# DATA CLEANING

August 7, 2023

### 0.0.1 Finding missing data

```
[ ]:
```

```
[1]: import pandas as pd
     import numpy as np
```

```
[ ]:
```

```
[2]: build_permits = pd.read_csv('Building_Permits.csv')
```

```
/usr/lib/python3/dist-packages/IPython/core/interactiveshell.py:3457:
DtypeWarning: Columns (22,32) have mixed types.Specify dtype option on import or
set low_memory=False.
  exec(code_obj, self.user_global_ns, self.user_ns)
```

```
[3]: build_permits.head()
```

```
[3]:   Permit Number  Permit Type            Permit Type Definition  \
     0  201505065519            4                      sign - erect
     1  201604195146            4                      sign - erect
     2  201605278609            3  additions alterations or repairs
     3  201611072166            8            otc alterations permit
     4  201611283529            6                       demolitions

       Permit Creation Date Block  Lot  Street Number Street Number Suffix  \
     0           05/06/2015  0326  023            140                  NaN
     1           04/19/2016  0306  007            440                  NaN
     2           05/27/2016  0595  203           1647                  NaN
     3           11/07/2016  0156  011           1230                  NaN
     4           11/28/2016  0342  001            950                  NaN

       Street Name Street Suffix  …  Existing Construction Type  \
     0       Ellis            St  …                         3.0
     1       Geary            St  …                         3.0
     2     Pacific            Av  …                         1.0
     3     Pacific            Av  …                         5.0
     4      Market            St  …                         3.0
```

```
  Existing Construction Type Description Proposed Construction Type  \
0                          constr type 3                        NaN   
1                          constr type 3                        NaN   
2                          constr type 1                        1.0   
3                         wood frame (5)                        5.0   
4                          constr type 3                        NaN   

  Proposed Construction Type Description Site Permit Supervisor District  \
0                                    NaN         NaN                 3.0   
1                                    NaN         NaN                 3.0   
2                          constr type 1         NaN                 3.0   
3                         wood frame (5)         NaN                 3.0   
4                                    NaN         NaN                 6.0   

  Neighborhoods - Analysis Boundaries  Zipcode  \
0                          Tenderloin  94102.0   
1                          Tenderloin  94102.0   
2                        Russian Hill  94109.0   
3                            Nob Hill  94109.0   
4                          Tenderloin  94102.0   

                                    Location      Record ID  
0  (37.785719256680785, -122.40852313194863)  1380611233945  
1   (37.78733980600732, -122.41063199757738)  1420164406718  
2    (37.7946573324287, -122.42232562979227)  1424856504716  
3   (37.79595867909168, -122.41557405519474)  1443574295566  
4   (37.78315261897309, -122.40950883997789)   144548169992  

[5 rows x 43 columns]
```

```
[ ]:
```

```
[4]: build_permits.shape
```

```
[4]: (198900, 43)
```

```
[5]: build_permits.isnull().head()
```

```
[5]:    Permit Number  Permit Type  Permit Type Definition  Permit Creation Date  \
     0          False        False                   False                 False   
     1          False        False                   False                 False   
     2          False        False                   False                 False   
     3          False        False                   False                 False   
     4          False        False                   False                 False   

        Block    Lot  Street Number  Street Number Suffix  Street Name  \
0  False  False          False                  True        False
1  False  False          False                  True        False
2  False  False          False                  True        False
3  False  False          False                  True        False
4  False  False          False                  True        False

   Street Suffix  …  Existing Construction Type  \
0          False  …                       False
1          False  …                       False
2          False  …                       False
3          False  …                       False
4          False  …                       False

   Existing Construction Type Description  Proposed Construction Type  \
0                                   False                        True
1                                   False                        True
2                                   False                       False
3                                   False                       False
4                                   False                        True

   Proposed Construction Type Description  Site Permit  Supervisor District  \
0                                    True         True                False
1                                    True         True                False
2                                   False         True                False
3                                   False         True                False
4                                    True         True                False

   Neighborhoods - Analysis Boundaries  Zipcode  Location  Record ID
0                                False    False     False      False
1                                False    False     False      False
2                                False    False     False      False
3                                False    False     False      False
4                                False    False     False      False

[5 rows x 43 columns]
```

[6]:

```python
# finding total missing values

total_missing_count = build_permits.isnull().sum()
total_missing = total_missing_count.sum()
print(total_missing)
```

```
2245941
```

[ ]:

```
```

[7]:

```
total_cells = np.product(build_permits.shape)
total_cells
```

[7]:

```
8552700
```

[8]:

```
# Percent of data that is missing

percent_missing = (total_missing/total_cells) * 100
print('Percent of data that is missing :',percent_missing)
```

```
Percent of data that is missing : 26.26002315058403
```

[9]:

```
build_permits.shape
```

[9]:

```
(198900, 43)
```

### 0.0.2 Drop missing Values

[10]:

```
build_permits.dropna()
```

[10]:

```
Empty DataFrame
Columns: [Permit Number, Permit Type, Permit Type Definition, Permit Creation
Date, Block, Lot, Street Number, Street Number Suffix, Street Name, Street
Suffix, Unit, Unit Suffix, Description, Current Status, Current Status Date,
Filed Date, Issued Date, Completed Date, First Construction Document Date,
Structural Notification, Number of Existing Stories, Number of Proposed Stories,
Voluntary Soft-Story Retrofit, Fire Only Permit, Permit Expiration Date,
Estimated Cost, Revised Cost, Existing Use, Existing Units, Proposed Use,
Proposed Units, Plansets, TIDF Compliance, Existing Construction Type, Existing
Construction Type Description, Proposed Construction Type, Proposed Construction
Type Description, Site Permit, Supervisor District, Neighborhoods - Analysis
Boundaries, Zipcode, Location, Record ID]
Index: []

[0 rows x 43 columns]
```

[11]:

```
build_permits.shape
```

[11]:

```
(198900, 43)
```

[12]:

```
# Remove the column with atleast one missing value

drop_column_wise = build_permits.dropna(axis = 1)
drop_column_wise.head()
```

[12]:

```
  Permit Number  Permit Type           Permit Type Definition  \
0  201505065519            4                     sign - erect
```

```
1  201604195146            4                      sign - erect
2  201605278609            3  additions alterations or repairs
3  201611072166            8            otc alterations permit
4  201611283529            6                       demolitions

  Permit Creation Date Block  Lot  Street Number Street Name Current Status  \
0           05/06/2015  0326  023            140       Ellis        expired
1           04/19/2016  0306  007            440       Geary         issued
2           05/27/2016  0595  203           1647     Pacific      withdrawn
3           11/07/2016  0156  011           1230     Pacific       complete
4           11/28/2016  0342  001            950      Market         issued

  Current Status Date  Filed Date      Record ID
0          12/21/2017  05/06/2015  1380611233945
1          08/03/2017  04/19/2016  1420164406718
2          09/26/2017  05/27/2016  1424856504716
3          07/24/2017  11/07/2016  1443574295566
4          12/01/2017  11/28/2016   144548169992
```

```
[13]: drop_column_wise.shape
```

```
[13]: (198900, 12)
```

```
[14]: # finding the how much data we lost?

      #
      original_data = build_permits.shape[1]
      #column wise we lose
      col_lose = drop_column_wise.shape[1]

      #how much data we lose
      data_lose = original_data - col_lose
      data_lose
```

```
[14]: 31
```

```
[ ]:
```

## 0.1 Filling in Missing Values Automatically

```
[ ]:
```

```
[15]: build_permits.fillna(0).head(2)
```

```
[15]:   Permit Number  Permit Type Permit Type Definition Permit Creation Date  \
      0  201505065519            4           sign - erect           05/06/2015
      1  201604195146            4           sign - erect           04/19/2016
```

```
  Block  Lot  Street Number Street Number Suffix Street Name Street Suffix  \
0  0326  023           140                    0       Ellis            St
1  0306  007           440                    0       Geary            St

   …  Existing Construction Type Existing Construction Type Description  \
0  …                         3.0                          constr type 3
1  …                         3.0                          constr type 3

  Proposed Construction Type Proposed Construction Type Description  \
0                        0.0                                      0
1                        0.0                                      0

  Site Permit Supervisor District Neighborhoods - Analysis Boundaries  \
0           0                 3.0                          Tenderloin
1           0                 3.0                          Tenderloin

   Zipcode                                  Location      Record ID
0  94102.0  (37.785719256680785, -122.40852313194863)  1380611233945
1  94102.0   (37.78733980600732, -122.41063199757738)  1420164406718

[2 rows x 43 columns]
```

[16]:
```
build_permits.head(2)
```

[16]:
```
  Permit Number  Permit Type Permit Type Definition Permit Creation Date  \
0  201505065519            4           sign - erect           05/06/2015
1  201604195146            4           sign - erect           04/19/2016

  Block  Lot  Street Number Street Number Suffix Street Name Street Suffix  \
0  0326  023           140                  NaN       Ellis            St
1  0306  007           440                  NaN       Geary            St

   …  Existing Construction Type Existing Construction Type Description  \
0  …                         3.0                          constr type 3
1  …                         3.0                          constr type 3

  Proposed Construction Type Proposed Construction Type Description  \
0                        NaN                                    NaN
1                        NaN                                    NaN

  Site Permit Supervisor District Neighborhoods - Analysis Boundaries  \
0         NaN                 3.0                          Tenderloin
1         NaN                 3.0                          Tenderloin

   Zipcode                                  Location      Record ID
0  94102.0  (37.785719256680785, -122.40852313194863)  1380611233945
```

```
1  94102.0   (37.78733980600732, -122.41063199757738)  1420164406718

[2 rows x 43 columns]
```

[23]:

```
# replace all NAN's the values that comes directly after/before it in the same␣
 ↪column,
#then replace all the remaining NAN's with 0

fill_null = build_permits.fillna(method = 'bfill',axis = 1, inplace = False).
 ↪fillna(0).head()
```

[24]:

```
fill_null
```

[24]:

```
  Permit Number  Permit Type            Permit Type Definition  \
0  201505065519            4                      sign - erect
1  201604195146            4                      sign - erect
2  201605278609            3  additions alterations or repairs
3  201611072166            8            otc alterations permit
4  201611283529            6                       demolitions

  Permit Creation Date Block  Lot  Street Number Street Number Suffix  \
0           05/06/2015  0326  023            140                Ellis
1           04/19/2016  0306  007            440                Geary
2           05/27/2016  0595  203           1647              Pacific
3           11/07/2016  0156  011           1230              Pacific
4           11/28/2016  0342  001            950               Market

  Street Name Street Suffix  … Existing Construction Type  \
0       Ellis            St  …                        3.0
1       Geary            St  …                        3.0
2     Pacific            Av  …                        1.0
3     Pacific            Av  …                        5.0
4      Market            St  …                        3.0

  Existing Construction Type Description Proposed Construction Type  \
0                          constr type 3                        3.0
1                          constr type 3                        3.0
2                          constr type 1                        1.0
3                         wood frame (5)                        5.0
4                          constr type 3                        6.0

  Proposed Construction Type Description Site Permit Supervisor District  \
0                                    3.0         3.0                 3.0
1                                    3.0         3.0                 3.0
2                          constr type 1         3.0                 3.0
3                         wood frame (5)         3.0                 3.0
4                                    6.0         6.0                 6.0
```

```
  Neighborhoods - Analysis Boundaries  Zipcode  \
0                          Tenderloin  94102.0
1                          Tenderloin  94102.0
2                        Russian Hill  94109.0
3                            Nob Hill  94109.0
4                          Tenderloin  94102.0

                                 Location      Record ID
0  (37.785719256680785, -122.40852313194863)  1380611233945
1   (37.78733980600732, -122.41063199757738)  1420164406718
2    (37.7946573324287, -122.42232562979227)  1424856504716
3   (37.79595867909168, -122.41557405519474)  1443574295566
4   (37.78315261897309, -122.40950883997789)   144548169992

[5 rows x 43 columns]
```

```
[19]: check_isnull = fill_null.isnull().sum()
      check_isnull[10:30]
```

```
[19]: Unit                                  0
      Unit Suffix                           0
      Description                           0
      Current Status                        0
      Current Status Date                   0
      Filed Date                            0
      Issued Date                           0
      Completed Date                        0
      First Construction Document Date      0
      Structural Notification               0
      Number of Existing Stories            0
      Number of Proposed Stories            0
      Voluntary Soft-Story Retrofit         0
      Fire Only Permit                      0
      Permit Expiration Date                0
      Estimated Cost                        0
      Revised Cost                          0
      Existing Use                          0
      Existing Units                        0
      Proposed Use                          0
      dtype: int64
```

```
[20]: # Save the dataset after modifications

      #fill_null.to_csv('Building_Permits.csv')
```

```
[74]: #df = pd.read_csv('Building_Permits.csv')
```

[75]:

```
#df = df.drop('Unnamed: 0',axis = 1)
```

[76]:

```
#df.isnull().sum()[10:30]
```

[77]:

```
#df.describe()
```

[28]:

```
#df.describe().transpose
```

[78]:

```
#df.head()
```

## 0.2 Scaling And Normalization

[30]:

```
#!pip install stats
```

[31]:

```
#!pip install scipy
```

[32]:

```
import pandas as pd
import numpy as np
#Ploting modules
import seaborn as sns
import matplotlib.pyplot as plt
#for box-cox transformation
from scipy import stats
# for minmax scaling
from mlxtend.preprocessing import minmax_scaling
# set seed for reproducibility
np.random.seed(0)
```

```
/usr/lib/python3/dist-packages/scipy/__init__.py:146: UserWarning: A NumPy
version >=1.17.3 and <1.25.0 is required for this version of SciPy (detected
version 1.25.2
  warnings.warn(f"A NumPy version >={np_minversion} and <{np_maxversion}"
```

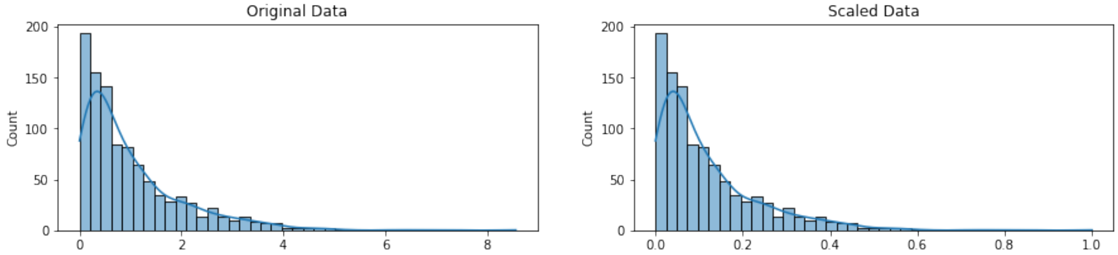
## 0.3 Scaling

This means that you're transforming your data so that it fits within a specific scale, like 0-100 or 0-1. 1) You want to scale data when you're using methods based on measures of how far apart data points are, like support vector machines (SVM) or k-nearest neighbors (KNN). With these algorithms, a change of "1" in any numeric feature is given the same importance.

[33]:

```
# Generate 1000 data points randomly drawn from an exponential distribution

original_data = np.random.exponential(size = 1000)
#original_data

# Min-max scale the data b/w 0 & 1
scaled_data = minmax_scaling(original_data,columns=[0])
```

```python
#plot both together to compare

fig, ax = plt.subplots(1,2,figsize = (15,3))
#Original plot
sns.histplot(original_data, ax = ax[0], kde = True, legend= False)
ax[0].set_title("Original Data")
#scaled plot
sns.histplot(scaled_data,ax = ax[1], kde = True, legend= False)
ax[1].set_title("Scaled Data")

plt.show()
```



## 0.4 Normalization

1) Scaling just changes the range of your data. Normalization is a more radical transformation. The point of normalization is to change your observations so that they can be described as a normal distribution.

2) Normal distribution: Also known as the “bell curve”, this is a specific statistical distribution where a roughly equal observations fall above and below the mean, the mean and the median are the same, and there are more observations closer to the mean. The normal distribution is also known as the Gaussian distribution.

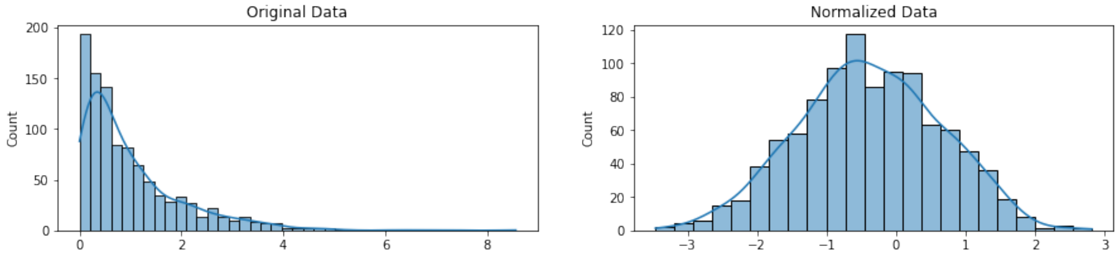
3) In general, you’ll normalize your data if you’re going to be using a machine learning or statistics technique that assumes your data is normally distributed. Some examples of these include linear discriminant analysis (LDA) and Gaussian naive Bayes. (Pro tip: any method with “Gaussian” in the name probably assumes normality.)

4) The method we’re using to normalize here is called the Box-Cox Transformation.

[34]:

```python
normalized_data = stats.boxcox(original_data)
# plot both together to compare
fig, ax = plt.subplots(1,2,figsize = (15,3))
sns.histplot(original_data,ax = ax[0], kde = True,legend=False)
ax[0].set_title("Original Data")
sns.histplot(normalized_data[0],ax = ax[1],kde = True,legend=False)
ax[1].set_title("Normalized Data")
```

```
plt.show()
```



[35]:

```
kickstarters_2017 = pd.read_csv("ks-projects-201801.csv")
```

[36]:

```
kickstarters_2017.head()
```

[36]:

```
           ID                                               name  \
0  1000002330                    The Songs of Adelaide & Abullah
1  1000003930      Greeting From Earth: ZGAC Arts Capsule For ET
2  1000004038                                     Where is Hank?
3  1000007540  ToshiCapital Rekordz Needs Help to Complete Album
4  1000011046  Community Film Project: The Art of Neighborhoo…

         category main_category currency    deadline     goal  \
0          Poetry    Publishing      GBP  2015-10-09   1000.0
1  Narrative Film  Film & Video      USD  2017-11-01  30000.0
2  Narrative Film  Film & Video      USD  2013-02-26  45000.0
3           Music         Music      USD  2012-04-16   5000.0
4    Film & Video  Film & Video      USD  2015-08-29  19500.0

              launched  pledged     state  backers country  usd pledged  \
0  2015-08-11 12:12:28      0.0    failed        0      GB          0.0
1  2017-09-02 04:43:57   2421.0    failed       15      US        100.0
2  2013-01-12 00:20:50    220.0    failed        3      US        220.0
3  2012-03-17 03:24:11      1.0    failed        1      US          1.0
4  2015-07-04 08:35:03   1283.0  canceled       14      US       1283.0

   usd_pledged_real  usd_goal_real
0               0.0        1533.95
1            2421.0       30000.00
2             220.0       45000.00
3               1.0        5000.00
4            1283.0       19500.00
```

[37]:

```
# select the usd_goal_real column
original_data = pd.DataFrame(kickstarters_2017.usd_goal_real)
```

```python
# scale the goals from 0 to 1
scaled_data = minmax_scaling(original_data, columns=['usd_goal_real'])

print('Original data\nPreview:\n', original_data.head())
print('Minimum value:', float(original_data.min()),
      '\nMaximum value:', float(original_data.max()))
print('_'*30)

print('\nScaled data\nPreview:\n', scaled_data.head())
print('Minimum value:', float(scaled_data.min()),
      '\nMaximum value:', float(scaled_data.max()))
```

```
Original data
Preview:
    usd_goal_real
0        1533.95
1       30000.00
2       45000.00
3        5000.00
4       19500.00
Minimum value: 0.01
Maximum value: 166361390.71
______________________________

Scaled data
Preview:
    usd_goal_real
0       0.000009
1       0.000180
2       0.000270
3       0.000030
4       0.000117
Minimum value: 0.0
Maximum value: 1.0
```

[38]:

```python
original_goal_data = pd.DataFrame(kickstarters_2017.goal)
original_goal_data.head(6)
```

[38]:

```
      goal
0   1000.0
1  30000.0
2  45000.0
3   5000.0
4  19500.0
5  50000.0
```

[39]:

```
scaled_goal_data = minmax_scaling(original_goal_data,columns=['goal'])
scaled_goal_data.head(6)
```

[39]:

```
       goal
0  0.000010
1  0.000300
2  0.000450
3  0.000050
4  0.000195
5  0.000500
```

[40]:

```
# #scaled plot
# sns.histplot(scaled_goal_data, kde = True, legend= False)
# plt.title("Scaled Data")

# plt.show()
```

[41]:

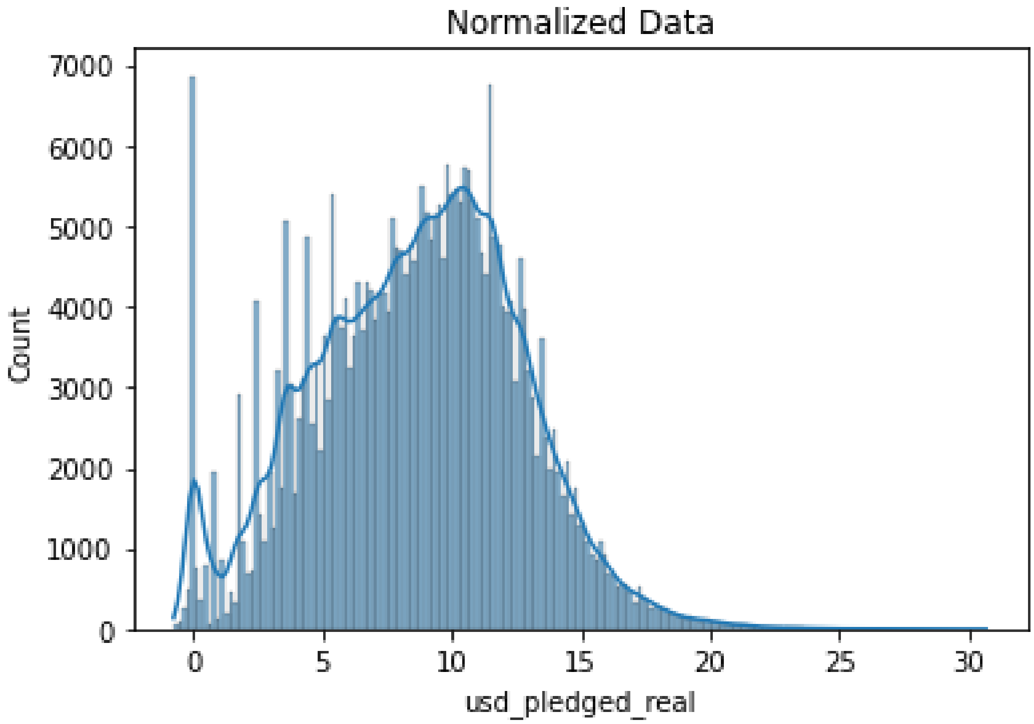
```
# get the index of all positive pledges (Box-Cox only takes positive values)
index_of_positive_pledges = kickstarters_2017.usd_pledged_real > 0

# get only positive pledges (using their indexes)
positive_pledges = kickstarters_2017.usd_pledged_real.
 ↪loc[index_of_positive_pledges]

# normalize the pledges (w/ Box-Cox)
normalized_pledges = pd.Series(stats.boxcox(positive_pledges)[0],
                               name='usd_pledged_real', index=positive_pledges.
 ↪index)

print('Original data\nPreview:\n', positive_pledges.head())
print('Minimum value:', float(positive_pledges.min()),
      '\nMaximum value:', float(positive_pledges.max()))
print('_'*30)

print('\nNormalized data\nPreview:\n', normalized_pledges.head())
print('Minimum value:', float(normalized_pledges.min()),
      '\nMaximum value:', float(normalized_pledges.max()))
```

```
Original data
Preview:
 1     2421.0
2      220.0
3        1.0
4     1283.0
5    52375.0
Name: usd_pledged_real, dtype: float64
Minimum value: 0.45
```

```
Maximum value: 20338986.27
------------------------------

Normalized data
Preview:
 1     10.165142
2      6.468598
3      0.000000
4      9.129277
5     15.836853
Name: usd_pledged_real, dtype: float64
Minimum value: -0.7779954122762203
Maximum value: 30.69054020451361
```

[73]:

```
# # get the index of all positive pledges (Box-Cox only takes positive values)
# index_of_positive_pledges = kickstarters_2017.usd_pledged_real > 0

# # get only positive pledges (using their indexes)
# positive_pledges = kickstarters_2017.usd_pledged_real.
 ↪loc[index_of_positive_pledges]

# # normalize the pledges (w/ Box-Cox)
# normalized_pledges = pd.Series(stats.boxcox(positive_pledges)[0],
#                                 name='usd_pledged_real',␣
 ↪index=positive_pledges.index)


sns.histplot(normalized_pledges, kde = True, legend= False)
plt.title("Normalized Data")

plt.show()
```



[ ]:

```
```

## 0.5 Parsing Dates

[43]:

```
earthquakes = pd.read_csv('Earthquake_database.csv')
```

[44]:

```
earthquakes.head()
```

[44]:

```
         Date      Time  Latitude  Longitude        Type  Depth  Depth Error  \
0  01/02/1965  13:44:18    19.246    145.616  Earthquake  131.6          NaN
1  01/04/1965  11:29:49     1.863    127.352  Earthquake   80.0          NaN
2  01/05/1965  18:05:58   -20.579   -173.972  Earthquake   20.0          NaN
3  01/08/1965  18:49:43   -59.076    -23.557  Earthquake   15.0          NaN
4  01/09/1965  13:32:50    11.938    126.427  Earthquake   15.0          NaN

   Depth Seismic Stations  Magnitude Magnitude Type  …  \
0                     NaN        6.0             MW  …
1                     NaN        5.8             MW  …
2                     NaN        6.2             MW  …
3                     NaN        5.8             MW  …
4                     NaN        5.8             MW  …

   Magnitude Seismic Stations  Azimuthal Gap  Horizontal Distance  \
0                         NaN            NaN                  NaN
1                         NaN            NaN                  NaN
2                         NaN            NaN                  NaN
3                         NaN            NaN                  NaN
4                         NaN            NaN                  NaN

   Horizontal Error  Root Mean Square            ID  Source Location Source  \
0               NaN               NaN  ISCGEM860706  ISCGEM          ISCGEM
1               NaN               NaN  ISCGEM860737  ISCGEM          ISCGEM
2               NaN               NaN  ISCGEM860762  ISCGEM          ISCGEM
3               NaN               NaN  ISCGEM860856  ISCGEM          ISCGEM
4               NaN               NaN  ISCGEM860890  ISCGEM          ISCGEM

  Magnitude Source     Status
0           ISCGEM  Automatic
1           ISCGEM  Automatic
2           ISCGEM  Automatic
3           ISCGEM  Automatic
4           ISCGEM  Automatic

[5 rows x 21 columns]
```

[45]:

```
earthquakes.isnull().sum()
```

[45]:

```
Date                              0
Time                              0
Latitude                          0
Longitude                         0
Type                              0
Depth                             0
Depth Error                   18951
Depth Seismic Stations        16315
Magnitude                         0
Magnitude Type                    3
Magnitude Error               23085
Magnitude Seismic Stations    20848
Azimuthal Gap                 16113
Horizontal Distance           21808
Horizontal Error              22256
Root Mean Square               6060
ID                                0
Source                            0
Location Source                   0
Magnitude Source                  0
Status                            0
dtype: int64
```

[46]:

```
earthquakes.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 23412 entries, 0 to 23411
Data columns (total 21 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   Date                        23412 non-null  object
 1   Time                        23412 non-null  object
 2   Latitude                    23412 non-null  float64
 3   Longitude                   23412 non-null  float64
 4   Type                        23412 non-null  object
 5   Depth                       23412 non-null  float64
 6   Depth Error                 4461 non-null   float64
 7   Depth Seismic Stations      7097 non-null   float64
 8   Magnitude                   23412 non-null  float64
 9   Magnitude Type              23409 non-null  object
 10  Magnitude Error             327 non-null    float64
 11  Magnitude Seismic Stations  2564 non-null   float64
 12  Azimuthal Gap               7299 non-null   float64
 13  Horizontal Distance         1604 non-null   float64
 14  Horizontal Error            1156 non-null   float64
 15  Root Mean Square            17352 non-null  float64
 16  ID                          23412 non-null  object
 17  Source                      23412 non-null  object
 18  Location Source             23412 non-null  object
 19  Magnitude Source            23412 non-null  object
 20  Status                      23412 non-null  object
dtypes: float64(12), object(9)
memory usage: 3.8+ MB
```

[47]:

```
earthquakes['Date'].head()
```

[47]:

```
0    01/02/1965
1    01/04/1965
2    01/05/1965
3    01/08/1965
4    01/09/1965
Name: Date, dtype: object
```

[ ]:

```

```

1) You may have to check the numpy documentation to match the letter code to the dtype of the object. "O" is the code for "object", so we can see that these two methods give us the same information.

[48]:

```
earthquakes['Date'].dtype
```

[48]:

```
dtype('O')
```

### 0.5.1 Convert our date columns to datetime

1) Now that we know that our date column isn't being recognized as a date, it's time to convert it so that it is recognized as a date. This is called "parsing dates" because we're taking in a string and identifying its component parts.

2) We can determine what the format of our dates are with a guide called "strftime directive", which you can find more information on at this link. The basic idea is that you need to point out which parts of the date are where and what punctuation is between them. There are lots of possible parts of a date, but the most common are %d for day, %m for month, %y for a two-digit year and %Y for a four digit year.

3) Some examples:

   - 1/17/07 has the format "%m/%d/%y"
   - 17-1-2007 has the format "%d-%m-%Y"

4) Looking back up at the head of the "date" column in the landslides dataset, we can see that it's in the format "month/day/two-digit year", so we can use the same syntax as the first example to parse in our dates:

[ ]:

```

```

[49]:

```
date_length = earthquakes.Date.str.len()
date_length.value_counts()
```

[49]:

```
10    23409
24        3
Name: Date, dtype: int64
```

[50]:

```
indices = np.where([date_length == 24])[1]
print('Indices with currepted data : ',indices)
earthquakes.loc[indices]
```

```
Indices with currepted data :  [ 3378  7512 20650]
```

[50]:

```
                           Date                      Time  Latitude  \
3378   1975-02-23T02:58:41.000Z  1975-02-23T02:58:41.000Z     8.017
7512   1985-04-28T02:53:41.530Z  1985-04-28T02:53:41.530Z   -32.998
20650  2011-03-13T02:23:34.520Z  2011-03-13T02:23:34.520Z    36.344

       Longitude        Type  Depth  Depth Error  Depth Seismic Stations  \
3378     124.075  Earthquake  623.0          NaN                     NaN
7512     -71.766  Earthquake   33.0          NaN                     NaN
20650    142.344  Earthquake   10.1         13.9                   289.0

       Magnitude Magnitude Type  …  Magnitude Seismic Stations  \
3378         5.6             MB  …                         NaN
```

```
7512          5.6             MW  …                         NaN
20650         5.8            MWC  …                         NaN

       Azimuthal Gap  Horizontal Distance  Horizontal Error  Root Mean Square  \
3378             NaN                  NaN               NaN               NaN
7512             NaN                  NaN               NaN              1.30
20650           32.3                  NaN               NaN              1.06

              ID Source Location Source Magnitude Source    Status
3378   USP0000A09     US              US               US  Reviewed
7512   USP0002E81     US              US              HRV  Reviewed
20650  USP000HWQP     US              US             GCMT  Reviewed

[3 rows x 21 columns]
```

[51]:

```
earthquakes.loc[3378,'Date'] = '02/23/1975'
earthquakes.loc[7512,'Date'] = '04/28/1985'
earthquakes.loc[20650,'Date'] = '03/13/2011'

earthquakes['date_parsed'] = pd.to_datetime(earthquakes['Date'],format='%m/%d/
↪%Y')
```

1) What if I run into an error with multiple date formats? While we're specifying the date format here, sometimes you'll run into an error when there are multiple date formats in a single column. If that happens, you can have pandas try to infer what the right date format should be. You can do that like so: landslides['date_parsed']=pd.to_datetime(landslides['Date'],infer_datetime_format=True)

-

2) Why don't you always use 'infer_datetime_format = True?' There are two big reasons not to always have pandas guess the time format. The first is that pandas won't always been able to figure out the correct date format, especially if someone has gotten creative with data entry. The second is that it's much slower than specifying the exact format of the dates.

[ ]:

```

```

[52]:

```
earthquakes.date_parsed.head()
```

[52]:

```
0   1965-01-02
1   1965-01-04
2   1965-01-05
3   1965-01-08
4   1965-01-09
Name: date_parsed, dtype: datetime64[ns]
```

[53]:

```
earthquakes.head()
```

```
[53]:         Date      Time  Latitude  Longitude        Type  Depth  Depth Error  \
      0  01/02/1965  13:44:18    19.246    145.616  Earthquake  131.6          NaN
      1  01/04/1965  11:29:49     1.863    127.352  Earthquake   80.0          NaN
      2  01/05/1965  18:05:58   -20.579   -173.972  Earthquake   20.0          NaN
      3  01/08/1965  18:49:43   -59.076    -23.557  Earthquake   15.0          NaN
      4  01/09/1965  13:32:50    11.938    126.427  Earthquake   15.0          NaN

         Depth Seismic Stations  Magnitude Magnitude Type  …  Azimuthal Gap  \
      0                     NaN        6.0             MW  …            NaN
      1                     NaN        5.8             MW  …            NaN
      2                     NaN        6.2             MW  …            NaN
      3                     NaN        5.8             MW  …            NaN
      4                     NaN        5.8             MW  …            NaN

         Horizontal Distance  Horizontal Error  Root Mean Square            ID  \
      0                  NaN               NaN               NaN  ISCGEM860706
      1                  NaN               NaN               NaN  ISCGEM860737
      2                  NaN               NaN               NaN  ISCGEM860762
      3                  NaN               NaN               NaN  ISCGEM860856
      4                  NaN               NaN               NaN  ISCGEM860890

         Source Location Source Magnitude Source     Status date_parsed
      0  ISCGEM          ISCGEM           ISCGEM  Automatic  1965-01-02
      1  ISCGEM          ISCGEM           ISCGEM  Automatic  1965-01-04
      2  ISCGEM          ISCGEM           ISCGEM  Automatic  1965-01-05
      3  ISCGEM          ISCGEM           ISCGEM  Automatic  1965-01-08
      4  ISCGEM          ISCGEM           ISCGEM  Automatic  1965-01-09

      [5 rows x 22 columns]
```

### 0.5.2 Select the day of the month

1) Now that we have a column of parsed dates, we can extract information like the day of the month that a landslide occurred.

```
[ ]:
```

```
[54]: day_of_month = earthquakes['date_parsed'].dt.day
      day_of_month.head()
```

```
[54]: 0    2
      1    4
      2    5
      3    8
      4    9
      Name: date_parsed, dtype: int64
```

### 0.5.3 Plot the day of the month to check the date parsing

1) One of the biggest dangers in parsing dates is mixing up the months and days. The to_datetime() function does have very helpful error messages, but it doesn't hurt to double-check that the days of the month we've extracted make sense.

2) To do this, let's plot a histogram of the days of the month. We expect it to have values between 1 and 31 and, since there's no reason to suppose the landslides are more common on some days of the month than others, a relatively even distribution. (With a dip on 31 because not all months have 31 days.) Let's see if that's the case:

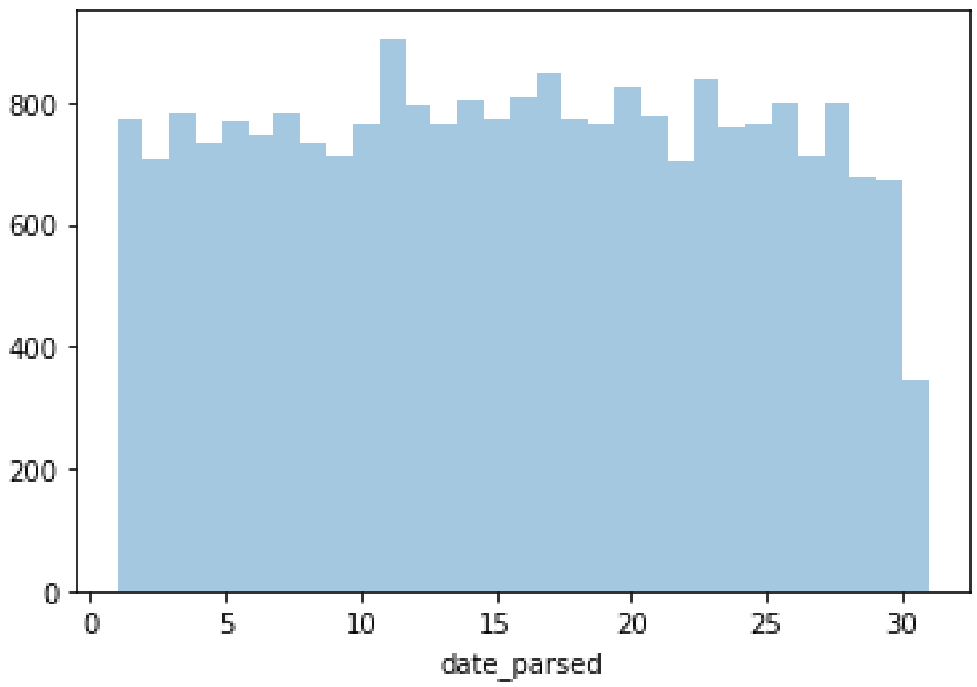
[ ]:

```

```

[55]:

```python
# remove na's
day_of_month = day_of_month.dropna()
#plot
sns.distplot(day_of_month,kde = False,bins = 31)
plt.show()
```

```
/tmp/ipykernel_5179/3349062656.py:4: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(day_of_month,kde = False,bins = 31)
```



## 0.6 Inconsistent data Entry

[56]:
```
#!pip install fuzzywuzzy
```

[57]:
```
#!pip install charset_normalizer
```

[58]:
```
import pandas as pd
import numpy as np
#Helpful modules
import fuzzywuzzy
from fuzzywuzzy import process
import charset_normalizer
```

```
/home/mahesh/.local/lib/python3.10/site-packages/fuzzywuzzy/fuzz.py:11:
UserWarning: Using slow pure-python SequenceMatcher. Install python-Levenshtein
to remove this warning
  warnings.warn('Using slow pure-python SequenceMatcher. Install python-
Levenshtein to remove this warning')
```

[59]:
```
professors = pd.read_csv('pakistan_intellectual_capital.csv')
```

[60]:
```
np.random.seed(0)
```

[61]:
```
professors = professors.drop('Unnamed: 0',axis = 1)
```

### 0.6.1 Do some preliminary text pre-processing

[ ]:

```
```

[62]:

```
professors.head()
```

[62]:

```
   S#         Teacher Name           University Currently Teaching  \
0   3      Dr. Abdul Basit               University of Balochistan
1   5      Dr. Waheed Noor               University of Balochistan
2   6     Dr. Junaid Baber               University of Balochistan
3   7  Dr. Maheen Bakhtyar               University of Balochistan
4  25          Samina Azim  Sardar Bahadur Khan Women's University

             Department Province University Located          Designation  \
0  Computer Science & IT                Balochistan  Assistant Professor
1  Computer Science & IT                Balochistan  Assistant Professor
2  Computer Science & IT                Balochistan  Assistant Professor
3  Computer Science & IT                Balochistan  Assistant Professor
4       Computer Science                Balochistan             Lecturer

  Terminal Degree                                       Graduated from  \
0             PhD                      Asian Institute of Technology
1             PhD                      Asian Institute of Technology
2             PhD                      Asian Institute of Technology
3             PhD                      Asian Institute of Technology
4              BS  Balochistan University of Information Technolo…

    Country    Year          Area of Specialization/Research Interests  \
0  Thailand     NaN                        Software Engineering & DBMS
1  Thailand     NaN                                               DBMS
2  Thailand     NaN          Information processing, Multimedia mining
3  Thailand     NaN  NLP, Information Retrieval, Question Answering…
4  Pakistan  2005.0                      VLSI Electronics DLD Database

  Other Information
0               NaN
1               NaN
2               NaN
3               NaN
4               NaN
```

[63]:

```
countries = professors['Country'].unique()
```

[64]:

```
countries.sort()
countries
```

```
[64]: array([' Germany', ' New Zealand', ' Sweden', ' USA', 'Australia',
             'Austria', 'Canada', 'China', 'Finland', 'France', 'Greece',
             'HongKong', 'Ireland', 'Italy', 'Japan', 'Macau', 'Malaysia',
             'Mauritius', 'Netherland', 'New Zealand', 'Norway', 'Pakistan',
             'Portugal', 'Russian Federation', 'Saudi Arabia', 'Scotland',
             'Singapore', 'South Korea', 'SouthKorea', 'Spain', 'Sweden',
             'Thailand', 'Turkey', 'UK', 'USA', 'USofA', 'Urbana', 'germany'],
            dtype=object)
```

```
[ ]:
```

1) Just looking at this, I can see some problems due to inconsistent data entry: ' Germany', and 'germany', for example, or ' New Zealand' and 'New Zealand'.

2) The first thing I'm going to do is make everything lower case (I can change it back at the end if I like) and remove any white spaces at the beginning and end of cells. Inconsistencies in capitalizations and trailing white spaces are very common in text data and you can fix a good 80% of your text data entry inconsistencies by doing this.

```
[ ]:
```

```
[65]: professors['Country'] = professors['Country'].str.lower()
      professors['Country'] = professors['Country'].str.strip()
```

```
[66]: countries = professors['Country'].unique()
      countries.sort()
      countries
```

```
[66]: array(['australia', 'austria', 'canada', 'china', 'finland', 'france',
             'germany', 'greece', 'hongkong', 'ireland', 'italy', 'japan',
             'macau', 'malaysia', 'mauritius', 'netherland', 'new zealand',
             'norway', 'pakistan', 'portugal', 'russian federation',
             'saudi arabia', 'scotland', 'singapore', 'south korea',
             'southkorea', 'spain', 'sweden', 'thailand', 'turkey', 'uk',
             'urbana', 'usa', 'usofa'], dtype=object)
```

```
[ ]:
```

### 0.6.2 Use fuzzy matching to correct inconsistent data entry

Alright, let's take another look at the 'Country' column and see if there's any more data cleaning we need to do.

```
[ ]:
```

It does look like there is another inconsistency: 'southkorea' and 'south korea' should be the same.

We're going to use the fuzzywuzzy package to help identify which strings are closest to each other. This dataset is small enough that we could probably could correct errors by hand, but that approach doesn't scale well. (Would you want to correct a thousand errors by hand? What about ten thousand? Automating things as early as possible is generally a good idea. Plus, it's fun!)

**Fuzzy matching:**

3) The process of automatically finding text strings that are very similar to the target string. In general, a string is considered "closer" to another one the fewer characters you'd need to change if you were transforming one string into another. So "apple" and "snapple" are two changes away from each other (add "s" and "n") while "in" and "on" and one change away (rplace "i" with "o"). You won't always be able to rely on fuzzy matching 100%, but it will usually end up saving you at least a little time.

Fuzzywuzzy returns a ratio given two strings. The closer the ratio is to 100, the smaller the edit distance between the two strings. Here, we're going to get the ten strings from our list of cities that have the closest distance to "south korea".

[67]:
```python
matches = fuzzywuzzy.process.extract('south korea',countries,limit = 10,
                                     scorer=fuzzywuzzy.fuzz.token_sort_ratio)
```

[68]:
```python
matches
#matches
```

[68]:
```
[('south korea', 100),
 ('southkorea', 48),
 ('saudi arabia', 43),
 ('norway', 35),
 ('ireland', 33),
 ('portugal', 32),
 ('singapore', 30),
 ('netherland', 29),
 ('macau', 25),
 ('usofa', 25)]
```

[ ]:
```

```

We can see that two of the items in the cities are very close to "south korea": "south korea" and "southkorea". Let's replace all rows in our "Country" column that have a ratio of > 47 with "south korea".

To do this, I'm going to write a function. (It's a good idea to write a general purpose function you can reuse if you think you might have to do a specific task more than once or twice. This keeps you from having to copy and paste code too often, which saves time and can help prevent mistakes.)

[ ]:
```

```

[69]:
```python
def replace_matches_in_column(df,column,string_to_match,min_ratio = 47):
    #get a list of unique strings
    string = df[column].unique()
    #get the top 10 closest matches to our input string
    matches = fuzzywuzzy.process.extract(string_to_match,string,limit = 10,
                                          scorer=fuzzywuzzy.fuzz.
↪token_sort_ratio)
    # only get matches with ratio > 90
    close_matches = [matches[0] for matches in matches if matches[1] >=␣
↪min_ratio]

    #get the rows of all the close matches in our dataframe
    rows_with_matches = df[column].isin(close_matches)

    # replace all rows with close matches with the input matches
    df.loc[rows_with_matches,column] = string_to_match
    print("Done all")
```

[70]:
```
replace_matches_in_column(df =␣
↪professors,column='Country',string_to_match='south korea')
```

```
Done all
```

1) And now let's check the unique values in our "Country" column again and make sure we've tidied up "south korea" correctly.

[71]:
```
countries = professors['Country'].unique()
```

[72]:
```
countries
```

[72]:
```
array(['thailand', 'pakistan', 'germany', 'austria', 'australia', 'uk',
       'china', 'france', 'usofa', 'south korea', 'malaysia', 'sweden',
       'italy', 'canada', 'norway', 'ireland', 'new zealand', 'urbana',
       'portugal', 'russian federation', 'usa', 'finland', 'netherland',
       'greece', 'turkey', 'macau', 'singapore', 'spain', 'japan',
       'hongkong', 'saudi arabia', 'mauritius', 'scotland'], dtype=object)
```

[ ]:

# 1 THANKYOU KAGGLE

[ ]: