# Exploratory Data Analysis:

## Required libraries:

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

In [2]:
```
df= pd.read_csv("C:/Users/Vp/OneDrive/Desktop/Healthcare_Data/train_data.csv")
```

In [3]:
```
df
```

Out[3]:

| | case_id | Hospital_code | Hospital_type_code | City_Code_Hospital | Hospital_region_code | Available Extra Rooms in Hospital | Department in Hospital | Ward_Type | Ward_Facility_Code | Grade | Bed patientid | City_Code_Patient | Admission | Type of | Severity of Illness | Visitors with Patient | Age | A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1 | 8 | c | 3 | Z | 3 | radiotherapy | R | F | 2.0 | 31397 | 7.0 | Emergency | Extreme | 2 | | 51-60 | |
| **1** | 2 | 2 | c | 5 | Z | 2 | radiotherapy | S | F | 2.0 | 31397 | 7.0 | Trauma | Extreme | 2 | | 51-60 | |
| **2** | 3 | 10 | e | 1 | X | 2 | anesthesia | S | E | 2.0 | 31397 | 7.0 | Trauma | Extreme | 2 | | 51-60 | |
| **3** | 4 | 26 | b | 2 | Y | 2 | radiotherapy | R | D | 2.0 | 31397 | 7.0 | Trauma | Extreme | 2 | | 51-60 | |
| **4** | 5 | 26 | b | 2 | Y | 2 | radiotherapy | S | D | 2.0 | 31397 | 7.0 | Trauma | Extreme | 2 | | 51-60 | |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **318433** | 318434 | 6 | a | 6 | X | 3 | radiotherapy | Q | F | 4.0 | 86499 | 23.0 | Emergency | Moderate | 3 | | 41-50 | |
| **318434** | 318435 | 24 | a | 1 | X | 2 | anesthesia | Q | E | 4.0 | 325 | 8.0 | Urgent | Moderate | 4 | | 81-90 | |
| **318435** | 318436 | 7 | a | 4 | X | 3 | gynecology | R | F | 4.0 | 125235 | 10.0 | Emergency | Minor | 3 | | 71-80 | |
| **318436** | 318437 | 11 | b | 2 | Y | 3 | anesthesia | Q | D | 3.0 | 91081 | 8.0 | Trauma | Minor | 5 | | 11-20 | |
| **318437** | 318438 | 19 | a | 7 | Y | 5 | gynecology | Q | C | 2.0 | 21641 | 8.0 | Emergency | Minor | 2 | | 11-20 | |

318438 rows × 18 columns

In [4]:
```
df.head()
```

Out[4]:

| | case_id | Hospital_code | Hospital_type_code | City_Code_Hospital | Hospital_region_code | Available Extra Rooms in Hospital | Department in Hospital | Ward_Type | Ward_Facility_Code | Grade | Bed patientid | City_Code_Patient | Admission | Type of | Severity of Illness | Visitors with Patient | Age | Admissi |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1 | 8 | c | 3 | Z | 3 | radiotherapy | R | F | 2.0 | 31397 | 7.0 | Emergency | Extreme | 2 | | 51-60 | |
| **1** | 2 | 2 | c | 5 | Z | 2 | radiotherapy | S | F | 2.0 | 31397 | 7.0 | Trauma | Extreme | 2 | | 51-60 | |
| **2** | 3 | 10 | e | 1 | X | 2 | anesthesia | S | E | 2.0 | 31397 | 7.0 | Trauma | Extreme | 2 | | 51-60 | |
| **3** | 4 | 26 | b | 2 | Y | 2 | radiotherapy | R | D | 2.0 | 31397 | 7.0 | Trauma | Extreme | 2 | | 51-60 | |
| **4** | 5 | 26 | b | 2 | Y | 2 | radiotherapy | S | D | 2.0 | 31397 | 7.0 | Trauma | Extreme | 2 | | 51-60 | |

In [5]:
```
df.tail()
```

Out[5]:

| | case_id | Hospital_code | Hospital_type_code | City_Code_Hospital | Hospital_region_code | Available Extra Rooms in Hospital | Department in Hospital | Ward_Type | Ward_Facility_Code | Grade | Bed patientid | City_Code_Patient | Admission | Type of | Severity of Illness | Visitors with Patient | Age | A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **318433** | 318434 | 6 | a | 6 | X | 3 | radiotherapy | Q | F | 4.0 | 86499 | 23.0 | Emergency | Moderate | 3 | | 41-50 | |
| **318434** | 318435 | 24 | a | 1 | X | 2 | anesthesia | Q | E | 4.0 | 325 | 8.0 | Urgent | Moderate | 4 | | 81-90 | |
| **318435** | 318436 | 7 | a | 4 | X | 3 | gynecology | R | F | 4.0 | 125235 | 10.0 | Emergency | Minor | 3 | | 71-80 | |
| **318436** | 318437 | 11 | b | 2 | Y | 3 | anesthesia | Q | D | 3.0 | 91081 | 8.0 | Trauma | Minor | 5 | | 11-20 | |
| **318437** | 318438 | 19 | a | 7 | Y | 5 | gynecology | Q | C | 2.0 | 21641 | 8.0 | Emergency | Minor | 2 | | 11-20 | |

In [6]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 318438 entries, 0 to 318437
Data columns (total 18 columns):
#   Column                                Non-Null Count   Dtype
---  ------                                --------------   -----
0   case_id                               318438 non-null  int64
1   Hospital_code                         318438 non-null  int64
2   Hospital_type_code                    318438 non-null  object
3   City_Code_Hospital                    318438 non-null  int64
4   Hospital_region_code                  318438 non-null  object
5   Available Extra Rooms in Hospital     318438 non-null  int64
6   Department                            318438 non-null  object
7   Ward_Type                             318438 non-null  object
8   Ward_Facility_Code                    318438 non-null  object
9   Bed Grade                             318325 non-null  float64
10  patientid                             318438 non-null  int64
11  City_Code_Patient                     313906 non-null  float64
12  Type of Admission                     318438 non-null  object
13  Severity of Illness                   318438 non-null  object
14  Visitors with Patient                 318438 non-null  int64
15  Age                                   318438 non-null  object
16  Admission_Deposit                     318438 non-null  float64
17  Stay                                  318438 non-null  object
dtypes: float64(3), int64(6), object(9)
memory usage: 43.7+ MB
```

In [7]:
```
df.dtypes
```

Out[7]:

```
case_id                                    int64
Hospital_code                              int64
Hospital_type_code                        object
City_Code_Hospital                         int64
Hospital_region_code                      object
Available Extra Rooms in Hospital          int64
Department                                object
Ward_Type                                 object
Ward_Facility_Code                        object
Bed Grade                                float64
patientid                                  int64
City_Code_Patient                        float64
Type of Admission                         object
Severity of Illness                       object
Visitors with Patient                      int64
Age                                       object
Admission_Deposit                        float64
Stay                                      object
dtype: object
```

In [8]:
```
df.shape
```

Out[8]:

```
(318438, 18)
```

## Before Null Values checking :

In [22]:
```
df.isnull().sum().sum()
```

Out[22]:

```
4445
```

In [23]:
```
df.isnull()
```

Out[23]:

| | case_id | Hospital_code | Hospital_type_code | City_Code_Hospital | Hospital_region_code | Available Extra Rooms in Hospital | Department in Hospital | Ward_Type | Ward_Facility_Code | Grade | Bed patientid | City_Code_Patient | Admission | Type of | Severity of Illness | Visitors with Patient | Age | A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | |
| **1** | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | |
| **2** | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | |
| **3** | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | |
| **4** | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **318433** | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | |
| **318434** | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | |
| **318435** | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | |
| **318436** | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | |
| **318437** | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | False | |

318438 rows × 18 columns

In [24]:
```
df.describe()
```

Out[24]:

| | case_id | Hospital_code | City_Code_Hospital | Available Extra Rooms in Hospital | Bed Grade | patientid | City_Code_Patient | Visitors with Patient | Admission_Deposit |
|---|---|---|---|---|---|---|---|---|---|
| **count** | 318438.000000 | 318438.000000 | 318438.000000 | 318438.000000 | 318325.000000 | 318438.000000 | 313906.000000 | 318438.000000 | 318438.000000 |
| **mean** | 159219.500000 | 18.318841 | 4.771717 | 3.197627 | 2.625807 | 65747.579472 | 7.251859 | 3.286099 | 4980.740920 |
| **std** | 91925.276847 | 8.623755 | 3.102515 | 1.158171 | 0.873146 | 37979.936440 | 4.745266 | 1.764061 | 1085.770254 |
| **min** | 1.000000 | 1.000000 | 1.000000 | 0.000000 | 1.000000 | 1.000000 | 0.000000 | 1.000000 | 1800.000000 |
| **25%** | 79610.250000 | 11.000000 | 2.000000 | 2.000000 | 2.000000 | 32847.000000 | 4.000000 | 2.000000 | 4186.000000 |
| **50%** | 159219.500000 | 19.000000 | 5.000000 | 3.000000 | 3.000000 | 65724.500000 | 8.000000 | 3.000000 | 4741.000000 |
| **75%** | 238828.750000 | 26.000000 | 7.000000 | 4.000000 | 4.000000 | 98470.000000 | 8.000000 | 4.000000 | 5408.000000 |
| **max** | 318438.000000 | 32.000000 | 13.000000 | 24.000000 | 4.000000 | 131624.000000 | 38.000000 | 32.000000 | 11008.000000 |

In [27]:
```
df.isnull().sum()
```

Out[27]:

```
case_id                                    0
Hospital_code                              0
Hospital_type_code                         0
City_Code_Hospital                         0
Hospital_region_code                       0
Available Extra Rooms in Hospital          0
Department                                 0
Ward_Type                                  0
Ward_Facility_Code                         0
Bed Grade                                113
patientid                                  0
City_Code_Patient                       4522
Type of Admission                          0
Severity of Illness                        0
Visitors with Patient                      0
Age                                        0
Admission_Deposit                          0
Stay                                       0
dtype: int64
```

In [31]:
```
df.corr()
```

Out[31]:

| | case_id | Hospital_code | City_Code_Hospital | Available Extra Rooms in Hospital | Bed Grade | patientid | City_Code_Patient | Visitors with Patient | Admission_Deposit |
|---|---|---|---|---|---|---|---|---|---|
| **case_id** | 1.000000 | -0.043023 | -0.011352 | 0.042580 | 0.013702 | -0.001450 | 0.065194 | 0.001309 | -0.045972 |
| **Hospital_code** | -0.043023 | 1.000000 | 0.129294 | -0.059638 | -0.013739 | 0.000291 | -0.015530 | -0.028500 | 0.045466 |
| **City_Code_Hospital** | -0.011352 | 0.129294 | 1.000000 | -0.045771 | -0.049309 | 0.000750 | -0.023988 | 0.018184 | -0.034455 |
| **Available Extra Rooms in Hospital** | 0.042580 | -0.059638 | -0.045771 | 1.000000 | -0.115968 | 0.000921 | -0.009681 | 0.096714 | -0.143739 |
| **Bed Grade** | 0.013702 | -0.013739 | -0.049309 | -0.115968 | 1.000000 | 0.001645 | -0.008105 | 0.008945 | 0.073833 |
| **patientid** | -0.001450 | 0.000291 | 0.000750 | 0.000921 | 0.001645 | 1.000000 | 0.002002 | 0.004889 | -0.000877 |
| **City_Code_Patient** | 0.065194 | -0.015530 | -0.023988 | -0.009681 | -0.008105 | 0.002002 | 1.000000 | -0.012074 | 0.025837 |
| **Visitors with Patient** | 0.001309 | -0.028500 | 0.018184 | 0.096714 | 0.008945 | 0.004889 | -0.012074 | 1.000000 | -0.150358 |
| **Admission_Deposit** | -0.045972 | 0.045466 | -0.034455 | -0.143739 | 0.073833 | -0.000877 | 0.025837 | -0.150358 | 1.000000 |

In [28]:
```
df.isnull().sum().sum()
```

Out[28]:

```
4445
```

## Work With Null Values :

In [32]:
```
df['Bed Grade'].fillna(df['Bed Grade'].mean(),inplace=True)
```

In [33]:
```
df['Bed Grade'].isnull().sum()
```

Out[33]:

```
0
```

In [34]:
```
df.isnull().sum()
```

Out[34]:

```
case_id                                    0
Hospital_code                              0
Hospital_type_code                         0
City_Code_Hospital                         0
Hospital_region_code                       0
Available Extra Rooms in Hospital          0
Department                                 0
Ward_Type                                  0
Ward_Facility_Code                         0
Bed Grade                                  0
patientid                                  0
City_Code_Patient                       4522
Type of Admission                          0
Severity of Illness                        0
Visitors with Patient                      0
Age                                        0
Admission_Deposit                          0
Stay                                       0
dtype: int64
```

In [35]:
```
df["City_Code_Patient"].fillna(df["City_Code_Patient"].mean(),inplace=True)
```

In [36]:
```
df["City_Code_Patient"].isnull().sum()
```

Out[36]:

```
0
```

## After Cleaning Process :

## Total Null Values Checking :

In [37]:
```
df.isnull().sum()
```

Out[37]:

```
case_id                                    0
Hospital_code                              0
Hospital_type_code                         0
City_Code_Hospital                         0
Hospital_region_code                       0
Available Extra Rooms in Hospital          0
Department                                 0
Ward_Type                                  0
Ward_Facility_Code                         0
Bed Grade                                  0
patientid                                  0
City_Code_Patient                          0
Type of Admission                          0
Severity of Illness                        0
Visitors with Patient                      0
Age                                        0
Admission_Deposit                          0
Stay                                       0
dtype: int64
```

## Total Null Values :

In [38]:
```
df.isnull().sum().sum()
```

Out[38]:

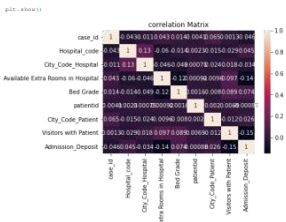
```
0
```

In [39]:
```
df.corr()
```

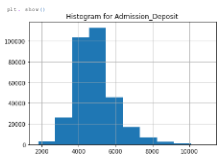
Out[39]:

| | case_id | Hospital_code | City_Code_Hospital | Available Extra Rooms in Hospital | Bed Grade | patientid | City_Code_Patient | Visitors with Patient | Admission_Deposit |
|---|---|---|---|---|---|---|---|---|---|
| **case_id** | 8.450257e+09 | -341452.559636 | -322751.0037 | 45724.814177 | 10999.462408 | -1.468859e+07 | 280306.639476 | 21220.60614 | -4592730.e+06 |
| **Hospital_code** | -3.414526e+04 | 74.541723 | 3.436541 | -0.601495 | -0.013516 | 7.511144e+02 | -0.627298 | -0.434073 | 4264.13 5e+02 |
| **City_Code_Hospital** | -3.237513e+03 | 3.436541 | 9.625726 | -0.165887 | -0.133549 | 8.841958e+01 | -0.348165 | 0.099525 | -1161750.e+02 |
| **Available Extra Rooms in Hospital** | 4.572484e+03 | -0.601495 | -0.165887 | 1.364624 | -0.118145 | 4.085839e+01 | -0.052888 | 0.199302 | -1824827.e+02 |
| **Bed Grade** | 1.099464e+03 | -0.103516 | -0.133549 | -0.118145 | 0.762113 | 5.452883e+01 | -0.033075 | 0.136962 | 7004405.2e+01 |
| **patientid** | -1.468858e+07 | 751.114364 | 884.195778 | 40.858395 | 54.528834 | 1.442476e+09 | 355.729321 | 461.576369 | -3620715.e+04 |
| **City_Code_Patient** | 2.803664e+04 | -0.627298 | -0.348165 | -0.052888 | -0.033075 | 3.557299e+02 | 22.197075 | -0.099496 | 1312733.6e+02 |
| **Visitors with Patient** | 2.122606e+03 | -0.434073 | 0.099525 | 0.199302 | 0.136962 | 4.617564e+02 | -0.099496 | 3.111913 | -2882567.e+02 |
| **Admission_Deposit** | -4.592730e+06 | 4264.13524 | -1161750.38 | -1824827.6 | 7004405.18 | -3.620715e+04 | 131273.639 | -2882566.79 | 1181083e+06 |

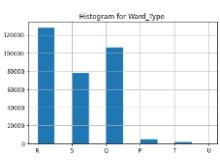
In [40]:
```
sns.heatmap(df.corr(),annot=True)
plt.title("correlation Matrix")
plt.show()
```

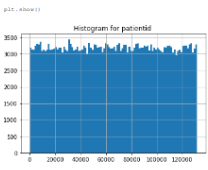



In [41]:
```
df["Admission_Deposit"].hist(bins=10)
plt.title("Histogram for Admission_Deposit ")
plt.show()
```




In [42]:
```
df["Ward_Type"].hist(bins=10)
plt.title("Histogram for Ward_Type ")
plt.show()
```




In [43]:
```
df["patientid"].hist(bins=100)
plt.title("Histogram for patientid ")
plt.show()
```