A2_31378

January 21, 2022

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0.1 Assignment-2 : Data Wrangling II

Create an "Academic performance" dataset of students and perform the following operations using Python.

1. Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them.

2. Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniques to deal with them.

3. Apply data transformations on at least one of the variables. The purpose of this transformation should be one of the following reasons: to change the scale for better understanding of the variable, to convert a non-linear relation into a linear one, or to decrease the skewness and convert the distribution into a normal distribution.

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import scipy.stats as stats
import pylab
import seaborn as sns
```

[2]:
```
df = pd.read_csv('StudentsPerformance.csv') #Loading the dataset
```

[3]:
```
df
```

[3]:

	gender	race/ethnicity	parental level of education	lunch	\
0	female	group B	bachelor's degree	standard	
1	female	group C	some college	standard	
2	female	group B	master's degree	standard	
3	male	group A	associate's degree	free/reduced	
4	male	group C	some college	standard	
..	…	…	…	…	

```
995  female        group E            master's degree      standard
996    male        group C                high school  free/reduced
997  female        group C                high school  free/reduced
998  female        group D              some college      standard
999  female        group D              some college  free/reduced

    test preparation course  math score  reading score  writing score
0                      none        72.0           72.0           74.0
1                 completed        69.0           90.0            NaN
2                      none        90.0           95.0           93.0
3                      none        47.0           57.0           44.0
4                      none        76.0           78.0           75.0
..                      …           …              …              …
995               completed        88.0           99.0            NaN
996                    none        62.0           55.0           55.0
997               completed        59.0            NaN           65.0
998               completed        68.0           78.0           77.0
999                    none        77.0           86.0           86.0

[1000 rows x 8 columns]
```

[4]:
```
df.head() #Print first 5 rows
```

[4]:
```
   gender race/ethnicity parental level of education         lunch  \
0  female        group B           bachelor's degree      standard
1  female        group C                some college      standard
2  female        group B              master's degree      standard
3    male        group A           associate's degree  free/reduced
4    male        group C                some college      standard

  test preparation course  math score  reading score  writing score
0                    none        72.0           72.0           74.0
1               completed        69.0           90.0            NaN
2                    none        90.0           95.0           93.0
3                    none        47.0           57.0           44.0
4                    none        76.0           78.0           75.0
```

[5]:
```
df.tail() #Print last 5 rows
```

[5]:
```
     gender race/ethnicity parental level of education         lunch  \
995  female        group E            master's degree      standard
996    male        group C                high school  free/reduced
997  female        group C                high school  free/reduced
998  female        group D              some college      standard
999  female        group D              some college  free/reduced

    test preparation course  math score  reading score  writing score
```

```
995              completed        88.0          99.0           NaN
996                   none        62.0          55.0          55.0
997              completed        59.0           NaN          65.0
998              completed        68.0          78.0          77.0
999                   none        77.0          86.0          86.0
```

[6]:
```
df.describe() #Show statistical information
```

[6]:
```
       math score  reading score  writing score
count  982.000000     988.000000     983.000000
mean    67.569246      69.149798      68.025432
std     27.600928      14.600240      15.238844
min      0.000000      17.000000      10.000000
25%     57.000000      59.000000      57.000000
50%     66.000000      70.000000      69.000000
75%     77.000000      79.000000      79.000000
max    605.000000     100.000000     100.000000
```

0.1.1 Dealing with Missing Values

[7]:
```
df.isnull().sum()
```

[7]:
```
gender                         0
race/ethnicity                 0
parental level of education    0
lunch                          0
test preparation course        0
math score                    18
reading score                 12
writing score                 17
dtype: int64
```

[8]:
```
mean_value=df['math score'].mean()
df['math score'].fillna(value=mean_value, inplace=True)
```

[9]:
```
mean_value=df['reading score'].mean()
df['reading score'].fillna(value=mean_value, inplace=True)
```

[10]:
```
mean_value=df['writing score'].mean()
df['writing score'].fillna(value=mean_value, inplace=True)
```

[11]:
```
df.isnull().sum()
```

[11]:
```
gender                        0
race/ethnicity                0
parental level of education   0
lunch                         0
test preparation course       0
```

```
math score                     0
reading score                  0
writing score                  0
dtype: int64
```

0.1.2 Data Formatting

[12]:
```
df.dtypes
```

[12]:
```
gender                          object
race/ethnicity                  object
parental level of education     object
lunch                           object
test preparation course         object
math score                     float64
reading score                  float64
writing score                  float64
dtype: object
```

[13]:
```
df['math score'] = df['math score'].astype(int)
df['reading score'] = df['reading score'].astype(int)
df['writing score'] = df['writing score'].astype(int)
```

[14]:
```
df.dtypes
```

[14]:
```
gender                         object
race/ethnicity                 object
parental level of education    object
lunch                          object
test preparation course        object
math score                      int32
reading score                   int32
writing score                   int32
dtype: object
```

0.1.3 Finding and Removing Outliers

[15]:
```
df['math score'].max()
```

[15]:
```
605
```

1. Inter Quartile Range Method

[16]:
```
Q1 = df['math score'].quantile(0.25) #First quartile
Q3 = df['math score'].quantile(0.75) #Third quartile
Q1, Q3
```

[16]:
```
(57.0, 77.0)
```

[17]:
```
IQR = Q3-Q1 #Inter quartile range
IQR
```

[17]:
```
20.0
```

[18]:
```
lower_limit = Q1 - 1.5 * IQR
upper_limit = Q3 + 1.5 * IQR
lower_limit, upper_limit
```

[18]:
```
(27.0, 107.0)
```

[19]:
```
df[(df['math score']<lower_limit) | (df['math score']>upper_limit)]
```

[19]:

	gender	race/ethnicity	parental level of education	lunch	test preparation course	math score	reading score	writing score
17	female	group B	some high school	free/reduced	none	18	32	28
59	female	group C	some high school	free/reduced	none	0	17	10
88	female	group A	some college	standard	none	200	70	67
145	female	group C	some college	free/reduced	none	22	39	33
166	male	group C	high school	free/reduced	completed	513	51	51
171	male	group E	some high school	standard	none	194	88	78
338	female	group B	some high school	free/reduced	none	24	38	27
466	female	group D	associate's degree	free/reduced	none	26	31	38
653	female	group A	associate's degree	standard	completed	605	70	74
787	female	group B	some college	standard	none	19	38	32
842	female	group B	high school	free/reduced	completed	23	44	36

[20]:
```
df_without_outliers=df[(df['math score']>lower_limit) & (df['math␣
↪score']<upper_limit)]
df_without_outliers
```

[20]:

	gender	race/ethnicity	parental level of education	lunch	test preparation course	math score	reading score	writing score
0	female	group B	bachelor's degree	standard	none	72	72	74
1	female	group C	some college	standard	completed	69	90	88
2	female	group B	master's degree	standard	none	90	95	93
3	male	group A	associate's degree	free/reduced	none	47	57	44

```
4      male        group C                some college      standard
..      …           …                          …           …
995  female        group E             master's degree      standard
996    male        group C                 high school  free/reduced
997  female        group C                 high school  free/reduced
998  female        group D                some college      standard
999  female        group D                some college  free/reduced

    test preparation course  math score  reading score  writing score
0                      none          72             72             74
1                 completed          69             90             68
2                      none          90             95             93
3                      none          47             57             44
4                      none          76             78             75
..                      …         …             …            …
995               completed          88             99             68
996                    none          62             55             55
997               completed          59             69             65
998               completed          68             78             77
999                    none          77             86             86

[986 rows x 8 columns]
```

2. Values in range 0 to 100

[21]:
```
lower_limit = 0
upper_limit = 100
df[(df['math score']<lower_limit) | (df['math score']>upper_limit)]
```

[21]:
```
     gender race/ethnicity parental level of education         lunch  \
88   female        group A                some college      standard
110  female        group D          associate's degree  free/reduced
121    male        group B          associate's degree      standard
160    male        group B          associate's degree  free/reduced
166    male        group C                 high school  free/reduced
171    male        group E           some high school      standard
573  female        group C                 high school  free/reduced
653  female        group A          associate's degree      standard

    test preparation course  math score  reading score  writing score
88                     none         200             70             67
110               completed         107             89             98
121               completed         101             89             92
160               completed         102             78             74
166               completed         513             51             51
171                    none         194             88             78
573               completed         102             66             64
653               completed         605             70             74
```

[22]:
```
df_without_outliers1 = df[(df['math score']>lower_limit) & (df['math␣
 ↪score']<upper_limit)]
df_without_outliers1
```

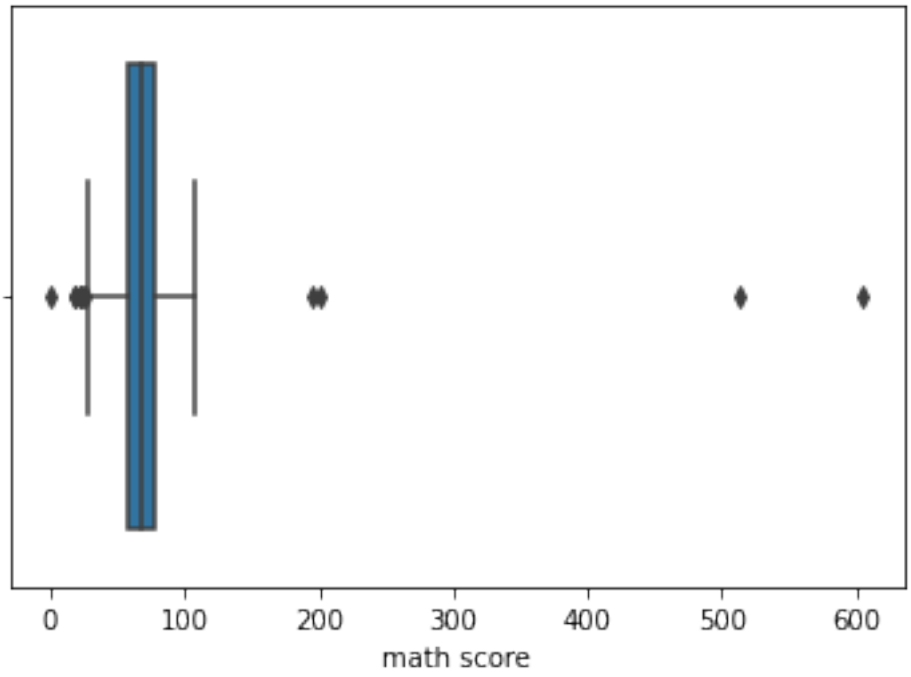
[22]:

	gender	race/ethnicity	parental level of education	lunch	test preparation course	math score	reading score	writing score
0	female	group B	bachelor's degree	standard	none	72	72	74
1	female	group C	some college	standard	completed	69	90	68
2	female	group B	master's degree	standard	none	90	95	93
3	male	group A	associate's degree	free/reduced	none	47	57	44
4	male	group C	some college	standard	none	76	78	75
..	…	…	…	…	…	…	…	…
995	female	group E	master's degree	standard	completed	88	99	68
996	male	group C	high school	free/reduced	none	62	55	55
997	female	group C	high school	free/reduced	completed	59	69	65
998	female	group D	some college	standard	completed	68	78	77
999	female	group D	some college	free/reduced	none	77	86	86

[984 rows x 8 columns]

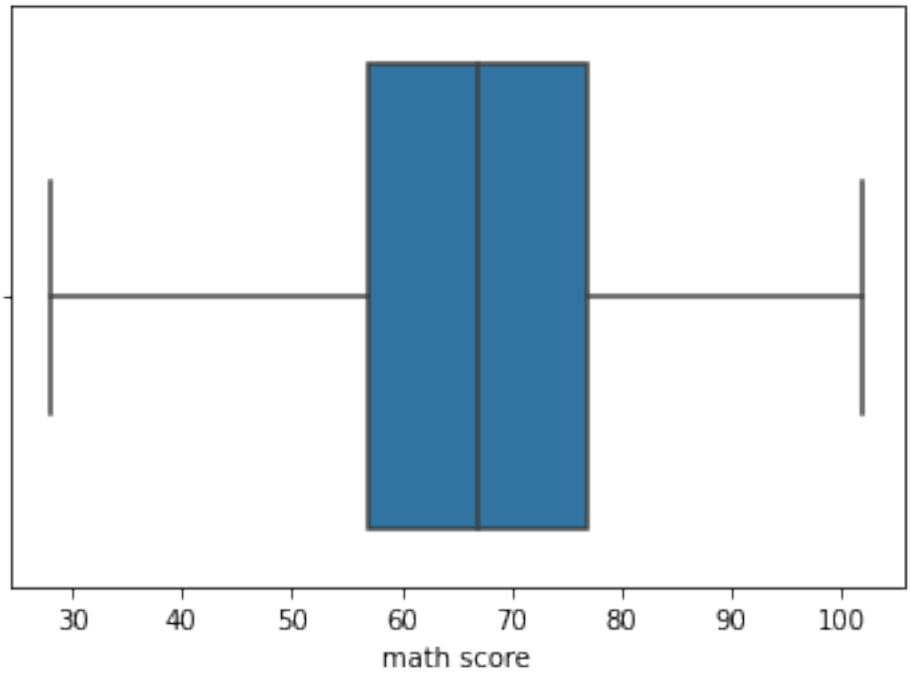
[23]:
```
sns.boxplot(x=df['math score'])
```

[23]:
```
<AxesSubplot:xlabel='math score'>
```



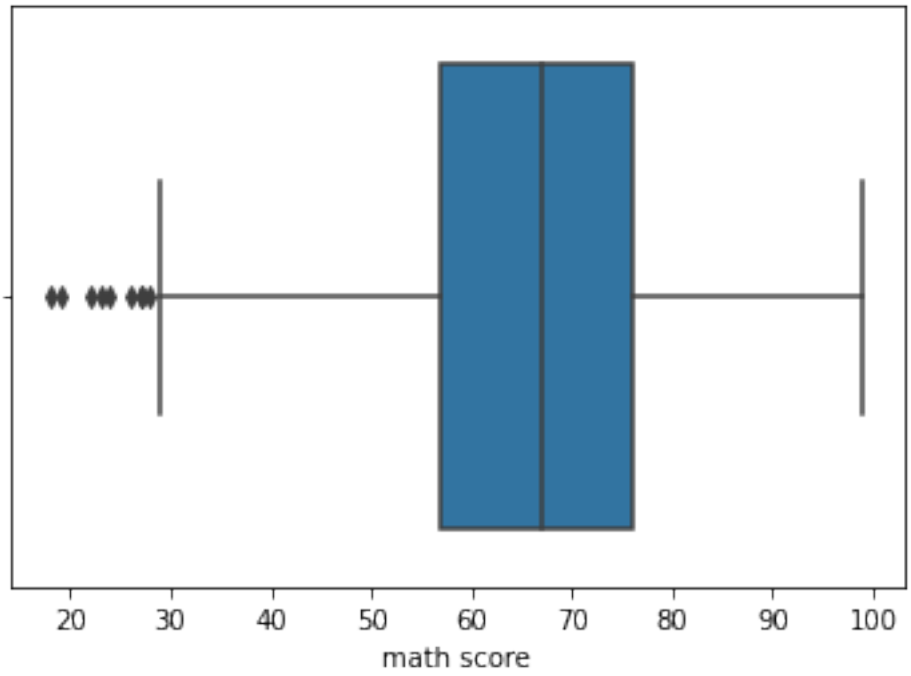
[24]:
```
sns.boxplot(x=df_without_outliers['math score'])
```

[24]: <AxesSubplot:xlabel='math score'>



[25]:
```
sns.boxplot(x=df_without_outliers1['math score'])
```

[25]:
```
<AxesSubplot:xlabel='math score'>
```



[26]:
```
df.skew() #returns skewness
```

```
C:\Users\kotka\AppData\Local\Temp/ipykernel_15024/938849225.py:1: FutureWarning:
Dropping of nuisance columns in DataFrame reductions (with 'numeric_only=None')
is deprecated; in a future version this will raise TypeError.  Select only valid
columns before calling the reduction.
  df.skew() #returns skewness
```

[26]:
```
math score       12.077775
reading score    -0.262018
writing score    -0.296788
dtype: float64
```

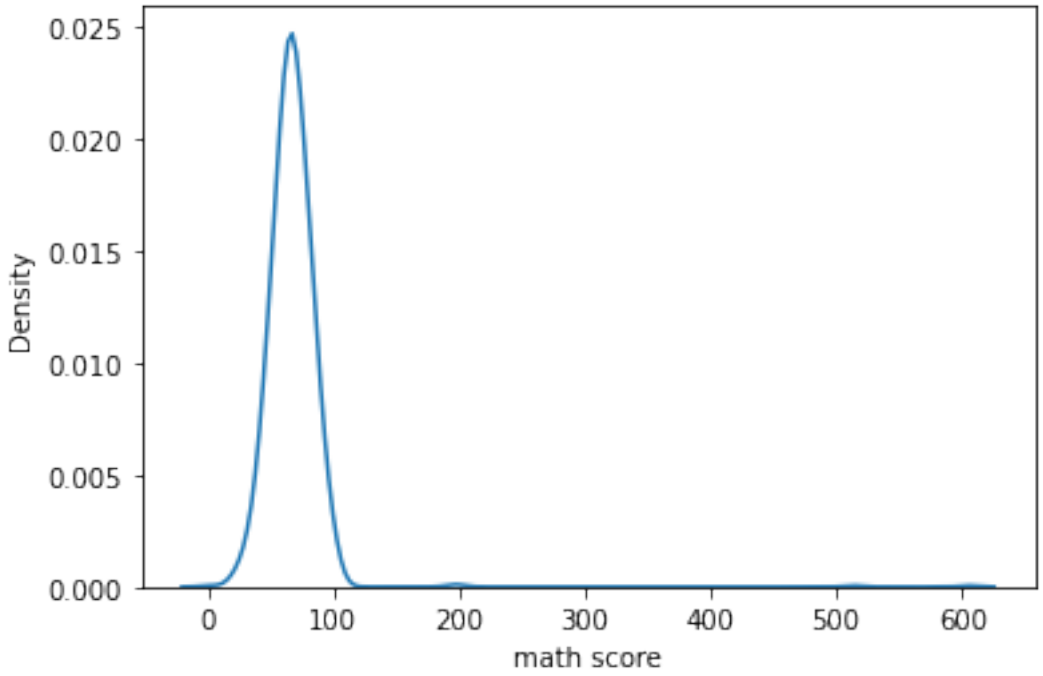
[27]:
```
df_without_outliers.skew()
```

```
C:\Users\kotka\AppData\Local\Temp/ipykernel_15024/1790224631.py:1:
FutureWarning: Dropping of nuisance columns in DataFrame reductions (with
'numeric_only=None') is deprecated; in a future version this will raise
TypeError.  Select only valid columns before calling the reduction.
  df_without_outliers.skew()
```

[27]:
```
math score      -0.031118
reading score   -0.194636
writing score   -0.219991
dtype: float64
```

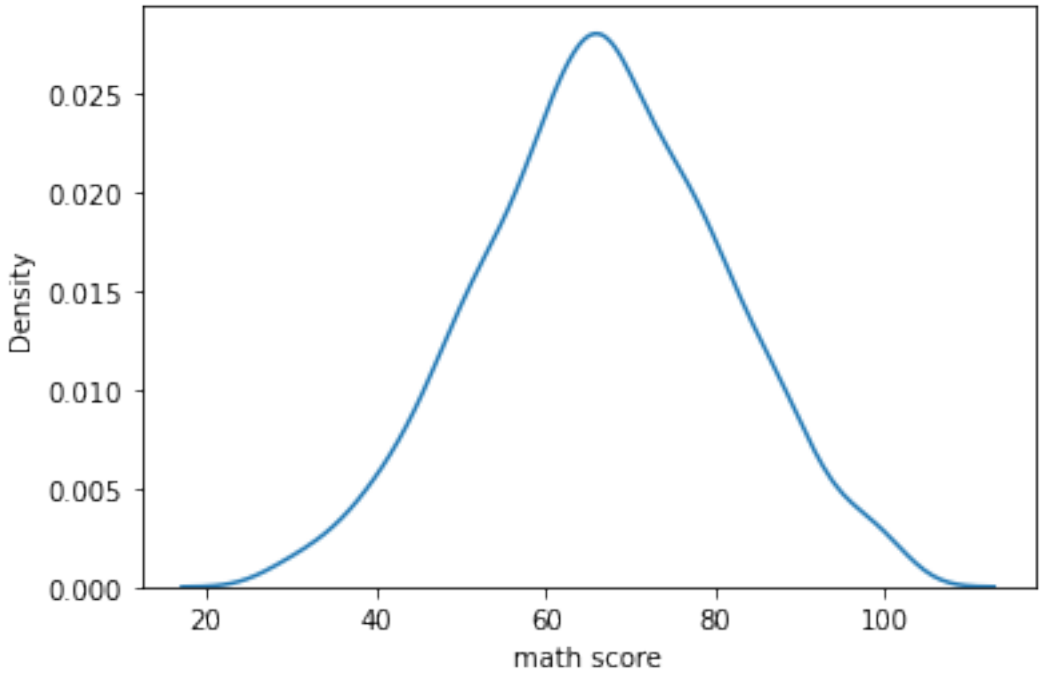
[28]:
```
sns.kdeplot(df['math score'])
```

[28]:
```
<AxesSubplot:xlabel='math score', ylabel='Density'>
```



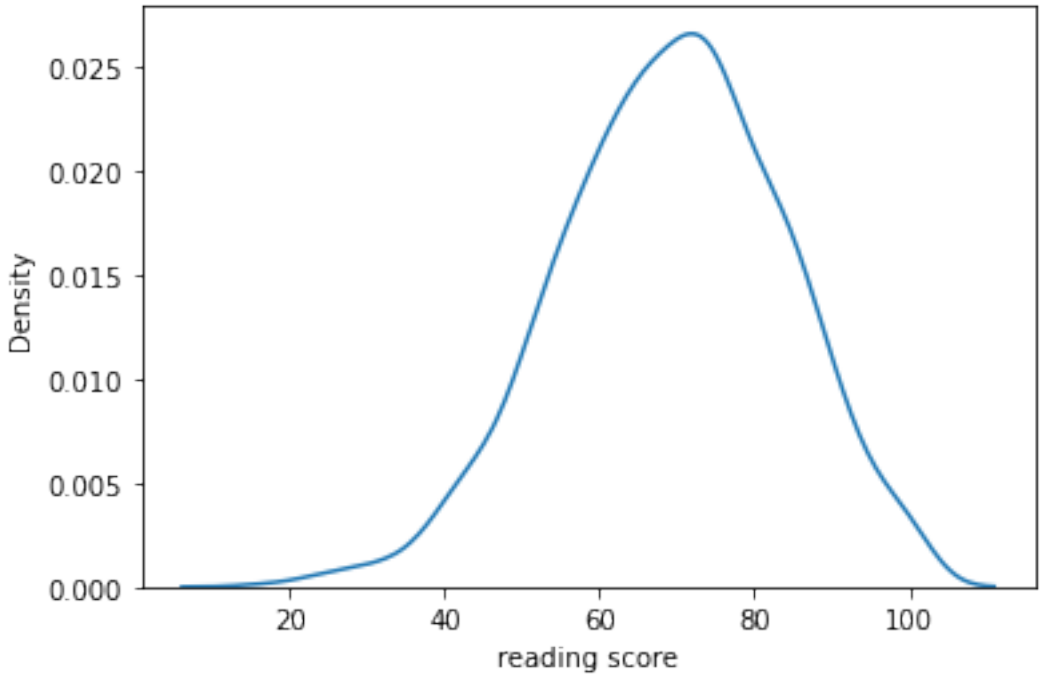
[29]:
```
sns.kdeplot(df_without_outliers['math score'])
```

[29]:
```
<AxesSubplot:xlabel='math score', ylabel='Density'>
```



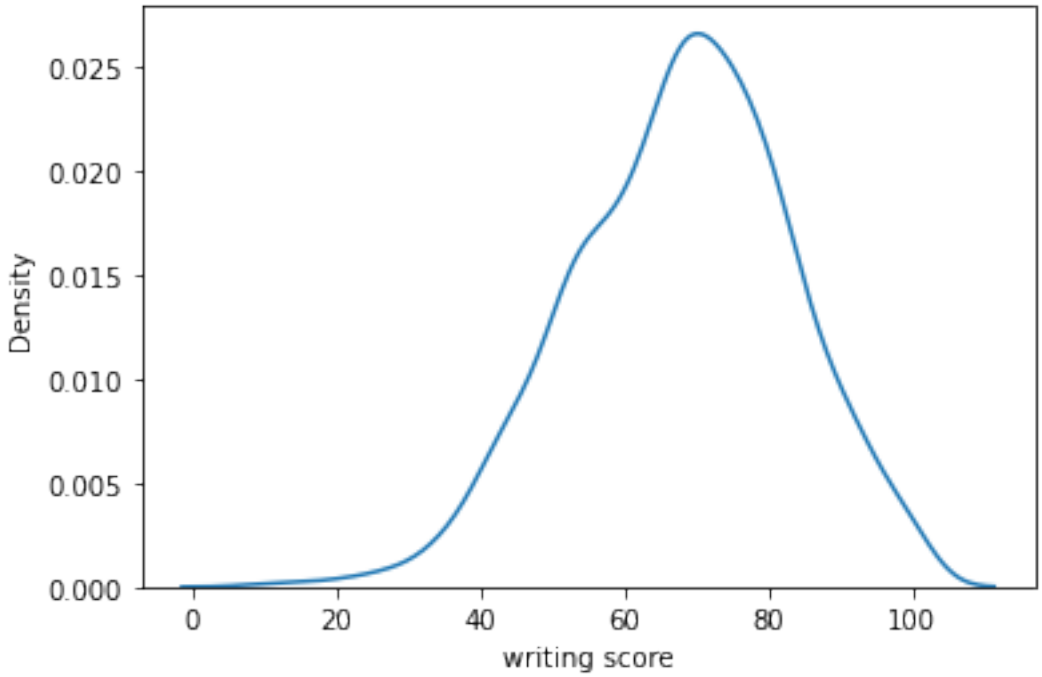
[30]:
```
sns.kdeplot(df['reading score'])
```

[30]: <AxesSubplot:xlabel='reading score', ylabel='Density'>



[31]:
```
sns.kdeplot(df['writing score'])
```

[31]: <AxesSubplot:xlabel='writing score', ylabel='Density'>



0.1.4 Data Transformations

[32]:
```
df['math score'].mean()
```

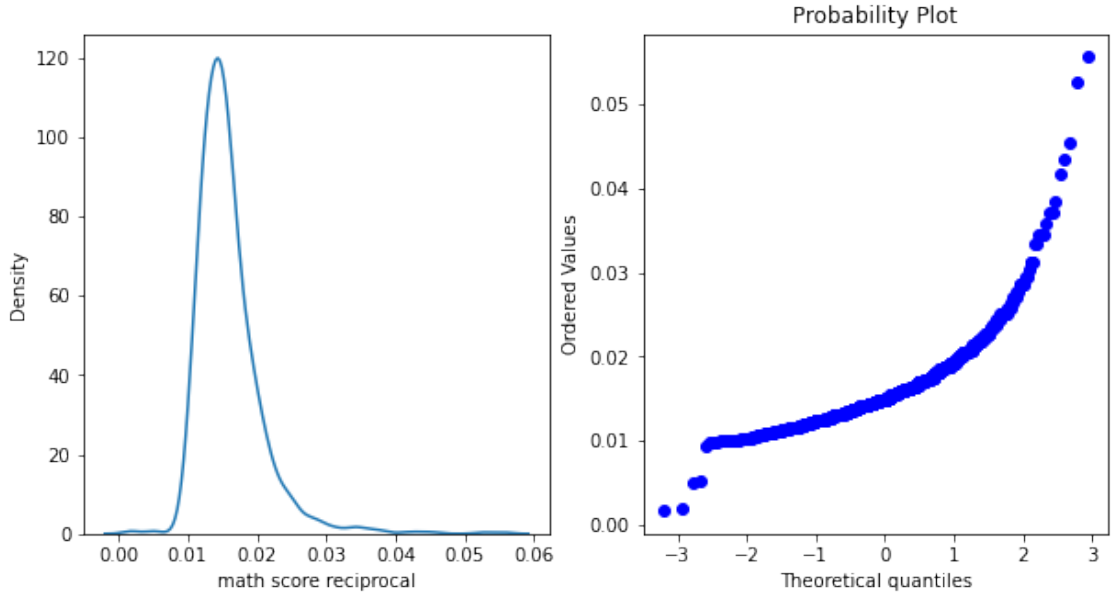
[32]: 67.559

[33]:
```
def normality(data,feature):
    plt.figure(figsize=(10,5))
    plt.subplot(1,2,1)
    sns.kdeplot(data[feature])
    plt.subplot(1,2,2)
    stats.probplot(data[feature],plot=pylab)
    plt.show()
```

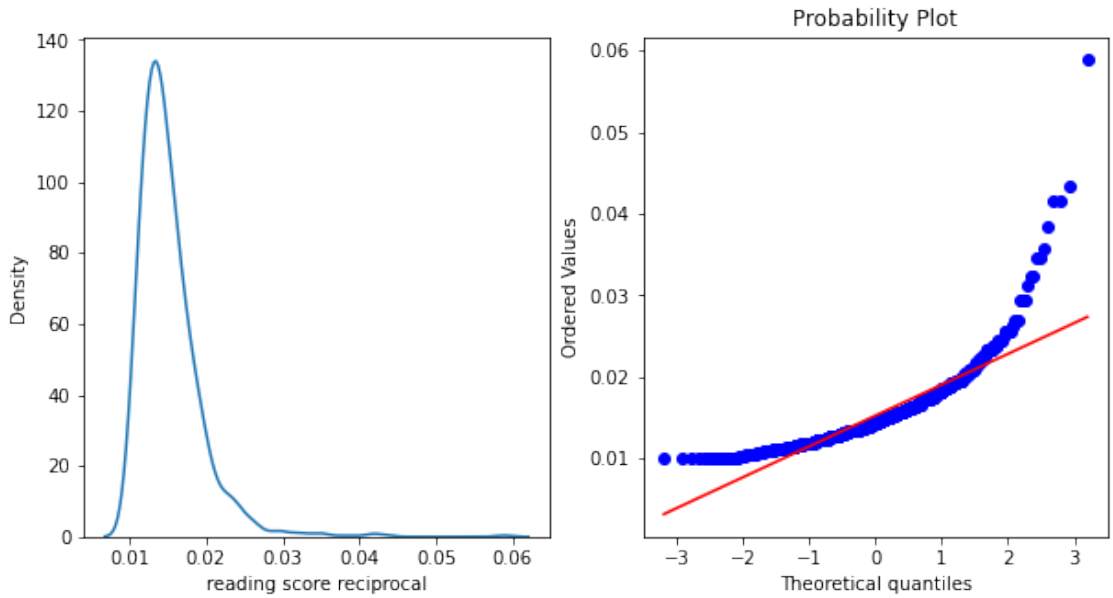
1. Reciprocal Transformation

[34]:
```
# Reciprocal Transformation
df['math score reciprocal']=1/df['math score']
normality(df,'math score reciprocal')
```

```
c:\users\kotka\appdata\local\programs\python\python39\lib\site-
packages\numpy\lib\function_base.py:2474: RuntimeWarning: invalid value
encountered in subtract
  X -= avg[:, None]
```



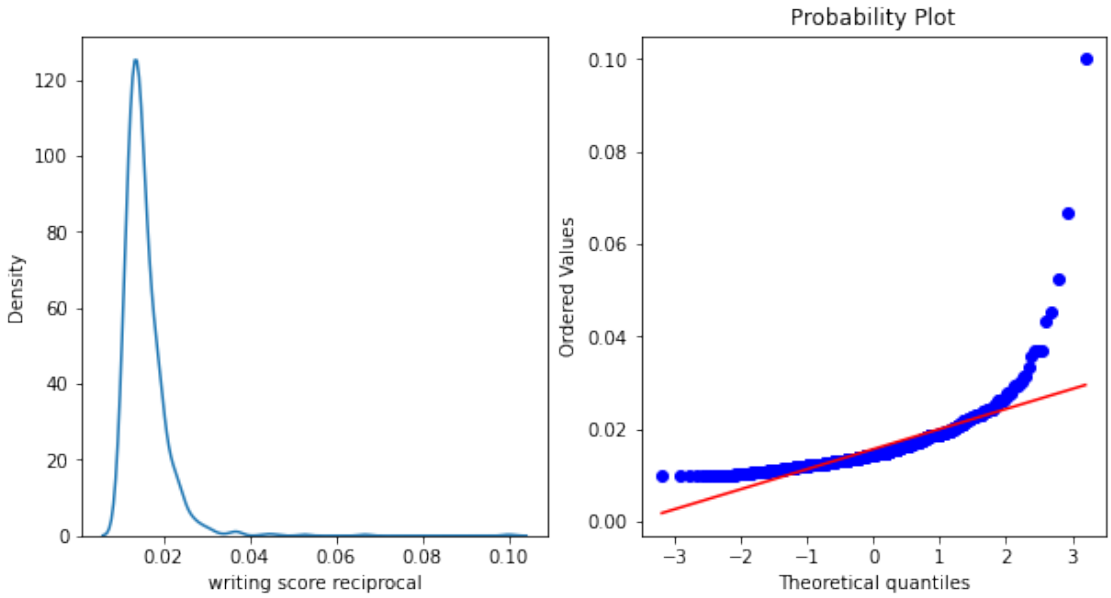
[35]:
```
df['reading score reciprocal']=1/df['reading score']
normality(df,'reading score reciprocal')
```



[36]:
```
df['reading score reciprocal'].skew()
```

[36]: 2.98632627454535

[37]:
```
df['writing score reciprocal']=1/df['writing score']
normality(df,'writing score reciprocal')
```

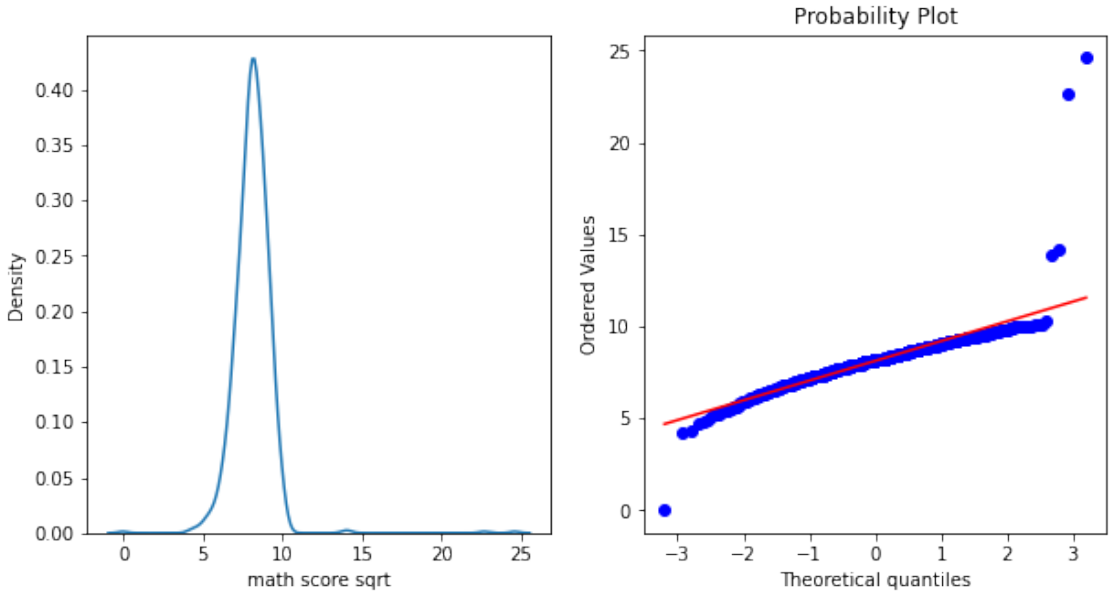


[38]:
```
df['writing score reciprocal'].skew()
```

[38]: 5.976786915855157

2. Square Root Transformation

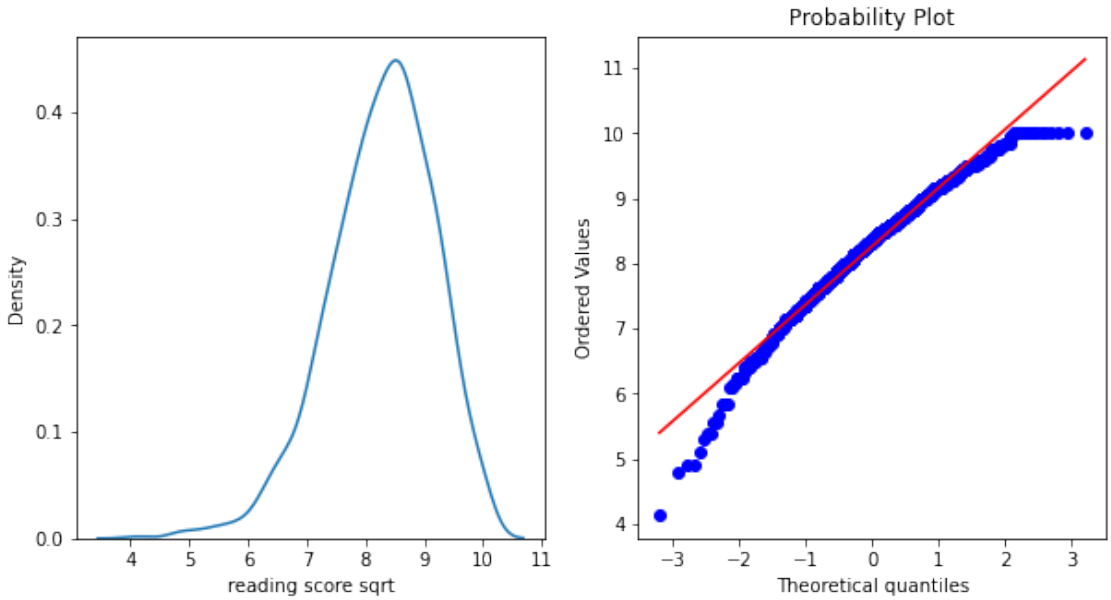
[39]:
```
# Square Root Transformation
df['math score sqrt']=np.sqrt(df['math score'])
normality(df,'math score sqrt')
```



[40]:
```
df['math score sqrt'].skew()
```

[40]: 3.692380545285561

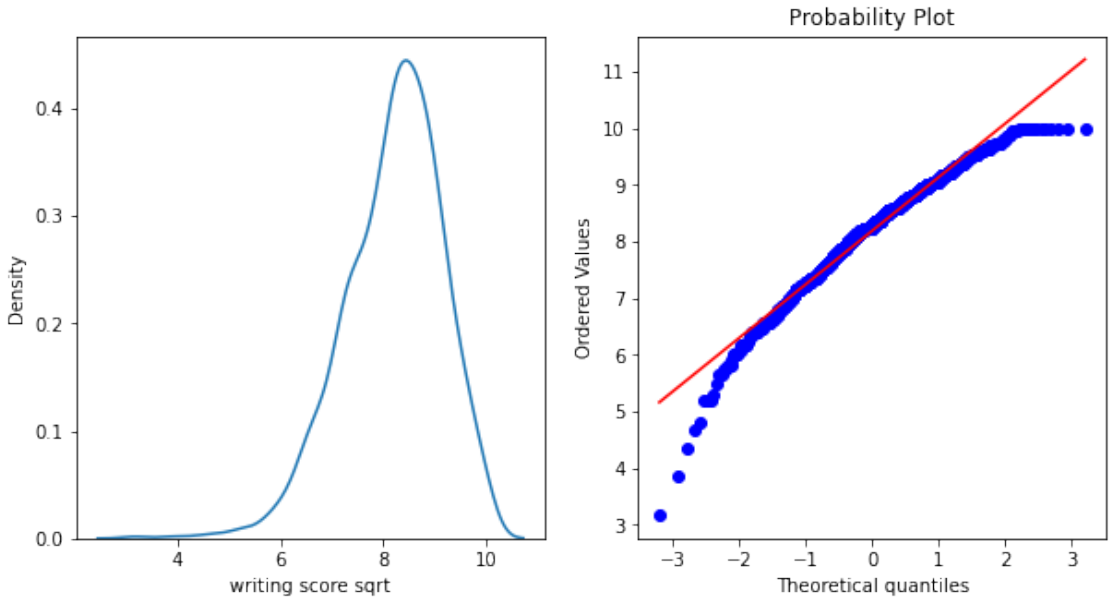
[41]:
```
df['reading score sqrt']=np.sqrt(df['reading score'])
normality(df,'reading score sqrt')
```



[42]:
```
df['reading score sqrt'].skew()
```

[42]:
```
-0.6398756178682481
```

[43]:
```
df['writing score sqrt']=np.sqrt(df['writing score'])
normality(df,'writing score sqrt')
```



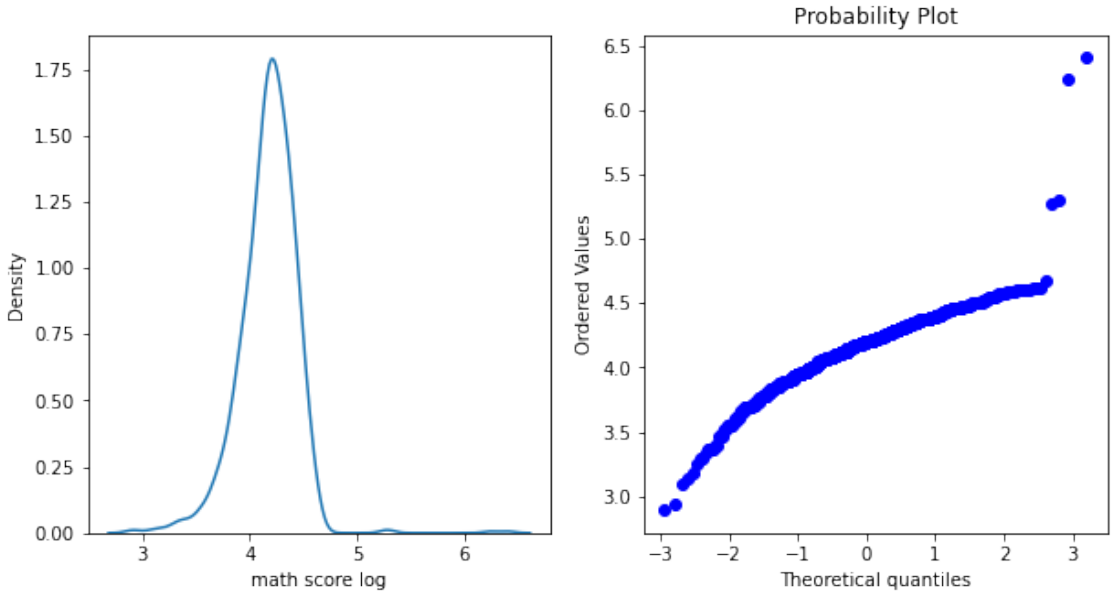
[44]:
```
df['writing score sqrt'].skew()
```

[44]:
```
-0.738922791844053
```

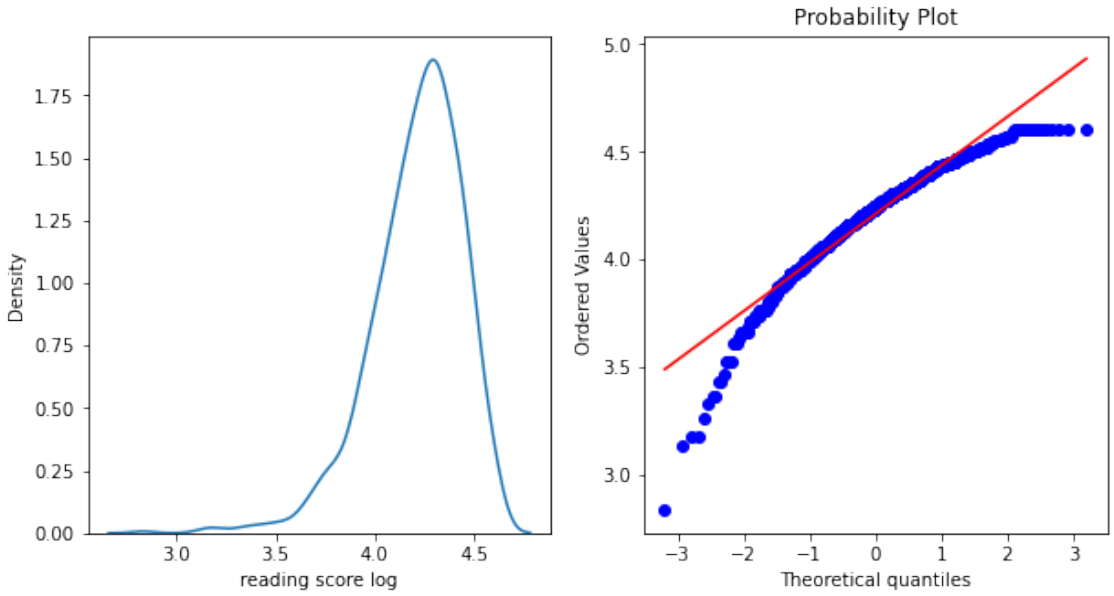
3. Logarithmic Transformation

[45]:
```
# Logarithmic Transformation
df['math score log']=np.log(df['math score'])
normality(df,'math score log')
```

```
c:\users\kotka\appdata\local\programs\python\python39\lib\site-
packages\pandas\core\arraylike.py:364: RuntimeWarning: divide by zero
encountered in log
  result = getattr(ufunc, method)(*inputs, **kwargs)
c:\users\kotka\appdata\local\programs\python\python39\lib\site-
packages\numpy\lib\function_base.py:2474: RuntimeWarning: invalid value
encountered in subtract
  X -= avg[:, None]
```



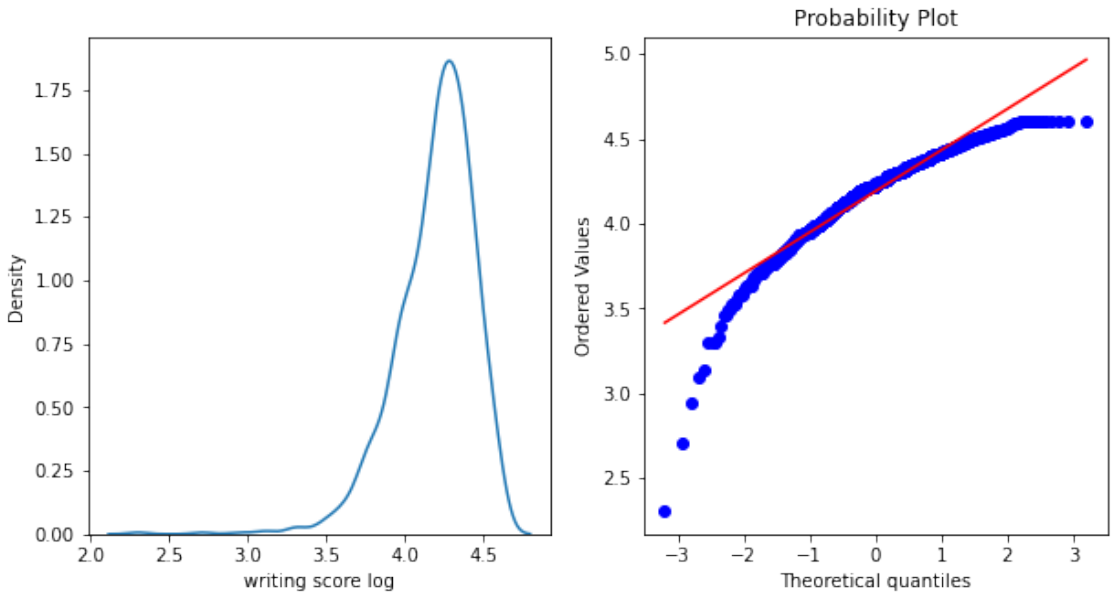
[46]:
```
df['reading score log']=np.log(df['reading score'])
normality(df,'reading score log')
```



[47]:
```
df['reading score log'].skew()
```

[47]: -1.1425959855465833

[48]:
```
df['writing score log']=np.log(df['writing score'])
normality(df,'writing score log')
```



[49]:
```
df['writing score log'].skew()
```

[49]: -1.4545902997722016