

# # Exploratory Data Analysis (EDA) with Pandas [CheatSheet]

## 1. Data Loading

- **Read CSV File:** `df = pd.read_csv('filename.csv')`
- **Read Excel File:** `df = pd.read_excel('filename.xlsx')`
- **Read from SQL Database:** `df = pd.read_sql(query, connection)`

## 2. Basic Data Inspection

- **Display Top Rows:** `df.head()`
- **Display Bottom Rows:** `df.tail()`
- **Display Data Types:** `df.dtypes`
- **Summary Statistics:** `df.describe()`
- **Display Index, Columns, and Data:** `df.info()`

## 3. Data Cleaning

- **Check for Missing Values:** `df.isnull().sum()`
- **Fill Missing Values:** `df.fillna(value)`
- **Drop Missing Values:** `df.dropna()`
- **Rename Columns:** `df.rename(columns={'old_name': 'new_name'})`
- **Drop Columns:** `df.drop(columns=['column_name'])`

## 4. Data Transformation

- **Apply Function:** `df['column'].apply(lambda x: function(x))`
- **Group By and Aggregate:** `df.groupby('column').agg({'column': 'sum'})`
- **Pivot Tables:** `df.pivot_table(index='column1', values='column2', aggfunc='mean')`
- **Merge DataFrames:** `pd.merge(df1, df2, on='column')`
- **Concatenate DataFrames:** `pd.concat([df1, df2])`

## 5. Data Visualization Integration

- **Histogram:** `df['column'].hist()`
- **Boxplot:** `df.boxplot(column=['column1', 'column2'])`

- **Scatter Plot:** `df.plot.scatter(x='col1', y='col2')`
- **Line Plot:** `df.plot.line()`
- **Bar Chart:** `df['column'].value_counts().plot.bar()`

## 6. Statistical Analysis

- **Correlation Matrix:** `df.corr()`
- **Covariance Matrix:** `df.cov()`
- **Value Counts:** `df['column'].value_counts()`
- **Unique Values in Column:** `df['column'].unique()`
- **Number of Unique Values:** `df['column'].nunique()`

## 7. Indexing and Selection

- **Select Column:** `df['column']`
- **Select Multiple Columns:** `df[['col1', 'col2']]`
- **Select Rows by Position:** `df.iloc[0:5]`
- **Select Rows by Label:** `df.loc[0:5]`
- **Conditional Selection:** `df[df['column'] > value]`

## 8. Data Formatting and Conversion

- **Convert Data Types:** `df['column'].astype('type')`
- **String Operations:** `df['column'].str.lower()`
- **Datetime Conversion:** `pd.to_datetime(df['column'])`
- **Setting Index:** `df.set_index('column')`

## 9. Advanced Data Transformation

- **Lambda Functions:** `df.apply(lambda x: x + 1)`
- **Pivot Longer/Wider Format:** `df.melt(id_vars=['col1'])`
- **Stack/Unstack:** `df.stack(), df.unstack()`
- **Cross Tabulations:** `pd.crosstab(df['col1'], df['col2'])`

## 10. Handling Time Series Data

- **Set Datetime Index:** `df.set_index(pd.to_datetime(df['date']))`
- **Resampling Data:** `df.resample('M').mean()`

- **Rolling Window Operations:** `df.rolling(window=5).mean()`

## 11. File Export

- **Write to CSV:** `df.to_csv('filename.csv')`
- **Write to Excel:** `df.to_excel('filename.xlsx')`
- **Write to SQL Database:** `df.to_sql('table_name', connection)`

## 12. Data Exploration Techniques

- **Profile Report (with pandas-profiling):** `from pandas_profiling import ProfileReport; ProfileReport(df)`
- **Pairplot (with seaborn):** `import seaborn as sns; sns.pairplot(df)`
- **Heatmap for Correlation (with seaborn):** `sns.heatmap(df.corr(), annot=True)`

## 13. Advanced Data Queries

- **Query Function:** `df.query('column > value')`
- **Filtering with isin:** `df[df['column'].isin([value1, value2])]`

## 14. Memory Optimization

- **Reducing Memory Usage:** `df.memory_usage(deep=True)`
- **Change Data Types to Save Memory:** `df['column'].astype('category')`

## 15. Multi-Index Operations

- **Creating MultiIndex:** `df.set_index(['col1', 'col2'])`
- **Slicing on MultiIndex:** `df.loc[(slice('index1_start', 'index1_end'), slice('index2_start', 'index2_end'))]`

## 16. Data Merging Techniques

- **Outer Join:** `pd.merge(df1, df2, on='column', how='outer')`
- **Inner Join:** `pd.merge(df1, df2, on='column', how='inner')`
- **Left Join:** `pd.merge(df1, df2, on='column', how='left')`
- **Right Join:** `pd.merge(df1, df2, on='column', how='right')`

## 17. Dealing with Duplicates

- **Finding Duplicates:** `df.duplicated()`
- **Removing Duplicates:** `df.drop_duplicates()`

## 18. Custom Operations with Apply

- **Custom Apply Functions:** `df.apply(lambda row: custom_func(row['col1'], row['col2']), axis=1)`

## 19. Handling Large Datasets

- **Chunking Large Files:** `pd.read_csv('large_file.csv', chunksize=1000)`
- **Iterating Through Data Chunks:** `for chunk in pd.read_csv('file.csv', chunksize=500): process(chunk)`

## 20. Integration with Matplotlib for Custom Plots

- **Custom Plotting:** `import matplotlib.pyplot as plt; df.plot(); plt.show()`

## 21. Specialized Data Types Handling

- **Working with Categorical Data:** `df['column'].astype('category')`
- **Dealing with Sparse Data:** `pd.arrays.SparseArray(df['column'])`

## 22. Performance Tuning

- **Using Swifter for Faster Apply:** `import swifter; df['column'].swifter.apply(lambda x: func(x))`
- **Parallel Processing with Dask:** `import dask.dataframe as dd; ddf = dd.from_pandas(df, npartitions=10)`

## 23. Visualization Enhancement

- **Customize Plot Style:** `plt.style.use('ggplot')`
- **Histogram with Bins Specification:** `df['column'].hist(bins=20)`
- **Boxplot Grouped by Category:** `df.boxplot(column='num_column', by='cat_column')`

## 24. Advanced Grouping and Aggregation

- **Group by Multiple Columns:** `df.groupby(['col1', 'col2']).mean()`
- **Aggregate with Multiple Functions:** `df.groupby('col').agg(['mean', 'sum'])`
- **Transform Function:** `df.groupby('col').transform(lambda x: x - x.mean())`

## 25. Time Series Specific Operations

- **Time-Based Grouping:** `df.groupby(pd.Grouper(key='date_col', freq='M')).sum()`
- **Shifting Series for Lag Analysis:** `df['column'].shift(1)`
- **Resample Time Series Data:** `df.resample('M', on='date_col').mean()`

## 26. Text Data Specific Operations

- **String Contains:** `df[df['column'].str.contains('substring')]`
- **String Split:** `df['column'].str.split(' ', expand=True)`
- **Regular Expression Extraction:** `df['column'].str.extract(r'(regex)')`

## 27. Data Normalization and Standardization

- **Min-Max Normalization:** `(df['column'] - df['column'].min()) / (df['column'].max() - df['column'].min())`
- **Z-Score Standardization:** `(df['column'] - df['column'].mean()) / df['column'].std()`

## 28. Working with JSON and XML

- **Reading JSON:** `df = pd.read_json('filename.json')`
- **Reading XML:** `df = pd.read_xml('filename.xml')`

## 29. Advanced File Handling

- **Read CSV with Specific Delimiter:** `df = pd.read_csv('filename.csv', delimiter=';')`
- **Writing to JSON:** `df.to_json('filename.json')`

## 30. Dealing with Missing Data

- **Interpolate Missing Values:** `df['column'].interpolate()`
- **Forward Fill Missing Values:** `df['column'].ffill()`
- **Backward Fill Missing Values:** `df['column'].bfill()`

## 31. Data Reshaping

- **Wide to Long Format:** `pd.wide_to_long(df, ['col'], i='id_col', j='year')`
- **Long to Wide Format:** `df.pivot(index='id_col', columns='year', values='col')`

## 32. Categorical Data Operations

- **Convert Column to Categorical:** `df['column'] = df['column'].astype('category')`
- **Order Categories:** `df['column'].cat.set_categories(['cat1', 'cat2'], ordered=True)`

## 33. Advanced Indexing

- **Reset Index:** `df.reset_index(drop=True)`
- **Set Multiple Indexes:** `df.set_index(['col1', 'col2'])`
- **MultiIndex Slicing:** `df.xs(key='value', level='level_name')`

## 34. Efficient Computations

- **Use of `eval()` for Efficient Operations:** `df.eval('col1 + col2')`
- **Query Method for Filtering:** `df.query('col1 < col2')`

## 35. Integration with SciPy and StatsModels

- **Linear Regression (with statsmodels):** `import statsmodels.api as sm; sm.OLS(y, X).fit()`
- **Kurtosis and Skewness (with SciPy):** `from scipy.stats import kurtosis, skew; kurtosis(df['column']), skew(df['column'])`

## 36. Handling Large Data Efficiently

- **Dask Integration for Large Data:** `import dask.dataframe as dd; ddf = dd.from_pandas(df, npartitions=10)`
- **Sampling Data for Quick Insights:** `df.sample(n=1000)`

## 37. Advanced Data Merging

- **SQL-like Joins:** `pd.merge(df1, df2, how='left', on='col')`
- **Concatenating Along a Different Axis:** `pd.concat([df1, df2], axis=1)`

## 38. Profiling Data for Quick Insights

- **Using Pandas Profiling for Quick Analysis:** `from pandas_profiling import ProfileReport; report = ProfileReport(df)`

## 39. Working with External Data Sources

- **Reading Data from HTML:** `dfs = pd.read_html('http://example.com')`
- **Connecting to a SQL Database:** `from sqlalchemy import create_engine; engine = create_engine('sqlite:///db.sqlite'); df = pd.read_sql('SELECT * FROM table_name', engine)`

## 40. Data Quality Checks

- **Assert Statement for Data Validation:** `assert df.notnull().all().all(), "There are missing values in the dataframe"`