ECON 0150 | Economic Data Analysis

The economist's data analysis skillset.

Part 1.3 | Time Series (Numerical) Data

Time Series Numerical Data

Tracking a numerical variable over time

> *Time series data: one entity, many points in time*

> *Numerical variable: values that change over time (price, GDP, temperature)*

> *Key question: What are the trends and patterns over time?*

Timeseries: Coffee Prices

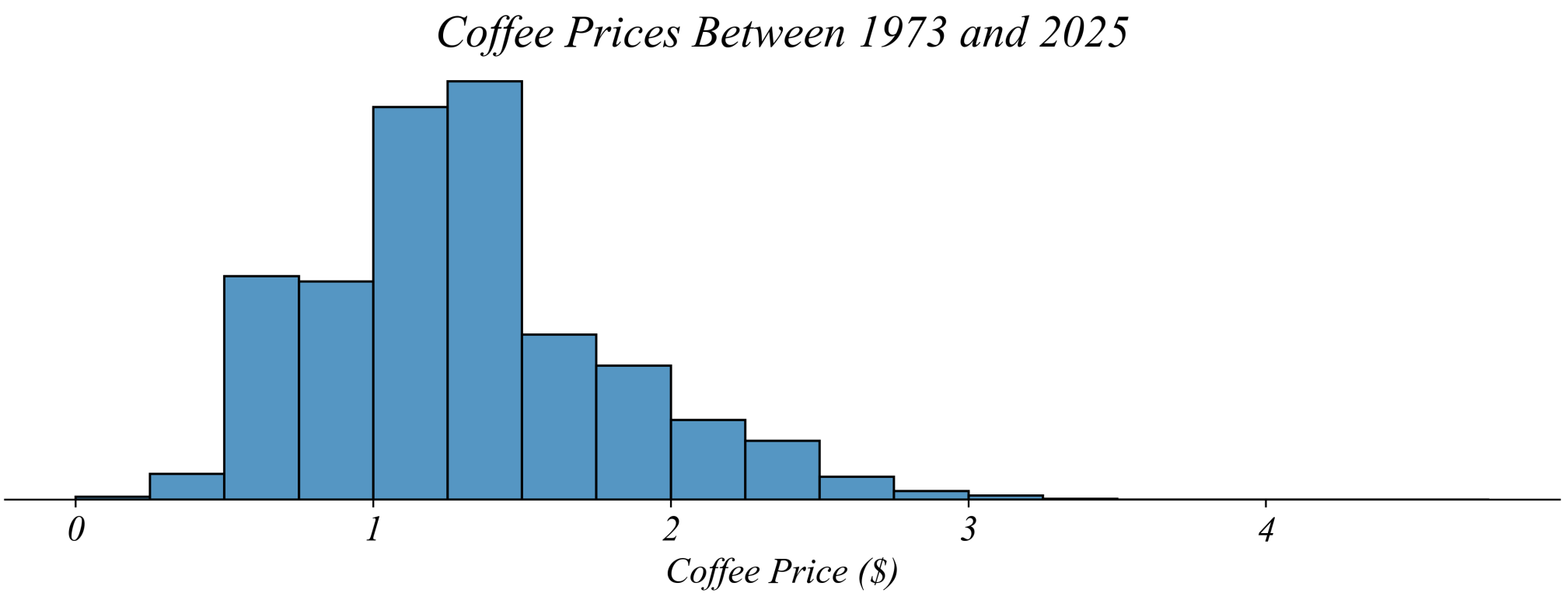
What price should we expect in January 2026?

date	price
2000-01-03	1.0545
2000-01-04	1.0300
2000-01-05	1.0550
2000-01-06	1.0225
2000-01-07	1.0250
…	…

> *how might we use this data to predict the price in January 2026?*

Timeseries: Coffee Prices

What price should we expect in January 2026?

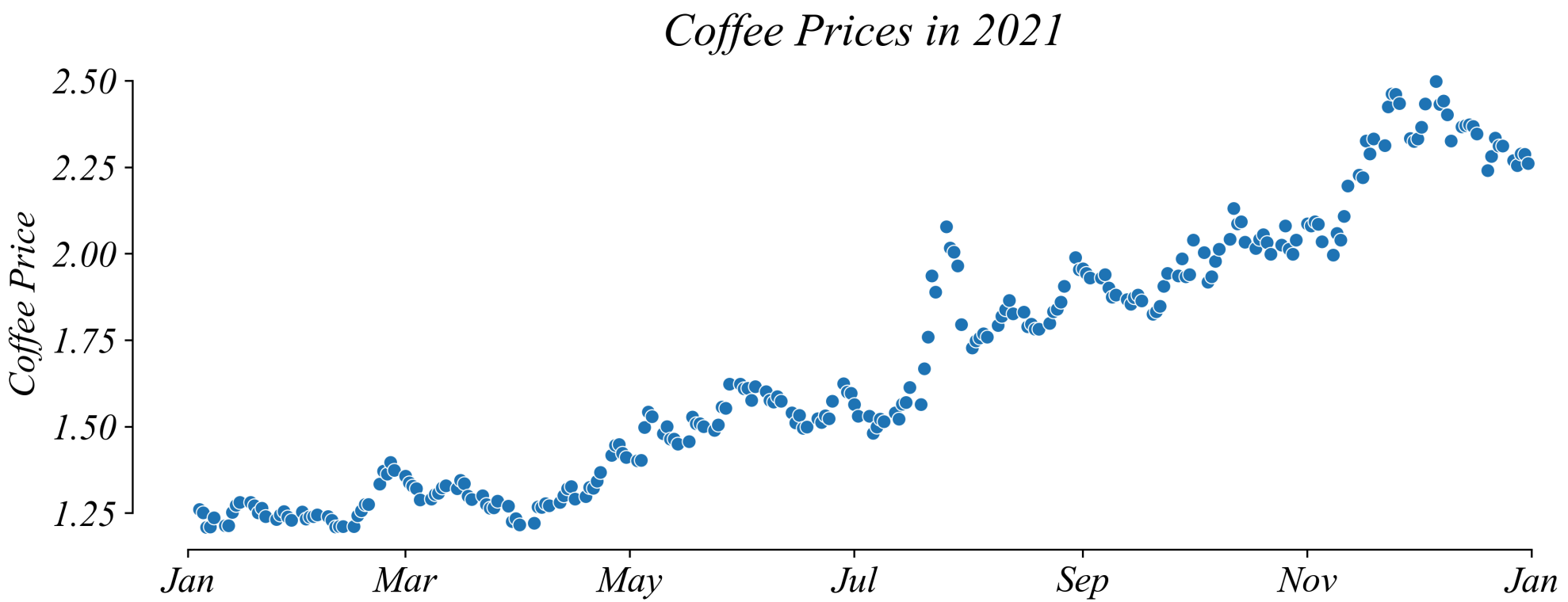


> *it's difficult to know... do we choose the mode?*

> *lets just organize prices by their ordered index, time*

Timeseries: Coffee Prices

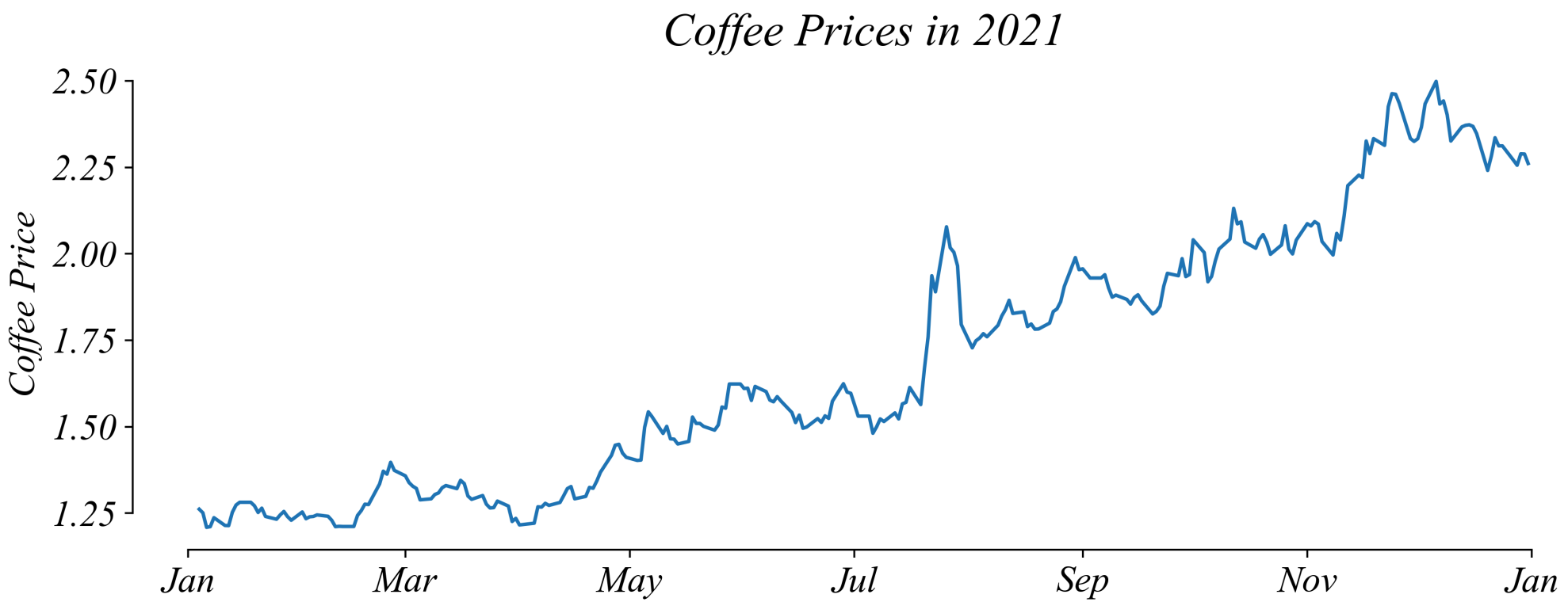
What price should we expect in January 2026?



> *lets indicate with a line that these points are in squence*

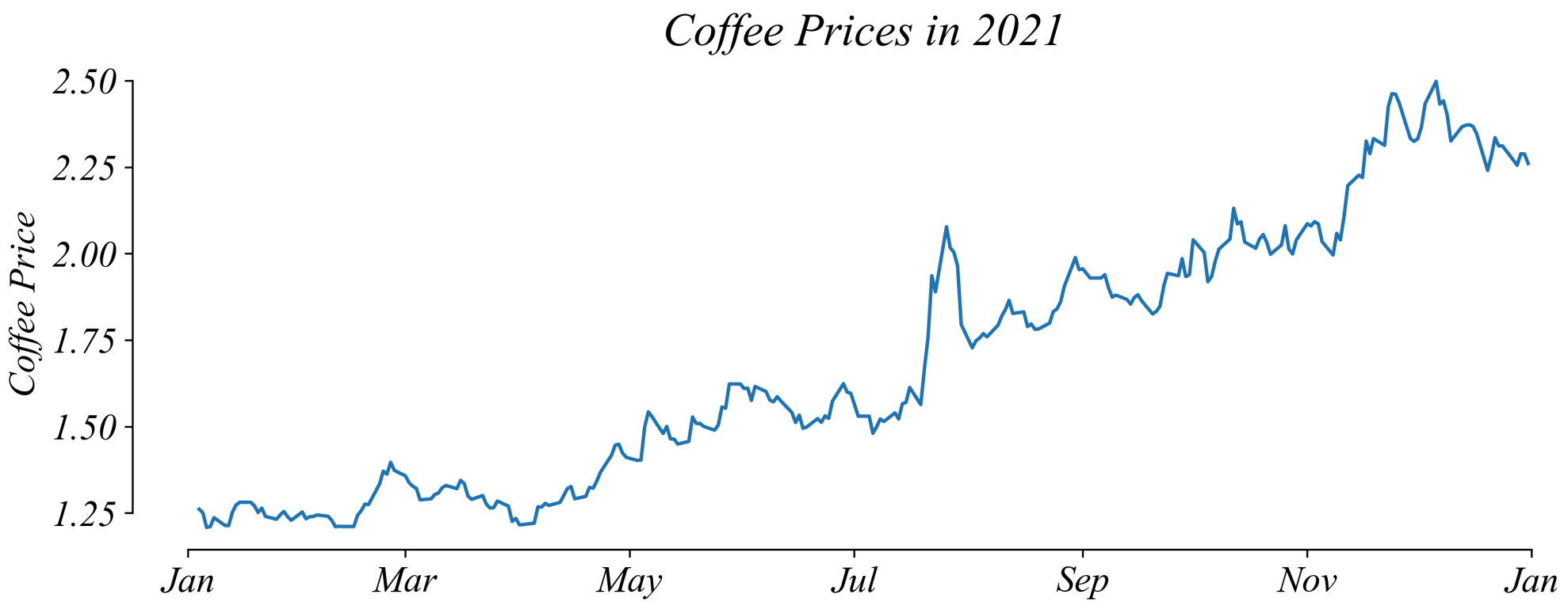
Timeseries: Line Graph

What price should we expect in January 2026?



Timeseries: Trends

*Do you notice a **trend** in price?*

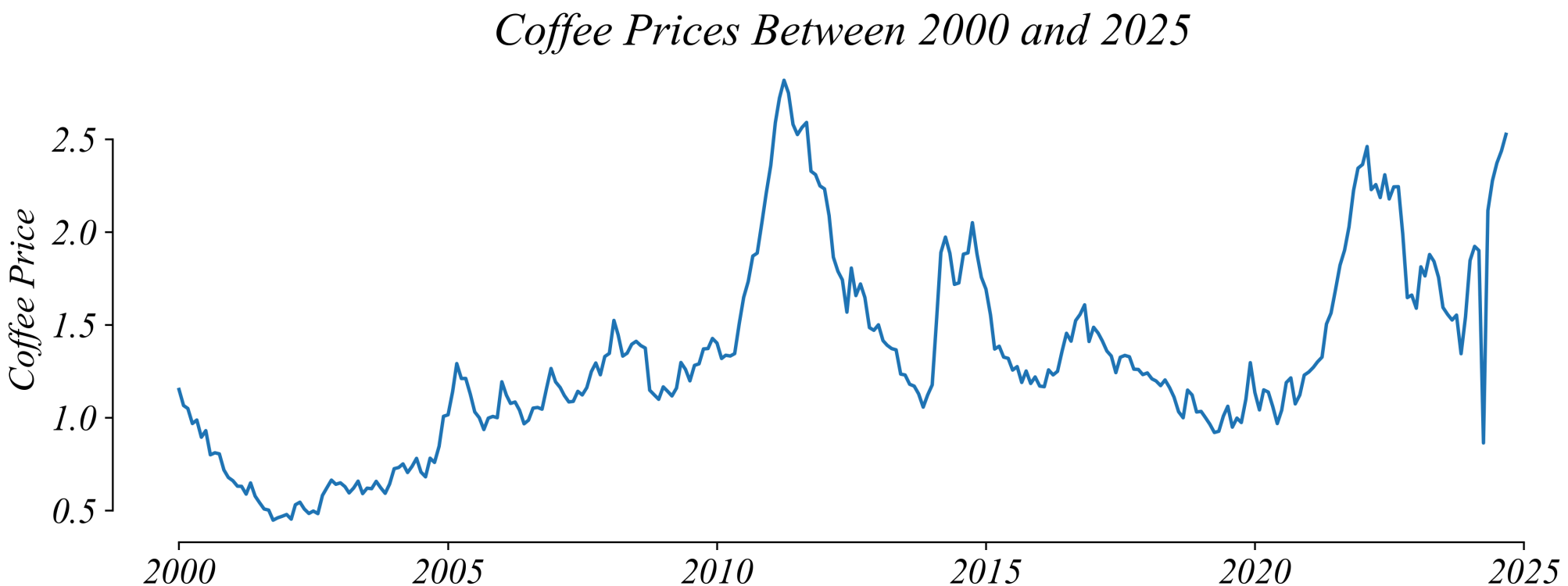


> *there was a **positive trend** in 2021*

> *we can zoom out to get a bigger picture*

Timeseries: Trends + Subtrends

*Do you notice a **trend** in price?*

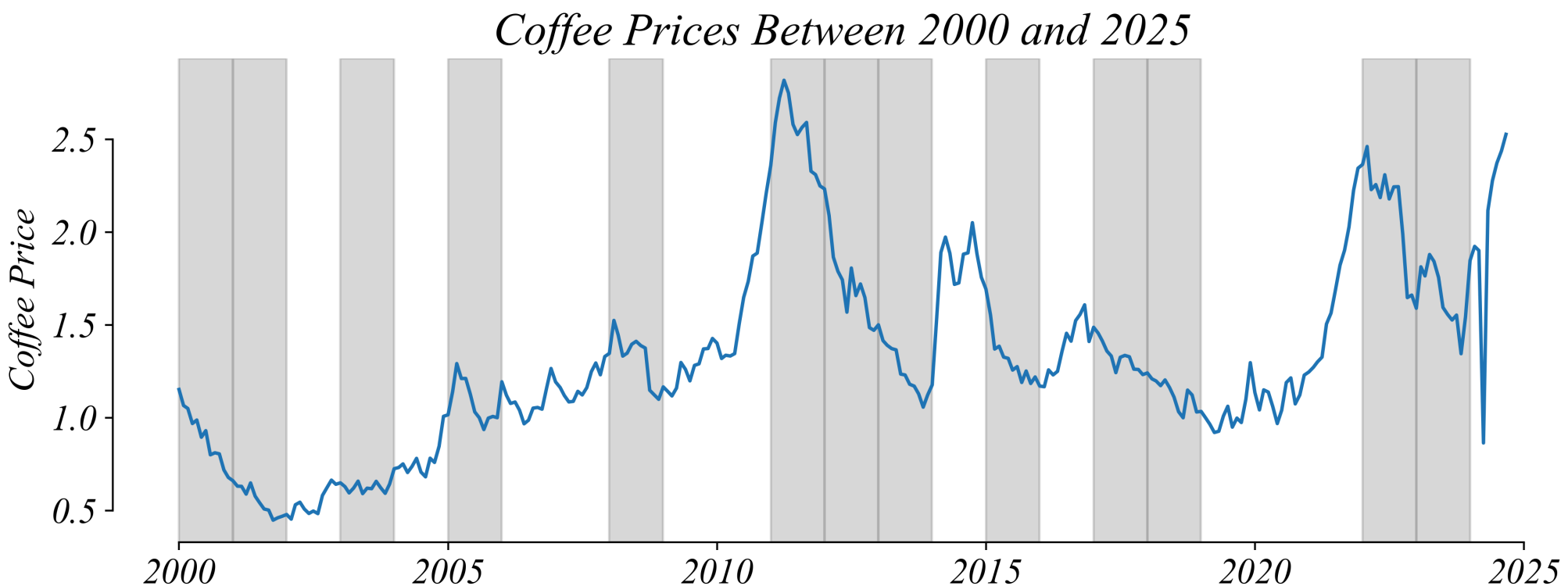


> *how have prices changed since 2000?*

> *prices have increased somewhat, with many periods of decrease*

Timeseries: Background Shading

What price should we expect in January 2026?



> *with background shading its easier to see periods with a negative trend in price*

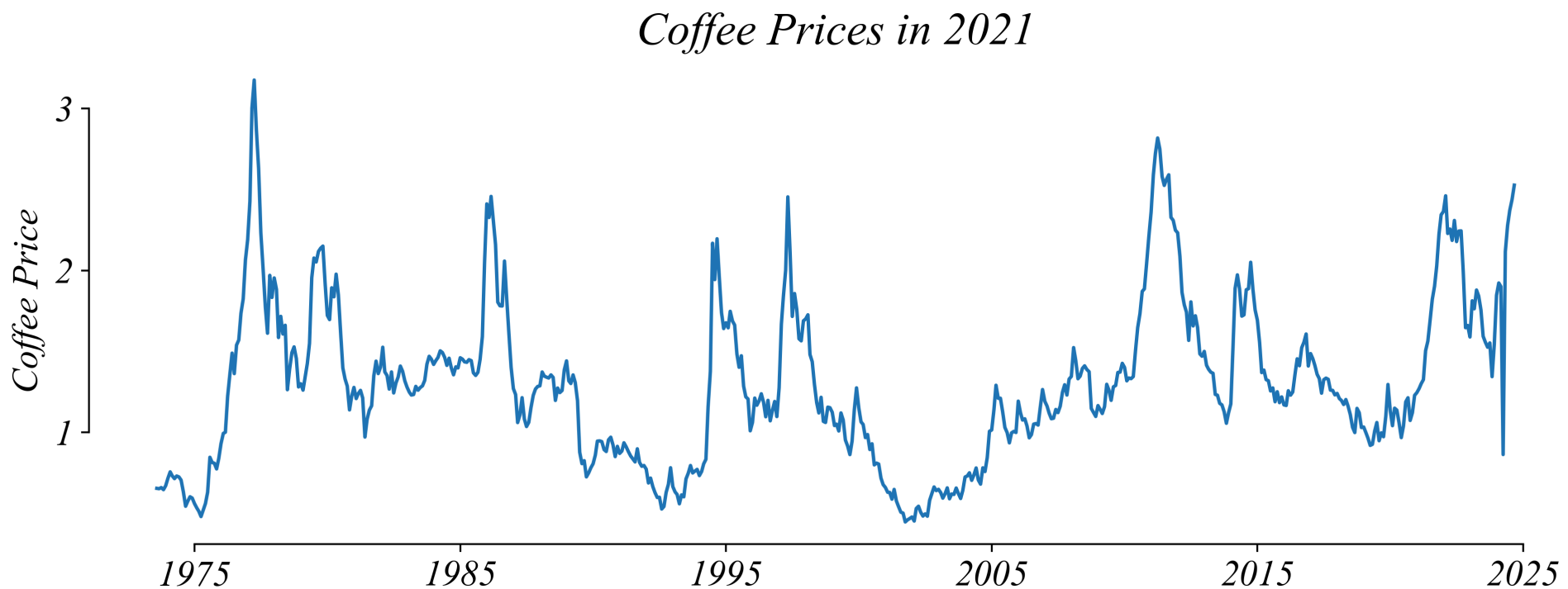
Exercise 1.3 | Timeseries

Lets use a linegraph to examine the trends in coffee prices.

- ***Data:*** `Coffee_Prices.csv`

Exercise 1.3 | Timeseries

```
1 # Lineplot
2 sns.lineplot(prices, y='price', x='date')
```



S-T-E for Line Graphs

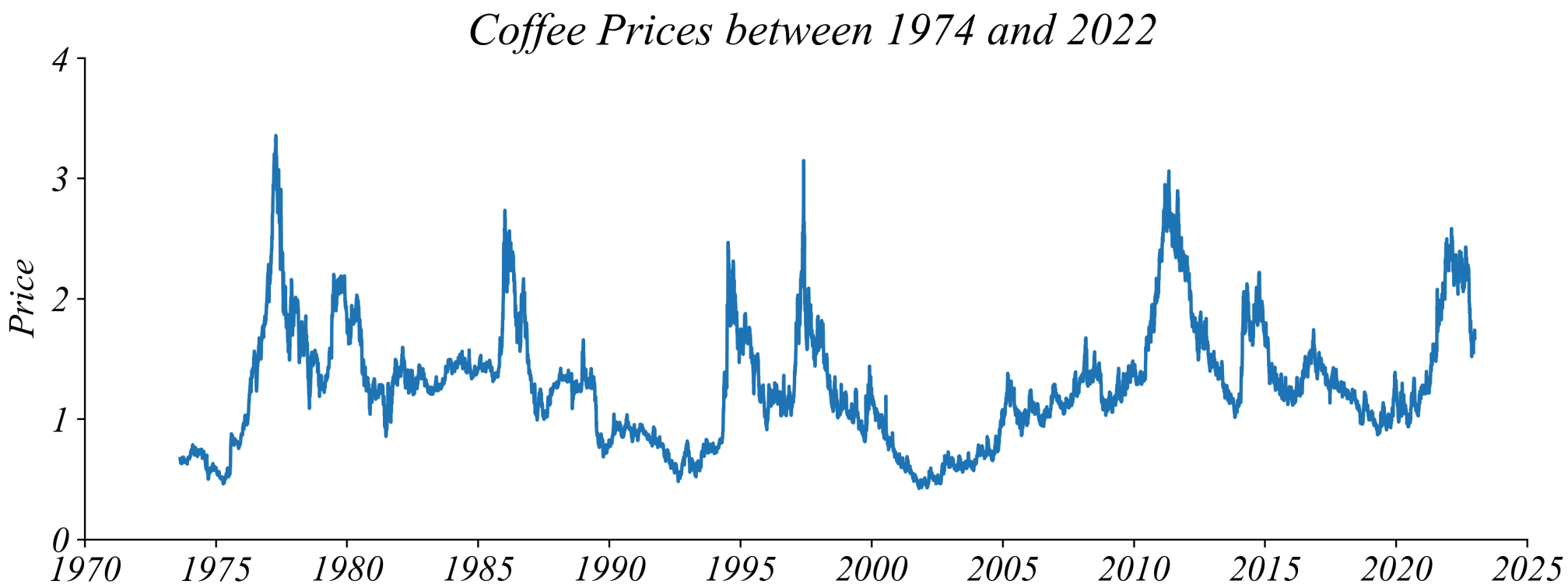
What we just did

Step	Action
SELECT	Coffee prices 2015-2025
TRANSFORM	Order by date
ENCODE	Date → x-position; Price → y-position; Sequence → connected line

> *ENCODE uses position for both time and value — the line shows sequence*

Timeseries: Longer Periods

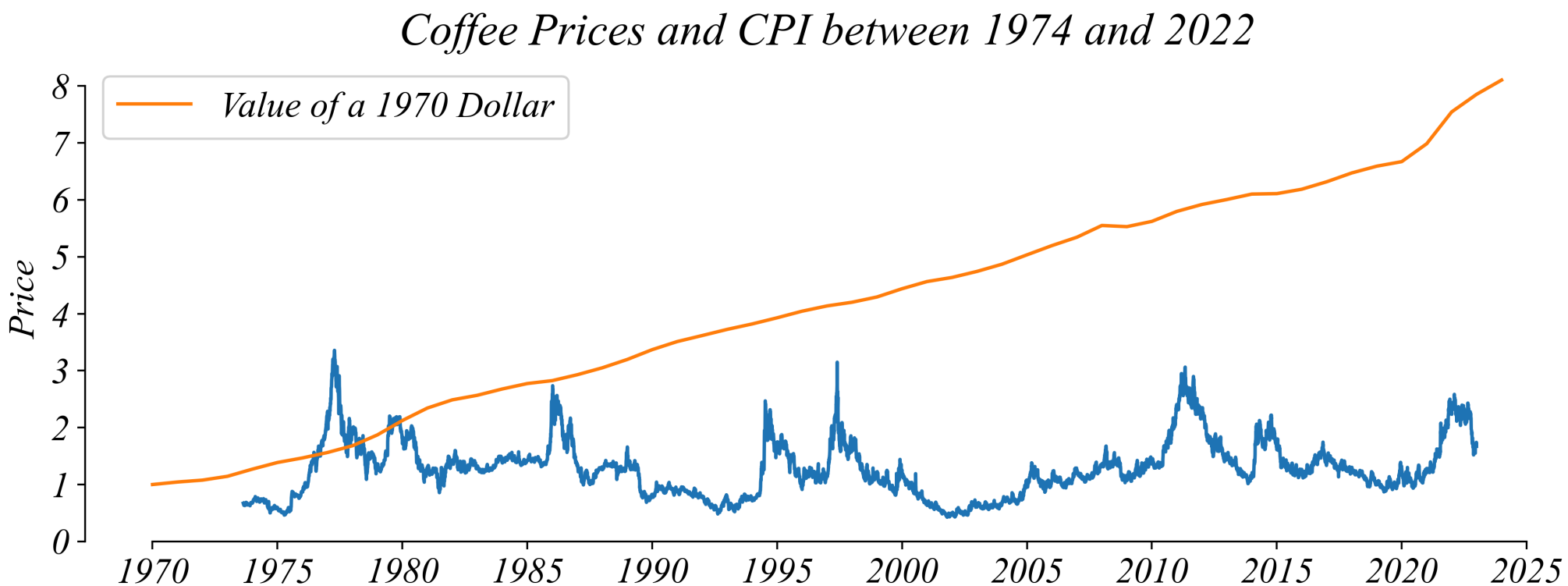
Are prices over long periods comparable?



> *was coffee about as expensive in 1980 as it is today?*

Timeseries: Longer Periods

A dollar in 1980 ≠ a dollar in 2025

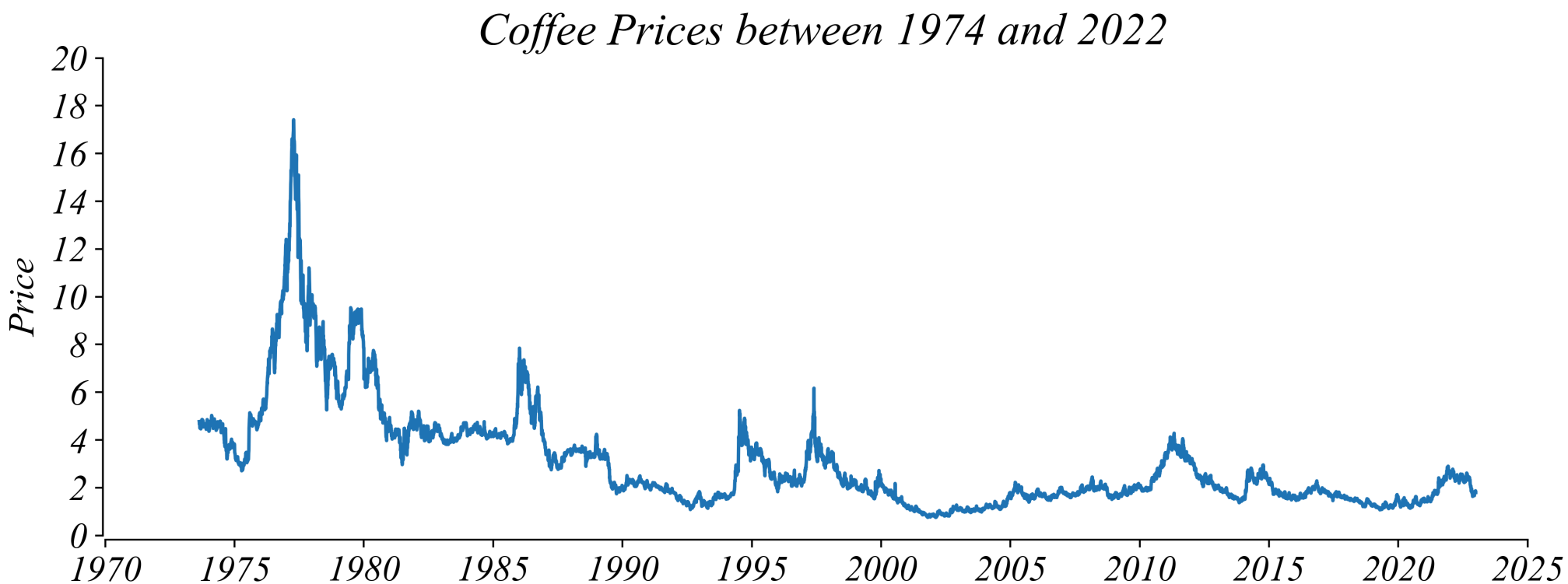


> *no! a dollar today is worth much less than in 1980*

> *we need to adjust for inflation to compare across time*

Real Coffee Prices

Adjusting for inflation changes the picture



> prices have actually dropped since 1980 and stabilized since 2000

Exercise 1.3 | Real Price Adjustment

Is there a trend in the real price of coffee?

Lets transform coffee prices from nominal dollars to real dollars.

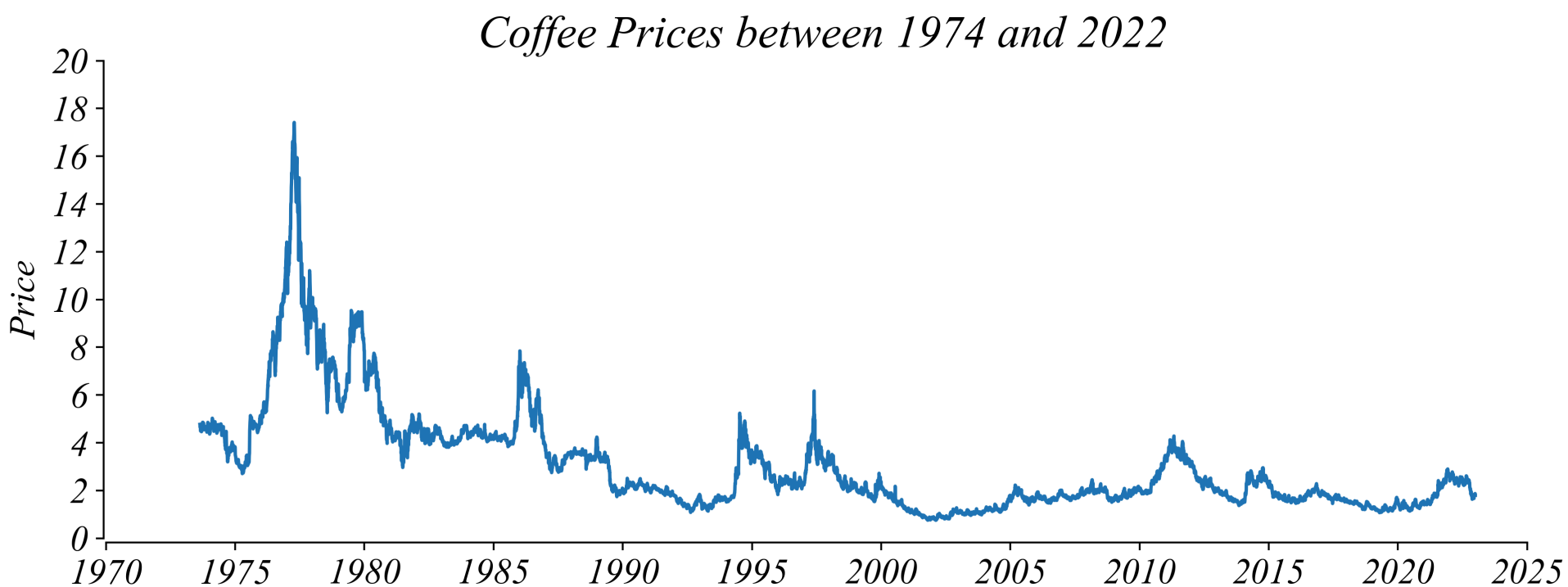
- ***Data:*** `Coffee_Prices_CPI.csv`

Exercise 1.3 | Real Price Adjustment

Is there a trend in the real price of coffee?

```
# Create real price column
data['real'] = data['price'] / data['today']
```

```
# Lineplot of real prices
sns.lineplot(data, x='date', y='real')
```



S-T-E for Real Price Adjustment

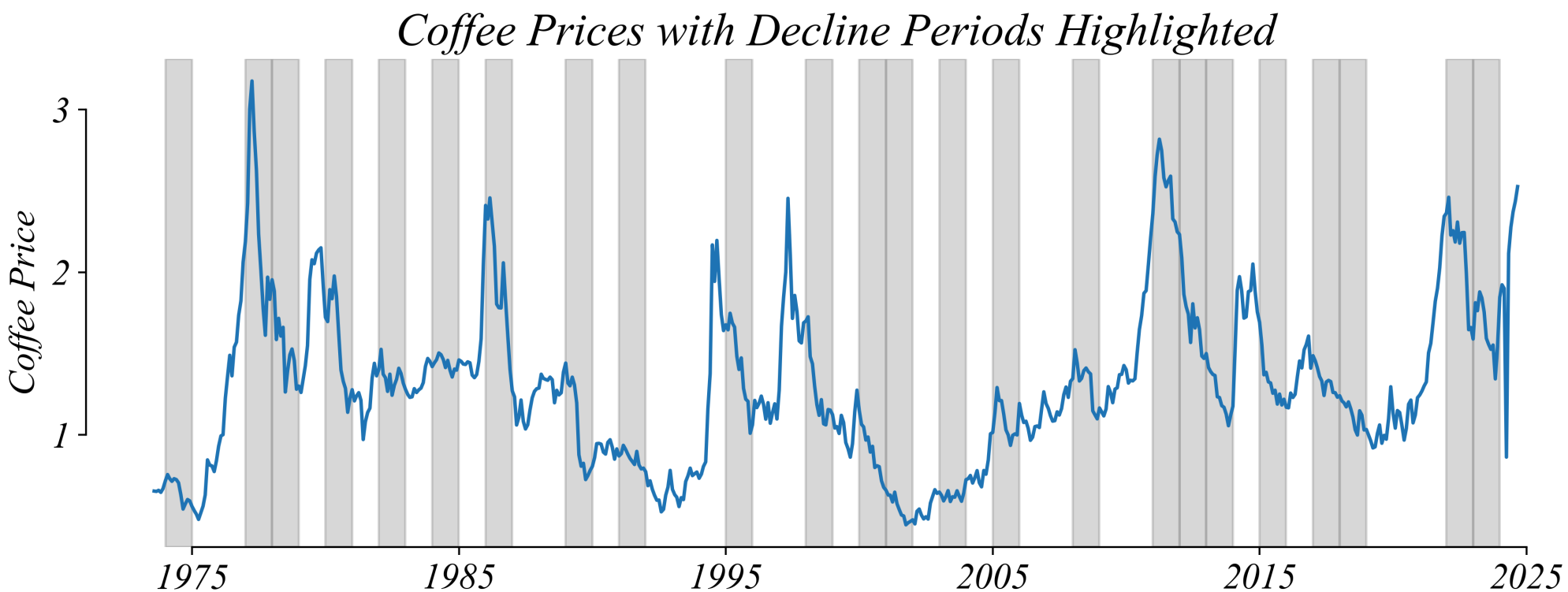
What we just did

Step	Action
SELECT	Coffee prices 1980-2025 with CPI data
TRANSFORM	Divide nominal price by CPI adjustment factor
ENCODE	Date → x-position; Real price → y-position; Sequence → connected line

> *TRANSFORM converts nominal dollars to real (inflation-adjusted) dollars*

Timeseries: Original Question

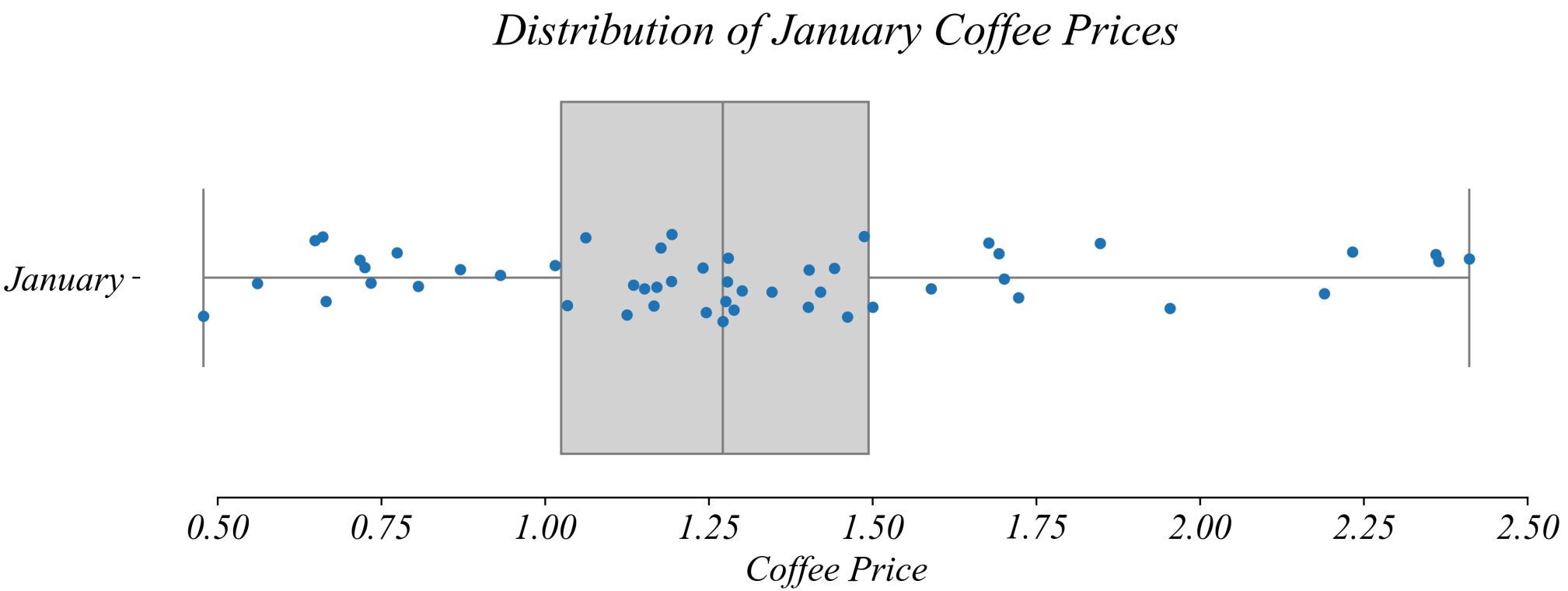
What price should we expect in January 2026?



> timeseries lineplots show us about the trends but is there something specific in January?

Seasonality: January

What price should we expect in January 2026?

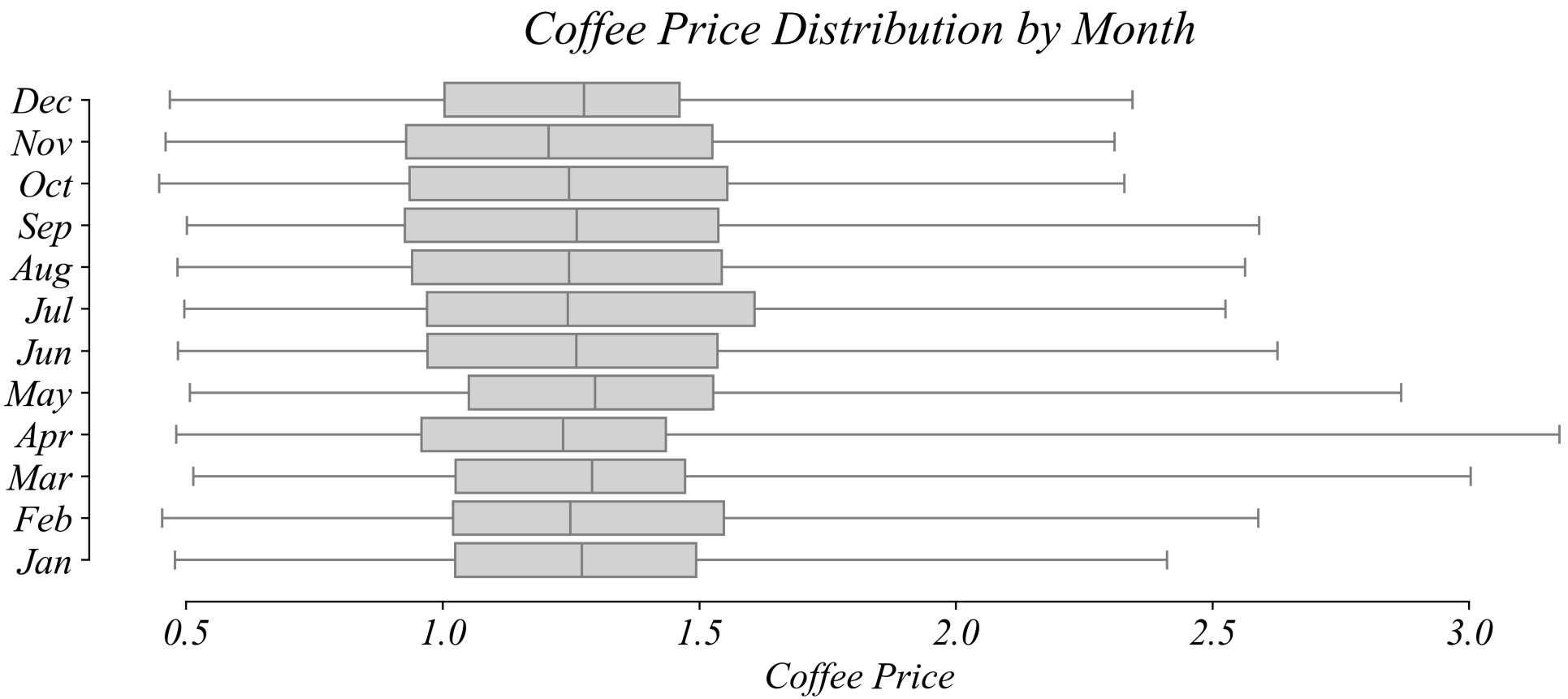


> *a boxplot gives us a picture of the prices just in January*

> *lets compare this to other months*

Seasonality: Monthly Boxplots

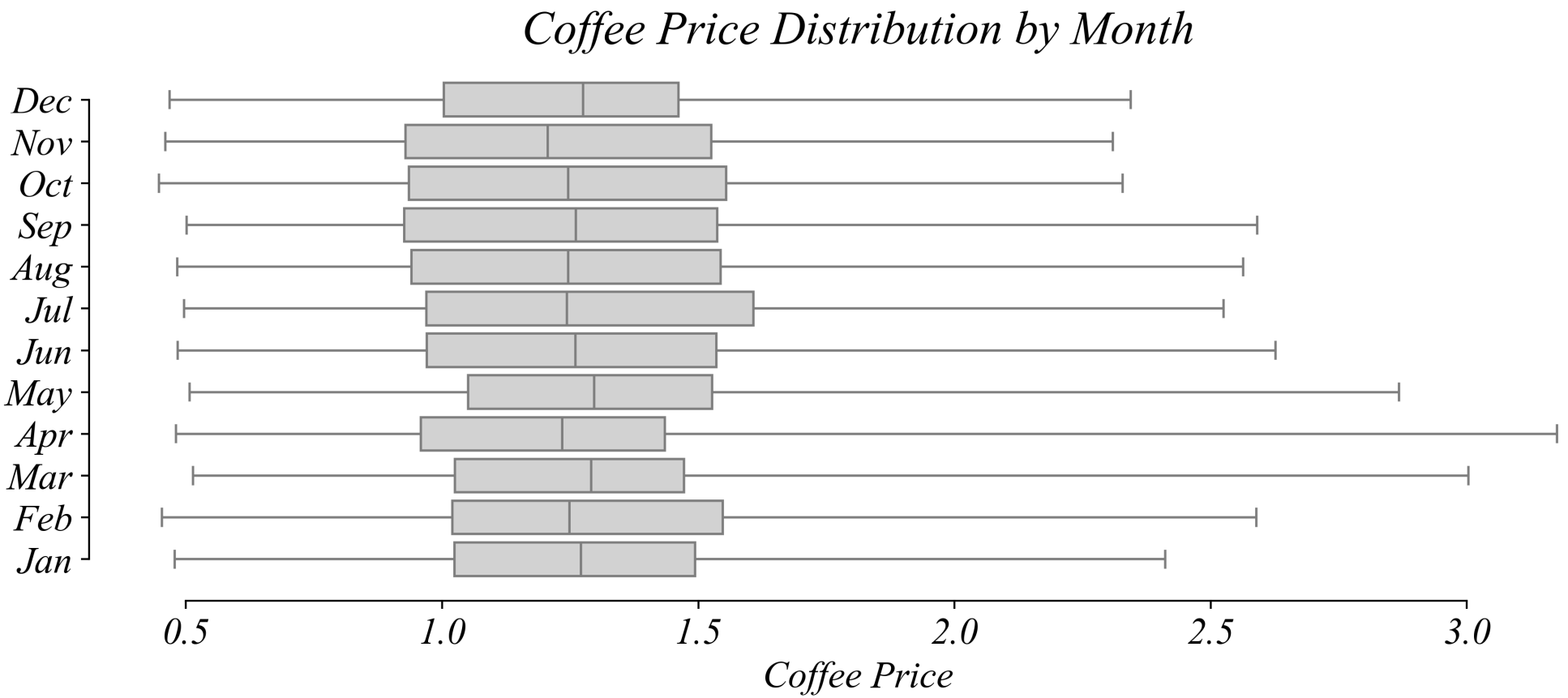
In addition to the overall trend, are there monthly patterns?



> lets be more specific…

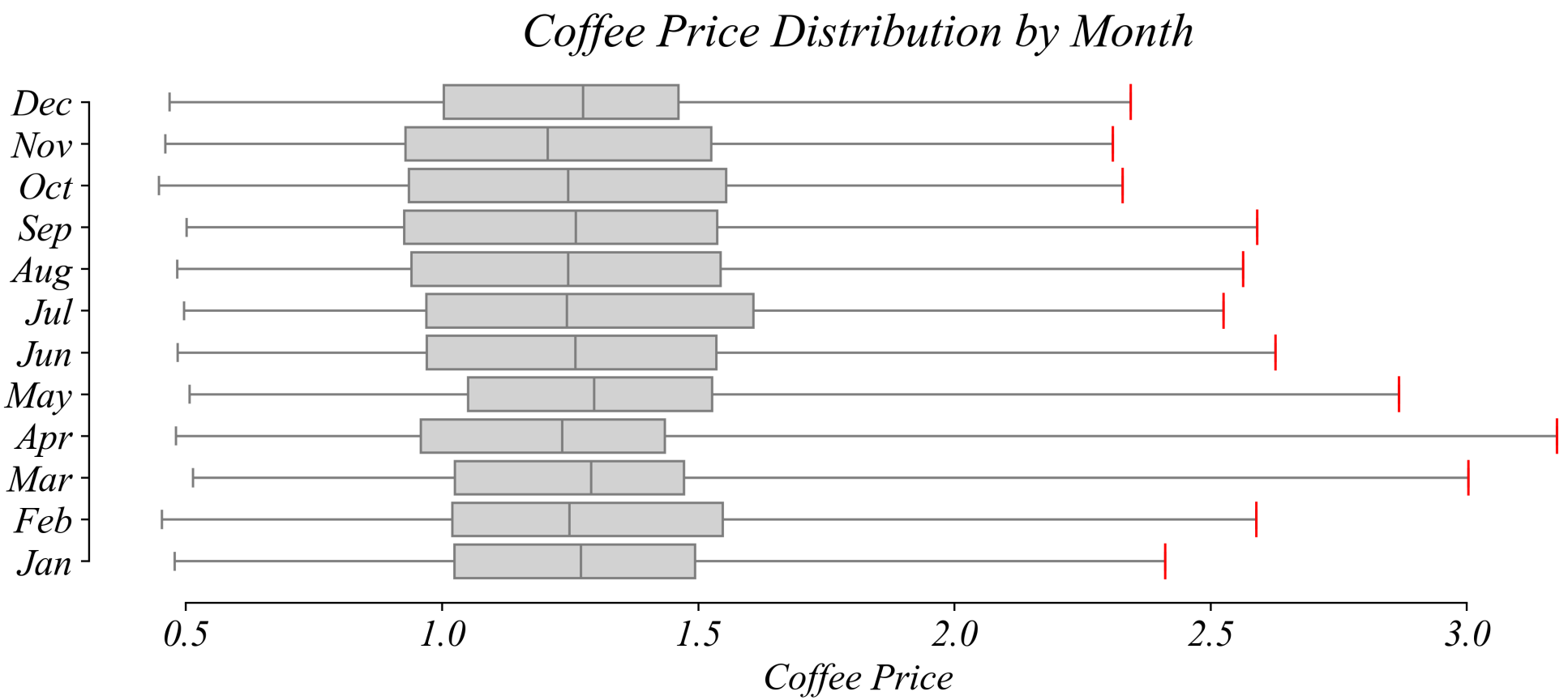
Seasonality: Monthly Boxplots

In which month was the record highest price set?



Seasonality: Monthly Boxplots

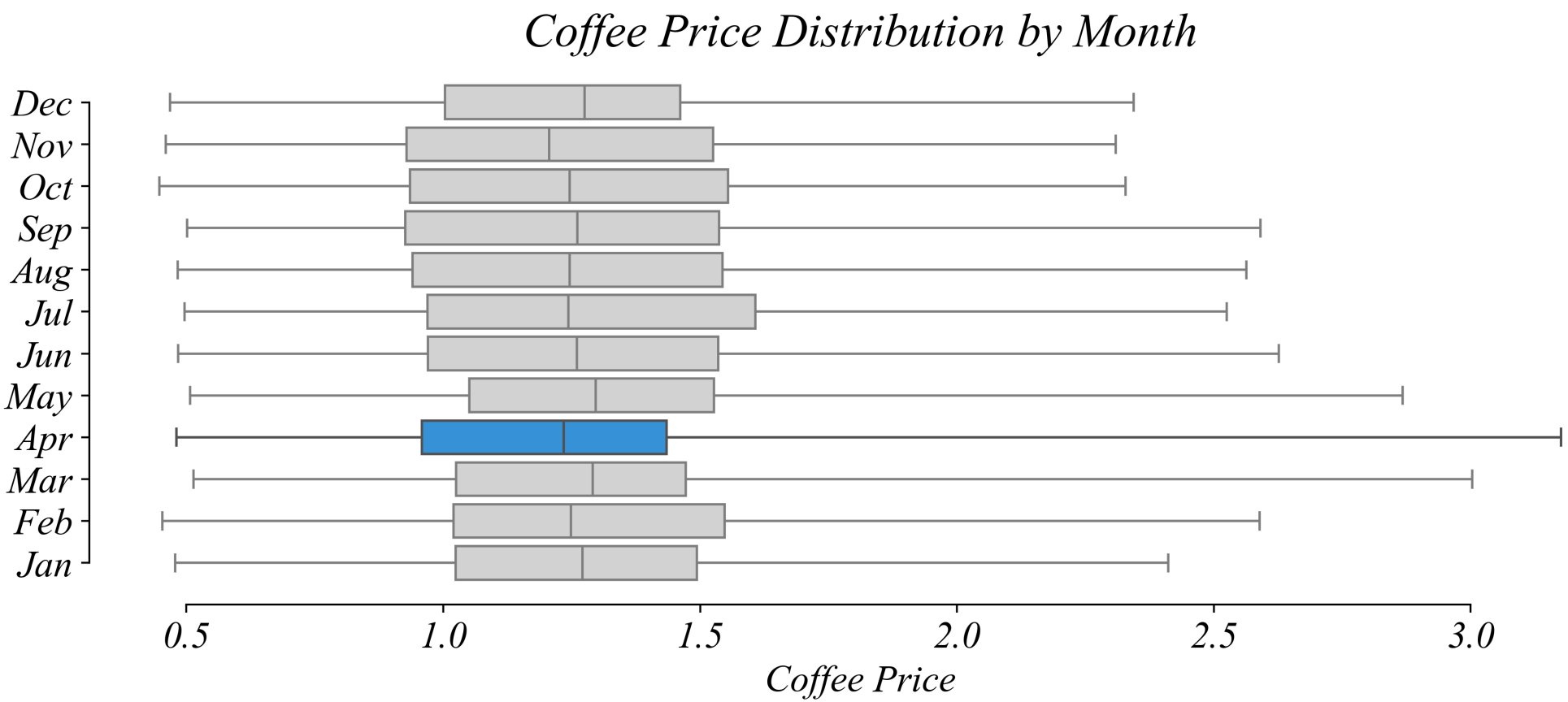
In which month was the record highest price set?



> *look at the maximums*

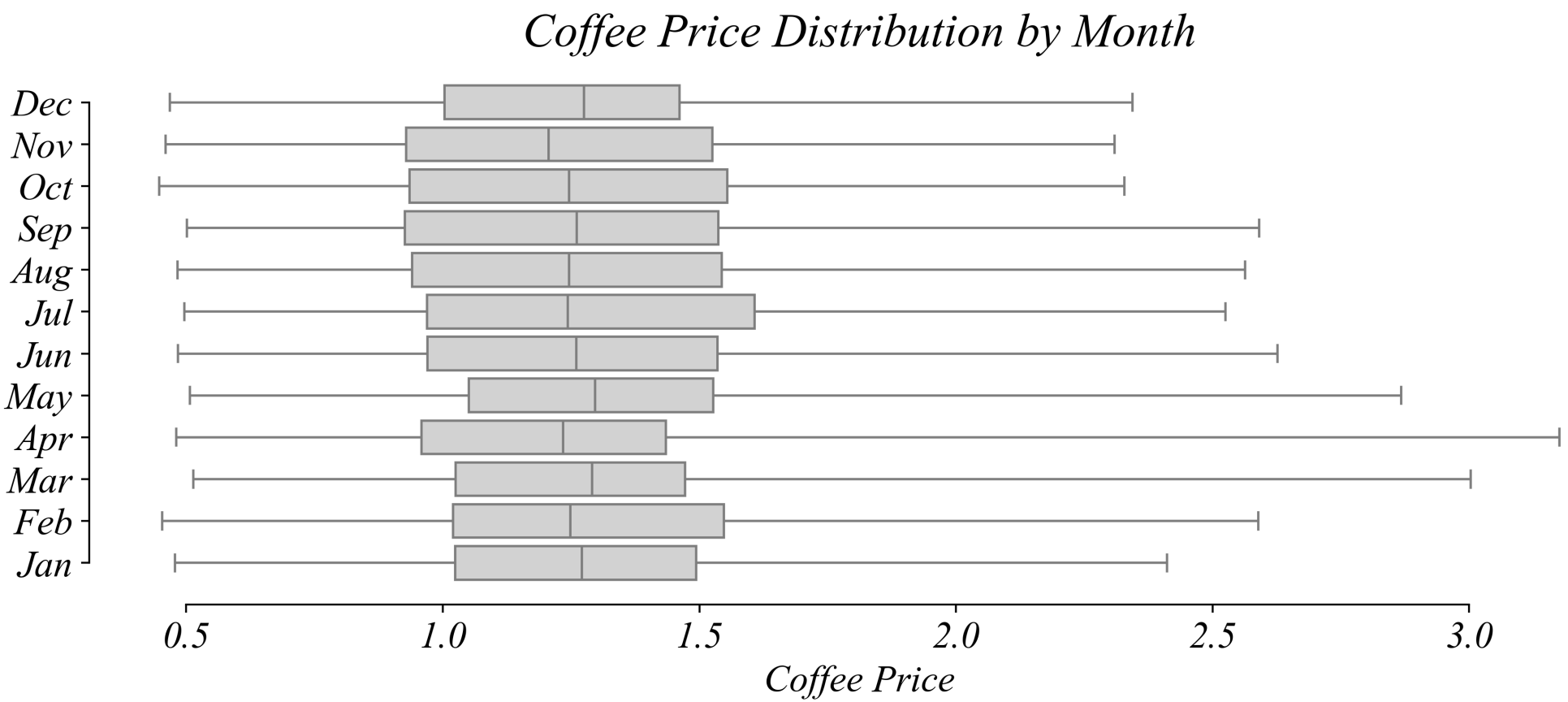
Seasonality: Monthly Boxplots

In which month was the record highest price set?



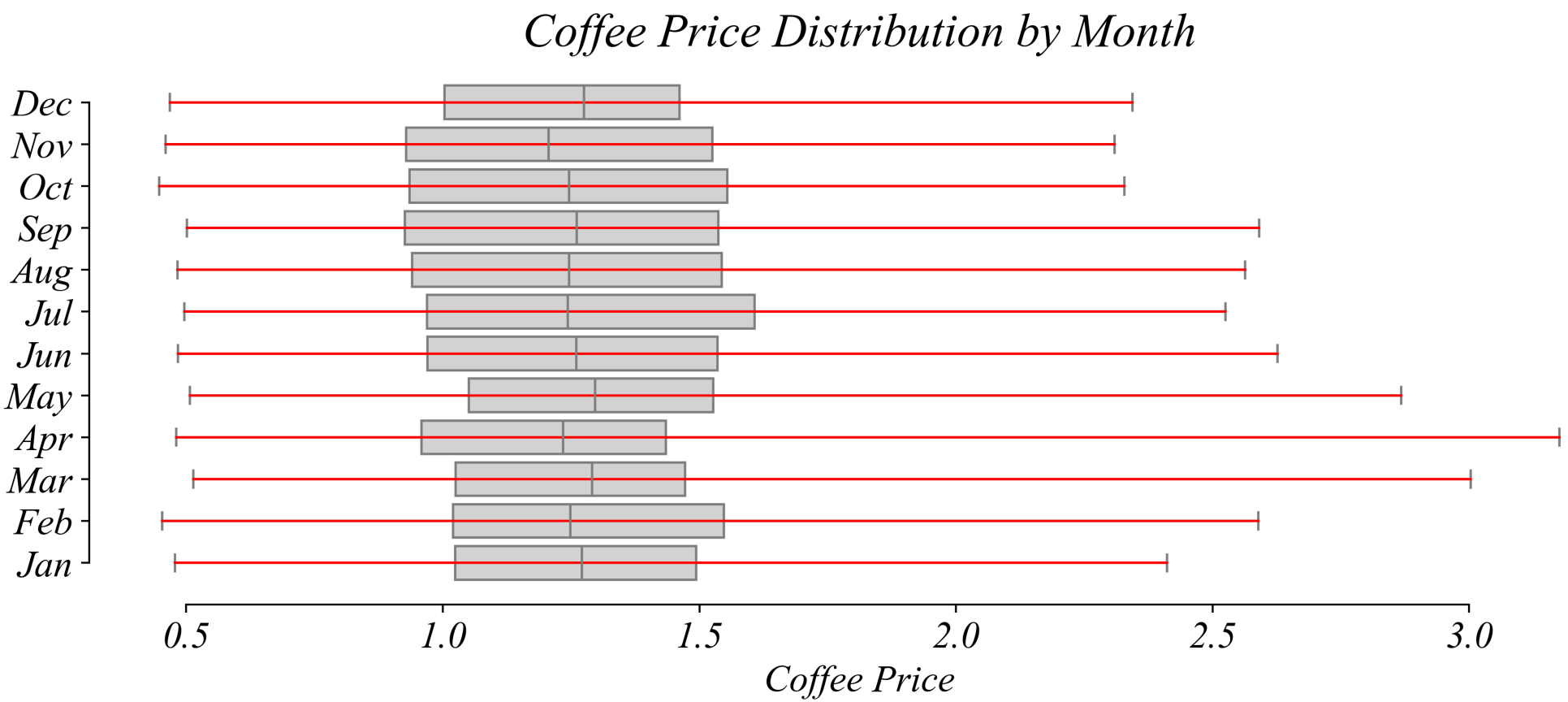
Seasonality: Monthly Boxplots

In which season are prices most spread out?



Seasonality: Monthly Boxplots

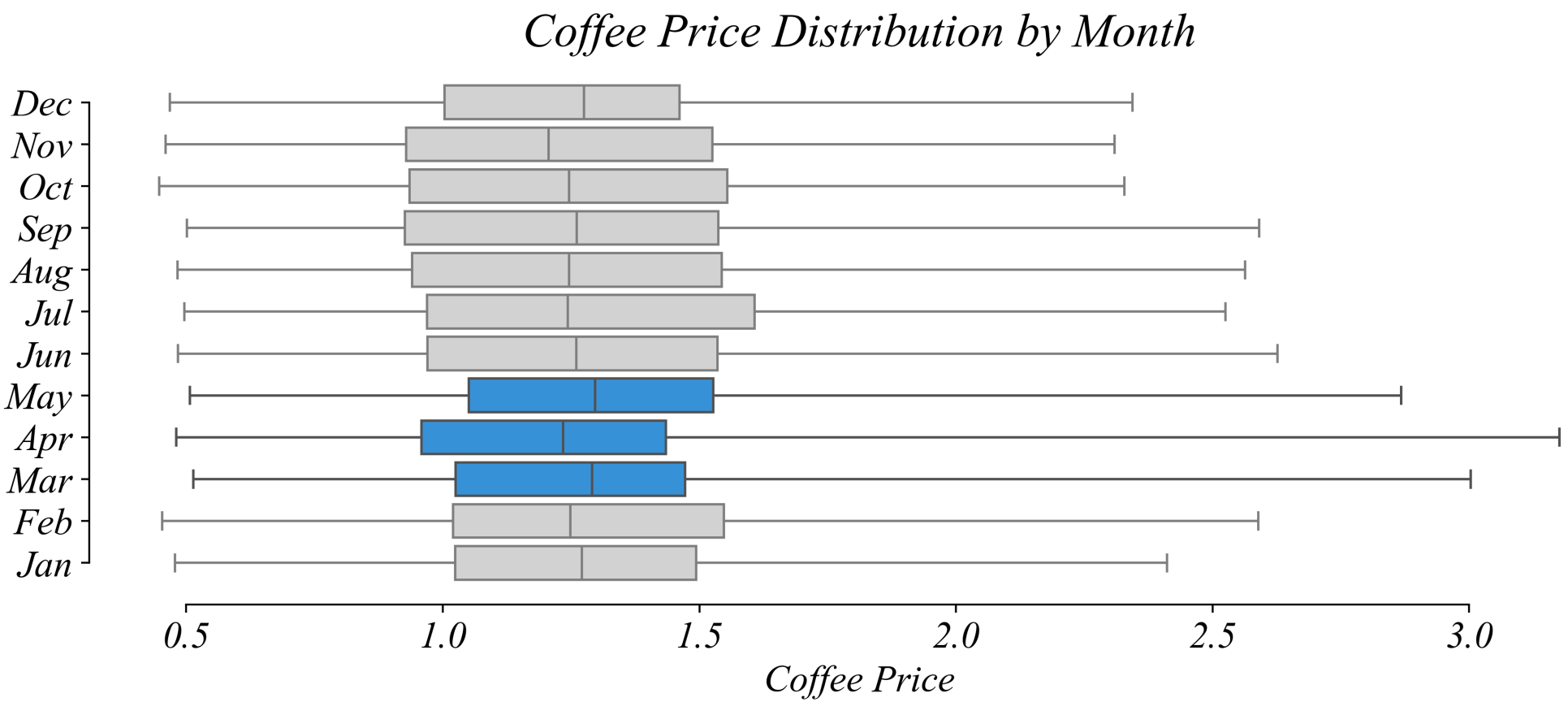
In which season are prices most spread out?



> *look at the ranges*

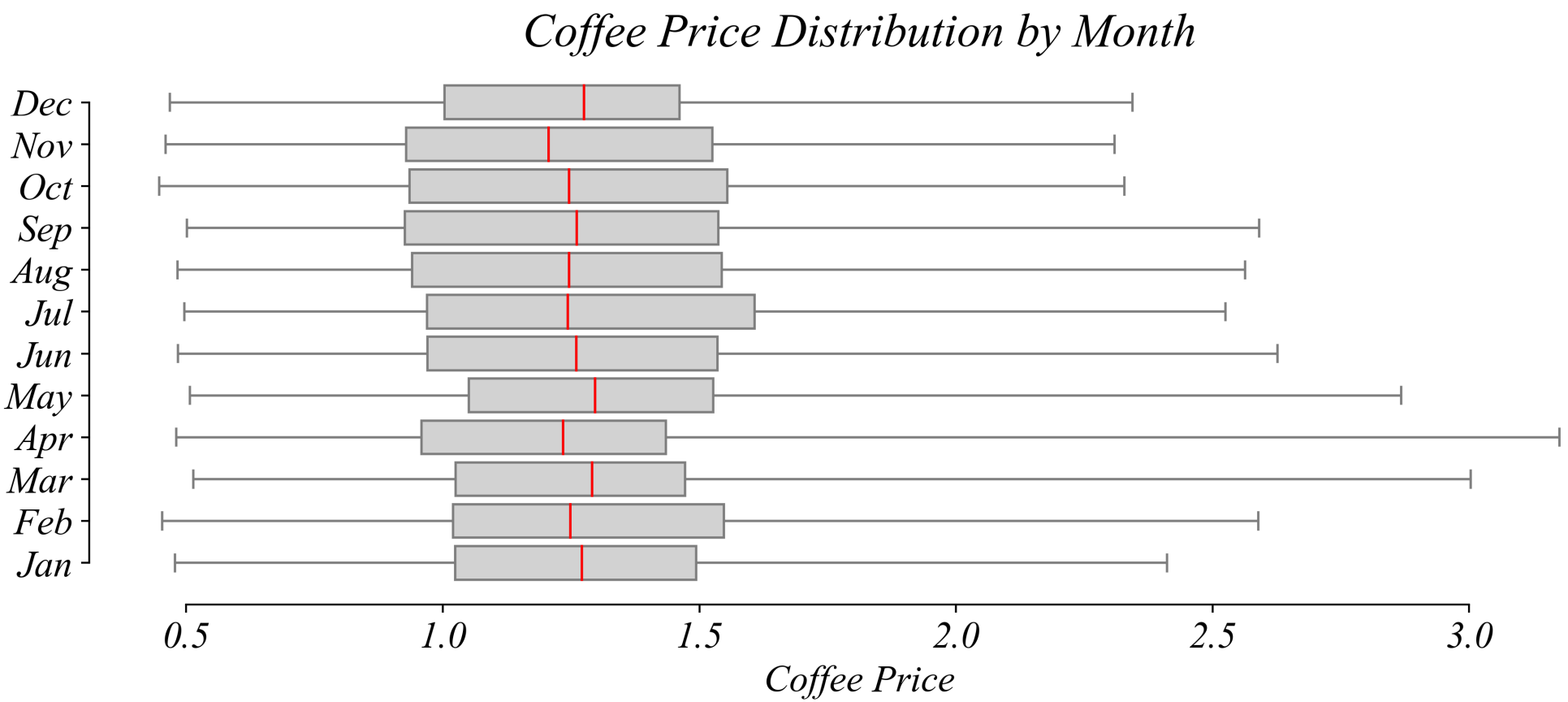
Seasonality: Monthly Boxplots

In which season are prices most spread out?



Seasonality: Multi-Boxplot

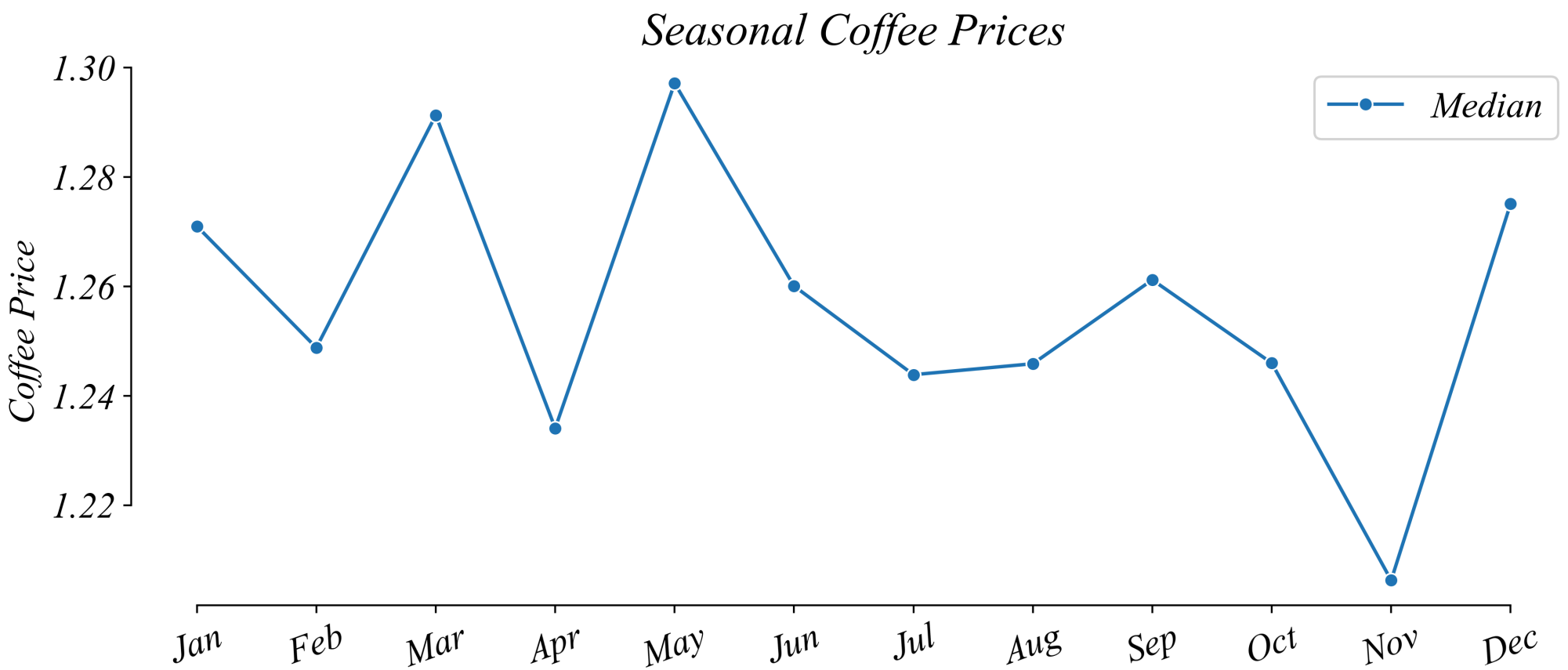
What is the trend in median price?



> *look at the medians…*

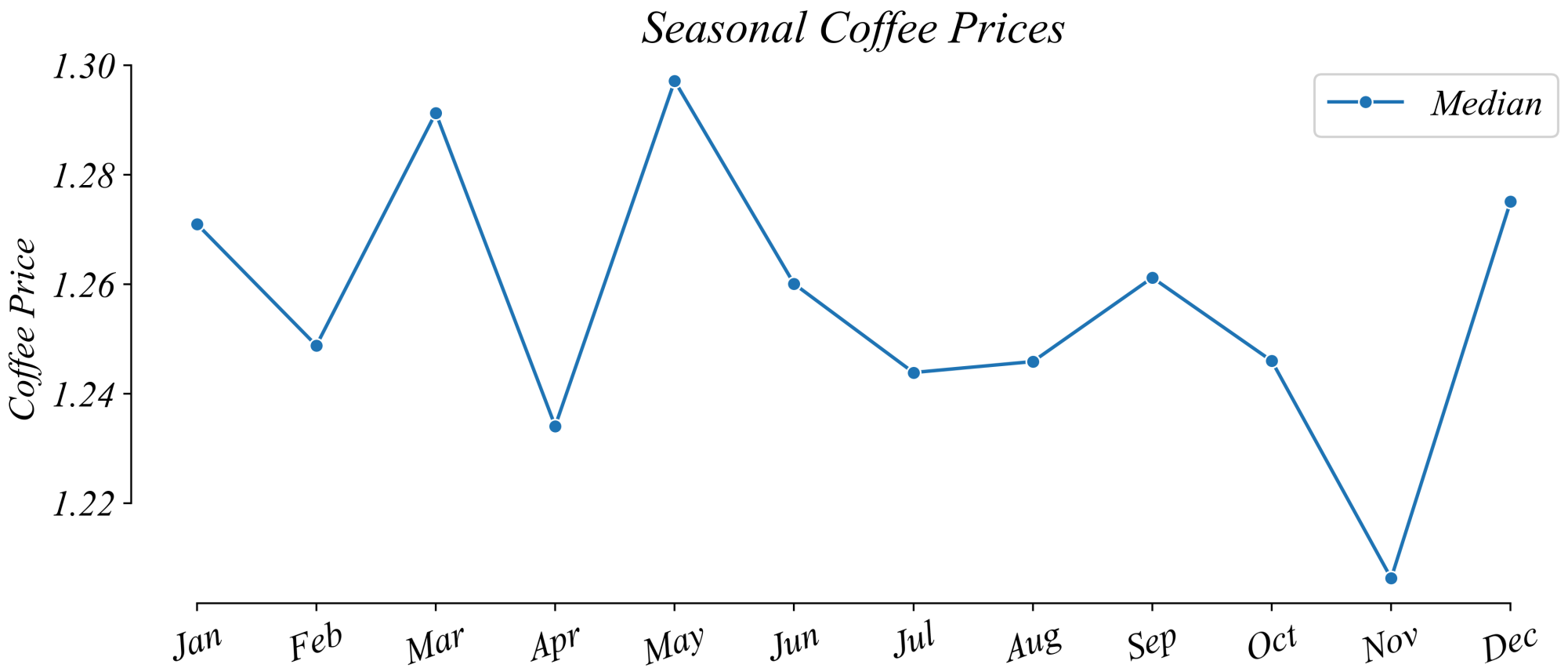
Seasonality: Quartile Lineplot

What is the trend in median price?



Seasonality: Quartile Lineplot

What is the difference between the largest and the smallest median price per pound?



> *something like $1.30 - $1.21 = $0.09*

Timeseries: Summary

Linegraphs show trends; multi-boxplots show between-period patterns.

- *Use a **linegraph** to show a numerical variable through time.*
- *Highlight changes in a linegraph using **shading**.*
- *Use a **multi-boxplot** to show the distribution between multiple periods.*

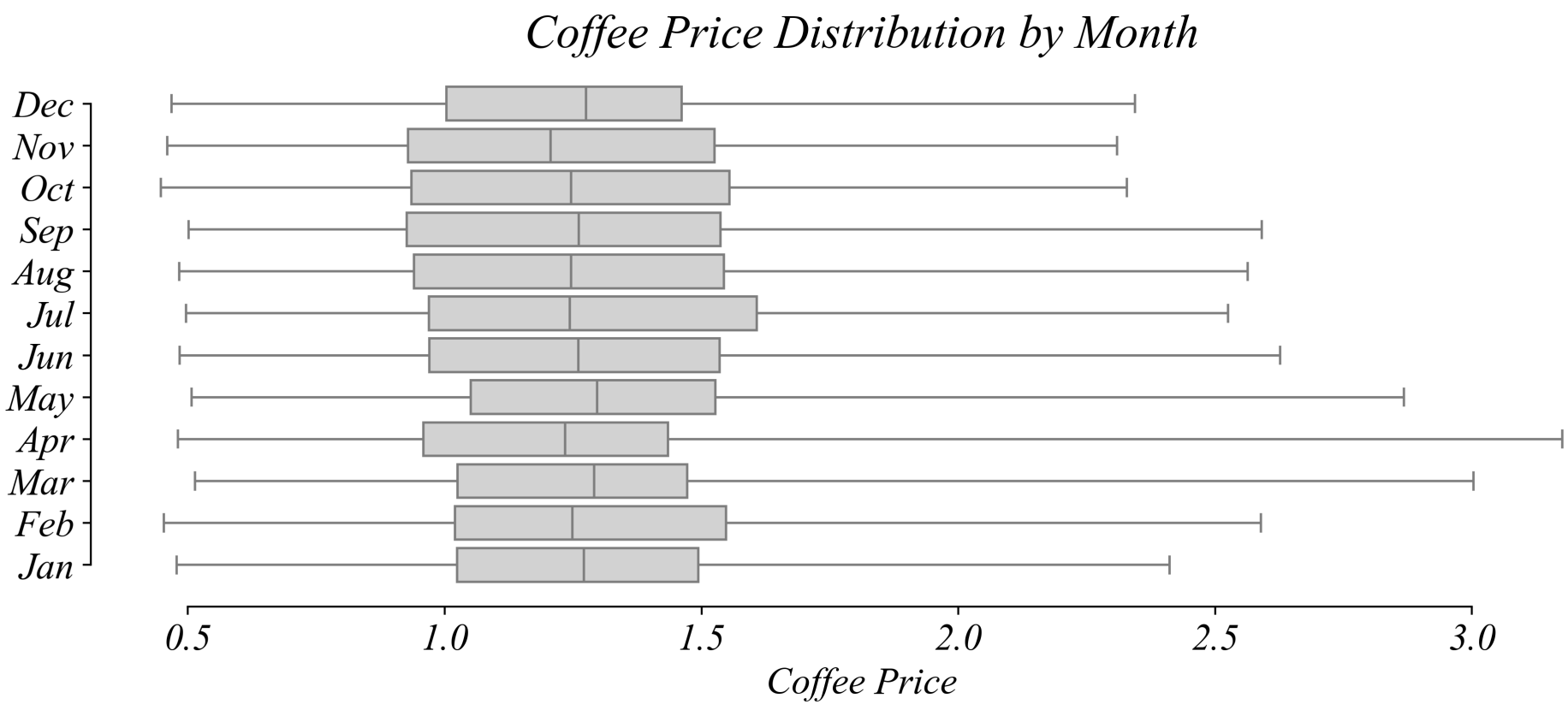
Exercise 1.3 | Seasonality

Lets use a multi-boxplot to examine the seasonal patterns of coffee prices.

- ***Data:*** `Coffee_Prices.csv`

Exercise 1.3 | Seasonality

```
1 # Multi-Boxplot
2 sns.boxplot(prices, y='month', x='price', whis=(0,100))
```



S-T-E for Multi-Boxplots

What we just did

Step	Action
SELECT	Coffee prices 2000-2025
TRANSFORM	Group by month; calculate quartiles within each group
ENCODE	Month → y-position; Price quartiles → box elements

> *TRANSFORM groups by time period, then summarizes within each group*

Building Blocks

What this unit adds to your toolkit

Block	**Part 1.3**
Variables	Numerical
Structures	Timeseries
Operations	Real price transformation; group by period
Visualizations	Line plot; Multi-boxplot

> Next: ***Panel Data*** *with both entity and time indexes!*