Elements of Macroeconomics TA
Session 6:
Midterm 2

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Slides on https://github.com/Haruki-Shibuya/TA

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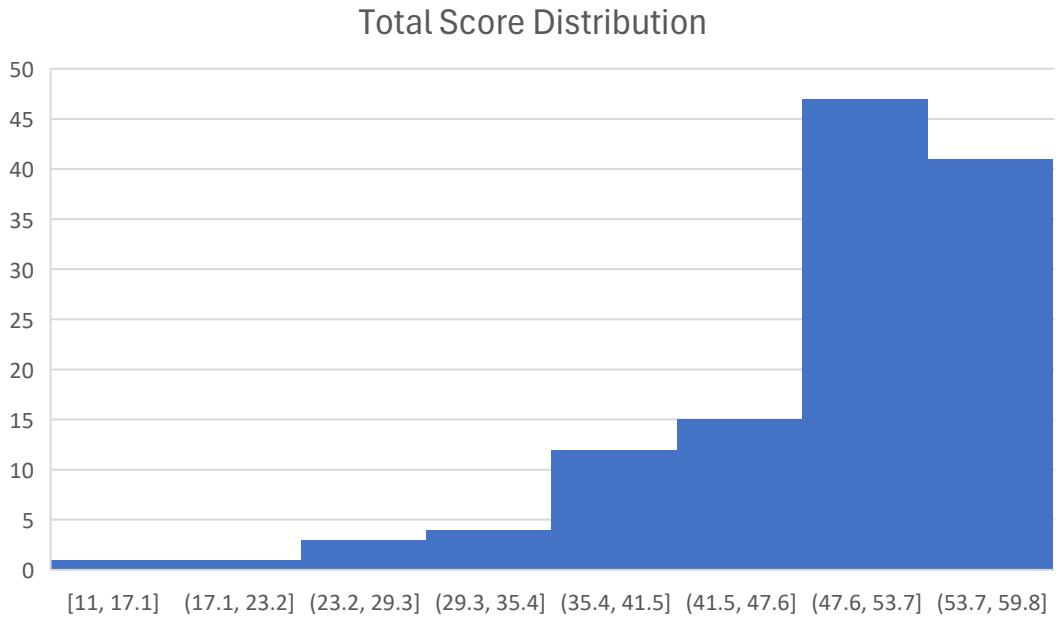
Grading

- Midterm 2 grading allocation

- Q1: Haruki hshibuy1@jh.edu
- Q2: Shiqi h.q@jh.edu
- Q3: Qingyuan qfang6@jh.edu

- Got a question? Check official answer keys & rubrics first!

Basic stats for Midterm Exam 2



	Q1	Q2	Q3	Bonus	Total
Full points	15	15	25	2	57
25% Percentile	11	10	22	2	46
Median	11	14	25	2	52
75% Percentile	15	15	25	2	56
Mean	12.452	12.121	22.589	1.935	49.097
Stand. Dev.	2.659	3.676	4.447	0.353	8.640

Midterm Exam 2 review

- Overall, impressive performance
- Most of the questions were similar to assignments

- I only cover one (sub)question today and then return your answer sheets

Q1(d)

Use the information in the below to answer the following questions.

Year	CPI
1990	130.7
2000	172.2
2010	218.1
2024	314.4

d) ***[4 points]*** Estimate the annualized growth rate in the cost of living between 2000 and 2024.

The inflation factor b/w 2000 and 2024 is 314.4/172.2 ≈ 1.826.

Thus, the annualized inflation factor is 1.826^{1/24} ≈1.0254. Hence approx. 2.54%.

Q1(d)

The geometric mean for the average growth rate, often called the **Compound Annual Growth Rate (CAGR)** for financial data, is calculated using the initial and final values of the series over the time period. It gives you the constant growth rate that would take the initial value to the final value over T periods.

Formula for Time-Averaged Growth Rate:

$$\text{CAGR (Time-Averaged Growth Rate)} = \left(\frac{x_T}{x_0}\right)^{\frac{1}{T}} - 1$$

Where:

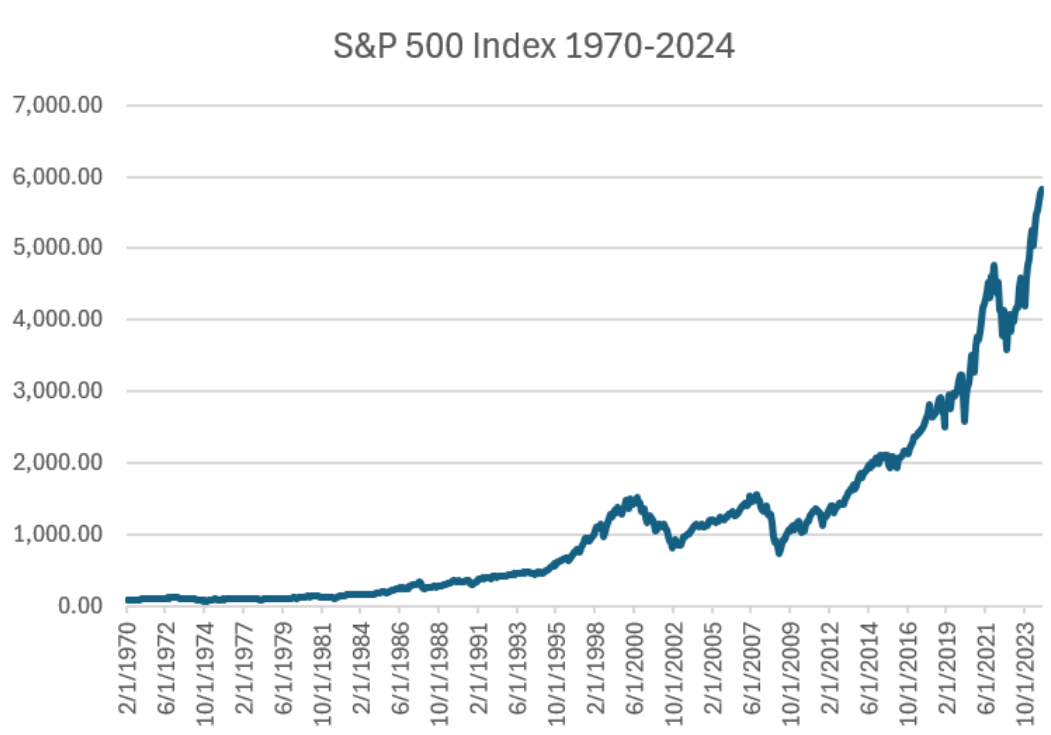
- x_T is the final value.
- x_0 is the initial value.
- T is the number of periods.

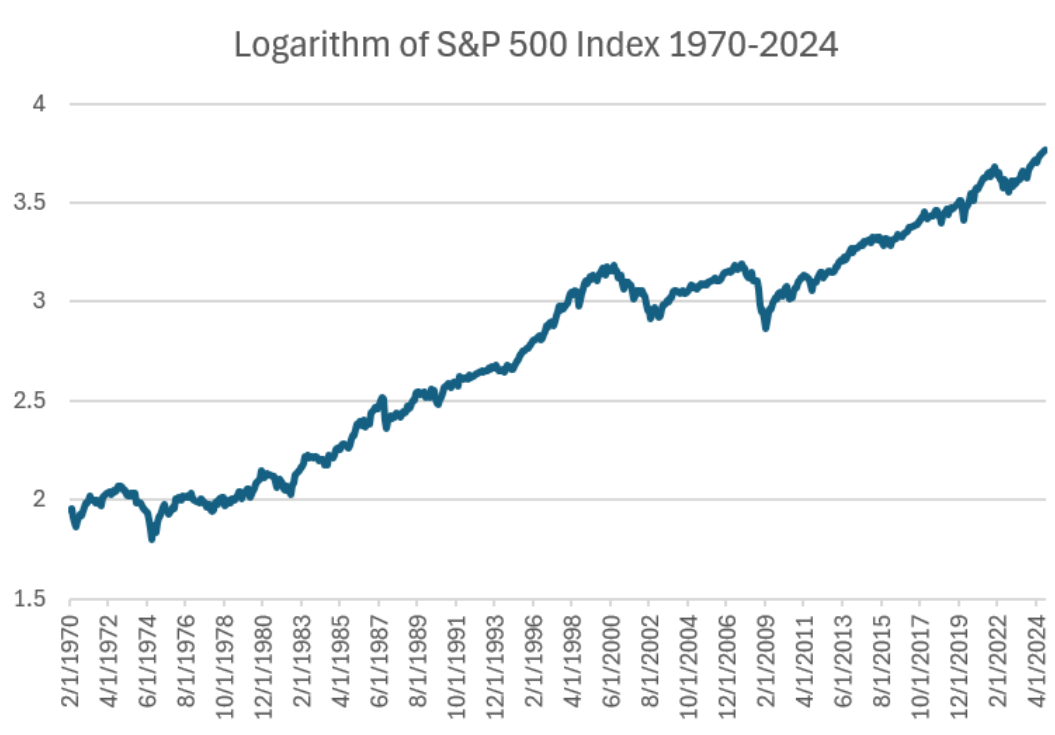
Q1(d)

- Why not arithmetic mean? Because it's misleading.
- If we were to compute arithmetic mean… (1.826-1)/24=0.0344
- i.e., 3.44%
- This doesn't really capture the 'average growth rate' since 1.0344^24 = 2.25, yielding a much bigger total growth than reality (=1.826)
- The geometric average gives you a good estimate of how much the index would grow in an average year
- The compound effect typically becomes more important when the growth is larger/period under consideration is longer

Another example: stock price index

- What is the 'average' annual return of the S&P 500 index?





Another example: stock price index

Date	S&P 500 Value	Description
2/1/1970	89.50	S&P 500 index value in February 1970
2/1/2024	5,096.27	S&P 500 index value in February 2024
Annual Return	$(\frac{5096.27}{89.50})^{\frac{1}{54}} - 1 = 7.77\%$	Average annual return from 1970 to 2024 (approximate)

- +7.77% annual average return on the index (excluding dividend) since 1970
- Subtract inflation for a real return
- If we were to use arithmetic mean… (5096/89.5-1)/54=1.03
- i.e., +103% return. But this info is not useful
- Lesson: use geometric mean for average growth rate or it will be misleading.

Q1(d) grading policy

- It's a simple question, so 4 points for the correct answer 2.54%
- But I gave you partial credits if you wrote "(314.4/172.2)^(1/24)," a correct formula (with actual numbers) that would lead to the correct answer even if you miscalculated.