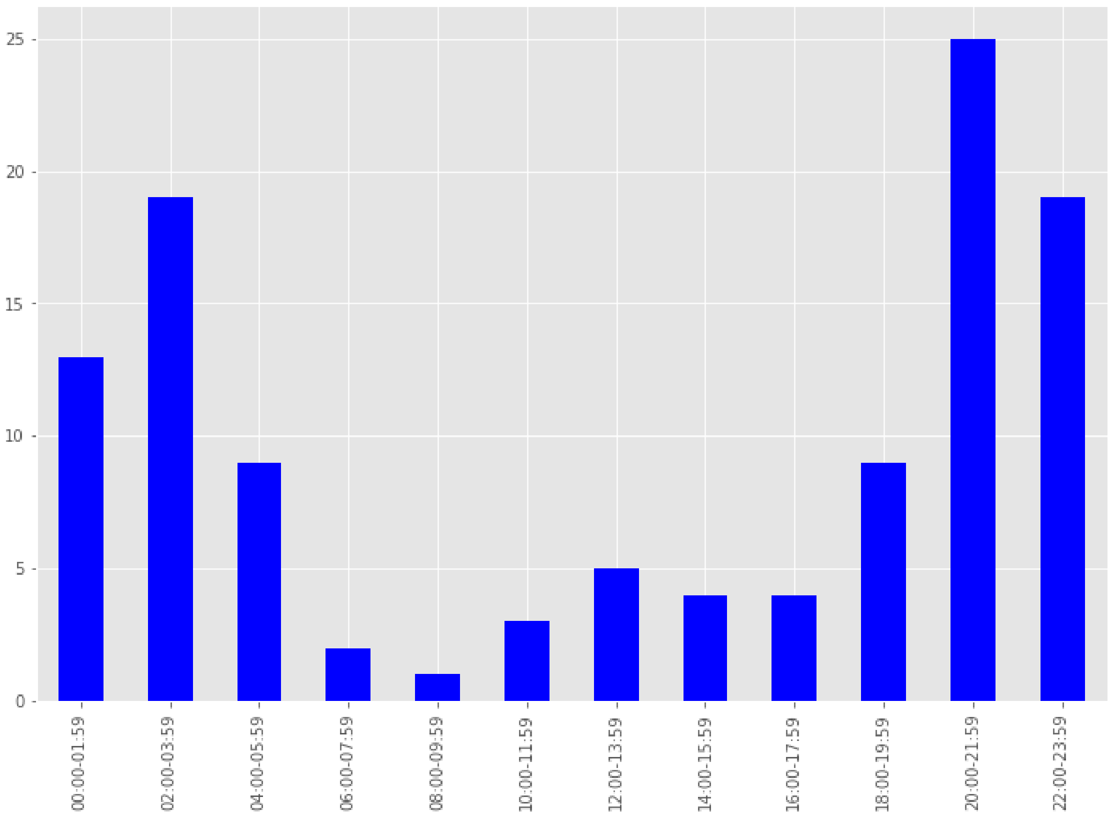


```
[30]: time_hist = pd.Series(reg_time_df['Streets + GIS'])
      #time_hist['Label'] = reg_time_df.index
      time_hist.reset_index(inplace=True, drop=True)
```

```
[31]: time_hist_2h = pd.Series([time_hist[i]+time_hist[i+1] for i in np.arange(0, 23,␣
       ↪2)],
                               index=['00:00-01:59', '02:00-03:59', '04:00-05:59',␣
       ↪'06:00-07:59', '08:00-09:59',
                                      '10:00-11:59', '12:00-13:59', '14:00-15:59',␣
       ↪'16:00-17:59', '18:00-19:59',
                                      '20:00-21:59', '22:00-23:59'])
```

```
[32]: time_hist_2h.plot(kind='bar', figsize=((12,8)), color='blue', )
```

```
[32]: <matplotlib.axes._subplots.AxesSubplot at 0x13416d1d0>
```



[33]:
```
# Array used in the netlogo code for the variable
# crime-rates-per-hour [13, 13, 19, 19, 9, 9, 2, 2, 1, 1, 3, 3, 5, 5, 4, 4, 4,␣
 ↪4, 9, 9, 25, 25, 19, 19]
list(time_hist_2h/sum(time_hist_2h))
```

[33]:
```
[0.11504424778761062,
 0.168141592920354,
 0.07964601769911504,
 0.017699115044247787,
 0.008849557522123894,
 0.02654867256637168,
 0.04424778761061947,
 0.035398230088495575,
 0.035398230088495575,
 0.07964601769911504,
 0.22123893805309736,
 0.168141592920354]
```

[34]:
```
sum(time_hist_2h)
```

[34]:
```
113.0
```

```
[37]: sum(reg_time_df['Streets + GIS'])
```

```
[37]: 113.0
```

```
[38]: reg_time_df['Streets + GIS']
```

```
[38]: 0      7.0
      1      6.0
      2     13.0
      3      6.0
      4      2.0
      5      7.0
      6      2.0
      7      0.0
      8      0.0
      9      1.0
      10     0.0
      11     3.0
      12     3.0
      13     2.0
      14     3.0
      15     1.0
      16     3.0
      17     1.0
      18     3.0
      19     6.0
      20    12.0
      21    13.0
      22     8.0
      23    11.0
      Name: Streets + GIS, dtype: float64
```

```
[ ]:
```