

109-1 證券市場微結構

SECURITIES MARKETS MICROSTRUCTURE PRACTICE

HW3

Kyle lambda 1985

組員

| | | |
|-----|------------|-----|
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<< 作業三>>

我們隨機挑選了大、中、小型股票總共 180 家來分析，其中公司如以下舉例：

| | code | name | 股本 | firm_size |
|----|-------|-------|-------------|-----------|
| | <int> | <chr> | <dbl> | <chr> |
| 1 | 1101 | 台泥 | 59402402590 | big |
| 2 | 1326 | 台化 | 58611862910 | big |
| 3 | 2838 | 聯邦銀 | 32933688060 | big |
| 4 | 2105 | 正新 | 32414155360 | big |
| 5 | 2608 | 嘉里大榮 | 4670004980 | medium |
| 6 | 3189 | 景碩 | 4508752900 | medium |
| 7 | 5521 | 工信 | 4475274130 | medium |
| 8 | 2538 | 基泰 | 4384487640 | medium |
| 9 | 3027 | 盛達 | 988563110 | small |
| 10 | 1323 | 永裕 | 912745540 | small |

第 1 題 求 β (法人交易強度 beta)

- $X_t = \beta(\theta_t - P_t)$

Step1：先計算 θ (均衡價)，再利用估計出來的均衡價代入 $X_t = \beta(\theta_t - P_t)$

其中， θ (均衡價)估計方式是以「EPS×產業的本益比」做估計。

計算出的各個統計敘述：

| StkNo | S | EPS | A | B | C | PER | NWR |
|-------------------|-------------------|-------------------|-------------------|------------------|-----------------|-------------------|----------------|
| Min. :1101 | Min. :1.000 | Min. :-8.8700 | Min. : 1.10 | Min. : 1.10 | Min. : 1.10 | Min. : 0.00 | Min. : 0.380 |
| 1st Qu.:2102 | 1st Qu.:2.000 | 1st Qu.: 0.2225 | 1st Qu.: 14.96 | 1st Qu.: 14.91 | 1st Qu.: 15.03 | 1st Qu.: 9.57 | 1st Qu.: 0.860 |
| Median :2801 | Median :3.000 | Median : 0.8400 | Median : 19.02 | Median : 19.02 | Median : 19.04 | Median : 13.82 | Median : 1.230 |
| Mean :3425 | Mean :2.511 | Mean : 1.9795 | Mean : 26.91 | Mean : 26.85 | Mean : 27.06 | Mean : 25.54 | Mean : 1.653 |
| 3rd Qu.:4034 | 3rd Qu.:4.000 | 3rd Qu.: 2.1700 | 3rd Qu.: 32.45 | 3rd Qu.: 32.45 | 3rd Qu.: 32.56 | 3rd Qu.: 20.44 | 3rd Qu.: 1.840 |
| Max. :9941 | Max. :4.000 | Max. :80.3000 | Max. :143.34 | Max. :143.34 | Max. :143.34 | Max. :982.00 | Max. :11.490 |
| TOR | RtR | NW | NWM | EPSB | Pr | BVol | |
| Min. : 0.0305 | Min. :-34.2408 | Min. : 1.10 | Min. : 3.078 | Min. :-413.250 | Min. : 2.919 | Min. :4.003e+03 | |
| 1st Qu.: 1.7028 | 1st Qu.: -3.1982 | 1st Qu.: 14.96 | 1st Qu.: 14.567 | 1st Qu.: 3.111 | 1st Qu.: 14.635 | 1st Qu.:2.169e+06 | |
| Median : 3.3462 | Median : -0.3950 | Median : 19.02 | Median : 25.746 | Median : 13.225 | Median : 25.182 | Median :1.648e+07 | |
| Mean : 8.8140 | Mean : 0.5461 | Mean : 26.94 | Mean : 54.237 | Mean : 33.261 | Mean : 51.539 | Mean :1.880e+08 | |
| 3rd Qu.: 8.0596 | 3rd Qu.: 2.1955 | 3rd Qu.: 32.56 | 3rd Qu.: 51.365 | 3rd Qu.: 30.665 | 3rd Qu.: 51.923 | 3rd Qu.:2.468e+08 | |
| Max. :200.2752 | Max. :151.6666 | Max. :143.34 | Max. :1329.319 | Max. :1375.206 | Max. :841.835 | Max. :2.827e+09 | |
| SVol | B_S | es_beta | ami | volatility | beta | betaTOR | NA's |
| Min. :6.104e+03 | Min. : 0 | Min. :0.000e+00 | Min. :0.000e+00 | Min. :0.002802 | Min. :0.0e+00 | Min. : 0.827 | |
| 1st Qu.:1.860e+06 | 1st Qu.: 538595 | 1st Qu.:2.735e+05 | 1st Qu.:1.964e-09 | 1st Qu.:0.014423 | 1st Qu.:0.0e+00 | 1st Qu.: 42.808 | |
| Median :1.711e+07 | Median : 2983723 | Median :1.994e+06 | Median :2.115e-08 | Median :0.025472 | Median :1.0e-06 | Median : 157.343 | |
| Mean :1.899e+08 | Mean : 25448357 | Mean :7.470e+07 | Mean :4.079e-07 | Mean :0.074791 | Mean :4.0e-06 | Mean : 410.042 | |
| 3rd Qu.:2.444e+08 | 3rd Qu.: 21397608 | 3rd Qu.:2.157e+07 | 3rd Qu.:1.917e-07 | 3rd Qu.:0.052893 | 3rd Qu.:3.0e-06 | 3rd Qu.: 377.079 | |
| Max. :3.023e+09 | Max. :623192378 | Max. :6.407e+09 | Max. :1.779e-05 | Max. :2.384353 | Max. :6.9e-05 | Max. :16315.701 | |
| NA's :2 | NA's :2 | NA's :2 | | NA's :31 | NA's :31 | NA's :31 | |

SVol 為法人需求量(為淨買賣)，Pr 為 P_t ，NWM 為 θ_t

Step2：計算求出 β

最後計算出的 β 如下

| beta | betaTOR |
|-----------------|------------------|
| Min. :0.0e+00 | Min. : 0.827 |
| 1st Qu.:0.0e+00 | 1st Qu.: 42.808 |
| Median :1.0e-06 | Median : 157.343 |
| Mean :4.0e-06 | Mean : 410.042 |
| 3rd Qu.:3.0e-06 | 3rd Qu.: 377.079 |
| Max. :6.9e-05 | Max. :16315.701 |
| NA's :31 | NA's :31 |

其中，我們也有用「**周轉率(TOR)/不確定性(Volatility)**」計算出 beta，計算結果如上面。

第 2 題 估計出 **beta** 後，要看其跟流動性及不確定性的相關性
跑簡單迴歸(Y:beta, X:流動性&不確定性)

從第 1 題中的 **beta**，我們用簡單線性迴歸來測試流動性及不確定性與 **beta** 的相關性。

我們各用周轉率(TOR)與 Amihud 來當作流動性，如以下。

Y：被解釋變數 β_i (es_beta)，每個公司一個 beta 橫斷面(我們取 mean)

X：流動性(TOR)以及不確定性(Volatility)

```
Call:
lm(formula = df$es_beta ~ df$TOR + df$volatility)

Residuals:
    Min       1Q   Median       3Q      Max
-89209812 -82974659 -74395991 -45857951 6321569643

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  90392294  16741252   5.399 9.32e-08 ***
df$TOR       -616307    743046  -0.829   0.407
df$volatility -91306191  63519168  -1.437   0.151
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 376100000 on 664 degrees of freedom
(31 observations deleted due to missingness)
Multiple R-squared:  0.004177, Adjusted R-squared:  0.001177
F-statistic: 1.393 on 2 and 664 DF, p-value: 0.2492
```

Y：被解釋變數 β_i (es_beta)，每個公司一個 beta 橫斷面(我們取 mean)

X：流動性(ami)以及不確定性(Volatility)

```
Call:
lm(formula = df$es_beta ~ df$ami + df$volatility)

Residuals:
    Min       1Q   Median       3Q      Max
-86590255 -82322631 -76331691 -43572075 6320162456

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  8.723e+07  1.550e+07   5.629 2.68e-08 ***
df$ami      -1.717e+13  1.675e+13  -1.025   0.306
df$volatility -5.206e+07  7.448e+07  -0.699   0.485
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.76e+08 on 664 degrees of freedom
(31 observations deleted due to missingness)
Multiple R-squared:  0.00472, Adjusted R-squared:  0.001723
F-statistic: 1.575 on 2 and 664 DF, p-value: 0.2079
```

➔ 可以從上面看出雖然 p 值還是大於 0.05，但是比前一次只有 10 筆資料下，這次再有 180 筆股票下值有比上次小一點，也較之前接近 Kyle 模型中的法人交易強度所述的相關性。

```
pred = predict mdl,df)
x_pred <- cbind(df,pred=pred)

x_pred[,c(1,21,23)]
```

預測 beta 結果如以下：

因結果眾多(698 筆)，只截前 40 筆的預測結果來看。

| | StkNo | betaTOR | pred | | StkNo | beta | pred |
|----|-------|--------------|----------|----|-------|--------------|----------|
| 1 | 2330 | 1.208982e+01 | 70016468 | 1 | 2330 | 1.987649e-08 | 76417912 |
| 2 | 2891 | 1.749689e+02 | 87256351 | 2 | 2891 | 3.238165e-08 | 86401389 |
| 3 | 2002 | 1.010515e+02 | 87962784 | 3 | 2002 | 1.799185e-08 | 86401545 |
| 4 | 2883 | 2.638894e+02 | 88101903 | 4 | 2883 | 9.063550e-09 | 86759020 |
| 5 | 2882 | 9.164484e+01 | 86976460 | 5 | 2882 | 2.210582e-08 | 86017890 |
| 6 | 2317 | 1.434170e+02 | 85173361 | 6 | 2317 | 9.622146e-08 | 85669943 |
| 7 | 2886 | 1.230197e+02 | 87542809 | 7 | 2886 | 5.064927e-09 | 86340837 |
| 8 | 5880 | 9.384796e+01 | 88406401 | 8 | 5880 | 4.743986e-08 | 86525926 |
| 9 | 2888 | 8.112338e+02 | 84785401 | 9 | 2888 | 2.247243e-08 | 86732639 |
| 10 | 2880 | 9.191304e+01 | 88096533 | 10 | 2880 | 8.691234e-09 | 86419830 |
| 11 | 2303 | 5.611793e+02 | 85142384 | 11 | 2303 | 7.100097e-09 | 86603309 |
| 12 | 2892 | 1.526375e+02 | 87947270 | 12 | 2892 | 4.399619e-08 | 86533354 |
| 13 | 2884 | 2.116391e+02 | 87419672 | 13 | 2884 | 1.654072e-09 | 86531669 |
| 14 | 2885 | 2.630230e+02 | 86411615 | 14 | 2885 | 1.988754e-08 | 86406803 |
| 15 | 2887 | 2.543141e+02 | 87069324 | 15 | 2887 | 1.372419e-08 | 86529363 |
| 16 | 2881 | 8.387047e+01 | 87051928 | 16 | 2881 | 6.162515e-08 | 85989103 |
| 17 | 2890 | 1.212671e+02 | 87788955 | 17 | 2890 | 4.154105e-09 | 86412605 |
| 18 | 2801 | 7.608622e+01 | 88395770 | 18 | 2801 | 8.415901e-08 | 86456981 |
| 19 | 3481 | 5.014886e+02 | 87020109 | 19 | 3481 | 1.801210e-09 | 86791233 |
| 20 | 2409 | 3.188497e+02 | 86507391 | 20 | 2409 | 4.526803e-09 | 86526208 |
| 21 | 6505 | 3.084915e+00 | 75052676 | 21 | 6505 | 1.999896e-07 | 78096685 |
| 22 | 1303 | 3.360223e+01 | 85700623 | 22 | 1303 | 4.111192e-09 | 85046441 |
| 23 | 2412 | 8.861836e+00 | 68782384 | 23 | 2412 | 1.466215e-08 | 75547315 |
| 24 | 2834 | 3.860960e+02 | 86388774 | 24 | 2834 | 6.519995e-09 | 86595594 |
| 25 | 1301 | 1.422963e+01 | 77952442 | 25 | 1301 | 3.888792e-08 | 80675410 |
| 26 | 1101 | 3.036581e+02 | 85679769 | 26 | 1101 | 5.786640e-08 | 86332072 |
| 27 | 1326 | 8.606642e+00 | 73461457 | 27 | 1326 | 6.856681e-09 | 78085485 |
| 28 | 1216 | 7.219966e+01 | 84105999 | 28 | 1216 | 4.237611e-08 | 84786353 |
| 29 | 2633 | 2.061094e+02 | 87202195 | 29 | 2633 | 7.875888e-08 | 86449539 |
| 30 | 2610 | 4.815347e+02 | 86238009 | 30 | 2610 | 6.427931e-09 | 86671495 |
| 31 | 1402 | 1.627908e+02 | 86699104 | 31 | 1402 | 1.150112e-07 | 86188587 |
| 32 | 2618 | 4.609634e+02 | 85500780 | 32 | 2618 | 5.976273e-08 | 86538241 |
| 33 | 2603 | 5.583740e+02 | 85191775 | 33 | 2603 | 2.676645e-08 | 86602707 |
| 34 | 5876 | 1.744911e+02 | 87457880 | 34 | 5876 | 5.628371e-07 | 86319085 |
| 35 | 2823 | 1.750182e+02 | 87077976 | 35 | 2823 | 3.815990e-08 | 86352739 |
| 36 | 2324 | 2.435335e+02 | 86833186 | 36 | 2324 | 5.200560e-08 | 86449229 |
| 37 | 3711 | 7.790514e+01 | 84938441 | 37 | 3711 | 1.365846e-07 | 85100132 |
| 38 | 2344 | 1.076757e+03 | 82832849 | 38 | 2344 | 2.944487e-09 | 86708153 |
| 39 | 2812 | 1.246272e+02 | 88051881 | 39 | 2812 | 2.126987e-08 | 86500118 |
| 40 | 2382 | 1.036112e+02 | 86368091 | 40 | 2382 | 1.358447e-07 | 85819236 |

以 TOR 估流動性

以 Ami 估流動性

第3題 & 第4題

估計市價(Pt)、lambda i

用 $\hat{P}(i, t)$ 估計 panel regression

Step1：先計算估計出 lambda

```
Rtx <- x_pred %>% group_by(StkNo, S) %>%  
  arrange(S) %>%  
  summarise(sVol=sum(B_S), MeanPr = mean(Pr), beta= pred) %>%  
  mutate(lambda= (MeanPr-lag(MeanPr))/sVol,  
          plambda = 1/beta)  
Rtx %>% summary()
```

$$P = P_0 + \lambda * Q$$

| S | sVol | MeanPr |
|---------------|-------------------|-----------------|
| Min. :1.000 | Min. : 0 | Min. : 2.919 |
| 1st Qu.:2.000 | 1st Qu.: 538595 | 1st Qu.: 14.635 |
| Median :3.000 | Median : 2983723 | Median : 25.182 |
| Mean :2.511 | Mean : 25448357 | Mean : 51.539 |
| 3rd Qu.:4.000 | 3rd Qu.: 21397608 | 3rd Qu.: 51.923 |
| Max. :4.000 | Max. :623192378 | Max. :841.835 |
| | NA's :2 | |

$\lambda = (\text{均價}-\text{前一期的均價}) / \text{量}$

| beta | lambda | plambda |
|-------------------|------------------|-----------|
| Min. :-208252475 | Min. :-0.00056 | Min. :0 |
| 1st Qu.: 80430498 | 1st Qu.: 0.00000 | 1st Qu.:0 |
| Median : 85296939 | Median : 0.00000 | Median :0 |
| Mean : 77910258 | Mean : Inf | Mean :0 |
| 3rd Qu.: 86399866 | 3rd Qu.: 0.00000 | 3rd Qu.:0 |
| Max. : 87083830 | Max. : Inf | Max. :0 |
| NA's :31 | NA's :179 | NA's :31 |

Step2：在求出 Pt(市價)

```
Rta <- df %>% group_by(StkNo, S) %>%  
  arrange(S) %>%  
  summarise(sVol=sum(B_S), MeanPr = mean(Pr)) %>%  
  mutate(lagPr=lag(MeanPr))  
colnames(Rta) <- c("StkNo", "S", "aVol", "aMeanPr", "alagPr")  
Rta <- left_join(Rta, Rtx, by=c("StkNo", "S"))  
Rta <- Rta %>% mutate(PP= alagPr+ plambda*aVol)  
Rta <- left_join(Rta, c_scale[,c(1,4)], by=c("StkNo"="code"))
```

```
result <- Rta %>% group_by(firm_size, S) %>%  
  summarise(MeanPr=mean(MeanPr), lambda=mean(lambda, na.rm=1),  
            plambda=mean(plambda, na.rm=1), PPr=mean(PP, na.rm=1), PPr-MeanPr)  
print(result, n=12)
```

下表中，MeanPr 為均價，PP 為預測價。

```
# A tibble: 12 x 7
# Groups:   firm_size [3]
  firm_size S MeanPr lambda plambda PPr `PPr - MeanPr`
  <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
1 big 1 38.5 NaN 0.0000000117 NaN NaN
2 big 2 39.2 9.56e-8 0.0000000117 39.3 0.0535
3 big 3 39.2 1.22e-7 0.0000000117 40.1 0.933
4 big 4 36.3 -1.25e-7 0.0000000117 39.9 3.61
5 medium 1 46.3 NaN 0.0000000120 NaN NaN
6 medium 2 55.9 1.47e-6 0.0000000122 46.4 -9.51
7 medium 3 52.1 -1.17e-6 0.0000000121 56.0 3.85
8 medium 4 41.0 -3.99e-6 0.0000000120 52.2 11.2
9 small 1 72.4 NaN 0.0000000117 NaN NaN
10 small 2 72.9 Inf 0.0000000108 80.6 7.76
11 small 3 68.2 -2.54e-5 0.0000000145 82.1 14.0
12 small 4 59.8 -3.12e-5 0.0000000187 77.2 17.4
```

→ 我們可以從上表計算出的預測價所看到，大公司所預測出的價格相對來說較為接近，中公司其次，然而小公司預測價格較為失真。

第 5 題 lambda/beta 與公司特色有什麼關係

什麼樣的公司 lambda/beta 比較大或小

beta 較大(法人交易強度較強)，代表法人交易對公司影響較大

lambda 較大，代表量會對下一期價格影響較大

```
# A tibble: 3 x 4
  firm_size MeanPr plambda PredictPr
  <chr> <dbl> <dbl> <dbl>
1 big 38.3 0.0000000117 39.8
2 medium 48.8 0.0000000121 51.5
3 small 68.3 0.0000000139 80.0
```

由下表可知，

| firm_size | meanlambda |
|-----------|--------------|
| <chr> | <dbl> |
| 1 big | 0.0000000117 |
| 2 medium | 0.0000000121 |
| 3 small | 0.0000000139 |

→ 以我們挑選的這 180 支股票來看的話，大公司的 lambda 最小，表示法人對大公司價格影響力較大，流動性較好，不確定性也較低，其次為中公司，然而小公司則為 lambda 值最大，所以流動性較為差，不確定性也較高，可以完全實現出 Kyle lambda 所闡述的價值。

第 6 題 發現如何應用

➔ 在我們挑選的 180 家公司中可實踐出 Kyle 的模型結果，但若依照 Kyle 理論，當 λ 越大，代表股價資訊流動性越小，流動成本增加，而當市場上雜訊越多，可能知情者交易則會越積極。然而在實際交易的話，會選擇跟著法人持股較多的個股，以及選擇大公司股票，跟著有法人買進的股票，因為法人對於大公司個股價格影響較為甚，再來隨時觀察個股流動性狀況，再來適時調整投資組合。