**Z7 Algorithm**

Assume we have the following dataset comprising of, time (t), ROA (r) and CAR (EA):

**Table 1 – Initial dataset**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **t** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **r** | 2 | 13 | 9 | 12 | 10 | 19 | 15 | 17 | 14 | 3 | 8 | 20 | 16 | 4 | 18 | 6 | 5 | 1 | 7 | 11 |
| **EA** | 3 | 17 | 20 | 12 | 8 | 13 | 6 | 15 | 9 | 4 | 2 | 5 | 11 | 16 | 7 | 14 | 18 | 10 | 19 | 1 |

, and for each , a corresponding and with .

**Step 1 + 2**

Fit rolling linear models with window length , and set . Extract coefficients, observed in Table 2.

**Step 3**

Extract the detrended observations from residuals observed at , and define them as “detrends”, see Table 2.

**Table 2 – Rolling linear model coefficients, midpoints and detrends**

|  |  |  |  |
| --- | --- | --- | --- |
| **t** | **(Intercept)** | **beta** | **detrends** |
| **1** | 1.0000000 | 3.5 | 5.0000000 |
| **2** | 12.8333333 | -0.5 | -2.3333333 |
| **3** | 8.3333333 | 0.5 | 1.6666667 |
| **4** | -3.8333333 | 3.5 | -3.6666667 |
| **5** | -0.3333333 | 2.5 | 4.3333333 |
| **6** | 24.0000000 | -1.0 | -2.0000000 |
| **7** | 19.3333333 | -0.5 | 1.6666667 |
| **8** | 74.3333333 | -7.0 | 2.6666667 |
| **9** | 38.3333333 | -3.0 | -5.3333333 |
| **10** | -83.1666667 | 8.5 | -2.3333333 |
| **11** | -33.3333333 | 4.0 | 5.3333333 |
| **12** | 117.3333333 | -8.0 | 2.6666667 |
| **13** | -1.3333333 | 1.0 | -8.6666667 |
| **14** | -5.6666667 | 1.0 | 8.6666667 |
| **15** | 113.6666667 | -6.5 | -3.6666667 |
| **16** | 46.5000000 | -2.5 | 1.0000000 |
| **17** | -13.6666667 | 1.0 | -3.3333333 |
| **18** | -88.6666667 | 5.0 | 0.6666667 |

**Step 4**

Calculate the standard deviation of the detrends above. This gives. Note that is a biased estimator as Bessel’s correction is an insufficient adjustment. When taking the square root in the normal standard deviation equation, the estimated sample standard deviation becomes biased upwards and should be corrected downwards.

**Step 5**

Remove the bias in by assuming detrends are normally distributed, and use Cochran’s theorem so that the square of , where is the length of the detrended observations, 18, the degrees of freedom are = 17, is the biased sd, and being the actual standard deviation, so that:

**Step 6**

Predict ROA\_{T+1} by using the Intercept and beta from , in Table 2. Recall that T = 20, so T+1 = 21.

ROA\_{T+1} = -88.6666667 + 5\*(T+1) = 16.33333.

**Step 7**

Define EA\_{T} = 1, the EA value at observed at

**Step 8**

Calculate Z7 = (-EA\_{T} - ROA\_{T+1}) / = -4.024853