Financial Assignment

Part 1

The first part of your task:

1. Read the data: excel file “First Assignment dataset”;
2. From S1-S10 and the risk-free rate data, create excess returns for the ten portfolios. Call these excess returns XS1-XS10;
3. Inspect the returns for each portfolio and comment on any exceptional features;
4. Compute summary statistics for the 10 excess return series. Comment on the variation in statistics across the portfolios and the implications of this variation.

Summary stats table:

	Mean	Std	Min	P25	Median	P75	Max	Skewness	Kurtosis	Sharpe_ann
XS1	1.09%	5.41%	-18.36%	-2.07%	0.97%	3.79%	27.25%	0.49	3.50	0.70
XS2	1.05%	5.53%	-21.27%	-1.75%	1.13%	3.99%	26.82%	-0.04	3.01	0.66
XS3	0.87%	5.37%	-24.59%	-1.72%	1.07%	4.14%	29.28%	-0.27	4.14	0.56
XS4	0.79%	5.55%	-22.68%	-2.07%	0.93%	3.74%	25.78%	-0.20	3.08	0.50
XS5	0.72%	5.49%	-23.28%	-1.91%	1.01%	3.63%	23.14%	-0.29	2.41	0.46
XS6	0.76%	5.46%	-24.31%	-2.01%	1.15%	3.64%	23.18%	-0.52	2.66	0.48
XS7	0.67%	5.45%	-24.74%	-1.93%	1.02%	3.61%	22.06%	-0.77	3.27	0.43
XS8	0.66%	5.45%	-26.24%	-1.94%	1.37%	3.90%	19.42%	-1.02	3.63	0.42
XS9	0.67%	5.53%	-29.38%	-2.23%	1.39%	4.06%	15.48%	-0.94	3.11	0.42
XS10	0.51%	4.55%	-27.70%	-1.80%	0.98%	3.32%	13.55%	-1.04	4.40	0.38

The table reports the main descriptive statistics for the monthly excess returns (XS1–XS10) of the ten size-sorted portfolios, from the smallest (XS1) to the largest (XS10).
Each column summarizes key features of the return distribution.

- **Mean** represents the average monthly excess return. It indicates the typical risk-adjusted performance of each portfolio. In most equity datasets, smaller portfolios (XS1–XS3) tend to show higher average returns, reflecting the well-known size premium.

- **Standard deviation (Std)** measures the volatility of returns. Higher values imply greater risk. We typically observe that smaller portfolios also have higher volatility, consistent with their higher expected returns.

- **Quantiles (P25, Median, P75)**, together with **Min** and **Max**, show the dispersion and asymmetry of returns. Wider gaps between percentiles suggest more variability or extreme movements in the tails of the distribution.

- **Skewness** captures the asymmetry of the return distribution.

    - A **negative** skewness means that extreme negative returns occur more often than extreme positive ones (left-tailed).

    - A **positive** skewness indicates more frequent large gains.
      For equity portfolios, a slightly negative skewness is common due to downside risk.

- **Kurtosis** measures the "tailedness" or the frequency of extreme outcomes compared to a normal distribution (which has kurtosis = 3).

    - Values **above 3** indicate fat tails — more extreme observations than expected under normality.

    - Values **close to 3** suggest a roughly normal distribution.
      In financial returns, high kurtosis (leptokurtic behavior) is typical, reflecting occasional large shocks.

- **Sharpe ratio** expresses the return per unit of risk:
  Sharpe = $E[R-Rf] / \sigma$. Higher Sharpe ratios imply better risk-adjusted performance. Usually, large-cap portfolios (XS8–XS10) exhibit lower Sharpe ratios than small-cap ones because their returns are smoother but less pronounced.

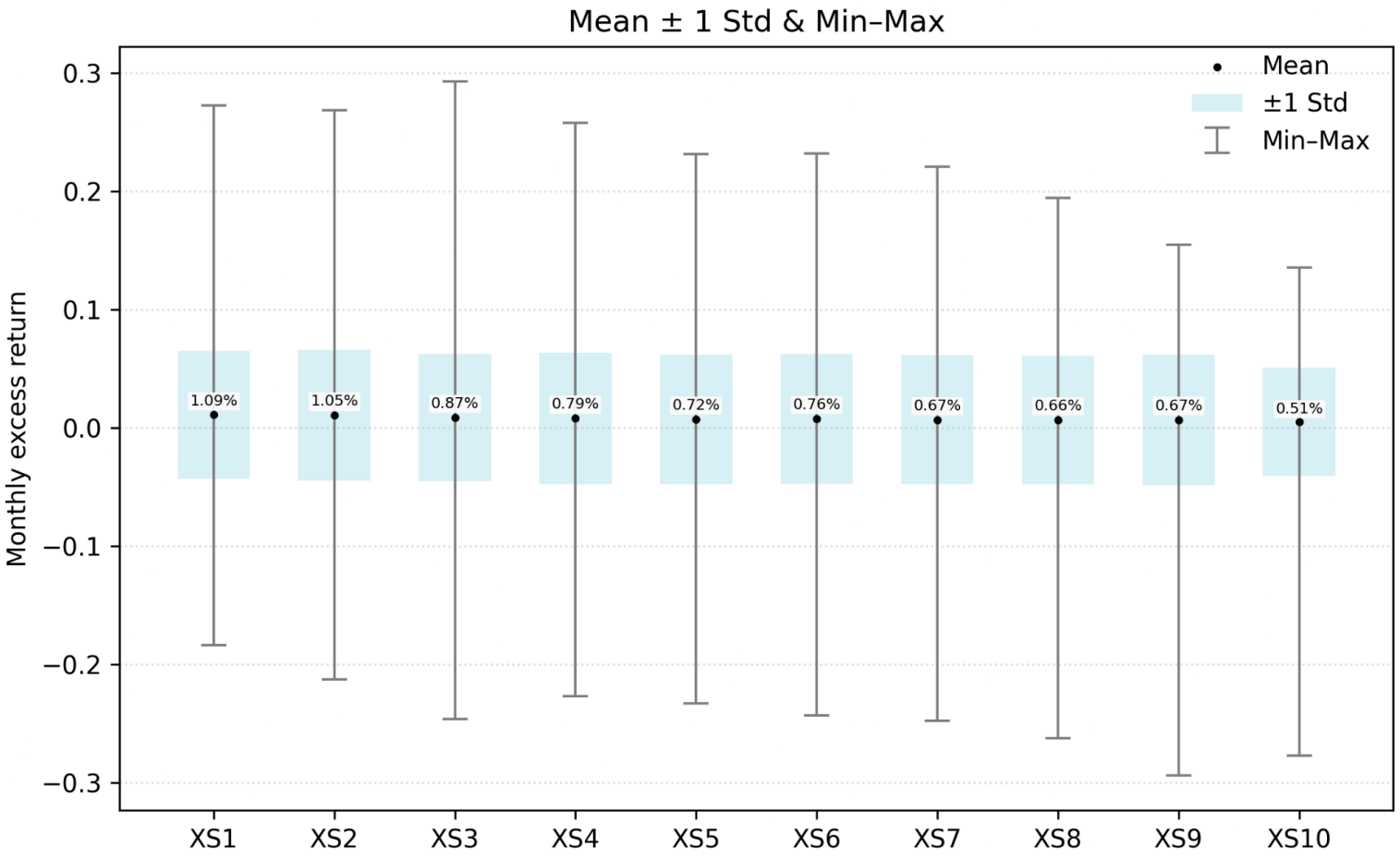
Average excess returns **(Mean)** and **Standard deviations** confirm the decreasing trend in both return and risk as firm size increases.

Skewness is mostly negative for larger portfolios, suggesting a higher likelihood of large negative returns, while smaller portfolios show slightly positive or near-zero skewness.

Kurtosis values are all above 3, indicating *fat tails* and the presence of extreme observations relative to the normal distribution.

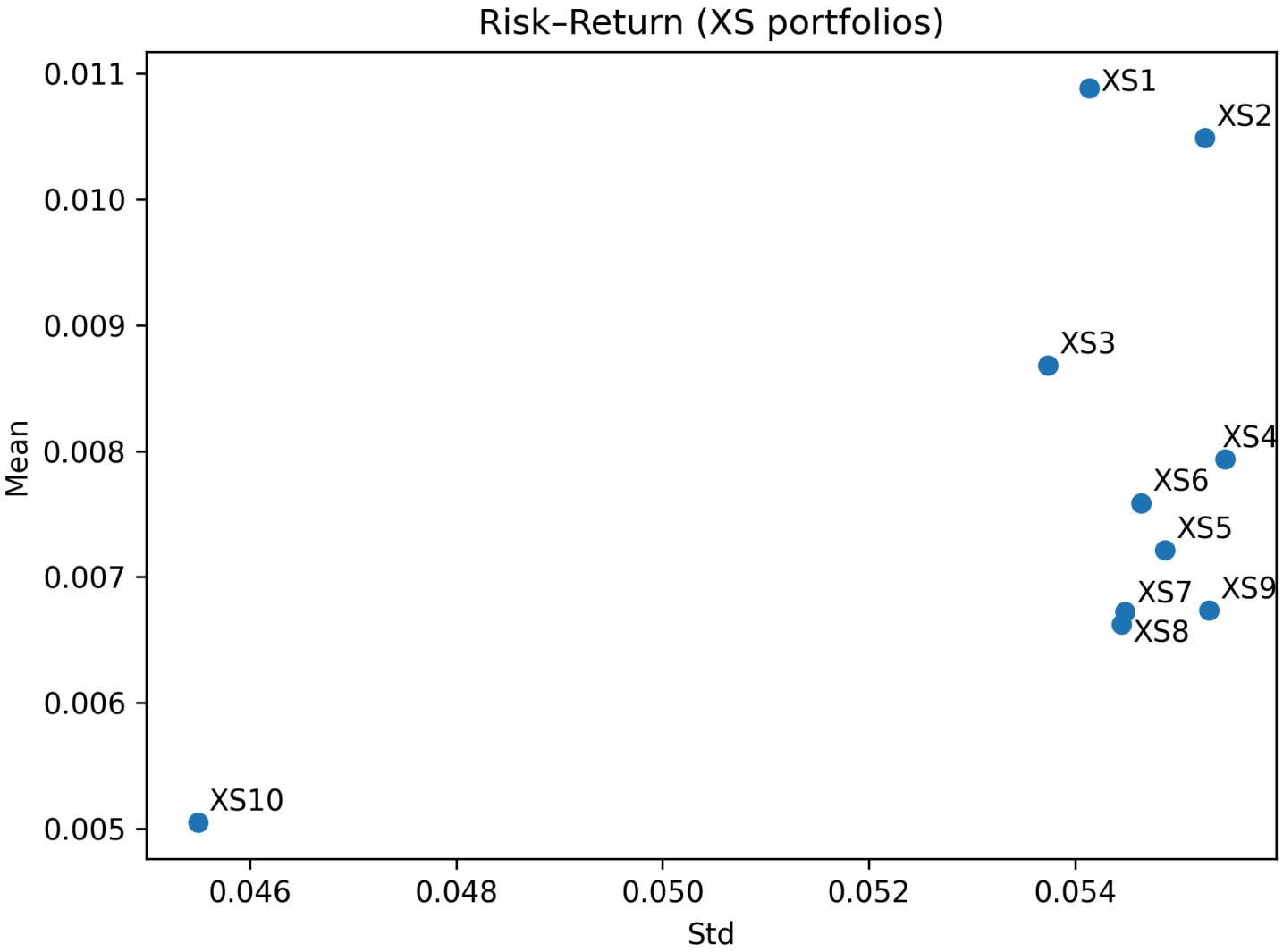
Finally, the **Sharpe ratio** declines from XS1 (0.70) to XS10 (0.38), highlighting that small-cap portfolios deliver higher risk-adjusted returns despite their greater volatility..

Mean +- 1 std & Min-Max:



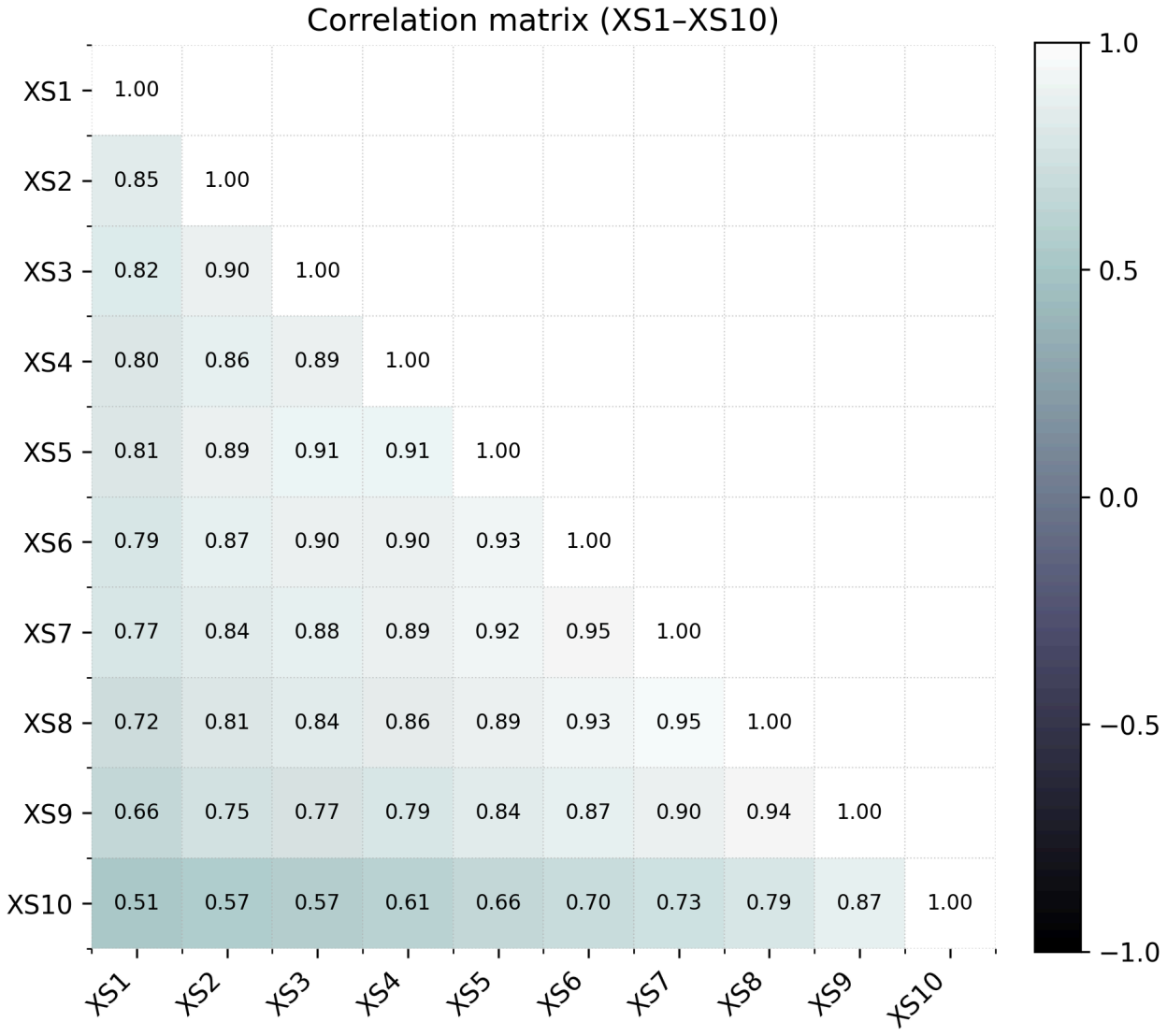
The figure provides a visual summary of the distribution of monthly excess returns across the ten size portfolios (XS1–XS10).
For each portfolio, the **blue bar** represents the range of one standard deviation above and below the mean, while the **gray whiskers** indicate the **minimum and maximum** observed values.
The **black dot** marks the average excess return, and the small **label above it** reports its value in percentage terms.
The figure clearly illustrates the size effect: smaller portfolios (XS1–XS3) exhibit higher mean returns and greater volatility, while larger portfolios (XS8–XS10) show lower but more stable excess returns.

Risk-Return:



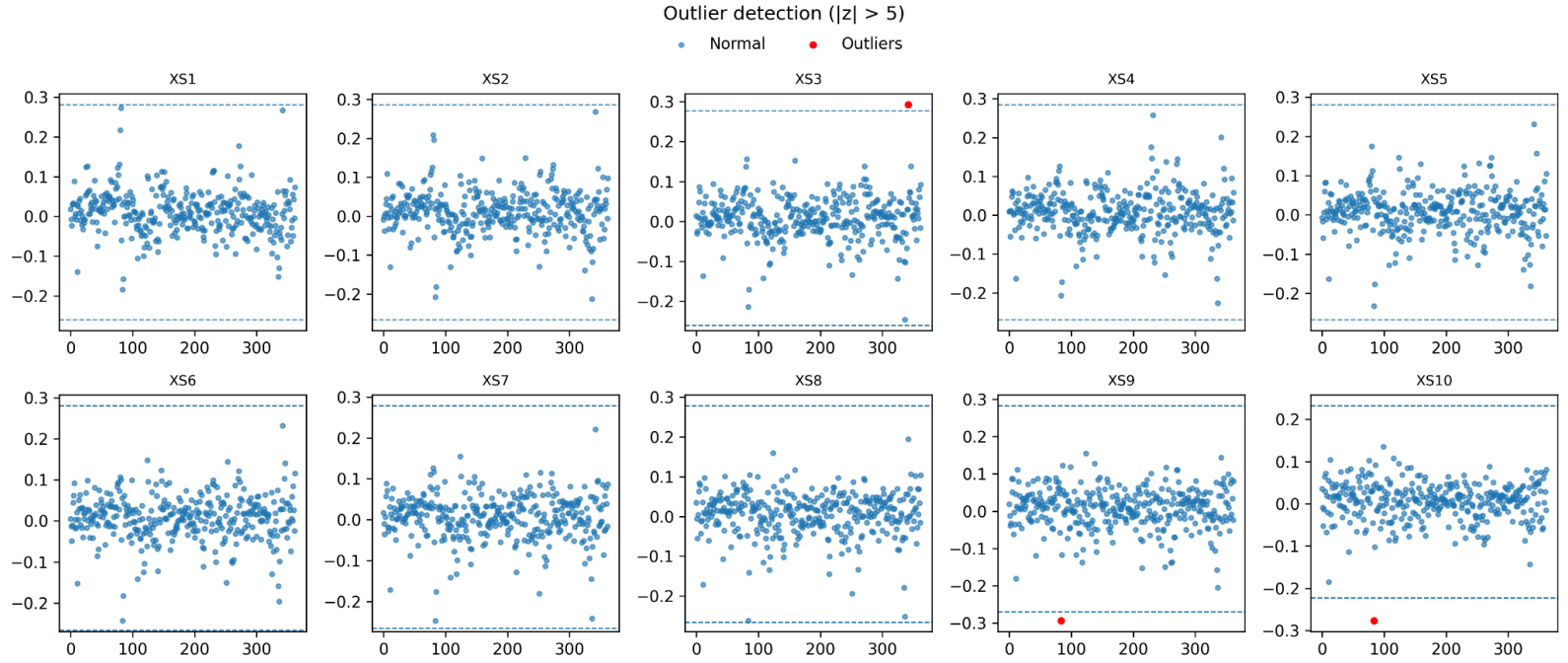
This scatter plot shows the relationship between **risk** (standard deviation of excess returns) and **average return** (mean) for the ten size-sorted portfolios.
Each point represents one portfolio (XS1–XS10), moving from the smallest to the largest firms.
The upward slope indicates the typical risk–return trade-off: portfolios with higher volatility (smaller-cap stocks such as XS1–XS3) also exhibit higher average excess returns.
Notably, XS10 stands out from the others, lying well below the general trend — it shows significantly lower risk but also a substantially smaller mean excess return, highlighting the weaker performance of the largest-cap stocks.
This pattern visually confirms the presence of the size effect in the UK market data.

Correlation matrix:



The heatmap shows the pairwise correlations among the monthly excess returns of the ten size portfolios.
All correlations are **strongly positive**, confirming that portfolios formed on firm size tend to move together, reflecting common market-wide risk factors.
Correlations are highest among portfolios with **similar size ranks** (e.g., XS4–XS7), and they gradually decrease as the difference in size increases.
Notably, XS10, which contains the largest-cap stocks, exhibits the lowest correlation with the smaller portfolios, indicating that large firms are less sensitive to the same shocks affecting small-cap segments of the market.

Outliers:



This grid shows the detection of extreme monthly excess returns across the ten portfolios (XS1–XS10).
Each blue dot represents a single monthly observation, while red dots identify outliers, defined as returns exceeding five standard deviations from the mean (|z| > 5).
The dashed horizontal lines mark the upper and lower cut-off thresholds.
Only a few extreme observations are detected — only in XS3, XS9, and XS10 — confirming that the return distributions are generally stable but occasionally affected by rare, large shocks.
The relatively few outliers suggest that the winsorization applied later only has a marginal impact on the overall results.