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Кафедра «Системы обработки информации и управления»

Лабораторная работа №2
по дисциплине
«Методы машинного обучения»
на тему
«Обработка признаков»

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Москва — 2023 г.

1. Лабораторная №2

Обработка пропусков в данных, кодирование категориальных признаков, масштабирование данных.

Задание:

1. Выбрать набор данных (датасет), содержащий категориальные признаки и пропуски в данных. Для выполнения следующих пунктов можно использовать несколько различных наборов данных (один для обработки пропусков, другой для категориальных признаков и т.д.)
2. Для выбранного датасета (датасетов) на основе материалов лекции решить следующие задачи:
    - устранение пропусков в данных;
    - кодирование категориальных признаков;
    - нормализация числовых признаков.

2. Описание данных

- Date - Дата наблюдений
- Location - Название локации, в которой расположена метеорологическая станция
- MinTemp - Минимальная температура в градусах цельсия
- MaxTemp - Максимальная температура в градусах цельсия
- Rainfall - Количество осадков, зафиксированных за день в мм
- Evaporation - Так называемое “pan evaporation” класса A (мм) за 24 часа до 9 утра
- Sunshine - Число солнечных часов за день
- WindGustDir - направление самого сильного порыва ветра за последние 24 часа
- WindGustSpeed - скорость (км / ч) самого сильного порыва ветра за последние 24 часа
- WindDir9am - направление ветра в 9 утра

[3]:
```
import sklearn
from sklearn.model_selection import train_test_split
from sklearn.impute import SimpleImputer
import pandas as pd
import numpy as np
import seaborn as sns
import scipy.stats as stats

import matplotlib.pyplot as plt
```

[67]:
```
data = pd.read_csv('weatherAUS.csv', parse_dates=['Date'])
```

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

[3]:

	Date	Location	MinTemp	MaxTemp	Rainfall	Evaporation	Sunshine	\
0	2008-12-01	Albury	13.4	22.9	0.6	NaN	NaN	
1	2008-12-02	Albury	7.4	25.1	0.0	NaN	NaN	
2	2008-12-03	Albury	12.9	25.7	0.0	NaN	NaN	
3	2008-12-04	Albury	9.2	28.0	0.0	NaN	NaN	
4	2008-12-05	Albury	17.5	32.3	1.0	NaN	NaN	

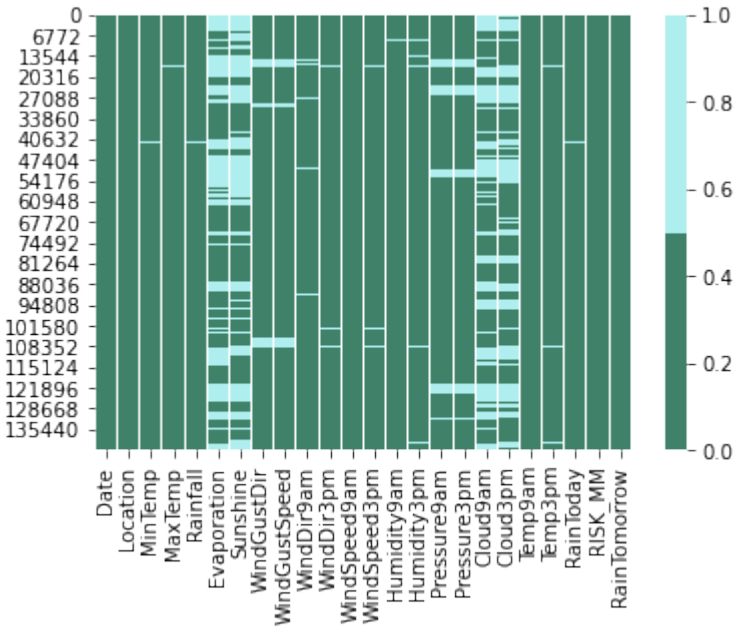
```
  WindGustDir  WindGustSpeed WindDir9am  … Humidity3pm  Pressure9am  \
0           W           44.0          W  …        22.0       1007.7
1         WNW           44.0        NNW  …        25.0       1010.6
2         WSW           46.0          W  …        30.0       1007.6
3          NE           24.0         SE  …        16.0       1017.6
4           W           41.0        ENE  …        33.0       1010.8

   Pressure3pm  Cloud9am  Cloud3pm  Temp9am  Temp3pm  RainToday  RISK_MM  \
0       1007.1       8.0       NaN     16.9     21.8         No      0.0
1       1007.8       NaN       NaN     17.2     24.3         No      0.0
2       1008.7       NaN       2.0     21.0     23.2         No      0.0
3       1012.8       NaN       NaN     18.1     26.5         No      1.0
4       1006.0       7.0       8.0     17.8     29.7         No      0.2

  RainTomorrow
0           No
1           No
2           No
3           No
4           No

[5 rows x 24 columns]
```

2.1. Устранение пропусков в данных

Светлым цветом отметим пропущенные данные

[4]:
```
cols = data.columns
colours = ['#408169', '#AFEEEE']
sns.heatmap(data[cols].isnull(), cmap=sns.color_palette(colours))
```

[4]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fe232f67f40>
```



[63]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 142193 entries, 0 to 142192
Data columns (total 24 columns):
 #   Column         Non-Null Count   Dtype
---  ------         --------------   -----
 0   Date           142193 non-null  datetime64[ns]
 1   Location       142193 non-null  object
 2   MinTemp        141556 non-null  float64
 3   MaxTemp        141871 non-null  float64
 4   Rainfall       140787 non-null  float64
 5   Evaporation    81350 non-null   float64
 6   Sunshine       74377 non-null   float64
 7   WindGustDir    132863 non-null  object
 8   WindGustSpeed  132923 non-null  float64
 9   WindDir9am     132180 non-null  object
 10  WindDir3pm     138415 non-null  object
 11  WindSpeed9am   140845 non-null  float64
 12  WindSpeed3pm   139563 non-null  float64
 13  Humidity9am    140419 non-null  float64
 14  Humidity3pm    138583 non-null  float64
 15  Pressure9am    128179 non-null  float64
 16  Pressure3pm    128212 non-null  float64
 17  Cloud9am       88536 non-null   float64
 18  Cloud3pm       85099 non-null   float64
 19  Temp9am        141289 non-null  float64
 20  Temp3pm        139467 non-null  float64
 21  RainToday      140787 non-null  object
 22  RISK_MM        142193 non-null  float64
 23  RainTomorrow   142193 non-null  object
dtypes: datetime64[ns](1), float64(17), object(6)
memory usage: 26.0+ MB
```

Рассмотрим числовые колонки с пропущенными значениями

[68]:
```
total_count = data.shape[0]
num_cols = []
for col in data.columns:
    temp_null_count = data[data[col].isnull()].shape[0]
    dt = str(data[col].dtype)
    if temp_null_count>0 and (dt=='float64' or dt=='int64'):
        num_cols.append(col)
        temp_perc = round((temp_null_count / total_count) * 100.0, 2)
        print('     {}.        {}.                 {}, {}%.'.format(col, dt,␣
 ↪temp_null_count, temp_perc))
```

```
    MinTemp.        float64.                637, 0.45%.
    MaxTemp.        float64.                322, 0.23%.
```

```
     Rainfall.        float64.                 1406, 0.99%.
     Evaporation.        float64.                 60843,
42.79%.
     Sunshine.        float64.                 67816, 47.69%.
     WindGustSpeed.         float64.                 9270,
6.52%.
     WindSpeed9am.         float64.                 1348,
0.95%.
     WindSpeed3pm.         float64.                 2630,
1.85%.
     Humidity9am.         float64.                 1774, 1.25%.
     Humidity3pm.         float64.                 3610, 2.54%.
     Pressure9am.         float64.                 14014,
9.86%.
     Pressure3pm.         float64.                 13981,
9.83%.
     Cloud9am.         float64.                 53657, 37.74%.
     Cloud3pm.         float64.                 57094, 40.15%.
     Temp9am.        float64.                904, 0.64%.
     Temp3pm.        float64.                2726, 1.92%.
```

Фильтр по колонкам с пропущенными значениями

[6]:
```
data_num = data[num_cols]
data_num
```

[6]:

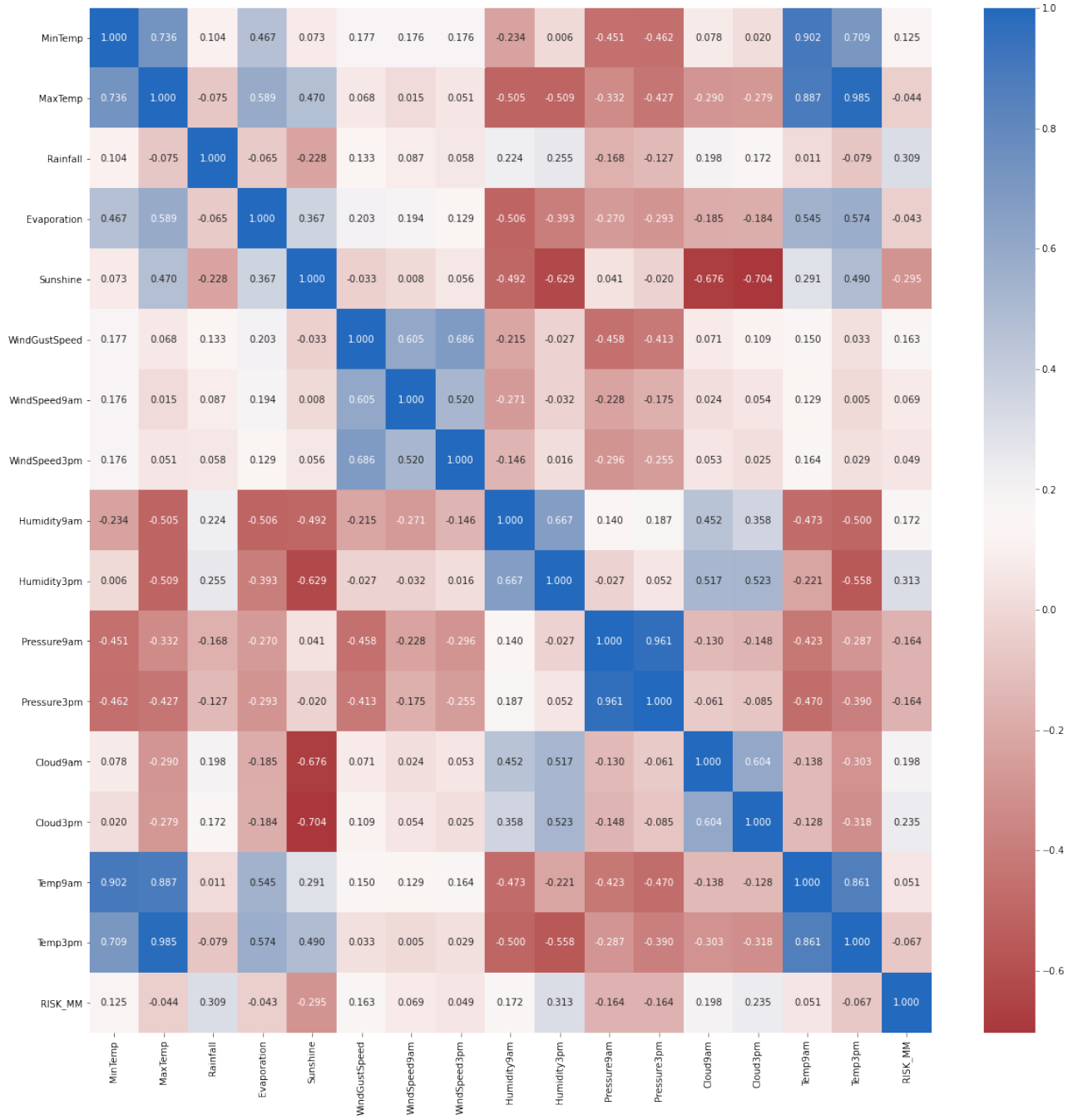
	MinTemp	MaxTemp	Rainfall	Evaporation	Sunshine	WindGustSpeed	\
0	13.4	22.9	0.6	NaN	NaN	44.0	
1	7.4	25.1	0.0	NaN	NaN	44.0	
2	12.9	25.7	0.0	NaN	NaN	46.0	
3	9.2	28.0	0.0	NaN	NaN	24.0	
4	17.5	32.3	1.0	NaN	NaN	41.0	
…	…	…	…	…	…	…	
142188	3.5	21.8	0.0	NaN	NaN	31.0	
142189	2.8	23.4	0.0	NaN	NaN	31.0	
142190	3.6	25.3	0.0	NaN	NaN	22.0	
142191	5.4	26.9	0.0	NaN	NaN	37.0	
142192	7.8	27.0	0.0	NaN	NaN	28.0	

	WindSpeed9am	WindSpeed3pm	Humidity9am	Humidity3pm	Pressure9am	\
0	20.0	24.0	71.0	22.0	1007.7	
1	4.0	22.0	44.0	25.0	1010.6	
2	19.0	26.0	38.0	30.0	1007.6	
3	11.0	9.0	45.0	16.0	1017.6	
4	7.0	20.0	82.0	33.0	1010.8	
…	…	…	…	…	…	
142188	15.0	13.0	59.0	27.0	1024.7	
142189	13.0	11.0	51.0	24.0	1024.6	
142190	13.0	9.0	56.0	21.0	1023.5	
142191	9.0	9.0	53.0	24.0	1021.0	
142192	13.0	7.0	51.0	24.0	1019.4	

```
        Pressure3pm  Cloud9am  Cloud3pm  Temp9am  Temp3pm
0            1007.1       8.0       NaN     16.9     21.8
1            1007.8       NaN       NaN     17.2     24.3
2            1008.7       NaN       2.0     21.0     23.2
3            1012.8       NaN       NaN     18.1     26.5
4            1006.0       7.0       8.0     17.8     29.7
…               …         …         …        …        …
142188       1021.2       NaN       NaN      9.4     20.9
142189       1020.3       NaN       NaN     10.1     22.4
142190       1019.1       NaN       NaN     10.9     24.5
142191       1016.8       NaN       NaN     12.5     26.1
142192       1016.5       3.0       2.0     15.1     26.0

[142193 rows x 16 columns]
```

[30]:
```
import sys
import numpy
numpy.set_printoptions(threshold=sys.maxsize)

corrmat = data.corr()
plt.figure(figsize=(20,20))
sns.heatmap(corrmat, annot=True, fmt='.3f', cmap="vlag_r")
```

[30]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fe22c411130>
```



В столбце Evaporation 42.79% пропущенных данных, и его корреляция с целевым признаком низкая, так что легче всего этот столбец удалить.

[69]:
```
data = data.drop(['Evaporation'], axis = 1)
num_cols.remove('Evaporation')
```

Все распределения, кроме Sunshine, одномодальные, так что будем использовать для заполнения пропусков моду. Для Sunshine медиану.

[70]:
```
data['Sunshine'] = data['Sunshine'].fillna(data.median(numeric_only=True))
```

[71]:
```
data['Humidity9am'] = data['Humidity9am'].fillna(data['Humidity9am'].mode())
```

[72]:
```
data = data.fillna(data.mode())
```

Рассмотрим пропуски в категориальных данных

[21]:
```
cat_cols = []
for col in data.columns:
    temp_null_count = data[data[col].isnull()].shape[0]
    dt = str(data[col].dtype)
    if temp_null_count>0 and (dt=='object'):
        cat_cols.append(col)
        temp_perc = round((temp_null_count / total_count) * 100.0, 2)
        print('     {}.        {}.                {}, {}%.'.format(col, dt,␣
 ↪temp_null_count, temp_perc))
```

```
    WindGustDir.        object.                9330, 6.56%.
    WindDir9am.        object.                10013, 7.04%.
    WindDir3pm.        object.                3778, 2.66%.
    RainToday.        object.                1406, 0.99%.
```

[75]:
```
for col in data[cat_cols]:
    print('     {}. {}'.format(col, data[col].unique()))
```

```
    WindGustDir. ['W' 'WNW' 'WSW' 'NE' 'NNW' 'N' 'NNE' 'SW' 'ENE' 'SSE' 'S'
'NW' 'SE' 'ESE'
 nan 'E' 'SSW']
    WindDir9am. ['W' 'NNW' 'SE' 'ENE' 'SW' 'SSE' 'S' 'NE' nan 'SSW' 'N'
'WSW' 'ESE' 'E'
 'NW' 'WNW' 'NNE']
    WindDir3pm. ['WNW' 'WSW' 'E' 'NW' 'W' 'SSE' 'ESE' 'ENE' 'NNW' 'SSW' 'SW'
'SE' 'N' 'S'
 'NNE' nan 'NE']
    RainToday. ['No' 'Yes' nan]
```

[73]:
```
data[:] = SimpleImputer(missing_values=np.nan, strategy='most_frequent').
 ↪fit_transform(data)
```

[110]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 142193 entries, 0 to 142192
Data columns (total 23 columns):
 #   Column         Non-Null Count   Dtype
---  ------         --------------   -----
 0   Date           142193 non-null  datetime64[ns]
 1   Location       142193 non-null  object
 2   MinTemp        142193 non-null  float64
 3   MaxTemp        142193 non-null  float64
 4   Rainfall       142193 non-null  float64
 5   Sunshine       142193 non-null  float64
 6   WindGustDir    142193 non-null  object
 7   WindGustSpeed  142193 non-null  float64
```

```
 8   WindDir9am     142193 non-null  object
 9   WindDir3pm     142193 non-null  object
 10  WindSpeed9am   142193 non-null  float64
 11  WindSpeed3pm   142193 non-null  float64
 12  Humidity9am    142193 non-null  float64
 13  Humidity3pm    142193 non-null  float64
 14  Pressure9am    142193 non-null  float64
 15  Pressure3pm    142193 non-null  float64
 16  Cloud9am       142193 non-null  float64
 17  Cloud3pm       142193 non-null  float64
 18  Temp9am        142193 non-null  float64
 19  Temp3pm        142193 non-null  float64
 20  RainToday      142193 non-null  object
 21  RISK_MM        142193 non-null  float64
 22  RainTomorrow   142193 non-null  object
dtypes: datetime64[ns](1), float64(16), object(6)
memory usage: 25.0+ MB
```

[42]:
```
data.isnull().sum()
```

[42]:
```
Date             0
Location         0
MinTemp          0
MaxTemp          0
Rainfall         0
Sunshine         0
WindGustDir      0
WindGustSpeed    0
WindDir9am       0
WindDir3pm       0
WindSpeed9am     0
WindSpeed3pm     0
Humidity9am      0
Humidity3pm      0
Pressure9am      0
Pressure3pm      0
Cloud9am         0
Cloud3pm         0
Temp9am          0
Temp3pm          0
RainToday        0
RISK_MM          0
RainTomorrow     0
dtype: int64
```

2.2. Кодирование категориальных признаков

[74]:
```
data['RainToday'] = data['RainToday'].apply(lambda x: 1 if x == 'Yes' else␣
↪0)
data['RainTomorrow'] = data['RainTomorrow'].apply(lambda x: 1 if x == 'Yes'␣
↪else 0)
```

[136]:
```
data['Location'].unique()
```

[136]:
```
array(['Albury', 'BadgerysCreek', 'Cobar', 'CoffsHarbour', 'Moree',
       'Newcastle', 'NorahHead', 'NorfolkIsland', 'Penrith', 'Richmond',
       'Sydney', 'SydneyAirport', 'WaggaWagga', 'Williamtown',
       'Wollongong', 'Canberra', 'Tuggeranong', 'MountGinini', 'Ballarat',
       'Bendigo', 'Sale', 'MelbourneAirport', 'Melbourne', 'Mildura',
       'Nhil', 'Portland', 'Watsonia', 'Dartmoor', 'Brisbane', 'Cairns',
       'GoldCoast', 'Townsville', 'Adelaide', 'MountGambier', 'Nuriootpa',
       'Woomera', 'Albany', 'Witchcliffe', 'PearceRAAF', 'PerthAirport',
       'Perth', 'SalmonGums', 'Walpole', 'Hobart', 'Launceston',
       'AliceSprings', 'Darwin', 'Katherine', 'Uluru'], dtype=object)
```

Слишком много категорий Location для OneHotEncoder

[75]:
```
from sklearn.preprocessing import LabelEncoder

le = LabelEncoder()
data['Location'] = le.fit_transform(data['Location'])
```

[76]:
```
categorical = ['WindDir3pm','WindDir9am', 'WindGustDir']

data = pd.concat([data, pd.get_dummies(data[categorical],␣
↪columns=categorical, drop_first=True)],axis=1)
data.drop(categorical, axis=1, inplace=True)
```

[11]:
```
data.shape
```

[11]:
```
(142193, 65)
```

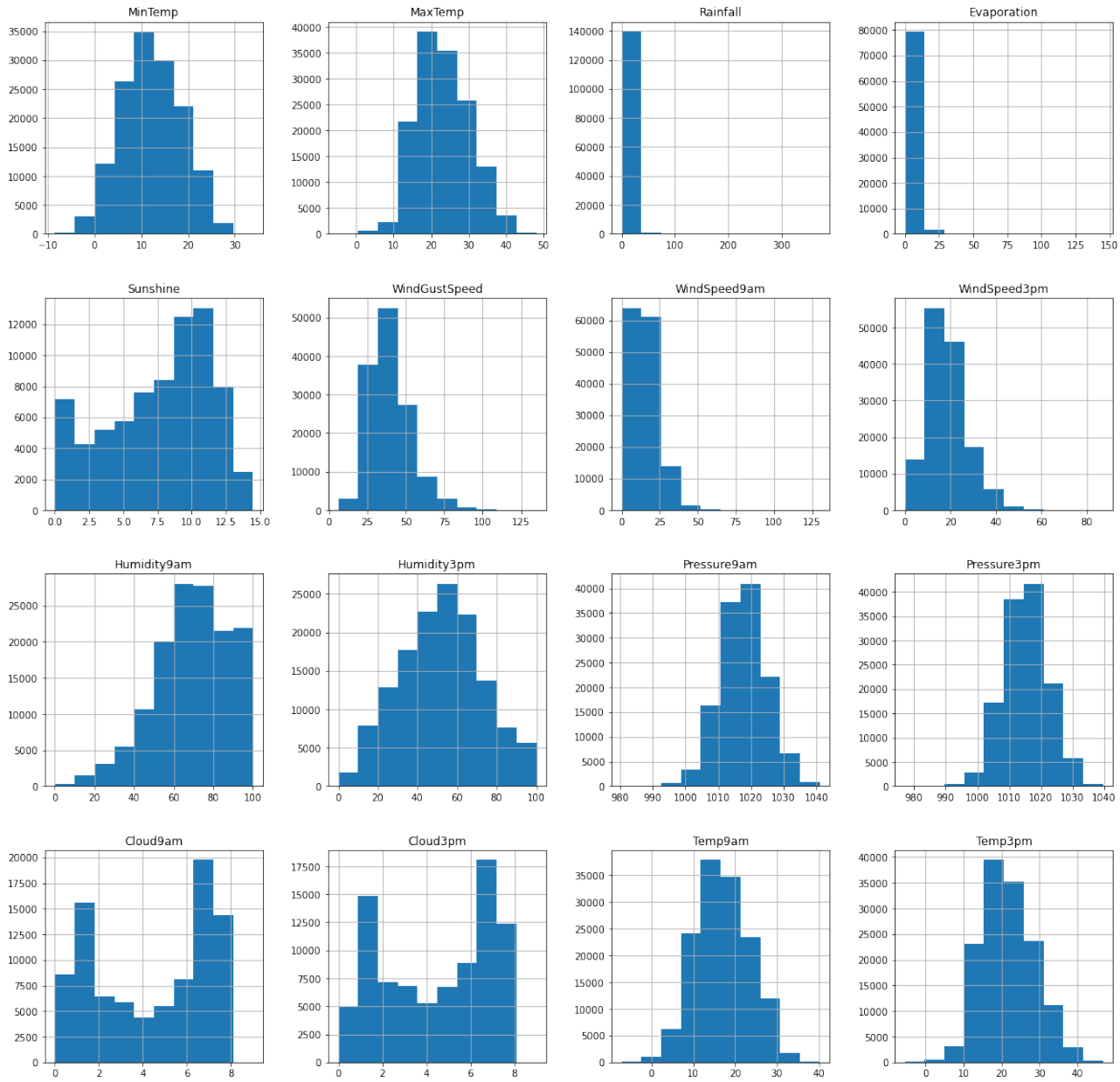
2.3. Нормализация числовых признаков

[77]:
```
data[num_cols] = data[data[num_cols] > 0][num_cols]
```

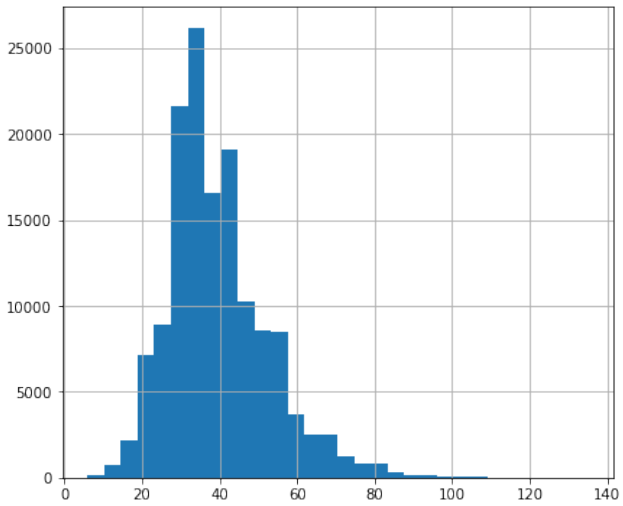
[79]:
```
def diagnostic_plots(df, variable):
    plt.figure(figsize=(15,6))
    #
    plt.subplot(1, 2, 1)
    df[variable].hist(bins=30)
    ## Q-Q plot
    plt.subplot(1, 2, 2)
    stats.probplot(df[variable], dist="norm", plot=plt)
    plt.show()
```

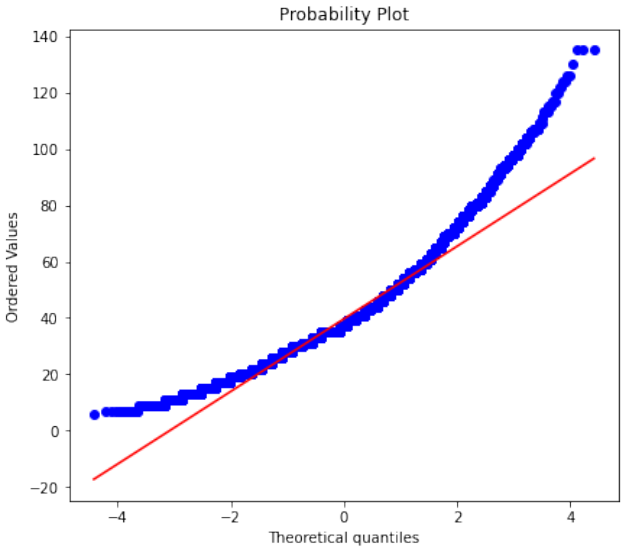
[128]:
```
def diagnostic_plots_data(df):
    plt.figure(figsize=(15,6))
    #
    plt.subplot(1, 2, 1)
    df.hist(bins=30)
    ## Q-Q plot
    plt.subplot(1, 2, 2)
    stats.probplot(df, dist="norm", plot=plt)
    plt.show()
```

[59]:
```
data_num.hist(figsize=(20,20))
plt.show()
```

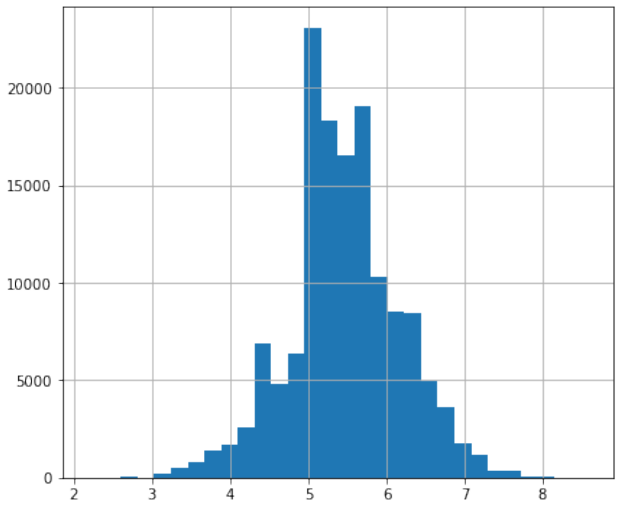


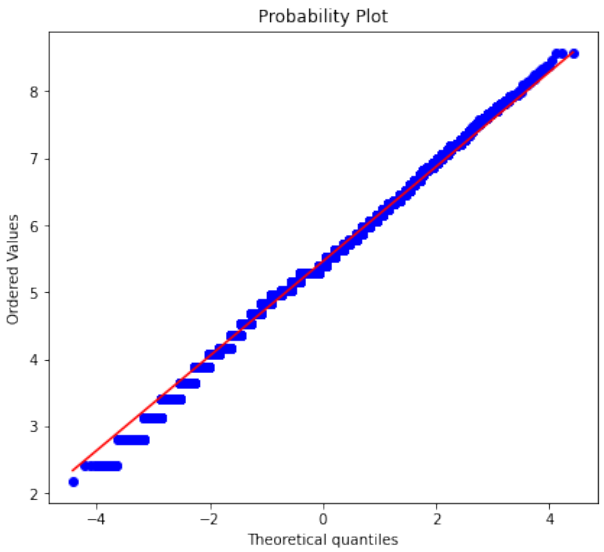
[138]:
```
diagnostic_plots(data, 'WindGustSpeed')

data['WindGustSpeed_boxcox'], param = stats.boxcox(data['WindGustSpeed'])
print('                = {}'.format(param))
diagnostic_plots(data, 'WindGustSpeed_boxcox')
```



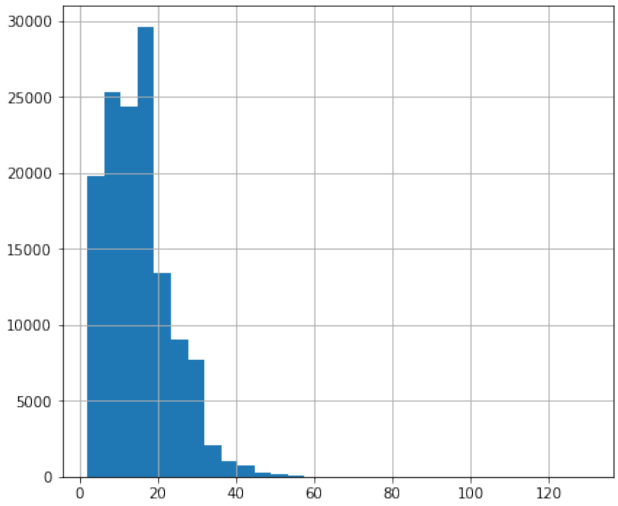


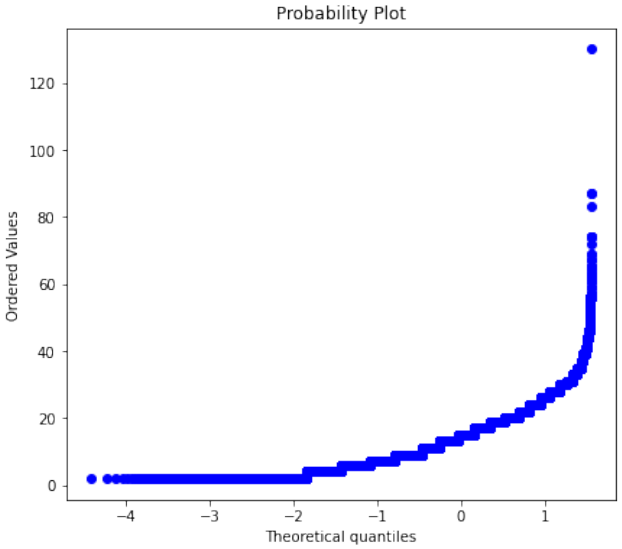

```
= 0.21000467599892894
```

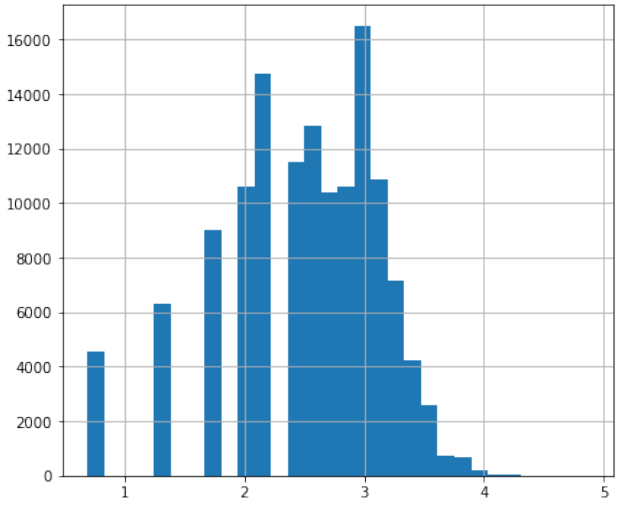


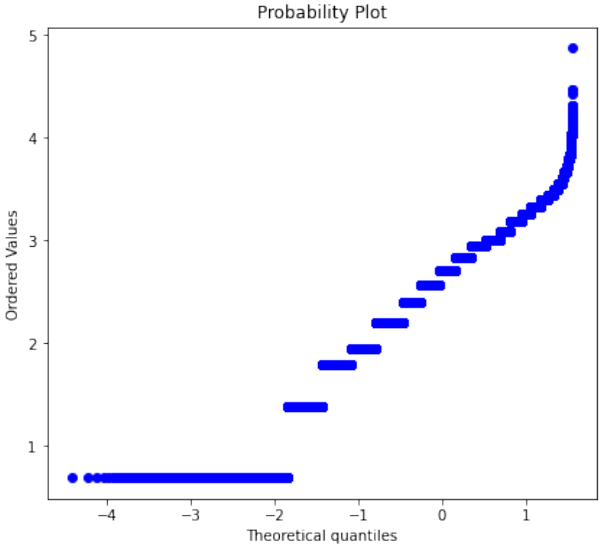


[139]:
```
diagnostic_plots(data, 'WindSpeed9am')
diagnostic_plots_data( np.log(data['WindSpeed9am']) )
```

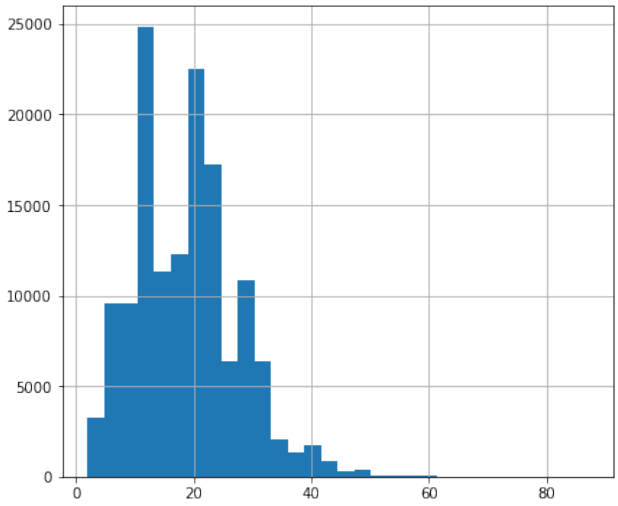


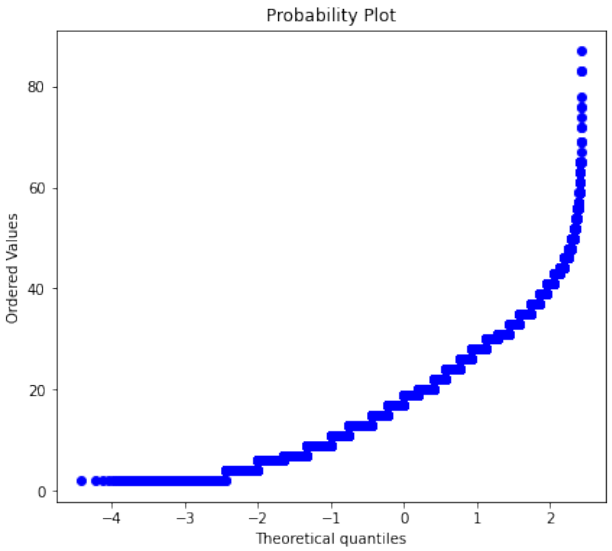


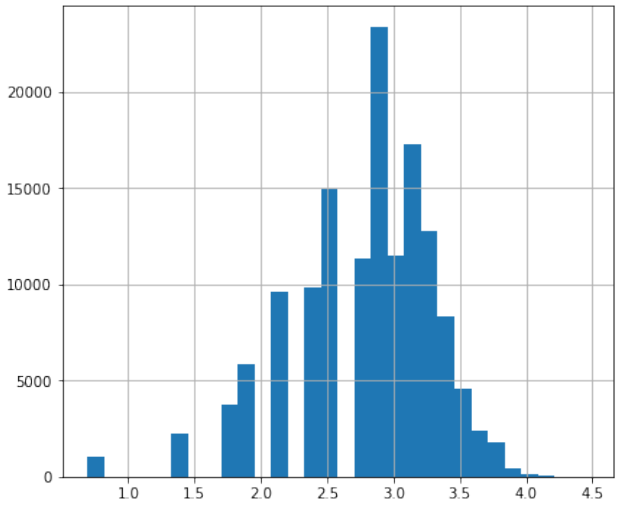


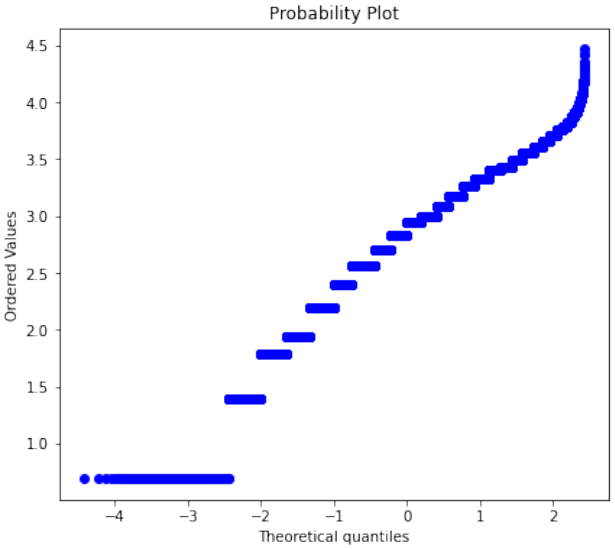


[167]:
```
diagnostic_plots(data, 'WindSpeed3pm')
diagnostic_plots_data( np.log( (data['WindSpeed3pm']) ) )
```









[81]:
```
data['WindSpeed9am'] = np.log( (data['WindSpeed9am']) )
data['WindSpeed3pm'] = np.log( (data['WindSpeed3pm']) )
data['WindGustSpeed'], param = stats.boxcox(data['WindGustSpeed'])
```