ML-ZC Homework 2

In [8]:

```python
import pandas as pd
import ssl

# Disable SSL certificate verification
ssl._create_default_https_context = ssl._create_unverified_context

# Load the dataset from the URL
url = "https://raw.githubusercontent.com/alexeygrigorev/datasets/master/lapt
laptops_df = pd.read_csv(url)

# Display the first few rows to confirm
laptops_df.head()
```

Out[8]:

	Laptop	Status	Brand	Model	CPU	RAM	Storage	Storage type	GPU	S
0	ASUS ExpertBook B1 B1502CBA-EJ0436X Intel Core...	New	Asus	ExpertBook	Intel Core i5	8	512	SSD	NaN	
1	Alurin Go Start Intel Celeron N4020/8GB/256GB ...	New	Alurin	Go	Intel Celeron	8	256	SSD	NaN	
2	ASUS ExpertBook B1 B1502CBA-EJ0424X Intel Core...	New	Asus	ExpertBook	Intel Core i3	8	256	SSD	NaN	
3	MSI Katana GF66 12UC-082XES Intel Core i7-1270...	New	MSI	Katana	Intel Core i7	16	1000	SSD	RTX 3050	
4	HP 15S-FQ5085NS Intel Core i5-1235U/16GB/512GB...	New	HP	15S	Intel Core i5	16	512	SSD	NaN	

In [10]:

```python
# Update the column names by converting to lowercase and replacing spaces wi
laptops_df.columns = laptops_df.columns.str.lower().str.replace(' ', '_')

# Display the updated column names to confirm the changes
laptops_df.columns
```

Out[10]:

```
Index(['laptop', 'status', 'brand', 'model', 'cpu', 'ram', 'storage',
       'storage_type', 'gpu', 'screen', 'touch', 'final_price'],
      dtype='object')
```

In [11]:

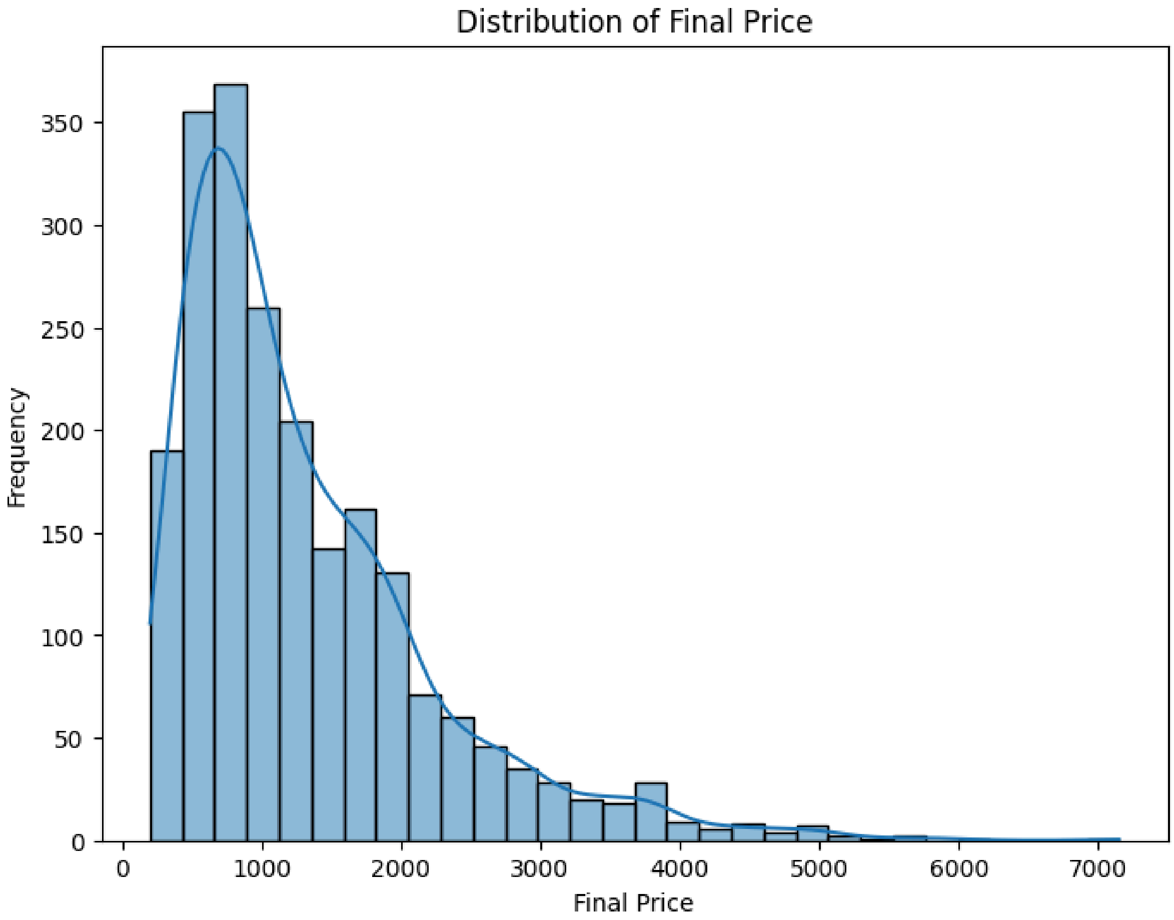
```python
# Select only the specified columns: 'ram', 'storage', 'screen', and 'final_
laptops_selected_columns = laptops_df[['ram', 'storage', 'screen', 'final_pr

# Display the first few rows of the new dataframe to confirm
laptops_selected_columns.head()
```

Out[11]:

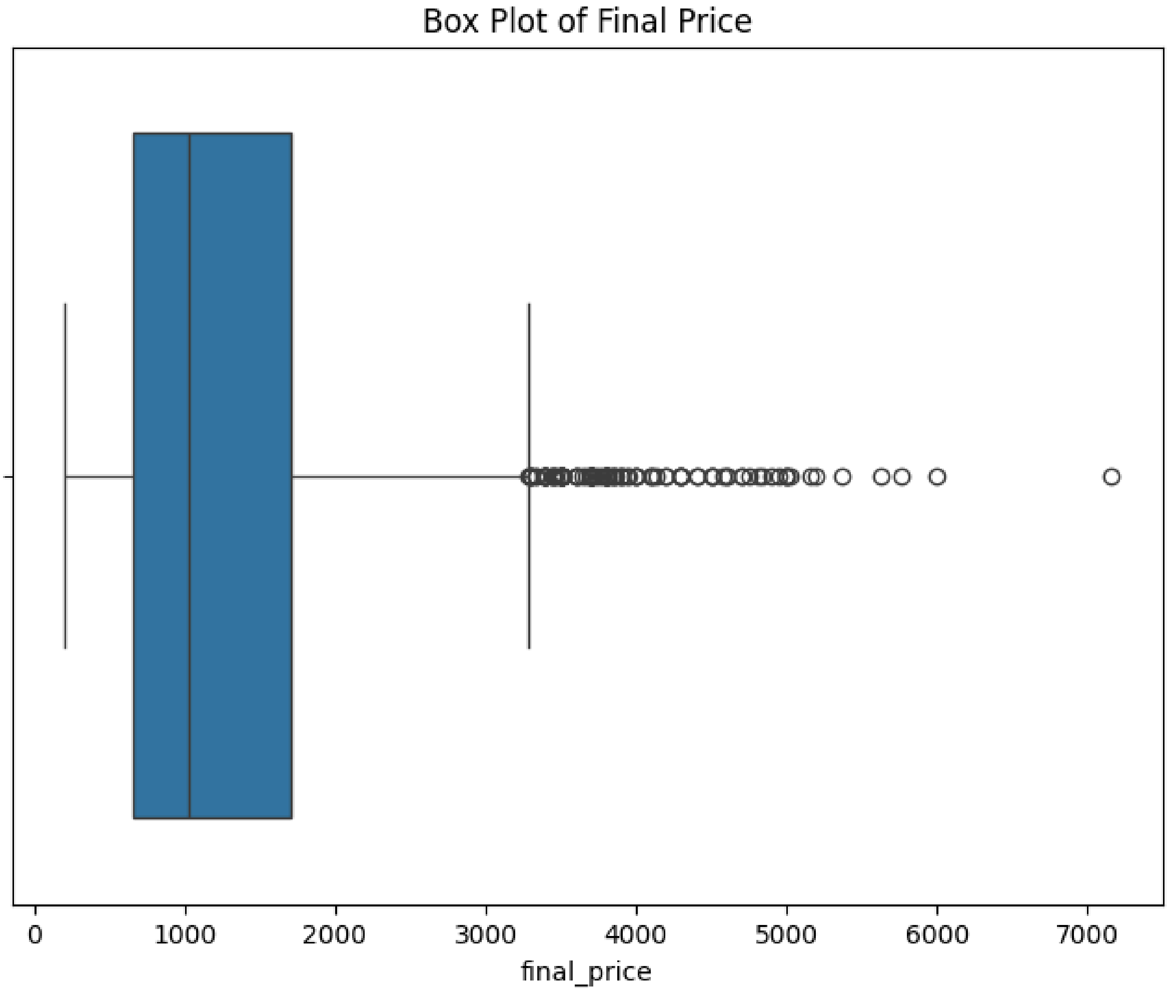
	ram	storage	screen	final_price
0	8	512	15.6	1009.00
1	8	256	15.6	299.00
2	8	256	15.6	789.00
3	16	1000	15.6	1199.00
4	16	512	15.6	669.01

In [13]:

```
# First, standardize the column names (lowercase and replace spaces with und
laptops_df.columns = laptops_df.columns.str.lower().str.replace(' ', '_')

# Now, try plotting the histogram again with the corrected column name
import matplotlib.pyplot as plt
import seaborn as sns

# Plot a histogram for the 'final_price' column
plt.figure(figsize=(8, 6))
sns.histplot(laptops_df['final_price'], bins=30, kde=True)
plt.title('Distribution of Final Price')
plt.xlabel('Final Price')
plt.ylabel('Frequency')
plt.show()

# Summary statistics (mean, median)
mean_price = laptops_df['final_price'].mean()
median_price = laptops_df['final_price'].median()

print(f"Mean: {mean_price}, Median: {median_price}")

# Box plot to detect outliers
plt.figure(figsize=(8, 6))
sns.boxplot(x=laptops_df['final_price'])
plt.title('Box Plot of Final Price')
plt.show()
```



```
Mean: 1312.638509259259, Median: 1031.9450000000002
```



Q1 Missing values

In [14]:

```
# Check for missing values in each column
missing_values = laptops_df.isnull().sum()

# Display columns that have missing values
print(missing_values[missing_values > 0])
```

```
storage_type      42
gpu             1371
screen             4
dtype: int64
```

Q2 Median of RAM

In [16]:

```
# Calculate the median of the 'ram' column (in lowercase)
ram_median = laptops_df['ram'].median()

print(f"The median (50th percentile) for RAM is: {ram_median} GB")
```

```
The median (50th percentile) for RAM is: 16.0 GB
```

In [17]:

```
# Shuffle the dataset with a random seed of 42
shuffled_laptops_df = laptops_df.sample(frac=1, random_state=42).reset_index

# Display the first few rows of the shuffled dataframe to confirm
shuffled_laptops_df.head()
```

Out[17]:

	laptop	status	brand	model	cpu	ram	storage	storage_type
0	MSI Modern 15 A11SBU-620XES Intel Core i7-1165...	Refurbished	MSI	Modern	Intel Core i7	32	1000	SSD
1	Thomson Neo White Intel Celeron N4020/4GB/64GB...	New	Thomson	Neo	Intel Celeron	4	64	eMMC
2	MSI Modern 14 B11SB-420XES Intel Core i7-1165G...	Refurbished	MSI	Modern	Intel Core i7	32	1000	SSD
3	ASUS ZenBook 13 OLED UX325EA Intel Evo Core i7...	New	Asus	ZenBook	Intel Evo Core i7	16	512	SSD
4	Acer Predator Triton 500 SE PT516-51s-75K6 Int...	New	Acer	Predator	Intel Core i7	32	1000	SSD

In [18]:

```
from sklearn.model_selection import train_test_split

# First, split the data into training and temporary sets (60% train, 40% tem
train_set, temp_set = train_test_split(laptops_df, test_size=0.4, random_sta

# Then, split the temporary set into validation and test sets (50% of 40% ea
val_set, test_set = train_test_split(temp_set, test_size=0.5, random_state=4

# Display the sizes of each set
```

```
print(f"Training set size: {len(train_set)}")
print(f"Validation set size: {len(val_set)}")
print(f"Test set size: {len(test_set)}")
```

```
Training set size: 1296
Validation set size: 432
Test set size: 432
```

Question 3

In [21]:

```
# Check the data types of the training dataset
print(train_set.dtypes)

# Select only numeric columns to calculate mean and fill missing values
numeric_columns = train_set.select_dtypes(include=['float64', 'int64']).colu

# Duplicate the training dataset
train_set_mean = train_set.copy()  # For replacing with mean
train_set_zero = train_set.copy()   # For replacing with zero

# Calculate the mean for each numeric column in the training set
mean_values = train_set_mean[numeric_columns].mean()

# Replace missing values in the first dataset with the mean values
train_set_mean[numeric_columns] = train_set_mean[numeric_columns].fillna(mea

# Replace missing values in the second dataset with zero for numeric columns
train_set_zero[numeric_columns] = train_set_zero[numeric_columns].fillna(0)

# Optionally, display the first few rows to confirm changes
print("Train Set with Mean Values:")
print(train_set_mean.head())

print("\nTrain Set with Zero Values:")
print(train_set_zero.head())
```

```
laptop           object
status           object
brand            object
model            object
cpu              object
ram               int64
storage           int64
storage_type     object
gpu              object
screen          float64
touch            object
final_price     float64
dtype: object
Train Set with Mean Values:
                                                 laptop       status  \
1357  Gigabyte AERO 17 XE5-73PT738HP Intel Core i7-1...          New
1055  Samsung Chromebook 4 XE310XBA-K01ES Intel Cele...          New
513   MSI Stealth 14 Studio A13VE-052XES Intel Core ...          New
81    HP Victus 15-fa0026ns Intel Core i5-12450H/16G...          New
1803  Asus Rog Zephyrus G15 GA502IV-HN024 AMD Ryzen ...  Refurbished

         brand       model            cpu  ram  storage storage_type  \
1357  Gigabyte        Aero  Intel Core i7   16     2000          SSD
1055   Samsung  Chromebook  Intel Celeron    4       32         eMMC
513        MSI     Stealth  Intel Core i7   16     1000          SSD
81          HP      Victus  Intel Core i5   16      512          SSD
1803      Asus         ROG    AMD Ryzen 7   16     1000          SSD

           gpu  screen touch  final_price
1357  RTX 3070    17.3    No      2228.59
1055       NaN    11.6    No       365.90
513   RTX 4050    14.0    No      1989.01
81    GTX 1650    15.6    No       999.00
1803  RTX 2060    15.6    No      1091.09

Train Set with Zero Values:
                                                 laptop       status  \
1357  Gigabyte AERO 17 XE5-73PT738HP Intel Core i7-1...          New
1055  Samsung Chromebook 4 XE310XBA-K01ES Intel Cele...          New
513   MSI Stealth 14 Studio A13VE-052XES Intel Core ...          New
81    HP Victus 15-fa0026ns Intel Core i5-12450H/16G...          New
1803  Asus Rog Zephyrus G15 GA502IV-HN024 AMD Ryzen ...  Refurbished

         brand       model            cpu  ram  storage storage_type  \
1357  Gigabyte        Aero  Intel Core i7   16     2000          SSD
1055   Samsung  Chromebook  Intel Celeron    4       32         eMMC
513        MSI     Stealth  Intel Core i7   16     1000          SSD
81          HP      Victus  Intel Core i5   16      512          SSD
1803      Asus         ROG    AMD Ryzen 7   16     1000          SSD

           gpu  screen touch  final_price
1357  RTX 3070    17.3    No      2228.59
1055       NaN    11.6    No       365.90
513   RTX 4050    14.0    No      1989.01
81    GTX 1650    15.6    No       999.00
1803  RTX 2060    15.6    No      1091.09
```

In [22]:

```
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error
import numpy as np
```

```
# Prepare the features (X) and target (y) for the models
# Assume 'final_price' is the target variable and the rest are features
features = ['ram', 'storage', 'screen']  # Adjust features as needed
target = 'final_price'

# Prepare X and y for the first model (mean values)
X_train_mean = train_set_mean[features]
y_train_mean = train_set_mean[target]
X_test = test_set[features]  # Use the same features for the test set
y_test = test_set[target]

# Train the linear regression model with mean values
model_mean = LinearRegression()
model_mean.fit(X_train_mean, y_train_mean)

# Make predictions on the test set
y_pred_mean = model_mean.predict(X_test)

# Calculate RMSE for the model with mean replacement
rmse_mean = np.sqrt(mean_squared_error(y_test, y_pred_mean))

# Prepare X and y for the second model (zero values)
X_train_zero = train_set_zero[features]
y_train_zero = train_set_zero[target]

# Train the linear regression model with zero values
model_zero = LinearRegression()
model_zero.fit(X_train_zero, y_train_zero)

# Make predictions on the test set
y_pred_zero = model_zero.predict(X_test)

# Calculate RMSE for the model with zero replacement
rmse_zero = np.sqrt(mean_squared_error(y_test, y_pred_zero))

# Display the RMSE results
print(f"RMSE for the model with mean replacement: {rmse_mean}")
print(f"RMSE for the model with zero replacement: {rmse_zero}")
```

```
RMSE for the model with mean replacement: 684.07248803113
RMSE for the model with zero replacement: 684.089743558418
```

Question 4

In [23]:

```
from sklearn.linear_model import Ridge
from sklearn.metrics import mean_squared_error
import numpy as np

# Prepare the features (X) and target (y) for the model with zero replacemen
X_train_zero = train_set_zero[features]
y_train_zero = train_set_zero[target]

# Define the regularization strengths
r_values = [0, 0.01, 0.1, 1, 5, 10, 100]

# Store RMSE values for each r
rmse_results = []

# Train and evaluate Ridge regression for each r value
for r in r_values:
    # Create and train the model
    model_ridge = Ridge(alpha=r)
    model_ridge.fit(X_train_zero, y_train_zero)

    # Make predictions on the test set
    y_pred_zero = model_ridge.predict(X_test)

    # Calculate RMSE and round to two decimals
    rmse_zero = np.sqrt(mean_squared_error(y_test, y_pred_zero))
    rmse_results.append(round(rmse_zero, 2))

# Display the RMSE results for each r
for r, rmse in zip(r_values, rmse_results):
    print(f"RMSE for r={r}: {rmse}")
```

```
RMSE for r=0: 684.09
RMSE for r=0.01: 684.09
RMSE for r=0.1: 684.09
RMSE for r=1: 684.09
RMSE for r=5: 684.08
RMSE for r=10: 684.07
RMSE for r=100: 683.94
```

Question 5

```
In [25]: import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error

# Initialize an empty list to collect RMSE scores
rmse_scores = []

# Define the seeds
seeds = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]

# Prepare the features (X) and target (y) for the model
features = ['ram', 'storage', 'screen']  # Adjust this based on your datase
target = 'final_price'

# Loop over each seed
for seed in seeds:
    # Split the dataset into train and test (60% train, 40% test)
    train_temp_set, test_set = train_test_split(laptops_df, test_size=0.4, r

    # Split the train_temp_set into train and validation (60% train, 40% tem
    train_set, val_set = train_test_split(train_temp_set, test_size=0.4, ra

    # Replace missing values with 0 in the training set
    train_set.fillna(0, inplace=True)

    # Replace missing values with 0 in the validation set to prevent NaN in

    val_set.fillna(0, inplace=True)

    # Prepare features and target for training and validation
    X_train = train_set[features]
    y_train = train_set[target]
    X_val = val_set[features]
    y_val = val_set[target]
    # Train a linear regression model
    model = LinearRegression()
    model.fit(X_train, y_train)

    # Make predictions on the validation set
    y_pred_val = model.predict(X_val)

    # Calculate RMSE for the validation set
    rmse_val = np.sqrt(mean_squared_error(y_val, y_pred_val))

    # Append the RMSE score to the list
    rmse_scores.append(rmse_val)

# Calculate the standard deviation of RMSE scores
std_rmse = np.std(rmse_scores)

# Round the standard deviation to 3 decimal places
std_rmse_rounded = round(std_rmse, 3)

# Display the standard deviation of RMSE scores
print(f"Standard deviation of RMSE scores: {std_rmse_rounded}")
```

```
Standard deviation of RMSE scores: 25.473
```

Question 6

In [26]:

```
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.linear_model import Ridge
from sklearn.metrics import mean_squared_error

# Prepare the features (X) and target (y) for the model
features = ['ram', 'storage', 'screen']  # Adjust this based on your dataset
target = 'final_price'

# Split the dataset into train and test (60% train, 40% test) using seed 9
train_temp_set, test_set = train_test_split(laptops_df, test_size=0.4, rando

# Split the train_temp_set into train and validation (60% train, 40% temp = 
train_set, val_set = train_test_split(train_temp_set, test_size=0.4, random_

# Combine train and validation datasets
combined_train_set = pd.concat([train_set, val_set])

# Replace missing values with 0 in the combined dataset
combined_train_set.fillna(0, inplace=True)

# Prepare features and target for training
X_train = combined_train_set[features]
y_train = combined_train_set[target]

# Prepare features for the test set (replace missing values with 0)
test_set.fillna(0, inplace=True)
X_test = test_set[features]
y_test = test_set[target]

# Train a Ridge regression model with r = 0.001
model = Ridge(alpha=0.001)
model.fit(X_train, y_train)
```

```python
# Make predictions on the test set
y_pred_test = model.predict(X_test)

# Calculate RMSE for the test set
rmse_test = np.sqrt(mean_squared_error(y_test, y_pred_test))

# Display the RMSE for the test dataset
print(f"RMSE on the test dataset: {rmse_test:.3f}")
```

```
RMSE on the test dataset: 612.863
```