Research Program on Forecasting

Nowcasting German Turning Points Using CUSUM Analysis

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ABSTRACT

Heilemann and Schnorr-Backer (2016) presented a record of real-time announcements relating to the German economy. They assigned binary values to the information of each release. This paper shows that by applying CUSUM procedures to these binary values it is possible to identify the German recessions of 2008-9 and 2012 in pseudo real-time.

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Many studies have shown that forecasters generally do not forecast recessions in advance. (Loungani, 2001; Fildes and Stekler, 2002; Heilemann and Stekler, 2013; Dopke and Fritsche, 2006; Stekler, 2008). In fact there also is evidence that recessions may not even be identified as they are occurring. (Hamilton, 2011). In a recent paper, Heilemann and Schnorr-Backer (2016) confirmed these findings as they relate to the German economy. They indicated that in many instances the recessions were not even recognized in the years in which they occurred.

Even with the all the attention that has been devoted to forecasting turning points, the forecasting record in this regard has not improved. This suggests that we should focus on what should be an easier task, recognizing recessions as they occur. In essence this is a problem of nowcasting, i.e. determining the state of the economy in real time. (Hamilton, 2011). An Appendix in the Heilemann and Schnorr-Backer paper contains a set of official statistics that we will use as real time data in a nowcasting framework. These data can be combined with an existing statistical technique, CUSUM, to determine whether the German economy remains in an upward trend or has entered a recession.

The Appendix in the Heilemann and Schnorr-Backer paper contains a record of all the real time statistical announcements issued by the Federal Statistical Office of Germany relating to the German economy for most of 2008. The authors had assigned values to the information that was contained in each release: the value was 1 (-1) if the announcement indicated that the

variable of interest had shown positive (negative) changes from the previous period. This is as far as Heilemann and Schnorr-Backer had taken their analysis of these announcements.

However, it is possible to use these announcements in a nowcasting framework. This procedure involves a two-step procedure. First, similar to Heilemann and Schnorr-Backer we make a qualitative assessment of the direction of change of the variable, without regard to the magnitude of the quantitative movement. Then the qualitative assessment is converted into a quantitative measure which makes it possible to combine the information from all the variables.[1]

As indicated, the original data in the Appendix were only for 2008. We collected all of the similar statistical announcements for the period, 2009-2014 and assigned values to the individual releases similar to those of Heilemann and Schnorr-Backer. We then used CUSUM procedures to determine if and when the recessions of 2008-9 and 2012-13 could have been identified in pseudo-real time.

The next section presents the data for the German economy. This is followed by a discussion of the statistical procedure, CUSUM, which we use. The results and the implications for forecasting recessions are in the final sections.

I. Data

The data that are used in this pseudo-real time exercise are 15 sets of releases issued by the Federal Statistical Office of Germany, usually on a monthly basis. These are the official statistics measuring the real sector of the German economy. They refer to GDP, employment, manufacturing and retail sales, new orders, etc. The full list of indicators that we examined is

[1] There have been a number of forecasting analyses in which qualitative information is transformed into a quantitative measure and then analyzed. (See Goldfarb et al., (2005); Lundquist and Stekler, (2012); Stekler and Symington (2016).

contained in the Appendix of this paper.[2] Table 1 presents two examples of the announcements that accompanied the publication of the data. The first release is scored as showing a negative effect; the second is considered positive.

We adopt the same scoring system as used by Heilemann and Schnorr-Backer. There is a positive score if the indicator increased from the previous period regardless whether or not the value of the earlier observation was revised. For each variable, the scores are associated with the

Table 1 Examples of Announcements and Scores

Date	Indicator	Press Release	Brief summary	Assessment
May 30, 2008	Retail sales	Press release number 201.	As compared to April 2007, nominal retail revenues increased by 1.5% while real retail revenues decreased by 1.0%, in April 2008. It is important to take into account that April 2008 had three business days more (26) than April 2007 (23). After consideration of seasonal effects, nominal and real revenues decreased by 1.3% and 1.7%, respectively, as compared to March 2008.	-1
Oct. 30, 2008	Wholesale sales	Press release number 405.	As compared to September 2007, nominal and real wholesale revenues in September 2008 increased by 14.7% and 7.5%, respectively. After consideration of seasonal effects, nominal and real revenues increased by 0.9% and 0.5%, respectively, as compared to August 2008.	+1

date on which the information was released and are listed in chronological order. It is then possible to cumulate the scores across all the variables in the same chronological order. The

[2] The releases were obtained from the Statistiches Bundesant.

reason for cumulating the scores is that as an economy expands, the number of series referring to that economy should also be increasing.[3]

Figure 1 presents the cumulated running total of these scores while the dates of the turning points associated with the 2008-9 and 2012-13 business cycles are listed in Table2. The graph shows a clear cyclical pattern with peaks and troughs near the dates of the 2008-9 and 2012-13 cyclical turning points. Our interpretation of this information is that an ex-post analysis would have identified the dates of the turning points close to the dates when they actually occurred.[4] We now ask whether similar results could have been obtained in (pseudo) real time. We use CUSUM procedures for this analysis.

II. CUSUM

CUSUM is a well-established statistical quality control technique.[5] It has been used to detect whether an industrial process has deviated significantly from a given benchmark, i.e. whether a significant change has occurred. It is used after a process has been under control for a period of time and the benchmark criterion has been formulated.

After the benchmark has been established, each subsequent measurement of the process is compared with the benchmark, and deviations from the benchmark are cumulated to form the CUSUM. If the process is under control, the summed measurements should at no time diverge significantly from the benchmark. This implies that the deviations from the benchmark average

[3] In a sense, this procedure is similar to a diffusion index that measures the number of series that are increasing in a given month. One difference is that CUSUM cumulates the changes. Moreover, these data are the numbers that were released on a specific day and adjacent observations don't necessarily refer to the same month. We, thus avoid the "ragged edge" problem when all of the available data do not refer to the same month.

[4] Even recognizing the turning points with a lag would provide information because the first estimate of GDP for a quarter is published 30 or more days after the end of the quarter.

[5] Most statistical packages contain and discuss CUSUM.

out when the process is under control. When the process is out of control, the deviations of the new observations from the benchmark will not average out but rather will cumulate, i.e. the CUSUM will move further and further from the benchmark. When the CUSUM exceeds a threshold value, the observer would then determine that the process was out of control.

III. CUSUM and Nowcasting

It is possible to use CUSUM in a nowcasting task because the task of determining when a turning point occurred is similar to showing that a process is out of control. The trajectory of an economy is analogous to a production process with the exception that the economy is growing or declining. Given a growing economy, the incoming information should contain more positive rather than negative news. When the ratio of positive to negative news is less than expected, CUSUM will begin to decline and approach the benchmark. The turning point will have been identified in real time when the CUSUM is significantly less than the benchmark value.

The benchmark depends on the stage of the cycle. If the economy is growing, CUSUM is expected to increase. We first estimate a regression to obtain a linear growth rate of CUSUM over the previous six months. Equation 1shows the relationship between CUSUM (Y) and time.

$$Y = a + bt \qquad (1)$$

where t, the unit of time, corresponds to one day. We assume that this trend will continue and use equation 1 to estimate the values of CUSUM six and twelve months into the future. These estimates correspond to our benchmark. The threshold is established from the one-sided 95% confidence interval associated with the estimates of CUSUM.[6] If the observed CUSUM is *less*

[6] The confidence interval is calculated from the standard deviation of equation 1.

than this critical value, we would conclude that the economy has entered a recession.[7] Once the recession has been identified, the next task is to identify the trough of the cycle. We, therefore, start the process of calculating a new trend. When the CUSUM *exceeds* the benchmark, the trough has been identified.

IV. Results

A. 2008 Peak

We start our analysis with data beginning in January 2008 because the data releases from the Federal Statistical Office of Germany prior to that date had not been archived and were not readily available. Consequently, we did not have the growth trend from the previous year and used a zero growth line as the benchmark.[8] The standard deviation of the CUSUM for the first three months of 2008 was then used to establish the threshold. We began the pseudo-real time forecasting exercise with the data that became available in April 2008. Figure 2 shows that CUSUM became less than the critical value in the middle of May 2008 and remained below that number throughout the recession.[9] Thus the beginning of the recession which began in the second quarter of 2008 would have been identified simultaneously with its occurrence.

B. 2009 Trough

We now turn our attention to identifying the trough of this cycle. We assume that the recession will last at least six months and compute CUSUM for the six months training period beginning in May 2008. In order to establish the benchmark, the time trend of this variable is

[7] If we are looking for the end of a recession, the opposite rule would apply: CUSUM exceeds the expected value.
[8] If there had been a positive trend, the CUSUM would have breached the threshold earlier.
[9] The CUSUM marginally exceeded the threshold on May 7 and May 14, but an observation on May 15 reversed this result. The data released on May 19 definitively brought it below the threshold.

estimated and extrapolated into the future. The threshold is again based on the standard deviation of the estimated regression and the trough is identified when the CUSUM exceeded the critical value. (See Figure 3). This occurred on July 9, 2009. Officially, the recession had ended in the first quarter of 2009. Thus the identification of the trough was a quarter late. However, this may not be a serious error for the annualized growth rate of 2009Q2 was a mere 0.1%.

C. 2009-end 2011

We repeated this procedure periodically for the period 2009- mid 2011. Every three months this involved estimating the positive sloping baseline CUSUM, extending the baseline for six months and determining whether the real-time releases declined significantly below this baseline. In this period there was not a single signal of an impending recession, i.e. there were no false alarms.

D. 2012-13 Nowcasts

Figures 4A-4C show the CUSUM graphs for periods beginning in January, April, and July 2012, respectively. In each case the training period is based on data for the preceding six months. There was no signal of a recession between the January and April forecasts; similarly for the April-July time period. (Figures 4A and 4B). However, the CUSUM derived in July 2012 shows a definite negative trend by the Fall of 2012. It crosses the threshold in November 2012 and can be considered an excellent nowcast because the peak of that cycle was in 2012Q4. We do not present the graphs for the trough of this cycle but the procedure identified the turn in May 2013 whereas the turn actually occurred in 2013Q1- again a short lag in identifying the bottom of the cycle.

E. Summary

Table 2 summarizes our results. The peaks of the two German business cycles that occurred between 2008 and 2015 were identified in pseudo real-time relatively close to when they actually occurred. The troughs were identified with a one quarter lag. There were no false signals during this period.

V. Conclusions

Given economists' inability to forecast recessions in advance, the next best outcome would be the ability to recognize these cyclical turns as they occurred. This paper has suggested one approach for nowcasting cyclical turns. This method uses the qualitative content associated with each official statistical announcement to assess whether the economy has expanded or contracted in the latest reporting period. In an expanding economy there should be more positive than negative announcements. Thus it is possible to construct a benchmark to determine how the ratio of positive to negative announcements should unfold over time. When there is a significant departure from this benchmark, we would identify a turning point.

In this paper we used CUSUM to develop the benchmark and applied this procedure to the qualitative content of German official statistical announcements. We found that this procedure yielded positive results. It identified the cyclical turns of the 2008-9 and 2012-13 German recessions approximately at the time that they occurred and made no false predictions. Since these significant results were obtained only for two German recessions, it will be important to determine whether they can be duplicated in other economies. If so, we would have found a valuable procedure for now casting cyclical turns.

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Table 2

Dates of Turning Points and Dates of Nowcasts

Turning Point	**Official dates of turning points determined retrospectively**	**Identification of the turning point using the proposed model**
Peak 2008/9 recession	2nd Quarter 2008	Middle May 2008
Trough 2008/9 recession	1st Quarter 2009	July 2009
Peak 2012/13 recession	4th Quarter 2012	November 2012
Trough 2012/13 recession	1st Quarter 2013	May 2013

Figure 1

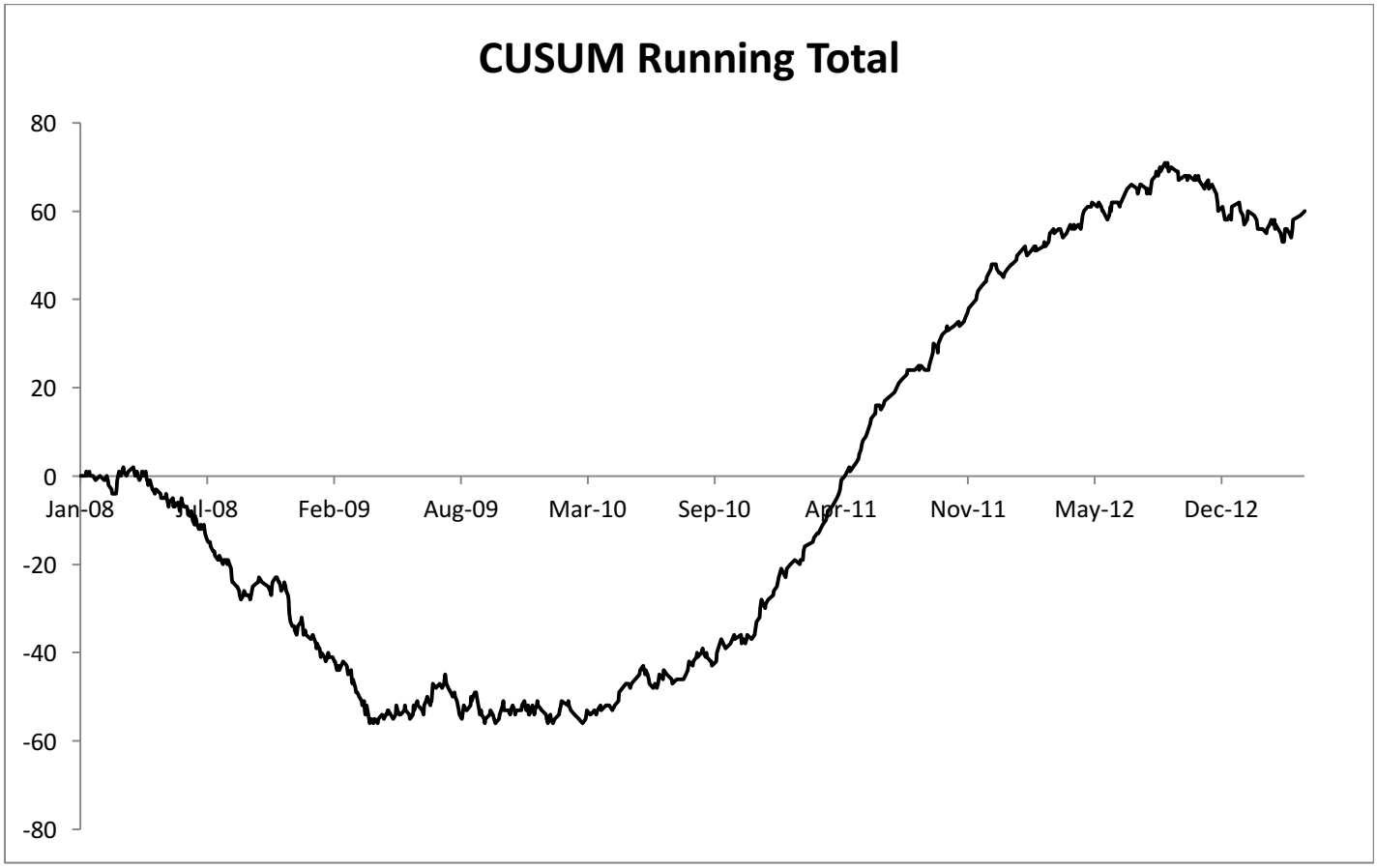

CUSUM Running Total
80
60
40
20
0
-20
-40
-60
-80
Jan-08
Jul-08
Feb-09
Aug-09
Mar-10
Sep-10
Apr-11
Nov-11
May-12
Dec-12

Figure 2

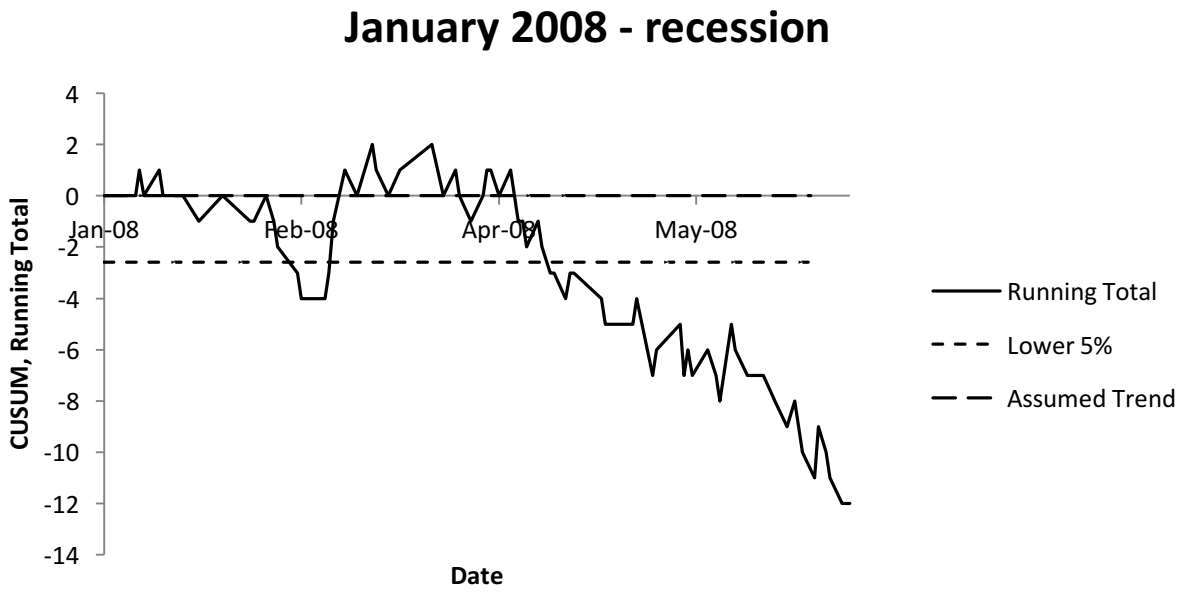


Figure 3

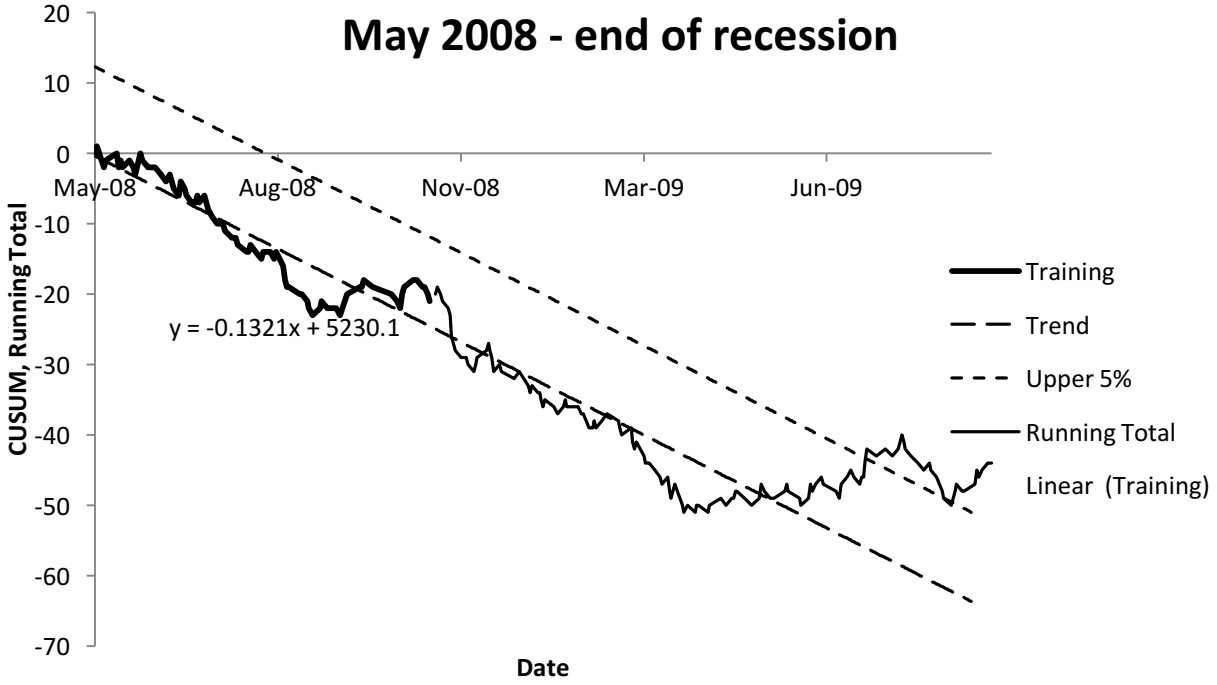
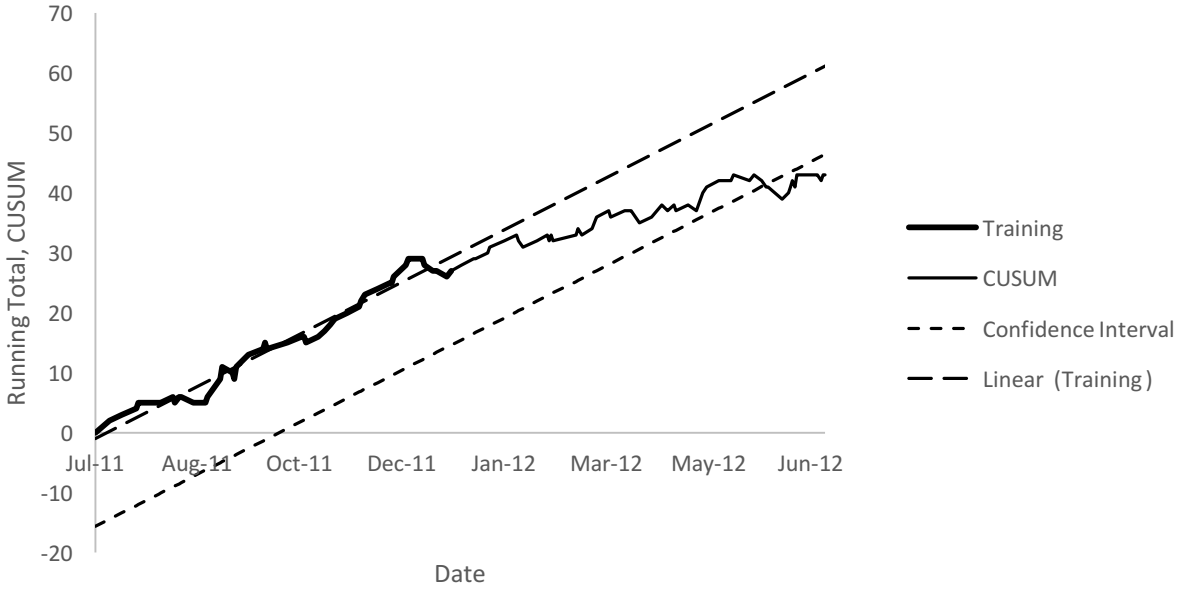


Figure 4A
January 2012 Forecast
July -Dec 2011Training



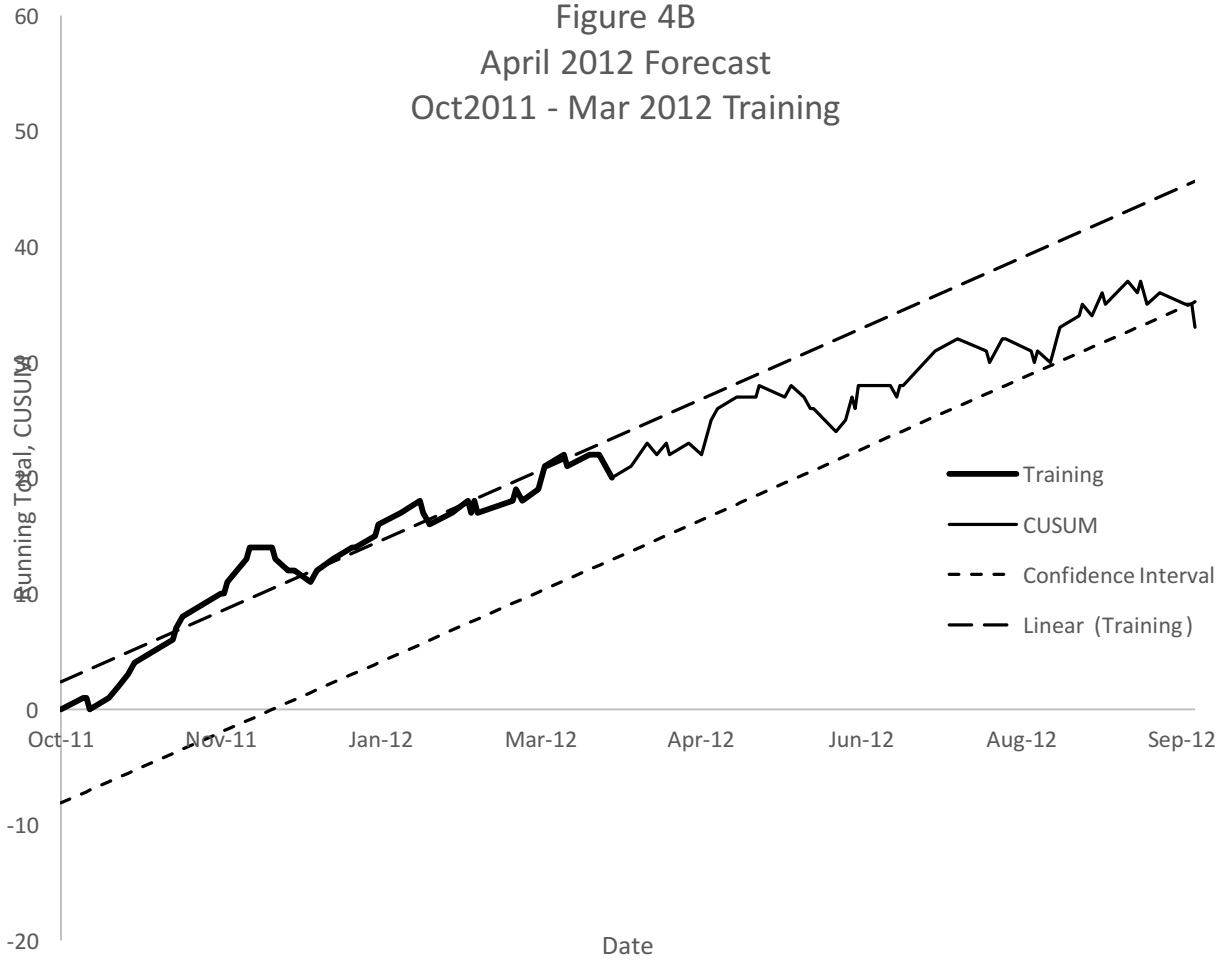
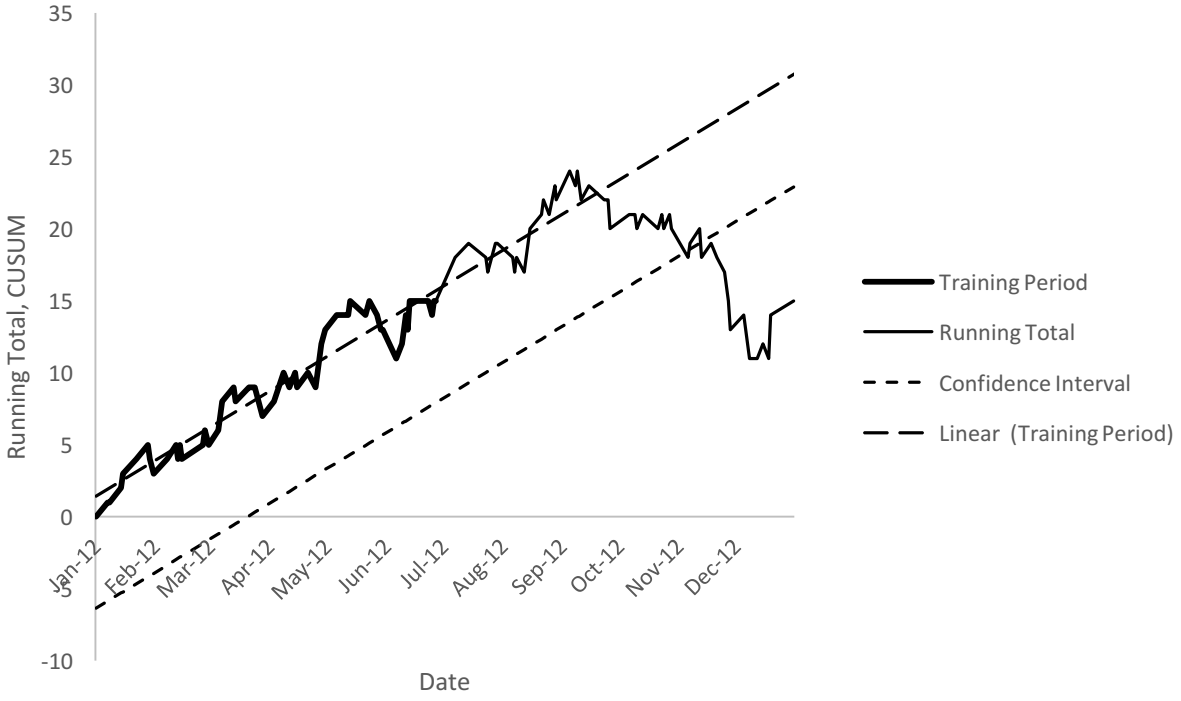


Figure 4B
April 2012 Forecast
Oct2011 - Mar 2012 Training
60
50
40
30
20
10
0
-10
-20
Running Total, CUSUM
Oct-11
Nov-11
Jan-12
Mar-12
Apr-12
Jun-12
Aug-12
Sep-12
Date
Training
CUSUM
Confidence Interval
Linear (Training)

Figure 4C
July 2012 Forecast
Jan- June 2012 Training



APPENDIX: List of Indicators:

1. Manufacturing employment
2. Manufacturing sales
3. Exports and Imports
4. Domestic transport (air, land, and water)
5. Retail sales
6. Employment data
7. Public sector (income, expenses, debt, deficit, surplus)
8. Services sales
9. Construction industry-New orders
10. Real earnings
11. Formation of larger firms
12. Bankruptcies
13. Wholesale sales
14. GDP growth rates
15. Manufacturing new orders