HOME.LLC SCREENING TASK

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I have broken down the task into 4 different parts:

1) Acquiring datasets showing the value of factors across the last 20 years.

I have used datasets from https://fred.stlouisfed.org/ for 4 different factors: Federal Funds Effective Rate, Unemployment Rates, CPI and Average Cost of Housing Inventory. They have been uploaded in the datasets folder for reference.

2) Clean and process the data: Ensure all factors align in dates, use mean to fill initial empty values and then use linear interpolation to fill the remaining empty ones.

```
# Align all datasets to the date range of home price index
start_date = '2004-01-01'
end_date = '2024-01-01'

cpi_aligned = cpi[start_date:end_date]
federal_funds_rate_aligned = federal_funds_rate[start_date:end_date]
housing_inventory_aligned = housing_inventory[start_date:end_date]
unemployment_rate_aligned = unemployment_rate[start_date:end_date]

# Resample CPI to monthly data (forward filling the values)
cpi_monthly = cpi_aligned.resample('M').ffill()

# Resample Federal Funds Effective Rate to monthly data (taking the average for each month)
federal_funds_rate_monthly = federal_funds_rate_aligned.resample('M').mean()

# Resample Housing Inventory Estimate to monthly data (forward filling the values)
housing_inventory_monthly = housing_inventory_aligned.resample('M').ffill()

# Combine all datasets into a single DataFrame
combined_data = pd.concat([
    home_price_index,
    cpi_monthly,
    federal_funds_rate_monthly,
    housing_inventory_monthly,
    unemployment_rate_aligned
], axis=1)
```

Here is a snippet from the code file **data_processing.py**, which shows how I've aligned all dates to the Home Price Index dataset. I have resampled CPI and Federal Funds Effective rate to monthly intervals using the mean of each month's values, so that it fits the dates. Then, I have combined all datasets to a single dataset.

```python
# Fill initial NaN values by taking the mean for the month across all years
combined_data = combined_data.apply(lambda x: x.fillna(x.groupby(x.index.month).transform('mean')))

# Interpolate missing values using linear interpolation after the first non-NaN value in each column
combined_data = combined_data.apply(lambda x: x.interpolate(method='linear', limit_area='inside'))

# Save the combined data to a CSV file
combined_data.to_csv('combined_data_last_20_years.csv')
```

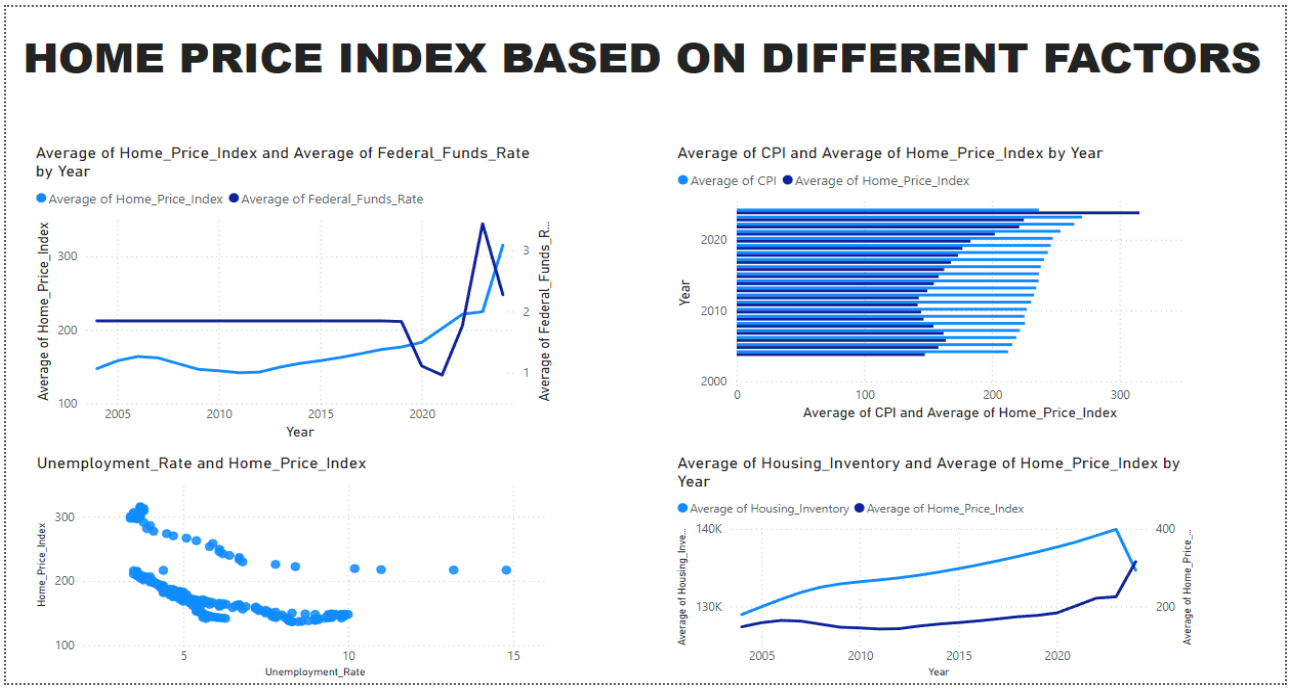
Here is another snippet from the same file. I have applied mean to fill some initial null values, and then used linear interpolation to fill the remaining values. Subsequently, I have combined all values into a single data file.

```python
import pandas as pd

# Load the combined data
combined_data = pd.read_csv('combined_data_last_20_years.csv', parse_dates=['DATE'], index_col='DATE')

# Filter the DataFrame to keep only data from the last 20 years
start_date = '2004-01-01'
end_date = '2024-01-01'
filtered_data = combined_data.loc[start_date:end_date]

# Save the filtered data to a new CSV file
filtered_data.to_csv('combined_data_last_20_years_filtered.csv')
```

Here is a snippet from the file **extra_dates.py**. Here, I have trimmed the dataset down so that it returns values for only the last 20 years.

3) Use Power BI to graph the factors and show the correlation between the CASE-SHILLER Index and the other variables.

Here is a Power BI dashboard showing the correlation of the Home Price Index with the factors:



This dashboard has been uploaded in the GitHub repository, so that it can be used interactively for showing data specific to different years.

4) Use linear regression to show the coefficient by which the factors affect the CASE-SHILLER Index.

From the dashboard in the previous step, we can conclude that the CASE-SHILLER index is:

1. Directly proportional to CPI.
2. Directly proportional to Federal Funding Effective Rates.
3. Directly proportional to Average cost of Housing Inventory.
4. Inversely proportional to Unemployment Rates.

We can confirm these relationships by performing linear regression, taking the CASE-SHILLER index as the dependent variable(y), and the other factors as independent variables(x).

Here's the output of the code file **coefficient_finder.py**, which is a Python file performing linear regression using the scikit-learn library.

```
PS C:\Users\ayush\Pictures\Home LLC> & 'c:\Python312\python.exe' 'c:\Users\ayush\.vscode\extensions\ms-python
.debugpy-2024.6.0-win32-x64\bundled\libs\debugpy\adapter/../..\debugpy\launcher' '60504' '--' 'c:\Users\ayush\
Pictures\Home LLC\coefficient_finder.py'
Coefficient for CPI: 0.012556262218143375
Coefficient for Federal_Funds_Rate: 1.116624047469781
Coefficient for Housing_Inventory: 5.483642054968281e-05
Coefficient for Unemployment_Rate: -12.952362543363542
PS C:\Users\ayush\Pictures\Home LLC>
```

The coefficients of CPI, Federal_Funds_Rate and Housing_Inventory are **positive**, and the coefficient of Unemployment_Rate is **negative**, hence confirming our findings.

Notes:

Some values are inconsistent because they're not exact and filled using various statistical values, hence showing some deviation from trends.