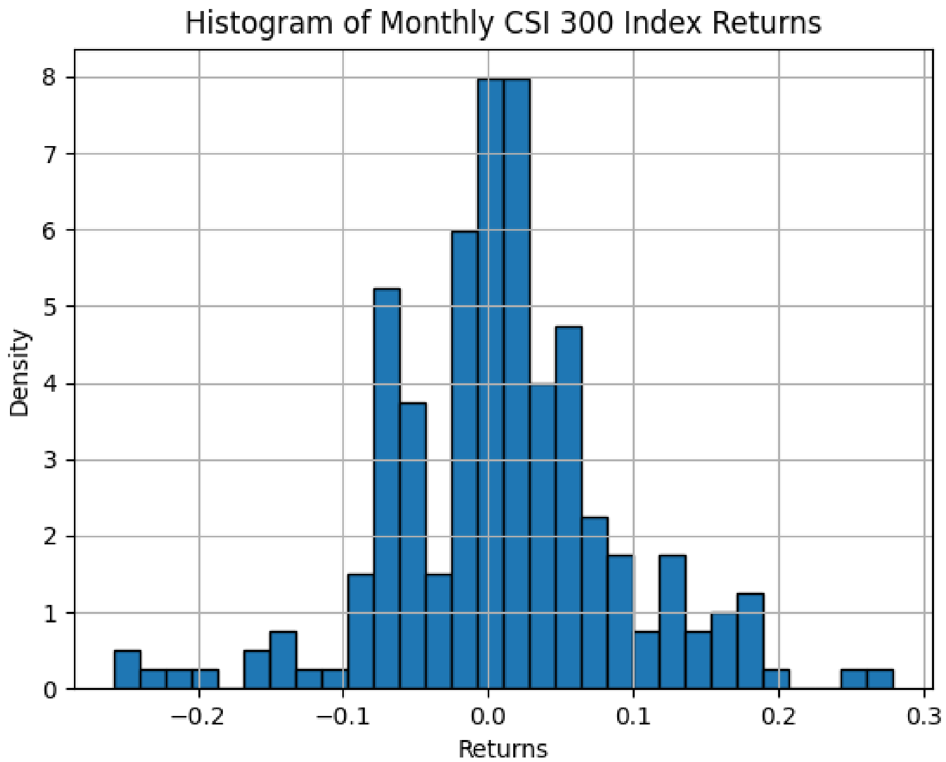
Q1

a)

```
Mean return: 0.009086453303326808
Standard deviation: 0.08071168146910553
Skewness: 0.015217498215472374
Kurtosis: 1.4498566009018719
```

b)



c)

```
Shapiro-Wilk test statistic: 0.971137523651123
Shapiro-Wilk test p-value: 0.00015469678328372538
```

1. First, the statistical results in part a can be used to preliminarily assess the normality of the data:

- The mean value is close to zero, indicating that the central tendency of the data roughly overlaps with that of a normal distribution.
- The small standard deviation suggests that the data has lower dispersion compared to a normal distribution.
- The skewness value is larger but close to zero , indicating that the distribution of the data is approximately symmetrical, with a slight right-skewness.
- The kurtosis value is lower than the kurtosis of a normal distribution (3), suggesting that

the data has a thicker tails.

Taking all these statistics into consideration, they imply that the data approximately follows a normal distribution, this pattern also observed in the histogram generated in part b.

2. The Shapiro-Wilk test used in part c provides a more rigorous and comprehensive assessment of the data's normality:

- The Shapiro-Wilk test statistic yields a p-value of 0.00015, which is smaller than 0.01. Then, we can reject the null hypothesis that the data follows a normal distribution at the 1% significance level. Therefore, based on the Shapiro-Wilk test results, we conclude that the data does not conform to the assumption of normality.

Q2

$$E(r_{p,t} - r_{f,t}) = \alpha_p + \beta_p (r_{m,t} - r_{f,t}) + \Sigma_{i,t}$$

Group_name	Beta	Beta t-value	Beta significance	Alpha	Alpha t-value	Alpha significance	R-squared
0	0.799336221	39.08258397	2.18E-62	-0.001276018	-1.983164298	0.050091511	0.938554118
1	0.879882882	51.71390697	5.63E-74	-2.81E-05	-0.052411342	0.958305493	0.963955238
2	0.895762337	66.59054029	1.20E-84	0.000200929	0.474800504	0.635964473	0.977945879
3	0.946873409	67.72321104	2.31E-85	0.000447539	1.017477551	0.311381693	0.978661811
4	1.001500617	98.00802322	3.56E-101	-5.37E-05	-0.166919838	0.867770188	0.989696641
5	1.045849566	82.31626006	1.09E-93	-4.96E-05	-0.124058669	0.901517847	0.98545659
6	1.04032716	91.00467066	5.45E-98	-0.000178176	-0.495440929	0.621375901	0.98806946
7	1.103965534	75.02788879	1.00E-89	-7.99E-05	-0.172528659	0.863370635	0.982545508
8	1.0878391	75.52563362	5.22E-90	0.000228211	0.503632991	0.615626975	0.982770863
9	1.15054344	63.23312003	1.88E-82	-0.000953477	-1.665711716	0.098900633	0.975600398

Table_2

$$E(r_{p,t} - r_{f,t}) = \gamma_0 + \gamma_1 \beta_p + \Sigma_p$$

```
                            OLS Regression Results
==============================================================================
Dep. Variable:     stock return premium   R-squared:                       0.455
Model:                              OLS   Adj. R-squared:                  0.387
Method:                   Least Squares   F-statistic:                     6.674
Date:                  Fri, 19 Apr 2024   Prob (F-statistic):             0.0324
Time:                          01:05:25   Log-Likelihood:                 66.839
No. Observations:                    10   AIC:                            -129.7
Df Residuals:                         8   BIC:                            -129.1
Df Model:                             1
Covariance Type:              nonrobust
============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
----------------------------------------------------------------------------
const         -0.0010      0.001     -1.014      0.340      -0.003       0.001
Beta           0.0026      0.001      2.583      0.032       0.000       0.005
============================================================================
Omnibus:                        1.942   Durbin-Watson:                   3.280
Prob(Omnibus):                  0.379   Jarque-Bera (JB):                0.938
Skew:                          -0.336   Prob(JB):                        0.626
Kurtosis:                       1.659   Cond. No.                         18.8
============================================================================
```

Tabel_3

- Based on Table 2, we have reached some similar conclusions to those in the paper:

1. The β_p values for each portfolio are relatively close, mostly around 1, with generally low levels of p-value, indicating a statistically significant effect of market returns on stock returns.
2. Firstly, the R-squared values are generally high, indicating that the regression explains most of the total variation in stock return. Additionally, the R-squared does not increase with β_p values, suggesting that stock returns are influenced by factors other than systematic risk.
3. Furthermore, we have also identified different conclusions from the paper: the p-values of α_p for the portfolios are generally large, thus we cannot reject the null hypothesis that alpha is zero.

- Based on Table 3, we have reached some similar conclusions to those in the paper:

1. R-squared is only 0.455, which is an average fit while $\gamma_1 = 0.0026$, indicating that the regression explains only half of the total variation in stock return.
2. $\gamma_1 = 0.0026$ and its t-statistics shows that the return is statistically significantly positively correlated with the systematic risk, indicating that the return increases with the systematic risk, which is consistent with the CAPM model.
3. Furthermore, we have also identified different conclusions from the paper: the p-values of α_p for the portfolios are generally large, thus we cannot reject the null hypothesis that alpha is zero. In response to this difference, we believe it is because over time, people's investment knowledge has become more enriched, further promoting market efficiency, then reducing other factors influencing returns, hence the α_p is not significantly non-zero.