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1

```
import numpy as np
import pandas as pd
import random
from faker import Faker
import datetime

np.random.seed(42)

num_samples = 100

# Generate Employee IDs (unique identifiers)
employee_ids = [str(i) for i in range(1, num_samples + 1)]

# Generate Employee Names (text data)
fake = Faker()
employee_names = [fake.name() for _ in range(num_samples)]

# Generate Departments (categorical)
departments = ['Sales', 'Marketing', 'Engineering', 'HR', 'Finance', 'IT']
employee_departments = [random.choice(departments) for _ in range(num_samples)]

# Generate Salaries (numerical)
employee_salaries = np.random.randint(30000, 90000, size=num_samples)

# Generate Joining Dates (date or datetime)
start_date = datetime.date(2010, 1, 1)
end_date = datetime.date(2023, 1, 1)
employee_joining_dates = [fake.date_between_dates(start_date, end_date).strftime('%Y-%m-%d') for _ in range(num_samples)]

# Create a DataFrame to store the data
data = pd.DataFrame({
    'Employee ID': employee_ids,
    'Employee Name': employee_names,
    'Department': employee_departments,
    'Salary': employee_salaries,
    'Joining Date': employee_joining_dates
})

# Add missing values to the dataset (you can customize the missing value pattern)
missing_value_prob = 0.1  # 10% of data will have missing values

for column in data.columns:
    data[column] = data[column].apply(lambda x: np.nan if random.random() < missing_value_prob else x)

# Print the first few rows of the dataset
print(data.head())
```

```
  Employee ID     Employee Name Department   Salary Joining Date
0           1   Kenneth Jackson         IT  86422.0   2021-11-30
1           2          Ann Bell  Marketing  45795.0   2018-07-08
2           3   Charles Alvarez      Sales  30860.0   2018-02-13
3           4  Jeremiah Schultz  Marketing  68158.0   2012-02-29
4           5     Nicole Fisher      Sales  84343.0   2013-12-20
```

2

```
import pandas as pd

# Assuming you have already created the 'data' DataFrame as shown in the previous code

# Count the missing values in each column
missing_count = data.isnull().sum()

# Calculate the percentage of missing values in each column
total_count = len(data)
missing_percentage = (missing_count / total_count) * 100

# Create a DataFrame to display the results
missing_info = pd.DataFrame({
    'Column Name': data.columns,
    'Missing Count': missing_count,
    'Missing Percentage': missing_percentage
})

print(missing_info)
```

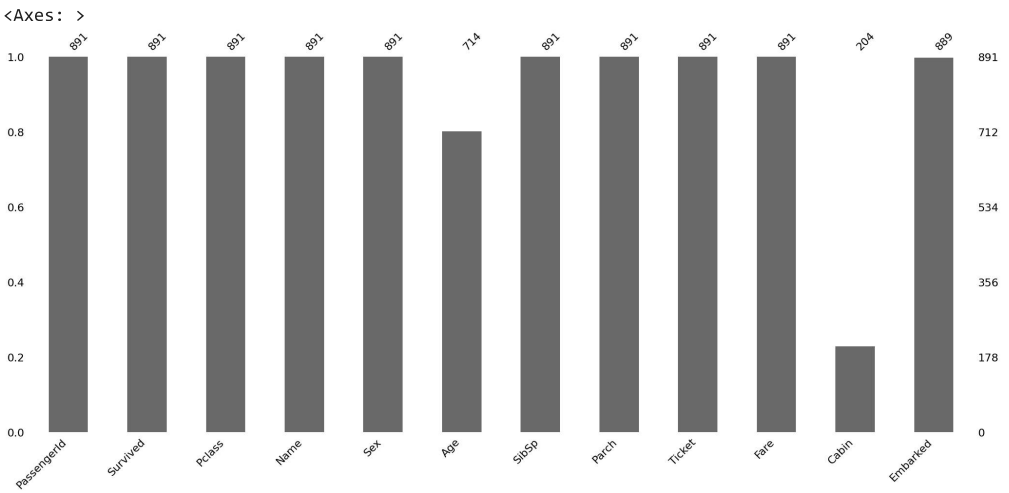
```
                  Column Name  Missing Count  Missing Percentage
Employee ID       Employee ID              7                 7.0
Employee Name   Employee Name             14                14.0
Department         Department             12                12.0
Salary                 Salary              9                 9.0
Joining Date    Joining Date               6                 6.0
```

3

```
import pandas as pd
import missingno as msno

# Load the Titanic dataset into a Pandas DataFrame
# Replace 'titanic_dataset.csv' with the actual file path if it's in a different location
titanic_data = pd.read_csv('titanic_dataset.csv')

# Visualize missing values with a bar chart
msno.bar(titanic_data)
```



4

```
import pandas as pd

# Assuming you have already loaded the Titanic dataset into a DataFrame named 'titanic_data'

# Create a copy of the DataFrame
titanic_data_copy = titanic_data.copy()

# Drop rows with missing values in the 'Fare' column
titanic_data_copy.dropna(subset=['Fare'], inplace=True)

# Now, 'titanic_data_copy' contains the DataFrame with rows that have no missing values in the 'Fare' column
```

5

```
import pandas as pd

most_frequent_cabin = titanic_data['Cabin'].mode()[0]

# Replace missing values in the 'Cabin' column with the most frequent value
titanic_data['Cabin'].fillna(most_frequent_cabin, inplace=True)
```

6

```
most_common_embarked = titanic_data_copy['Embarked'].mode()[0]
titanic_data_copy['Embarked'].fillna(most_common_embarked, inplace=True)
```

7

```
import numpy as np
from sklearn.impute import KNNImputer

# Assuming you have already loaded the Titanic dataset into a DataFrame named 'titanic_data'

# Extract the "Age" column as a 1D array
age_data = titanic_data['Age'].values.reshape(-1, 1)

# Create a KNN Imputer with the desired number of neighbors and weights
imputer = KNNImputer(n_neighbors=2, weights="uniform")

# Fit and transform the "Age" column to impute missing values
titanic_data['Age'] = imputer.fit_transform(age_data)

# Now, the missing values in the "Age" column have been imputed using KNN imputation
```

8

```
from sklearn.experimental import enable_iterative_imputer
from sklearn.impute import IterativeImputer

# Assuming you have already loaded the Titanic dataset into a DataFrame named 'titanic_data'

# Create a deep copy of the 'titanic_data' DataFrame
titanic_data_mice = titanic_data.copy(deep=True)

# Enable the IterativeImputer
enable_iterative_imputer

# Create an instance of the IterativeImputer
mice_imputer = IterativeImputer()

# Replace 'body' with the correct column name in your dataset
titanic_data_mice['Age'] = mice_imputer.fit_transform(titanic_data_mice[['Age']])


# Now, the 'body' column in 'titanic_data_mice' has missing values imputed based on multivariate feature imputation
```

9.a)

```
import numpy as np
import pandas as pd

data = {
    "X1": [np.nan, "Red", "Blue", "Red", np.nan, "Red", "Green", np.nan, "Blue", "Red"],
    "X2": ["Green", "Green", "Red", "Blue", "Green", "Blue", np.nan, "Red", "Green", np.nan]
}

colors = pd.DataFrame(data)
print(colors)
```

```
      X1     X2
0    NaN  Green
1    Red  Green
2   Blue    Red
3    Red   Blue
4    NaN  Green
5    Red   Blue
6  Green    NaN
7    NaN    Red
8   Blue  Green
9    Red    NaN
```

9.b)

```
# For each column, get value counts in decreasing order and take the index (value) of the most common class
df_most_common_imputed = colors.apply(lambda x: x.fillna(x.value_counts().idxmax()))
print(df_most_common_imputed)
```

```
      X1     X2
0    Red  Green
1    Red  Green
2   Blue    Red
3    Red   Blue
4    Red  Green
5    Red   Blue
6  Green  Green
7    Red    Red
8   Blue  Green
9    Red  Green
```

9.c)

```
df_unknown_imputed = colors.fillna("Unknown")
print(df_unknown_imputed)
```

```
        X1       X2
0  Unknown    Green
1      Red    Green
```

```
     2     Blue      Red
     3      Red     Blue
     4  Unknown    Green
     5      Red     Blue
     6    Green  Unknown
     7  Unknown      Red
     8     Blue    Green
     9      Red  Unknown
```

9.d)

```
for column in colors.columns:
    mode_value = colors[column].mode()[0]
    colors[column].fillna(mode_value, inplace=True)

print(colors)
```

```
           X1     X2
     0    Red  Green
     1    Red  Green
     2   Blue    Red
     3    Red   Blue
     4    Red  Green
     5    Red   Blue
     6  Green  Green
     7    Red    Red
     8   Blue  Green
     9    Red  Green
```

**Exercise III Remove Noise from Data **

1

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from scipy.stats import binned_statistic

# Load the dataset
df = pd.read_csv('cupcake.csv')
```

2.a)

```
# Binning by distance
min_val = df['Cupcake'].min()
max_val = df['Cupcake'].max()
```

2.b)

```
bins = np.linspace(min_val, max_val, 4)
bins
```

```
     array([  4.,  36.,  68., 100.])
```

2.c)

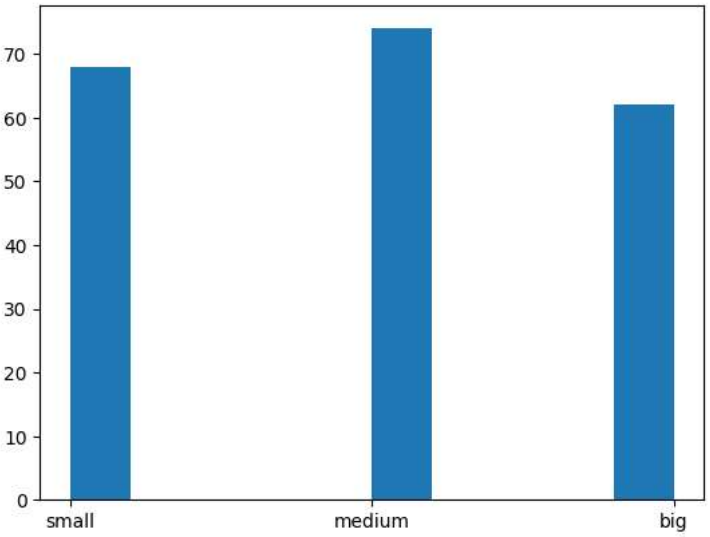
```
labels = ['small', 'medium', 'big']
```

2.d)

```
df['Cupcake_binned_distance'] = pd.cut(df['Cupcake'], bins=bins, labels=labels, include_lowest=True)
```

2.e)

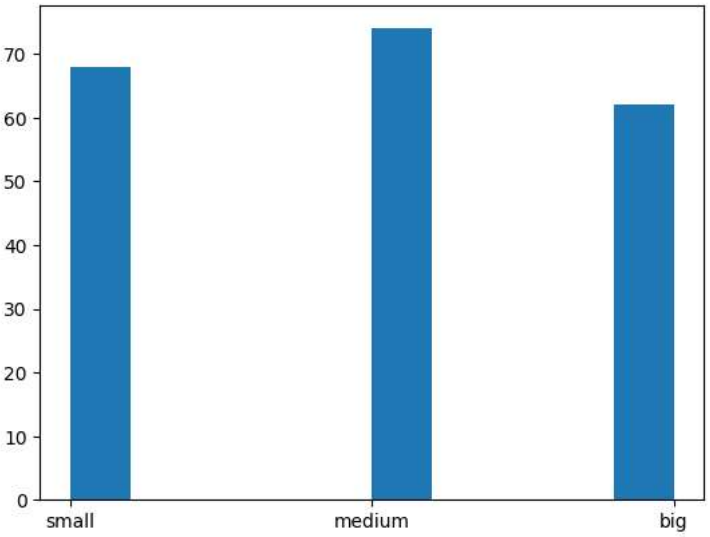
```
plt.hist(df['Cupcake_binned_distance'])
plt.show()
```



3.

```
df['Cupcake_binned_frequency'] = pd.qcut(df['Cupcake'], q=4)

plt.hist(df['Cupcake_binned_distance'])
plt.show()
```



4)

```
def set_to_mean(x):
    return np.mean(x)
def set_to_median(x):
    return np.median(x)
def set_to_boundary(x):
    return np.array([x.min(), x.max()])
num_bins = 10
bins = np.linspace(df['Cupcake'].min(), df['Cupcake'].max(), num_bins + 1)
bin_means, bin_edges, _ = binned_statistic(df['Cupcake'], df['Cupcake'], statistic='mean', bins=bins)
bin_medians, _, _ = binned_statistic(df['Cupcake'], df['Cupcake'], statistic='median', bins=bins)
result_df = pd.DataFrame({'Cupcake': df['Cupcake']})
result_df['Cupcake_Bin_Mean'] = df.groupby(pd.cut(df['Cupcake'], bins=bins, include_lowest=True))['Cupcake'].apply(lambda x: set_to_mean(x))
result_df['Cupcake_Bin_Median'] = df.groupby(pd.cut(df['Cupcake'], bins=bins, include_lowest=True))['Cupcake'].apply(lambda x: set_to_median(x))
result_df['Cupcake_Bin_Boundary'] = df.groupby(pd.cut(df['Cupcake'], bins=bins, include_lowest=True))['Cupcake'].apply(lambda x: set_to_boundary(x))
print(result_df)
```

```
     Cupcake  Cupcake_Bin_Mean  Cupcake_Bin_Median Cupcake_Bin_Boundary
0          5               NaN                 NaN                  NaN
1          5               NaN                 NaN                  NaN
```

2	4	NaN	NaN	NaN
3	6	NaN	NaN	NaN