Assignment 3

Dmitrii Kuptsov, Cherryl Chico, Olta Recica

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Given the following regression model:

$$RPmsoft_t = \beta_1 + \beta_2 RPsandp_t + \beta_3 Dprod_t + \beta_4 Dinflation_t + \beta_5 Dterm_t + \beta_6 m1_t + \epsilon_t$$

where

- $RPmsoft_t$ is the excess return of the Microsoft stock,
- $RPsandp_t$ is the risk premium of the S&P 500 index,
- $Dprod_t$ is the change in production,
- $Dinflation_t$ is the change in inflation,
- $Dterm_t$ is the change in term structure,
- $m1_t$ is the money supply growth,
- ϵ_t is the error term.

2.a

Using the data microsoft.csv, the resulting regression model is as follows:

$$\widehat{RPmsoft}_t = -0.9291 + 1.3232 RPsandp_t - 1.5216 Dprod_t + 0.4716 Dinflation_t + 4.1588 Dterm_t + 5.4352 m1_t$$

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. reg rpmsoft rpsandp dprod dinflation dterm m1
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Source	SS	df	MS			
				Number of obs	=	324
				F(5, 318)	=	17.26
Model	13628.1699	5	2725.63398	Prob > F	=	0.0000
Residual	50211.9204	318	157.899121	R-squared	=	0.2135
				Adj R-squared	=	0.2011
Total	63840.0903	323	197.647338	Root MSE	=	12.566

rpmsoft	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
rpsandp	1.323168	.1524728	8.68	0.000	1.023185	1.623151
dprod	-1.521569	1.283074	-1.19	0.237	-4.045955	1.002817
dinflation	.4715841	2.351165	0.20	0.841	-4.15422	5.097388
dterm	4.158737	2.487168	1.67	0.095	-.7346462	9.05212
m1	5.435169	2.869448	1.89	0.059	-.2103327	11.08067
_cons	-.9290695	.7598421	-1.22	0.222	-2.424022	.5658834

2.b

To test the *January effect* which is that on avereage, every else equal, the returns (or excess returns) are larger in the month of January than the rest of the months, we set-up the following hypothesis test:

$$H_0 : \beta_6 = 0 \quad \text{(No January effect)} \quad vs \quad H_a : \beta_6 > 0 \quad \text{(January effect exists and is positive)}$$

where β_6 is the estimated coefficient for the regressor $m1$ which is a 1 for January and 0 otherwise.

From there OLS regression results, we have $t - value = 1.89$. At $\alpha = 1\%$ and degrees of freedom $n - K = 324 - 6 = 298$, the $t - critical_{0.01}(298) = 2.339$. Because $t - value < t - critical$, we fail to reject the null hypothesis. That is, the data does not provide evidence to reject the claim that there is no January effect in the excess returns of Microsoft stock.

2.c

The starting point for use of the $t-test$ statistic is the (conditional) sampling distribution of the $\hat{\beta}_k$ which is derived from the classifical assumptions plus normality. Thus, the assumptions other than normality are:

(A1) Linearity: The regression model has been correctly specified such that $y = X\beta + \epsilon$

(A2) Strict exogeneity: The error term has an expected value of zero given any values of the regressors in all time periods, i.e. $E(\epsilon_i|X) = 0$ for all i.

(A3) Homoskedasticity: The variance of the error term is constant across all levels of the regressors, i.e. $Var(\epsilon_i|X) = \sigma^2$ for all i.

(A4) Disturbances are uncorrelated: The error terms are uncorrelated across observations, i.e. $Cov(\epsilon_i, \epsilon_j|X) = 0$ for all $i \neq j$.

In addition, to derive the distribution of the $t - test$ statistic, we used

$$\frac{\hat{\beta}_k - r}{\sqrt{\sigma^2 (X'X)^{-1}_{kk}}} \underset{\text{under } H_0}{\sim} N(0, 1)$$

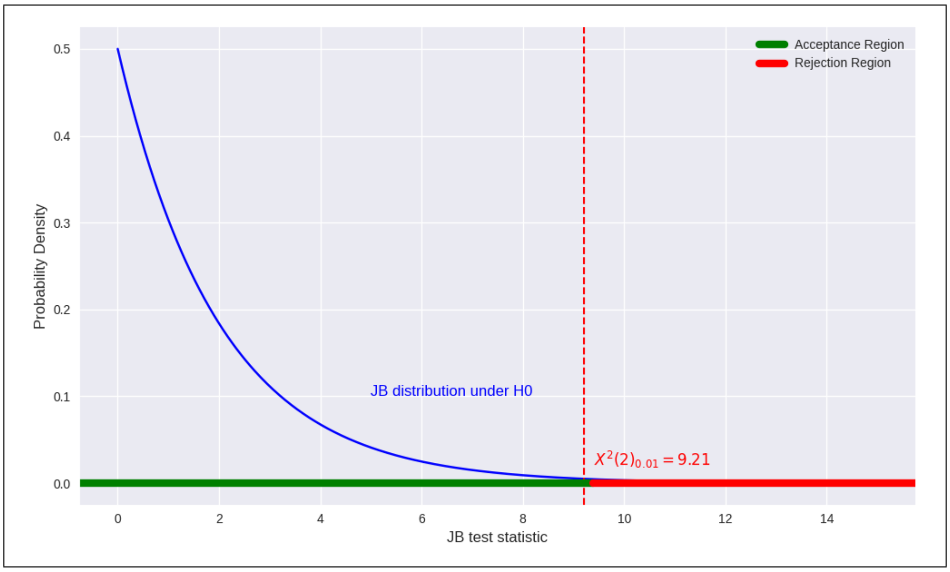
where r is the value of β_k under the null hypothesis. Thus, the distribution of the $t - test$ statistic is derived under the assumption that H_0 is true.

2.d

The $Jarque-Bera$ (JB) test can be used to check for normality of the distrubances. The JB-test statistic is given by:

$$JB = \frac{n}{6}\left(sk^2 + \frac{(kur-3)^2}{4}\right) \underset{\text{under } H_0}{\overset{a}{\sim}} X^2(2)$$

where sk is the sample coefficient of the skwness of the variable, kur is its sample coefficient of kurtosis, and n is the sample size. Using significance of level of $\alpha = 0.01$ and the critical value $X^2_{0.01}(2) = 9.21$. The acceptance and rejection regions are in the illustration below:


Acceptance Region
Rejection Region
Probability Density
JB distribution under H0
$X^2(2)_{0.01} = 9.21$
JB test statistic
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12
14