Automatic Modelling and Forecasting with Artificial Neural Networks– A forecasting competition evaluation

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Abstract

During 2007 we conducted an empirical evaluation of the accuracy of artificial Neural Networks (NN) and other methods of Computational Intelligence (CI) in time series prediction through a dedicated forecasting competition: the NN3 (www.neural-forecasting-competition.com). The competition aimed to resolve two research questions: (a) what is the current performance of CI methods in comparison to established statistical forecasting methods, and (b) what are the current "best practices" regarding the methodologies to model CI such as NN for time series forecasting. The NN3 competition evaluated the ex ante accuracy of multiple step ahead predictions across multiple error metrics. The data sample contained two homogeneous sets of 111 or 11 time series of varying length (short and long) and different time series patterns (seasonal and non-seasonal) taken from the original M3-competition, in order to analyse the conditions under which a particular method would perform well and to compare the accuracy to the contenders in the earlier competition. The NN3 competition attracted 60 submissions of CI methods as well as novel statistical contenders, one of the largest forecasting competitions conducted to date. The final results suggest that for monthly time series of different length and seasonality a variety of different CI methods are capable of forecasting automatically using a consistent methodology and show a robust and comparative performance, but that statistical methods still outperform the majority of CI- methods.

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[*] Dr. M Hibon was not funded by SAS/IIF for her participation in this project. She kindly agreed to analyse the forecasting performance of the competing methods and models using the same metrics and standards that she used to evaluate the original of the the M3 competition. The submission of this report as a full research paper to the International Journal of Forecasting will be co-authored by all three authors

1. Introduction

Despite over 15 years of research and more than 2000 publications on artificial Neural Networks (NN) for forecasting across various disciplines (Crone and Graffeille, 2004). Despite optimistic publications indicating the competitive or even superior performance of NN on single time series (Adya and Collopy, 1998, Zhang et al., 1998) or on a small subset of time series (Hill et al., 1996), NN have not yet been established as a valid and reliable forecasting method in empirical forecasting competitions. The results of the M3 competition (Makridakis and Hibon 2000) have indicated comparatively poor performance and the computational challenges in forecasting a large number of empirical time series with NN: following an initial interest by various NN research groups to participate in M3, only one competitor (Balkin and Ord, 2000) successfully submitted NN results to the competition. However, their modelling approach showed only disappointing performance, leading to inferior results in comparison to the majority of the twenty statistical approaches that provided forecasts (Table 15, Makridakis and Hibon, 2000). As a consequence, the performance of NN on batch forecasting of monthly data fell far short of their presumed potential.

Round table discussions with experts across disciplines at various international conferences, including the European Symposium on Artificial Neural Networks (ESANN 2004), the International Conference on Artificial Intelligence (IC-AI 2005), the International Joint Conference on Neural Networks (IJCNN 2005) and the International Symposium on Forecasting (ISF 2004), indicated that this may in part be contributed to the heuristic and largely ad-hoc modelling process to determine the large degrees of freedom, questioning the validity, reliability and robustness of application of NN for a large set of time series. NN modelling seems to consist more of an ad-hoc 'art' of hand tuning individual models than a scientific approach following a valid methodology and modelling process. Consequently, the necessity of manual expert interventions has prohibited large scale automation of NN modelling and their evaluation in forecasting competitions of valid and reliable scope. To reflect this, past forecasting competitions conducted within the NN domain, e.g. the Santa Fe competition (Weigend, 1994), EUNITE competition (Suykens and Vandewalle, 1998) or IJCNN'04 CATS-competition, have focussed on the evaluation on a single time series and from single time origin, ignoring evidence within the forecasting field on how to increase validity and reliability in evaluating forecasting methods (Fildes et al., 1998).

More recently, publications using empirical evaluations have documented a competitive performance of NN on a larger number of time series (Liao and Fildes, 2005, Zhang and Qi, 2005, Crone, 2005), indicating the successful use of increased computational power to model NN on a scale suitable for automatic forecasting. Therefore, a forecasting competition using a representative number of time series within a set time frame seems feasible. In addition, despite research by Remus and O'Connor (2001) little knowledge is disseminated on sound "principles" to assure valid and reliable modelling of NN for forecasting, particularly considering the ever increasing number of NN paradigms, architectures and extensions to existing models. Different research groups and application domains favour certain modelling paradigms, preferring specific data preprocessing techniques (e.g. deseasonalising, outlier correction or not etc.), data sampling, data projection (e.g. scaling and coding of variables), architecture specification (e.g. selection of the activation functions, rules to guide the number of hidden nodes) and the training algorithms to parameterise the methods. However, the motivation for these decisions – derived from objective modelling recommendations, internal best practices or a subjective, heuristic and iterative modelling process - is rarely documented in publications. In addition, original research often focuses on the publication of improvements to existing knowledge or practice, instead of the consolidation of accepted heuristic methodologies.

Therefore we seek to encourage the dissemination of implicit knowledge on NN for forecasting through evidence of current "best practices" methodologies on a representative set of time series. Consequently, we have conducted a forecasting competition to evaluate a set of consistent NN methodologies across a set of empirical time series. We sought to resolve two essential research questions, by inviting current experts in the NN academic community to participate in a forecasting competition: (a) what is the performance of NN in comparison to established forecasting methods, and (b) what are the current "best practice" methodologies utilised by researchers to model NN for time series forecasting?

The rest of the paper is structured as follows: section two discusses the findings of major forecasting competitions, section three the rational for another competition; the following three sections describe the setup and the results of the empirical evaluation and provide a brief discussion of the most important results. The paper ends with conclusions and an outlook for future activity.

2. The Importance of forecasting competitions and previous findings

Forecasting competitions have received substantial attention and initiated stimulating discussions within the academic forecasting community. They have successfully been established to provide evidence on the empirical accuracy of competing forecasting methods, leading to prominent publications and new areas of academic discussion (Fildes and Makridakis 1995, Chatfield 2000, Ord et al. 2000, Ord et al. 2001). Despite various concerns regarding the design of competitions over time, forecasting competitions are commonly accepted as one of the few approaches for an objective evaluation of the empirical accuracy of sophisticated or even theoretically superior forecasting methods. To provide evidence of a methods' empirical performance, the authors can utilise existing benchmark datasets from previous competitions to determine the accuracy under specified conditions, allowing a valid and reliable comparison to existing evidence. This in turn can show the improvement of a method or method family over time, and hence warrant replication of earlier competitions.

One of the most prominent forecasting competitions, the M3-Competition (Makridakis et. al. 2000), compared the accuracy of 26 different approaches on 3,003 univariate time series of historic demand data, the largest dataset ever used in a competition. The time series were selected from various domains of microeconomic, macroeconomic, industrial, financial and demographic activity, and included different time intervals between successive observations (yearly, quarterly and monthly) in order to cover a wide variety of time series structures. The forecasting methods were implemented by forecasting experts from academic institutions (Wharton School, Case Western Reserve, INSEAD, Imperial College) as well as from commercial software companies using their forecasting packages (Forecast Pro, SmartForecasts, ForecastX, Autocast and Autobox).

Results from the M-3 forecasting competition have been reported by Makridakis and Hibon (Makridakis et. al. 2000) and been analysed, replicated and discussed in detail. Across all time series, two methods on average outperformed all other methods: the software expert system Forecast Pro using automatic model selection and parameterisation of Exponential Smoothing and ARIMA models, and the Theta model (Assimakopoulos et. al. 2000), a new univariate forecasting method. Further statistical analysis has revealed statistically significantly better results for a group of four methods, also including Rule Base Forecasting and an equal weighted combination of Exponential smoothing methods (Koning *et al.* 2005). These conclusions drawn from the M3-Competition confirmed results of earlier studies (Makridakis et. al. 1993, Makridakis et. al. 1984) and are summarized below as hypotheses for future evaluations:

H_a: Statistically sophisticated or complex methods do not necessarily provide more accurate forecasts than simpler ones.

H_b: The relative ranking of the performance of the various methods varies according to the accuracy measure being used.

H_c: The accuracy when various methods are being combined outperforms, on average, the individual methods being combined and does very well in comparison to other methods.

H_d: The accuracy of the various methods depends upon the length of the forecasting horizon involved.

3. The Rational for another forecasting competition

In the prominent M3-competition no computationally intensive method was among the top performers, including methods using NN or other CI-approaches. In addition, only a single contestant had used NN, which has been attributed to the high computational costs in building and parameterising these methods. The underperformance of CI-methods in an objective competition stands in contrast to the presumed high accuracy frequently documented in academic publications. Although this in part confirms earlier findings that more sophisticated methods such as ARIMA-Models or Kalman Filters do not necessarily lead to an increase in forecasting accuracy, the discrepancy has since raised concerns regarding the validity of earlier results and the empirical performance of CI-methods in general, questioning their use in real life.

On the other hand, it may be argued, that the poor performance of CI-methods in the M3 competition is not representative of the past and current performance of the whole class of CI-methods, because: (a) only one CI-competitor in the form of a multilayer perceptron took part in M3, thus the results are not representative even for the class of NN, (b) the sample of 3,003 heterogeneous time series was too large and hence prevented the participation of many computationally intensive methods, as the heterogeneity required a flexible methodology for multiple time series structures, while the amount of time series required an automation of these methodologies without any expert user intervention, and (c) no contestant from the CI-, AI-, Informatics or Engineering community with enhanced knowledge of the methods took part in the competition.

The discrepancy between the theoretical and empirical performance and the advanced in modelling NN have provided the rationale to revisit progress in the development of NN in time series prediction through a renewed competition, dedicated to NN and CI-methods. In particular, recent developments in computational power could help to overcome the limitations in NN-modelling present in 1998 and facilitate automatic forecasting of a large number of time series. Also, substantial theoretical progress seems to have been made in forecasting single time series with NN in the past 10 years (Liao and Fildes, 2005, Zhang and Qi, 2005, Crone, 2005), and in developing methodologies for their automated application, that have not yet been evaluated in an objective empirical evaluation. In order to evaluate any potential progress in the development of CI-methods and NN in particular a renewed competition using the original setup and a homogeneous subset of the data seems most suitable.

4. The NN3 competition: experimental setup

Following the rationale provided, we sought to explore the current forecasting performance of NN and CI-methods using the data and experimental setup from the latest and most renowned forecasting competition. As a consequence we proposed the NN3-competition, created from a subset of 111 empirical time series taken from the M3-dataset of monthly industrial data. We are very grateful to the SAS corporation and the International Institution of Forecasters to have provided us with the opportunity to conduct a two year project aiming to re-evaluate the performance of contemporary CI-methods for automatic forecasting of many empirical time series.

The choice of using only a subset of the M3-database was motivated by the trade-off between limiting the number of time series to limit the computational intensity of the competition in order to attract as many contestants as possible, and the need for a sufficient number of time series in order to derive valid and reliable results from a single-origin evaluation for each of the classes of time series patterns, that can be generalised across the conditions under which the methods are evaluated. While ideally a new competition should adhere to existing best-practices on how to conduct empirical evaluations, evaluating the accuracy across a representative and homogeneous subset of time series and also across multiple time origins, this would require substantial resources in conducting the competition. Also, using an identical experimental setup as the original M3-competition will allow a direct comparison to evaluate the improvements in NN-forecasting with those of the past, and also a direct comparison to established statistical methods on a well analysed dataset.

To balance computational requirements and reliability of the results we have prepared two disguised data-subsets of 111 time series (compete dataset, denoted by ‘C’) and 11 time series (reduced dataset, denoted by ‘R’) of the monthly M3-competition data. Assuming that a fully automatic methodology exists to predict the time series with NN, all contenders should be able to equally predict the reduced and the complete dataset. More submissions on the reduced dataset would indicate the need for manual tuning, limitations of automating the relevant methodologies or extremely computational intensive approaches. In comparison to previous NN competitions using a single time series and a single time origin this would allow results of increased validity and reliability. The complete dataset contains a balanced sample of both long time series (more than 100 observations per series) and short time series (less than 50 observations per series), as well as an even split of seasonal and non-seasonal time series. In total the complete dataset is comprised of 100 series, including 25 short-seasonal, 25 long-seasonal, 25 short–non-seasonal, and 25 long non-seasonal time series plus the 11 time series of the reduced dataset. The reduced dataset contained 11 time series, 4 of which were seasonal and the remaining 7 non-seasonal, of which three were characterised as "difficult to forecast" (including outliers, structural breaks).

All previous contenders of the M3-competition, including the NN submission of Automat ANN (Balkin and Ord 2000), may serve as a benchmarks to evaluate progress in model development. The competition was open to all varieties of NN architectures, as well as other computational intelligence methods, such as Support Vector Regression (SVR), Fuzzy Logic, Evolutionary and genetic computation, and alternative non-linear methods and hybrid methods utilising any kind of CI-approach.

Our findings should either confirm established conclusions from the M3-competition H_a to H_d, and hence prove the validity of the previous competitions, or indicate progress in modelling NN for time series prediction and hence provide support for new empirical evidence and stimulate further research. In particular, we seek to explore hypothesis H_a, in that (a) more sophisticated methods such as NN do not show a higher forecasting accuracy, and (b) more complex CI-methods and methodologies should not necessarily provide more accurate forecasts than simpler ones such as the simple multilayer perceptron trained with backpropagation (e.g. of Balkin and Ord). In order to test the validity of hypothesis H_b, and to ensure consistency with the results of the M3-competition, we have utilized all error measures used in the M3 competition including Symmetric MAPE (SMAPE), Median RAE, MASE, Average Rankings as well as non-parametric errors and multiple comparison with the mean (ANOM) (Makridakis and Hibon

2000, Koning et. Al. 2002, Hyndman and Koehler 2006). Of all the metrics the average SMAPE across all forecasted values per time series and across all 11 or 111 time series was used as the criterion to determine the "winner" of the NN3 competition among the pure CI competitors.

All statistical and CI-contenders were given consecutive IDs starting with 'C' for CI-methods eligible to "win" the competition and 'B' for established or novel statistical benchmarks not eligible to win. All contestants were informed of their relative rank prior to disclosing the names of the authors, in order to limit negative publicity of the outcomes and encourage established academic and corporate contenders to participate. In the case of non-disclosure of the name, the submission was identified by its ID and the description of the method was anonymised.

Special sessions were held at various conferences throughout 2007, including the 2007 International Symposium on Forecasting (ISF'07), in New York, USA, the 2007 IEEE International Joint Conference on Neural Networks (IJCNN'07) in Orlando, USA, the 2007 International Conference in Data Mining (DMIN'07) in Las Vegas, USA, and the 2007 IEEE South American Summer School in Computational Intelligence (EVIC'07). Multiple sessions were conducted to limit biases in the participation through timing and location of the conferences.[1]

5. Methods and Models

The NN3 competition attracted 46 contenders using NN or CI-methods to predict the reduced or complete dataset. Due to the structure of the datasets, all 46 contenders provided predictions for the 11 time series of the reduced set, and 22 contenders provided predictions for the 111 time series of the complete set.

To provide a comparison against benchmarks of the CI-domain we computed the results of the only original NN-participant to the M3 competition by Balkin and Ord (Automat ANN, henceforth abbreviated as B0) on both datasets, retrieving the 111 forecasts from the original M3 submission through Michele Hibon. In addition, we computed various standard CI-benchmark methods to provide additional

[1] Unfortunately a possible bias may have arisen from the concentration of sessions in the Americas and the strict visa regulations.

levels of comparison of the entries, including a Naïve Support Vector Regression approach (B1) and a Naïve Mulitlayer Perceptron (B2), both developed by Sven Crone and Nikolaos Kourentzes and Swantje Pietsch, and a NN-extension of the successful Theta-Method named Theata-AI (B8).[2]

Five statistical Benchmarks were computed, such as the Naive 1 method (B4) computed by the organisers. Furthermore, we approached various experts in forecasting methods and software manufacturers to attract the latest versions of statistical benchmark methods that had performed well in the original M3-competition.We are grateful to have received submissions from Eric Stellwagen of Business Forecasting Systems, BFS, applying the latest version of the forecasting expert system Forecast Pro XE (B3, software version 5.0.2.6, submitted June 2007), one of the most established forecasting software packages to date and a strong benchmark as an earlier version of this software outperformed all other methods (together with Theta) on the monthly M3-dataset. Also, we are grateful to Dave Reilly of Autobox (B5), an expert software system for ARIMA-modelling that had also participated in the M3 competition and provided predictions using their latest version (software version 6.0, submitted June 2007). Furthermore, Tucker McElroy submitted benchmark results prepared with the Census X12 method for the reduced dataset (B6), and Nikolopoulos and Bougioukos provided predictions for the Theta model (B7) using an identical setup as in the M3 competition

In addition, we opened to competition to novel statistical benchmarks that had not participated in the original M3-competition in order to allow a comparison not only with the leading statistical contenders of 1998 but also of contemporary approaches and improvements. Five contenders were classified as statistical benchmark approaches, with neither NN nor any other CI- or hybridised components contributing to the method. Due to the actual focus on NN and CI-methods these benchmarks were

[2] This novel hybrid AI approach was developed by Konstantinos Nikolopoulos called Theta AI (B8) that is based upon the original Theta model (Asimakopoulos and Nikolopoulos, 2000), which showed superior performance in the M3-competition. For Theta-AI an NN is used to determine the optimal weights for the Theta-lines following a learning gated expert design. This approach has been withdrawn as an official contender from the final results of the competition as reported by Michele Hibon and was ranked as a benchmark, as it was (a) developed from one of the competition co-organisers, and (b) based on the Theta model that was known a-priori to perform extremely well on the selected data-subset of the monthly M3-time series. It will be proposed in a separate paper.

exempt from ‘winning’ the competition (full descriptions of all methods are available on the competition website, to allow replication of the methodologies and predictions).

Most notably, Marc Wildi proposed a novel method using an adaptive robust multi-step-ahead out-of-sample combination approach (B9), which showed exceptional performance on both datasets. The approach was motivated by the perception that traditional forecasting approaches are subject to severe model misspecifications due to non-stationarity and non-Gaussian time series. In order to overcome these difficulties, Wildi proposed a prototypical design derived from a traditional adaptive state-space approach to track non-stationarities, and to account for non-Gaussian time series, true out-of-sample performance, multiple-step-ahead performance and potential misspecifications.

In addition, Beadle proposed a novel statistical benchmark for forecasting using a composite forecasting strategy of seasonal schemata (B10) that learn a seasonal schema made up of different forecasting methods and use this schema to create a combined forecast. This technique does not use a simple weighted combination (see e.g. Bates & Granger’s, 1969) but a novel technique to combine different forecasting methods. Lewicke proposed a set of equation based models (B11), combining a variety of linear and non-linear trend-lines plus a series of sinusoidal error terms using conventional least squares regression, which has recently been developed for the ParaCaster forecasting software. Hazarika submitted forecasts using a novel algorithm CRANSEQ (Combination of RANdom SEQuences, B12) which decomposes the target time series into a set of random sequences and then combines multiple random sequences using a “temperature dependent” combiner. Each random sequence is regarded as a prediction model, which is combined using optimal weights based upon the previous performance of each forecasting sequence, similar to an adaptive critic approach. Njimi and Mélard suggest a novel expert system TSE-AX (B13) based upon a configurable expert system for automatic ARIMA-modelling, implementing several algorithms of intervention analysis and feedback to the users in multiple phases, in order to make the system applicable in a wide variety of domains and data sets.

6. Empirical Results

In total we have received predictions for 14 benchmark methods (4 CI-benchmarks, 5 statistical benchmarks and 5 new statistical methods) and 46 CI-contenders. We are therefore fortunate to evaluate a pool of 60 candidate methods for the 11 series and 36 for the 111 respectively, resulting in evidence from one of the largest forecasting competitions conducted for NN, CI and in general. The amount of submissions covers the complete range of established statistical methods, conventional CI-methods of feed-forward and recurrent NN, Fuzzy Logic, Genetic Algorithms and Evolutionary Computation and hybrid systems. Therefore we are confident that is competition provides a more comprehensive overview of the performance of CI-methods in predicting monthly time series. The results may contain some bias due to the heterogeneous background of the authors: the majority of submissions came from research students, while more advanced and usually patented NN, CI- or AI-software companies (e.g. Siemens SENN, Alyuda NeuroIntelligence, NeuroDimensions, and SAS Enterprise Miner) have not responded to the competition despite personal invitations.

Intermediate results of the competition have already been presented at two major conferences: to the forecasting community at the 2007 ISF in New York, USA, and to the Neural Network and Engineering community at the 2007 IEEE IJCNN in Orlando, USA. The official results in terms of SMAPE-accuracy and rankings have been published on the NN3 website (www.neural-forecasting-competition.com); results for the complete dataset of 111 time series are provided in table 1, results for the reduced dataset in table 2.

Table 1. NN3 results on SMAPE for the complete dataset of 111 series
(Source: http://www.neural-forecasting-competition.com/NN3/results.htm)

	Participant	SMAPE	Rank SMAPE only CI-methods	Rank SMAPE all methods
B9	Stat. Contender – Wildi	14.84%	-	1
B7	Stat. Benchmark - Theta Method (Nikolopoulos)	14.89%	-	2
C27	Illies, Jäger, Kosuchinas, Rincon, Sakenas, Vaskevcius	15.18%	1	3
B3	Stat. Benchmark - ForecastPro (Stellwagen)	15.44%	-	4
B8	CI Benchmark - Theta AI (Nikolopoulos)	15.66%	-	5
B5	Stat. Benchmark - Autobox (Reilly)	15.95%	-	6
C38	Adeodato, Vasconcelos, Arnaud, Chunha, Monteiro	16.17%	2	7
C03	Flores, Anaya, Ramirez, Morales	16.31%	3	8
C46	Chen, Yao	16.55%	4	9
C13	D'yakonov	16.57%	5	10
C50	Kamel, Atiya, Gayar, El-Shishiny	16.92%	6	11
C24	Abou-Nasr	17.54%	7	12
C31	Theodosiou, Swamy	17.55%	8	13
B2	CI Benchmark - Naive MLP (Crone)	17.84%	-	14
C26	de Vos	18.24%	9	15
C44	Yan	18.58%	10	16
B1	CI Benchmark - Naive SVR (Crone, Pietsch)	18.60%	-	17
C49	C49	18.72%	11	18
C11	Perfilieva, Novak, Pavliska, Dvorak, Stepnicka	18.81%	12	19
C20	Kurogi, Koyama, Tanaka, Sanuki	19.00%	13	20
B10	Stat. Contender - Beadle	19.14%	14	21
B11	Stat. Contender - Lewicke	19.17%	15	22
C36	Sorjamaa, Lendasse	19.60%	16	23
C15	Isa	20.00%	17	24
C28	C28	20.54%	18	25
C37	Duclos-Gosselin	20.85%	19	26
B4	Stat. Benchmark - Naive	22.69%	-	27
C51	Papadaki, Amaxopoulos	22.70%	20	28
B12	Stat. Benchmark - Hazarika	23.72%	21	29
C17	C17	24.09%	22	30
B13	Stat. Contender - Njimi, Mélard	24.90%	23	31
C30	Pucheta, Patino, Kuchen	25.13%	24	32
C57	Corzo, Hong	27.53%	25	33

Table 2. NN3 results on SMAPE for the reduced dataset of 11 series

Participant	SMAPE	Rank on SMAPE Only CI-methods	Rank on SMAPE All methods
CI Benchmark - Theta AI (Nikolopoulos)	13.07%		1
Stat. Benchmark - Autobox (Reily)	13.49%		2
Stat. Benchmark - ForecastPro (Stellwagen)	13.52%		3
Yan	13.68%	1	4
Stat. Benchmark - Theta (Nikolopoulos)	13.70%		5
llies, Jäger, Kosuchinas, Rincon, Sakenas, Vaskevcius	14.26%	2	6
Chen, Yao	14.46%	3	7
Yousefi, Miromeni, Lucas	14.49%	4	8
Ahmed, Atiya, Gayar, El-Shishiny	14.52%	5	9
Flores, Anaya, Ramirez, Morales	15.00%	6	10
Adeodato, Vasconcelos, Arnaud, Chunha, Monteiro	15.10%	7	11
Stat. Contender - Wildi	15.32%		12
Luna, Soares, Ballini	15.35%	8	13
Theodosiou, Swamy	16.19%	9	14
Hwang, Song, Kasabov	16.31%	10	15
Duclos-Gosselin	16.37%	11	16
Kurogi, Koyama, Tanaka, Sanuki	16.49%	12	17
White	16.56%	13	18
Abou-Nasr	16.69%	14	19
Stat. Contender - Beadle	17.14%		20
Sorjamaa, Lendasse	17.16%	15	21
Stat. Contender - Njimi, Mélard	17.19%		22
Rabie	17.24%	16	23
Jimenez, Rebuzzi Vellasco, Tanscheit	17.78%	17	24
Ruta, Gabrys	17.90%	18	25
Isa	18.07%	19	26
CI Benchmark - Naive SVR	18.37%		27
Fillon, Bartoli, Poloni	18.39%	20	28
CI Benchmark - Naive MLP	18.69%		29
Stat. Contender - Lewicke	19.51%		30
Perfilieva, Novak, Pavliska, Dvorak, Stepnicka	19.77%	21	31
Safavieh, Andalib, Andalib	20.04%	22	32
de Vos	20.26%	23	33
C52	20.35%	24	34
D'yakunov	20.45%	25	35
C32	20.63%	26	36
Weng, Liu, Cheng, Hwang	20.69%	27	37
C29	20.76%	28	38
C49	21.05%	29	39
Stat. Benchmark - X12 ARIMA (McElroy)	21.48%		40
C35	24.03%	30	41
C6	24.05%	31	42
C28	24.05%	32	43
Phienthrakul, Kijsirikul	25.69%	33	44
Stat. Benchmark - Naive	25.71%		45
C45	26.04%	34	46
Pucheta, Patino, Kuchen	27.39%	35	47
Papadaki, Amaxopoulos	28.10%	36	48
Stat. Benchmark - Hazarika	28.62%	37	49
C39	29.14%	38	50
C17	30.81%	39	51
C56	32.15%	40	52
C14	33.42%	41	53
Carjabal	34.77%	42	54
Peralta, Gutiereez, Sanchis	36.71%	43	55
Kuremoto, Obayashi, Kobayashi	38.45%	44	56
Corzo, Hong	67.38%	45	57

On the complete dataset the team of Illies, Jäger, Kosuchinas, Rincon, Sakenas and Vaskevcius (C27) provided the best results ranked by SMAPE across all time series and forecasting horizons. The authors implemented a number of standard textbook prediction methods (exponential smoothing, dampened exponential smoothing) as a baseline, compared these with likewise standard methods from computational intelligence (incl. feed-forward NNs, support vector regression, local methods, wavelet-decomposition based predictors) and found no convincing advantages or disadvantages. They finally opted for a set of Echo State Neural Networks, a novel paradigm of randomly connected recurrent neural networks, which they bundled in large voting ensembles trained on blocks of time series. They successfully outperformed ForecastPro and Autobox, as well as the majority of established and novel statistical benchmark methods, but not the highly successful Theta-method of the original M3-competition.

On the reduced dataset, the predictions by Yan (C44) show the lowest SMAPE across all CI-methods, closely followed by the winner on the complete set C27. Yan utilised conventional feed-forward multilayer perceptrons to achieve multiple level model fusion, using an ensemble of generalized regression neural networks for time-series forecasting and direct prediction of each forecasting horizon. His approach represents a fully automated methodology and modelling process that is applicable to a large number of time series, resulting a 10^{th} place on the complete dataset.

A thorough discussion and analysis of the methods and methodologies of all contenders is not feasible within the scope of this document, in particular due to the substantial heterogeneity of the methods and methodologies applied. All approaches are documented and published on the competition website (www.neural-forecasting-comeptition.com) for further enquires. Therefore we have limited our discussion to those CI-contenders that have provided the best performance on the complete and on the reduced dataset. A particular note should be given to the new statistical method developed by Mark Wildi (B9) that has managed to outperform in terms of SMAPE, both the Theta model and Forecast Pro, the respective "winners" of the Monthly-M3 data subsets, indicating potential for further improvement of statistical methods, although the returns may be diminishing for monthly data.

Results from tables 1 and 2 indicate that NN and AI- or CI-approaches can perform competitively with established statistical benchmark methods and software packages in batch forecasting tasks. Especially the contenders C27 and C44 outperformed many established statistical and CI-benchmarks across seasonal and non-seasonal, long and short time series. The majority of CI-approaches outperform the Naive benchmark, but also established statistical approaches such as X12. However, the majority of CI-methods still cannot outperform the leading expert software systems ForecastPro and Autobox, which confirms their role as benchmarks and their wide application in practice. Detailed results on the conditions under which a particular method performs well regarding SMAPE and alternative error measures are contained in the tables in the appendices of this report. We will restrict the discussion to summarise the most important findings. The results are consistent across multiple error metrics of Average SMAPE, MASE (Table 13), Median RAE (Table 18) and Average Ranking (Table 19): contenders B09 and C17 were performing robustly amongst the top methods (with the exception of MASE in Table 13 where B07 equally performed with B09). This was confirmed by the non-parametric statistics: ANOM (multiple comparisons to the mean) B09 was the only significantly better benchmark than any of the other approaches (and C17 the only among the competitors), while MCB shown no significant results

In considering the conditions of different time series formats, the competition revealed that for the most difficult time series (25 short and non-seasonal series), some of the best CI-contenders actually outperform all other approaches including the statistical benchmarks, thus proving evidence of the potential benefit in using CI-approaches in situations of high uncertainty, also providing evidence that time series do not need to be long to consider a NN in forecasting (see Tables 5-12).

The NN3 competition results will be analysed and discussed in detail, and will be submitted for publication as a research article to the International Journal of Forecasting in 2008. The results will also be presented in ISF2008 in Nice with support from this IIF/SAS grant.

7. Conclusions and Future Research

The NN3 competition evaluated the ex ante accuracy of forecasting 18 steps ahead on two representative and homogeneous sets of 111 or 11 time series of varying length and time series patterns, using multiple established error metrics; conditions examined include the presence of seasonality, the length of the series under examination, and the forecasting horizon. The final results from 60 different forecasting methods suggest that methods of NN and CI can perform competitively to established statistical benchmark methods in batch-time-series forecasting tasks, but cannot outperform them significantly. A variety of different CI-approaches have been successful in predicting both datasets, showing an increase in performance to the sole contestant entering the prominent M3-competition some 10 years ago.

We consider this to be encouraging evidence for the potential of NN and CI-methods in time series prediction even for an established domain with limited data and patterns such as monthly time series prediction. However, despite the large attention the competition has raised and the substantial number of submissions from experts in their respective fields, the majority of CI-methods still show an inferior empirical performance in comparison to expert software systems such as Autobox and ForecastPro that contain much simpler and faster forecasting engines. The discrepancy between the theoretical capabilities of CI-methods, their superior performance in academic papers and their lacking empirical evidence still raises concern with regard to the applicability of many of the approaches. However, individual academic contenders have demonstrated a preeminent performance. More research should be directed to towards the development and evaluation of CI-methods in forecasting. For future competitions, it will prove important to engage the large corporations with patented AI forecasting software to participate, assuming that their approaches may provide further increases in accuracy.

However, the NN3 competition has proven a stimulating exercise that has attracted, engaged and unified researchers from both forecasting, informatics, machine learning, data mining and engineering domains, and has shown the value of large scale empirical competitions to various disciplines previously unaware of the standards on empirical evaluations. Furthermore, the NN3 competition has provided a means for an externalisation and dissemination of best-practices and CI-methods beyond previous competitions. Its promising results motivate us to consider future competitions with a valid and reliable competition design to further existing knowledge in modelling neural networks for time series prediction.

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APPENDICES

Appendix A. Expenses

The expenses exceeded the allocated budget of $5000, but the excess was (and is going to be) covered from the home institutions (Lancaster University Management School and Manchester Business School) of the two researchers respectively

These expenses include(d):

- Participation and presentation of preliminary results from Dr S Crone to ISF 2007 and IJCNN 2007
- Participation and presentation of final results and discussion from Dr K Nikolopoulos to ISF 2008
- Creation of a research network with Dr. M. Hibon and submission of the final research to IJF
- Running of a workshop in U.K. in Autumn 2008
- Maintaining a website for 24 months (www.neural-forecasting-competition.com)

Appendix B. ADDITIONAL TABLES & FIGURES

Table 3. AVERAGE SYMMETRIC MAPE   11 series

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	#Series
B00	15.4	19.5	19.0	21.0	12.8	16.6	20.6	20.0	21.5	22.8	26.6	34.3	33.0	25.4	27.6	25.3	25.4	26.0	22.93	11
B01	20.5	18.4	20.1	20.0	7.5	11.6	8.9	13.2	16.4	10.6	15.1	22.9	22.8	13.9	17.2	10.6	13.3	17.7	15.60	11
B02	15.6	15.1	14.8	22.9	19.0	15.9	12.8	11.1	17.3	18.0	17.9	41.1	29.0	12.7	15.9	17.0	18.8	21.5	18.69	11
B03	8.2	11.4	11.8	13.5	12.1	14.7	13.1	9.3	15.6	9.1	15.1	27.0	21.4	9.6	13.3	11.2	10.5	16.4	13.52	11
B04	20.1	35.2	36.7	37.0	22.6	17.8	19.2	20.1	16.3	10.2	19.6	29.7	30.0	32.5	35.3	30.8	26.8	22.7	25.71	11
B05	13.6	12.4	12.3	17.4	10.5	10.3	5.8	11.7	14.4	9.5	17.7	28.8	24.7	8.5	9.7	10.1	9.9	15.3	13.49	11
B06	14.5	18.2	17.2	21.7	18.3	17.5	17.0	14.8	22.8	12.8	21.9	37.9	29.7	22.0	24.3	22.1	25.0	29.0	21.48	11
B07	16.1	10.3	8.3	10.8	13.0	15.4	13.9	10.5	12.6	9.8	13.3	22.7	23.6	12.5	15.2	12.2	10.2	16.3	13.70	11
B09	13.2	13.7	14.8	15.9	10.0	14.7	11.4	12.3	18.3	11.9	18.9	28.8	25.7	13.5	14.8	11.2	9.5	17.0	15.32	11
B10	12.1	10.1	9.0	11.3	15.9	22.7	16.9	23.3	20.4	17.3	12.5	26.4	26.2	12.1	16.4	20.0	13.3	22.6	17.14	11
B11	13.8	10.3	14.3	20.3	15.2	23.5	17.7	18.6	20.1	24.6	24.5	34.8	33.0	21.0	16.9	15.6	9.9	17.0	19.51	11
B12	15.1	27.7	25.5	36.6	27.0	31.9	19.4	19.8	30.2	38.4	42.0	43.1	39.8	23.4	21.7	19.4	25.0	29.1	28.62	11
B13	11.7	13.8	15.8	18.5	13.4	16.9	15.2	17.1	15.9	13.2	20.9	30.4	28.9	12.5	15.6	12.7	15.3	21.6	17.19	11
C03	10.8	10.9	12.6	19.1	13.8	15.3	13.4	11.3	15.2	11.4	16.8	28.5	22.2	11.9	14.9	9.7	12.5	19.7	15.00	11
C08	10.9	11.2	9.2	12.1	15.8	19.9	15.5	13.0	16.9	10.8	14.2	23.5	25.6	10.8	15.8	13.9	13.2	24.4	15.35	11
C09	21.2	11.1	9.6	21.4	9.0	20.5	18.7	14.8	19.4	16.1	26.0	29.9	27.5	15.4	19.3	13.9	12.0	16.3	17.90	11
C10	14.0	29.9	23.5	25.4	19.4	13.5	24.7	20.0	16.1	14.2	14.5	28.6	29.3	14.2	16.6	19.3	29.2	19.9	20.69	11
C11	23.2	11.2	26.2	17.3	30.5	8.2	13.8	20.4	21.9	18.4	26.1	34.4	35.9	10.9	13.4	20.3	8.0	16.0	19.77	11
C13	14.6	16.8	18.8	27.4	19.7	22.8	27.1	18.3	17.8	13.3	12.2	26.4	33.5	13.8	20.0	18.1	24.1	23.4	20.45	11
C14	22.0	30.0	27.8	30.9	30.0	34.9	38.9	31.8	31.7	39.1	34.5	47.2	40.3	25.2	33.3	31.1	35.5	37.2	33.42	11
C15	10.9	14.0	18.0	16.7	9.7	9.4	15.7	19.8	19.4	11.4	15.7	25.4	38.3	18.5	23.5	21.8	23.1	13.8	18.07	11
C16	22.3	15.8	19.4	24.1	15.5	16.8	14.0	17.1	18.7	17.8	20.4	33.4	33.7	13.7	21.0	17.0	21.4	18.5	20.04	11
C17	47.0	30.3	36.9	33.9	17.6	29.5	29.5	25.4	36.5	32.4	36.3	51.7	38.0	24.7	26.2	19.7	11.1	27.7	30.81	11
C18	22.5	11.5	12.2	15.1	8.7	6.8	12.3	15.3	14.5	17.0	23.6	31.7	33.9	10.0	12.2	7.9	8.8	10.8	15.27	11
C19	13.8	18.1	18.4	16.1	14.0	21.0	18.7	15.9	29.0	12.6	22.4	31.5	21.5	20.6	25.3	15.8	12.0	20.4	19.27	11
C20	11.1	7.4	11.8	17.0	18.2	18.4	12.7	14.7	18.2	10.7	19.6	22.1	23.0	22.0	13.6	17.3	16.2	23.0	16.49	11
C21	12.9	18.7	19.0	24.3	20.8	18.5	20.5	18.8	20.1	13.4	21.0	31.8	34.4	25.8	24.4	20.0	25.0	25.4	21.94	11
C24	14.2	28.7	15.2	16.7	10.0	18.5	12.4	11.1	16.0	13.6	15.8	21.1	32.0	21.5	16.0	10.7	9.3	17.6	16.69	11
C26	17.1	18.0	20.3	18.6	8.0	17.6	25.0	20.1	24.3	13.5	22.5	35.1	27.8	27.9	19.9	13.7	12.0	23.3	20.26	11
C27	10.2	11.1	11.4	16.1	12.9	15.5	17.1	10.5	12.7	8.2	12.8	29.2	23.3	11.1	16.0	10.6	10.8	17.1	14.26	11
C28	16.2	27.8	19.3	14.8	7.9	26.3	34.0	29.9	26.0	30.0	26.5	27.2	27.0	33.9	15.5	9.1	14.6	19.5	22.54	11
C29	17.4	21.5	17.0	19.5	14.8	18.6	20.7	22.2	25.3	18.5	22.4	31.3	29.3	24.6	22.8	15.7	10.0	22.1	20.76	11
C30	37.5	17.0	13.9	25.6	24.1	24.3	33.9	37.3	30.7	24.5	30.4	38.2	36.0	23.6	26.8	15.7	25.9	27.4	27.39	11
C31	16.4	15.5	12.9	17.1	9.7	12.0	11.8	15.2	17.0	15.0	18.9	22.9	32.9	18.8	19.2	25.2	12.3	17.4	17.23	11
C32	21.9	23.2	23.7	24.5	7.1	20.7	14.0	17.1	19.0	13.6	17.2	25.7	34.6	23.8	25.1	20.6	16.5	23.1	20.63	11
C35	9.0	24.6	20.2	23.6	23.8	24.9	26.8	16.9	14.6	9.3	19.5	26.1	37.1	42.0	29.8	32.7	18.9	32.9	24.03	11
C36	29.0	13.7	16.2	18.9	12.1	18.1	18.8	17.4	19.3	12.2	16.6	28.4	25.2	12.5	13.6	7.4	9.1	20.6	17.16	11

C37	6.2	14.9	13.0	14.7	13.3	14.8	16.7	18.0	18.9	12.1	19.0	28.3	22.7	15.2	16.9	14.8	14.2	21.0	16.37	11
C38	16.1	11.7	12.8	17.6	10.1	10.9	16.8	18.2	14.2	20.3	20.1	22.7	22.3	11.0	12.1	9.2	10.0	15.5	15.10	11
C39	28.6	23.5	17.7	21.7	22.0	24.0	30.7	29.1	20.4	22.9	15.4	24.9	23.2	25.4	18.0	13.0	16.4	21.6	22.13	11
C40	32.6	16.7	19.0	25.0	22.8	17.7	39.9	28.1	23.8	23.4	23.6	23.1	30.9	18.0	17.4	15.0	11.9	23.7	22.92	11
C41	28.0	30.4	30.4	34.4	40.4	43.6	40.6	36.4	39.0	40.1	43.8	47.9	44.4	31.7	37.1	30.7	31.2	30.4	36.71	11
C42	19.8	12.8	13.2	17.5	11.8	11.3	13.7	12.1	18.5	16.0	16.6	33.1	24.8	15.6	18.7	17.5	17.8	19.4	17.24	11
C43	19.1	30.1	29.4	32.3	27.4	41.5	39.2	43.7	36.8	31.6	34.5	34.3	35.9	53.4	57.7	45.8	46.7	52.6	38.45	11
C44	11.4	15.6	9.5	14.4	12.8	11.3	13.1	11.1	15.6	5.2	14.4	14.2	23.3	20.4	15.6	11.8	9.7	17.0	13.68	11
C45	22.3	30.4	26.7	27.4	19.2	30.4	30.8	22.9	26.0	22.1	20.1	34.9	26.6	31.9	29.5	20.1	19.6	28.0	26.04	11
C46	19.5	14.6	13.5	13.1	8.9	14.8	8.0	9.8	14.9	11.0	13.2	25.3	30.7	10.7	12.9	9.8	12.0	17.5	14.46	11
C47	13.3	13.2	16.5	20.6	9.9	15.9	11.5	14.7	19.7	14.1	17.7	25.9	28.7	22.2	20.2	16.2	14.6	25.2	17.78	11
C49	19.5	31.1	14.6	21.6	19.3	24.8	24.4	14.2	24.5	18.3	17.9	29.6	29.3	26.5	12.7	11.1	15.7	23.8	21.05	11
C50	22.5	16.6	12.5	12.6	7.9	14.7	11.1	9.8	18.1	7.5	15.1	19.0	23.7	14.8	14.0	9.2	13.0	19.3	14.52	11
C51	34.1	29.9	27.8	26.6	11.9	25.2	26.0	26.4	28.1	27.0	31.8	43.3	41.0	26.1	25.2	18.8	12.1	26.4	27.10	11
C52	19.7	28.0	13.4	23.4	22.9	21.8	22.6	10.6	20.6	9.4	15.4	19.5	41.4	32.8	15.8	22.9	7.3	18.8	20.35	11
C53	20.9	13.2	15.0	20.7	14.1	11.9	16.0	11.8	17.2	12.4	15.2	35.1	23.2	11.7	15.4	14.5	13.8	16.2	16.56	11
C54	13.9	19.1	22.6	19.0	15.9	18.1	18.6	17.6	30.4	14.2	18.4	32.1	26.3	20.8	25.6	15.4	13.3	21.1	20.12	11
C55	16.8	35.8	35.9	38.7	32.3	35.1	37.6	35.2	30.4	26.1	33.3	37.2	38.1	35.0	35.9	39.6	39.4	43.6	34.77	11
C56	23.2	39.9	20.7	29.7	23.0	29.3	18.8	31.1	38.3	24.1	25.7	41.3	41.5	40.6	31.3	31.0	44.0	45.2	32.15	11
C57	63.9	74.5	68.1	59.7	62.8	56.1	60.9	69.0	67.7	66.1	67.8	62.5	72.4	77.4	77.7	76.3	68.7	61.5	67.38	11
C58	43.2	33.0	43.9	52.9	40.4	40.9	55.0	44.3	39.3	44.2	40.1	58.5	49.7	43.2	58.8	55.6	51.1	62.9	47.62	11
C59	12.7	9.1	10.6	10.2	12.9	14.4	14.0	17.0	11.9	9.1	16.3	26.7	22.3	12.9	17.0	12.3	10.9	8.8	13.84	11

Table 4. AVERAGE SYMMETRIC MAPE 111 Series

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	# Series
B00	13.5	13	15.2	14.4	13.2	16.3	16.2	17.3	16	14.1	16.2	18	21.1	16.7	20.2	18.8	18.9	23.3	16.81	111
B01	15.2	15.1	17	17.7	15.4	17.5	17.2	17.6	17.5	13.6	16.9	19.3	21.8	19.3	22.3	20	21.8	24.4	18.32	111
B02	13.3	13.1	15.7	18.4	17	17.2	16.1	17.8	17.2	14.3	17.3	20.9	21.6	16.6	20.8	19.8	20.3	23.6	17.84	111
B03	11.5	11.9	13.8	14.7	15.3	15.4	15.6	15.5	13.9	11	14.9	17.2	17.2	14.4	18.2	17	18.7	21.5	15.44	111
B04	19.8	19.5	22.8	25.6	22.2	23	25.9	24.3	21.6	18.3	19.3	20	25.2	20.8	24	25.6	24.5	26.1	22.69	111
B05	12.3	11.8	16.2	15.5	14.1	15.5	15.1	16.7	14.9	13.2	15.8	18	17.9	14	19.2	17.1	18.8	21	15.95	111
B06	13.9	14.2	15.8	17.7	15.3	15.4	17.6	18.3	17.7	15.7	16.7	18.8	20.3	17.6	20	19.1	20.3	25.5	17.78	111
B07	11.6	11.6	13.1	14	14.1	14.7	16	14.6	14.7	11.6	14.1	16.3	17.7	13.7	15.9	16.8	16.6	20.9	14.89	111
B09	11.3	12.3	12.9	14.8	12.3	14.6	14	15.6	14	12.2	14.4	16.8	18	13.8	18	16.5	15.7	19.9	14.84	111
B10	14.7	15.5	16	17.4	15.9	19.8	22.2	20.2	18	16.2	16	22	22.7	20.4	20.4	21.7	20.3	25	19.14	111
B11	16.6	15.6	16.1	16.9	15.1	17.9	18.1	16.9	17.2	18.1	21.3	21.4	22.6	18.8	24.6	20.9	21.2	25.8	19.17	111
B12	20.9	20.4	22.2	24.6	20.7	25.7	22	22.5	25.4	21.6	24.3	22.5	29.5	20.8	22.9	25.5	23.1	32.3	23.72	111
B13	12.8	13.9	16	15.1	15.2	17.8	16.9	17.2	15.4	13.3	14.9	18.3	19.2	18.3	20.3	18.6	20.5	23.1	17.05	111
C03	15.2	12.9	15.7	16.5	14.4	15.9	15.6	17.1	17.2	12.1	14.9	16	19.1	14.5	17.9	18.3	19.2	21	16.31	111
C11	15.7	15	17.6	19	17.8	17	16.7	18.2	18.3	15	18.6	20.5	23	16.3	20.7	21.5	19.5	25	18.62	111
C13	12.9	13.6	14.7	16.9	14.6	14.9	16.8	17.8	16.2	13.5	16.6	16.5	20.8	14.1	19.7	17.9	18.8	22	16.57	111
C15	17.3	18.4	18.9	19	18.5	18.9	21.3	20.6	19.8	15.6	18	19.1	23.8	20.6	22.4	20.6	22.3	24.8	20	111
C17	24.9	21.2	24.8	28.3	24.8	24.6	27.4	24.4	21.9	17.3	23.1	25.4	27.3	20	22.3	24.2	23.3	28.7	24.09	111
C20	15.1	14.6	14.2	15.9	16.4	18.8	19.3	18.4	18.9	16.5	17.8	20.4	22.4	20	22.3	23.6	23.2	23.5	18.97	111
C24	16.6	15.3	17.1	16.8	15.4	18.7	16.5	17.4	18.7	14.5	17.3	17.3	20.5	15.8	18.1	17.9	19.4	22.3	17.54	111
C26	16.3	15.6	16.1	19.2	15.9	17	18	18.2	18.4	15	16.1	20.8	22.1	17.1	20.4	21.1	19.3	21.8	18.24	111
C27	11.1	13.7	14.1	15.8	13.4	15	14.3	15	14.5	12.5	14.5	16.9	17.9	13.4	18	15.5	17.1	20.5	15.18	111
C28	18.4	16.5	18.7	18	14.4	22.3	21.8	20.3	19.4	19.3	19.6	21.4	21.8	20.8	21.7	22.5	22.4	24	20.19	111
C30	18	23.1	18	23.8	22.8	24.3	27.8	27.3	23	23.4	26.3	26.7	30.3	24.5	28.2	25.3	28.8	30.7	25.13	111
C31	14	15.1	14.8	18.1	16.8	17.1	18.1	17.7	15.6	13.9	16.7	17.7	20.8	17	19.8	20	19.9	24.1	17.62	111
C36	17.4	15	15.5	18.1	18.7	19.2	19.5	19.8	18.7	17.2	21.6	19.1	22.8	19.1	23	20	20.6	25.8	19.51	111
C37	16.2	14.4	17.7	20.5	16.7	17.6	22.2	18.4	18	15.7	16.8	18.2	21.4	16.7	19.3	20.1	21.3	24.9	18.68	111
C38	13.8	15.1	15.5	17.5	14.5	17.1	18	19.3	18.3	15.5	16.3	20.1	21.3	18.5	20.9	18.1	18.8	23.2	17.87	111
C44	15.7	16.1	14.1	19.2	16.3	16.6	19.1	16.8	15.9	12.9	19.7	20	20.7	20.5	23.9	21.4	22.3	23.4	18.58	111
C46	14.9	12.5	15.5	16.5	14.6	16.9	15.4	17.7	16.9	13.7	16.1	17.2	20.8	15.5	18	16.8	17.6	21.1	16.55	111
C49	18	15.1	16.3	16.2	15.1	18.4	18.9	19.6	19.3	17.2	18.9	21.1	22.6	18.3	20.5	19.4	18.4	23.7	18.72	111
C50	13.6	12.2	13.8	14.8	12.8	16	15.7	17.5	15.6	15.8	17.7	17.4	21.2	16.8	21.2	19.5	18.7	24.4	16.92	111
C51	23.5	20.3	22.7	23.2	21.9	22.8	23.8	22.7	21.7	18.6	21.2	24.3	27	21.2	22	22.7	21.1	26.1	22.6	111
C57	28.1	28.8	29.1	30.6	28.9	31.2	32	31.1	37	30.1	30.7	31.6	37.8	33.5	37.6	34.8	38.4	36.5	32.66	111
C59	16.2	12.3	15.3	18.1	16.1	17.5	18	19.3	16.4	15.6	19.4	21.6	20.6	19	21.8	20.5	22.7	26.8	18.73	111

Table 5. AVERAGE SYMMETRIC MAPE Short - Seasonal

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	#Series
B01	12.7	14.4	15.5	13.1	15.7	12.8	14.3	18.9	14.3	10.9	17.6	15.4	22.8	19.5	24.8	21.6	24.8	30.5	17.77	25
B02	13.9	11.6	13.7	17.4	15.3	10.9	13.4	16.5	10.8	10.9	16.9	11.4	22	14.5	18.6	17.8	14.2	24.1	15.22	25
B03	12.6	14	13.1	13.6	19.9	14.2	15.7	17.6	9.8	10.9	15.1	16.2	21.8	19	21.3	19.2	23.9	27.8	16.99	25
B04	28.2	26.3	24.3	29.3	22.2	21.8	23.7	22.8	20.5	21.1	23.4	19.9	36.1	25.7	22.4	30.6	25.2	30.2	25.21	25
B05	10.2	12.9	12.6	13.4	15.4	9.7	12.5	16.6	13.2	11.5	12.8	11.2	17.8	14.1	16.7	17.1	16.9	23.4	14.33	25
B06	16.1	17.7	18.4	21.5	18.3	11.4	19.9	15.8	16.5	15.3	14.7	13.5	24	20.3	13.5	22.1	16.9	22	17.67	25
B07	10.6	14.5	12.3	13.5	13.8	11.4	14.5	12.9	12.2	10.5	15.6	10.7	19.1	13.1	12.7	18.1	16.8	24.2	14.25	25
B09	10.4	13.2	11.4	12.6	11.1	9.8	12.2	13.2	8.3	8.1	13.3	8.9	19.7	12.2	15.7	17.9	14	21.5	12.98	25
B10	15.8	23.1	16.7	16.3	14.1	12.6	18.1	22.6	14	15	12	16.2	25.8	31.9	21.4	20.9	15.6	23.8	18.66	25
B11	15	16.7	13	13.5	16.2	13.2	15.3	12.3	12.8	11.8	17.6	12.9	21.3	13.9	18.1	14.7	19	28.8	15.89	25
B12	18.7	17.3	17	22.9	15.2	20.5	16.5	15.1	16.3	13.7	22.4	11.1	26.4	17.6	20.6	26.3	17.5	29.7	19.16	25
B13	11.7	14.2	13.8	12	15.1	10.2	13.6	16.4	11	10.8	11.7	11.8	19.6	15.4	19.6	18.5	18.4	24.7	14.9	25
C03	11.8	15.5	15.3	15.9	17	11.9	12.6	15.8	11.2	8.5	15.8	11.8	20.7	15.1	17	19.6	17.3	23.6	15.34	25
C11	16.9	15.2	13.5	16.8	13.1	8.6	12.6	15.7	13.1	9.2	15.2	13.1	22	14.9	18.7	17.6	18.1	22.3	15.37	25
C13	13.7	15.2	13.3	16.3	13	8	10.4	15.4	11.6	10.7	17.2	8.6	22.5	13	18	18.5	17	24.3	14.81	25
C15	19.5	17.2	18.2	20.8	18.2	16.4	19.2	15.8	15.4	13.7	18.2	15.9	26.7	21.4	20.3	17.6	16.7	29.4	18.92	25
C17	21.3	22	23.4	27.8	27.1	20.2	23.6	22.4	18.6	14.5	19.2	18.3	25.2	20.8	24.9	27.1	28.4	34.7	23.31	25
C20	15.4	18.1	12.7	11.9	17	13	19.9	10.5	13.9	12.1	15.3	12.5	24.1	17.7	17.4	21.3	20.2	23.2	16.45	25
C24	14.2	14.8	16.4	15	16.8	12.3	15.1	16.9	17.5	10.9	15.3	12.2	20	15.6	18.6	21.9	18.8	26.9	16.63	25
C26	17.7	17.8	15.8	16.3	12.7	13.1	12.9	15.1	15.4	13.1	12	12	21.7	12.8	17.8	20.5	16.8	26.4	16.1	25
C27	9.5	14	10.9	11.5	12	10.3	11.1	13.6	12.1	9.3	14.7	8.6	19.8	12.6	16.5	15.7	15.3	23	13.37	25
C28	18.9	14.2	18.5	20.8	17	16.7	15.8	16.7	14.2	17.1	18.6	13.8	20.5	17.6	21.2	25.8	20.2	27.5	18.62	25
C30	12.1	18.5	12.9	16	15.3	18.2	18.6	25.2	19.7	16.7	27.5	18.9	29.1	20.9	25.1	24.9	23.8	30.5	20.76	25
C31	11.9	15.7	12.3	12.2	16.1	14.3	15.6	15.5	12	14.3	16.4	12.4	22.1	17.1	17.3	18.1	19.9	21.9	15.84	25
C36	18.7	14.3	19.1	20.6	22.9	17	17.2	23.4	19.5	17.1	23.6	11.9	23.8	23.1	24.3	26.8	22.5	33.6	21.08	25
C37	18.9	17.2	14.2	23.4	17.5	13.7	23.8	16.5	13.5	19.5	15.7	13.7	27.3	20.9	17.2	22.9	21.3	28.1	19.17	25
C38	13.5	14	12.6	16.5	15	9.8	14.7	13.5	12.6	12.8	15.5	11.8	23	15.3	21.8	23.5	20.4	26.8	16.28	25
C44	15.4	18.3	12.6	21.6	15.4	14.6	15.4	16.5	13.8	14.8	21.8	19.2	25.3	24.7	22.9	21.3	25.3	26.6	19.19	25
C46	12.8	12.7	13	16.5	14.9	10.1	11.3	15	12.8	9.1	13.8	9.2	19.4	16	16.8	19.4	15.8	24	14.58	25
C49	18.4	12.5	11.5	14.2	16	12.8	12.6	15.4	16	11.7	16.5	12.2	20.3	14.3	18.5	19.7	17.2	29.5	16.08	25
C50	12.6	12.8	11	12.5	12.5	8.5	12.7	12.7	8.9	9	14.4	10	24.2	12.2	15.8	20	14.6	22.3	13.7	25
C51	26.8	25.3	25.8	27.8	26.3	20.7	27.4	24	26.8	21.8	21.3	21.6	28.8	25.7	21.8	28.9	21.9	29.9	25.16	25
C57	16.5	21.4	24.9	25.3	21.8	21.3	25.1	22.3	30.5	18.2	18.1	22.1	34.6	25.4	34.7	27.9	42.7	39.4	26.24	25
C59	17	13.5	16.8	17	16	14.3	14.4	20.1	15.4	11.4	17.2	16.4	19.2	20.3	23.9	16.9	20.6	26.6	17.61	25

Table 6. AVERAGE SYMMETRIC MAPE Short - Non Seasonal

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	#Series
B01	22.2	14.6	21.3	26.3	18.6	18.5	19.3	15.4	18.7	14.9	17.8	21.1	21	16.5	24.8	21.4	25.4	22.2	20.01	25
B02	23.3	18.3	24.4	26.9	20.6	21.2	17	20	16.7	15.8	21.5	22.5	20.5	17.1	24.9	20.6	22.9	22.9	20.95	25
B03	22.6	16.2	23.6	24.6	19	19	17	14.6	16	12.8	20.7	21	22.7	15.8	22.1	21.9	21	18.9	19.41	25
B04	26.7	18.7	29.3	27	22.4	21.9	24.8	22	22.2	21.9	22.2	23.6	24.7	19.1	23.9	23.2	23.1	21.9	23.24	25
B05	21.7	14.3	27.8	26.4	18.5	19.4	18.1	15.1	15.7	17.4	18.1	20.4	17.8	14.9	26	22.2	27.2	21.2	20.12	25
B06	24.6	19.2	23.5	25.4	18.3	17.7	18.3	20.2	18.3	19.9	19.5	21.5	23.7	17.5	26.5	18.2	24.3	28.8	21.42	25
B07	20.8	15.3	22.4	22.1	17.1	18.6	15.6	14.8	15.8	16.5	18.6	21.8	21.4	17.4	22.5	18.5	20.8	19.9	18.89	25
B09	19.8	16.2	19.8	23.6	17.2	18.9	13.7	16.3	16.2	18.1	19	24.4	21.3	19.3	24.9	19.8	19.4	22.6	19.48	25
B10	19.6	17.6	21.1	28.2	20	20	23.7	16.1	19.7	17.7	22.1	28.9	23.3	25	23	27.7	29	25.9	22.7	25
B11	27.9	22.1	25.9	25.5	17.3	22	19.9	18	19.1	23.5	25.7	28.4	25.3	20.8	33.8	25.8	25.7	27.9	24.14	25
B12	26.1	19.9	27.4	29.7	17.6	29.1	21.5	26.6	24.3	19.3	23.4	22.1	34.8	15.8	26.7	24.5	29.5	40.8	25.52	25
B13	20.3	14.4	22.8	22	18.1	19.6	17.8	14.1	16.4	15.4	17.9	21.7	20.2	16	19.4	19.8	22.9	19.8	18.8	25
C03	34.9	17.7	26.1	26.1	19.4	23.4	18.2	21	23.5	17.4	19.1	19.2	26.4	15.6	21.8	22.8	26.6	20.7	22.22	25
C11	18.5	22.3	26.3	28.9	20.9	22.5	16.1	17.9	20.2	20.2	25.4	30	31.4	24.7	34	35.1	28.1	34.4	25.39	25
C13	20.3	16.8	22.5	27.6	20.4	17	17.8	15.6	13.4	17.7	23.2	20.9	23.2	16.7	27.1	18.7	23.4	24.6	20.39	25
C15	30.7	29.3	30.5	27.1	28.2	26.4	27.2	23.4	26.8	22.1	22.3	19.7	26.1	23	27.3	26.6	31.8	25.7	26.33	25
C17	30.7	22	30.7	32.5	26.4	20.3	28.3	23.7	19.7	18.6	31	23.1	33.5	19.2	22.5	24.8	25.6	25.4	25.44	25
C20	23.5	20.9	23.1	20.8	16.7	22.6	16.5	18.5	17.9	23.5	21.6	28.1	25	21.7	29.3	30.5	29.9	29.1	23.29	25
C24	28.1	17.8	27.2	26.9	19.4	20.4	14	15.8	17.3	17	20.5	20.7	20.8	17.1	21.8	16.8	26.4	18.6	20.38	25
C26	20.9	18.2	23.3	27.4	18.8	18.6	18.6	18.3	18.2	19.5	20.1	24.2	21.9	20.9	22.8	23.3	23.8	20.6	21.09	25
C27	16.9	17.3	20.5	23.3	13.7	17.2	14.1	14.4	13.9	16.6	18.1	22.7	19.9	15.5	22.7	17	21.7	20.2	18.1	25
C28	26	16.9	26.9	20.6	14.7	22.9	21.1	20.9	20.4	21.8	23.7	26.7	24.3	23.8	31.4	22.4	26.8	24.7	23.11	25
C30	24.6	36.3	30.9	36.4	27.8	28.3	32.2	32.8	24.4	28.2	33.3	31.2	39.2	30.4	38.9	31.7	40.9	40.8	32.67	25
C31	22.1	19.9	25.4	29.1	15.8	20	19	19.2	16.8	16.5	24.3	23.1	24.6	21.8	27.4	24.1	22.7	29	22.27	25
C36	25.9	20.1	20.2	25.6	25	19.4	21.6	19.6	22.7	16.9	24.8	19.9	25	20.6	29.5	22.6	26.7	24.6	22.81	25
C37	30.6	19.1	34.3	32.3	21.6	22.6	27	18.8	23.2	16.3	24.9	20.8	28.4	23.3	26.5	24.5	29.2	26.7	25	25
C38	23.5	19.4	24.9	26.4	18	26.3	22.3	25.3	21.8	21.5	22.7	30	30.2	23.7	29.5	19.1	23	27.8	24.18	25
C44	28.3	22.3	25.9	32	17.5	23.7	28.1	19.5	16.6	19.1	26.4	26.8	23.1	19.9	35.4	29.7	28.2	26.6	24.95	25
C46	22.3	14.6	22.5	23.6	17.8	20.1	15.6	18.4	17.2	15.4	18.7	20.8	18.9	16.9	21.5	18.1	22.9	19.3	19.14	25
C49	23.6	13.7	24.7	23	17.9	21.5	15.6	19.3	16.3	17.8	20.4	26.1	22.7	18.8	23	20.3	22.3	24.7	20.65	25
C50	19.5	14.4	21.4	24.8	14.4	17.5	13.9	19.6	17.1	21	19.3	25.3	23.5	17.9	27.7	18.9	22.6	25.3	20.22	25
C51	24.6	15.4	24.7	22.9	21.5	21.2	18.9	16.8	18.2	13.1	20.9	21.5	24.1	18.6	23	19.7	23.9	21.7	20.58	25
C57	27.6	18.7	19.1	31.5	24.5	27.5	24.5	18.3	32.8	20.1	18	26.4	32.7	25.5	25.7	24.1	31.9	25.5	25.24	25
C59	22.1	14.4	20	27.3	19.4	20.4	23.4	16.7	18.9	19.3	23.8	23.1	25	24.5	24.3	29.1	34.7	29.7	23.12	25

Table 7. AVERAGE SYMMETRIC MAPE Long - Seasonal

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	#Series
B01	9.5	11.9	13.3	12.2	16.1	19.8	17.8	16.1	15.4	11.5	13.7	19.3	20.7	20.3	17.4	17	18.2	20.2	16.14	25
B02	6.4	6.7	9.3	8	12.8	15.8	11.4	12	15.7	10.9	13.1	18.1	20.3	19.3	20.5	18.5	22.2	23.6	14.71	25
B03	6.6	5.7	7.8	6.1	10.5	13.8	11.1	9.4	7.7	5.8	8.6	9.7	9	8.8	9.9	7.9	11.7	19.3	9.41	25
B04	14.3	15.1	16.9	21.7	25	32.8	32.8	31.8	23.5	19.4	15.7	9.6	19.3	16.9	24.8	22.9	27.4	27.8	22.09	25
B05	7.2	8	11	8	12.7	14.6	11.1	12.5	9	9	10.4	11.3	14	12.7	14.8	13.3	14.2	19.5	11.85	25
B06	8.1	5.9	9.2	5.4	9	11.7	9.8	10.2	8.4	7.4	8.9	11	12.5	9.9	12.3	10.6	11.8	19.2	10.08	25
B07	6.2	5.9	8.8	7	11	11.9	12.5	8.8	9.7	6	8.9	10.1	11.5	10.3	9.1	9.1	10.9	16.5	9.68	25
B09	6.2	6.1	8.6	6	8.4	11.4	9.3	10.8	7.8	6.6	8	9.5	12.6	9.1	12.4	9.8	12.3	15.3	9.46	25
B10	11	9.9	14.4	10.2	13.4	20.8	27.3	15.4	12.4	9.9	14.7	14.1	19.2	14.6	18.9	16.3	14.6	26.6	15.75	25
B11	13.8	10.1	13.5	11.5	14.1	17	15.2	15.5	15.9	12.3	15.6	16.8	19.6	15.6	23.8	21.5	22.2	25.5	16.64	25
B12	24.4	18.7	24.3	21.2	27.6	24.7	29.6	22.9	29.3	21.3	25.3	22	28.5	24.4	25.3	28.9	24.2	32.2	25.25	25
B13	11.2	13.3	14.6	9.4	13.9	19	15.7	15.9	10.9	9	9	12.6	13.5	22.8	21.2	18	19.8	23.3	15.18	25
C03	8.4	7.7	10.7	8.1	8	11.9	11.6	11.3	10.4	8.7	8.3	9.9	14.4	10.7	11.4	12.4	12.7	14.8	10.63	25
C11	8.8	7.1	11.3	8.9	10.9	15.3	13.2	10.9	10.3	8.2	8.8	10	13.8	11.8	13.4	10.9	12.8	15.3	11.2	25
C13	8.2	8.2	8.9	6.7	7.6	12.9	13.9	15.2	11.9	7.5	9.1	10.9	13.8	12.5	14.3	12.6	14	16	11.34	25
C15	10.6	13	11.7	10.4	15.3	18.7	13	13.3	11.7	13.8	14.5	16.9	17.7	20.7	16.2	14.3	16.7	23.8	15.12	25
C17	24	20.3	23.1	27.4	28.4	33.3	32.4	24.5	16.7	11.8	18.7	22.7	26.9	20.2	20.5	24	24.3	29.3	23.8	25
C20	11.6	7.3	8.9	9.7	11.7	17.8	18.8	17.9	14.9	14.3	13.9	17	19.5	18.7	24.8	21.6	21.9	22.8	16.28	25
C24	12	10.1	12	11	15.2	18.7	16	13.3	14.6	11.9	14.3	15.2	19	13.6	11.2	15.9	16.9	21	14.55	25
C26	12.9	9.9	11.8	14.9	17	17.3	14.9	16.2	14	13.5	13.8	19.8	23.8	14.6	20.5	21.4	19.6	15.9	16.21	25
C27	8.3	6.9	12.5	9.3	12.1	13.2	8.2	9.4	10.3	7.2	9.4	10.5	12.4	10.8	12.1	12.2	14	18.7	10.97	25
C28	12.5	14.9	14.3	11.8	12.2	22.4	18.6	15.8	14.2	15.5	13.5	17.8	18.1	17.4	16.2	22.7	21.4	22.2	16.75	25
C30	12.1	17	12.6	22	23.1	26.6	25.3	11.7	17.4	22.1	19.7	21.7	26.3	27.4	30.3	21.2	24.3	19.6	21.13	25
C31	10.4	7.1	10.9	10	16.3	17.1	12.8	8.8	8.9	6.4	8.5	12.2	14.7	10.9	10.8	12.9	15	22.4	12	25
C36	10.3	10.8	11	9	13.4	18.3	17	10.7	11	11.1	15.1	16	17.6	16.2	15.3	15.4	18.9	21.3	14.35	25
C37	10.3	8	10.7	12.1	13	16	15.4	13.5	13	11.6	11	11.5	11.9	9.8	14.4	14.1	15.7	21.5	12.98	25
C38	8.3	11.6	9.7	7.8	11	14.2	12.8	14.7	15.8	8.4	11.3	15	13.1	20.9	15.8	12.5	14.1	16.2	12.95	25
C44	9.4	7.4	9.3	7.2	11.5	10.9	11.1	10.9	8.4	7	11.5	13.5	18.9	13.7	11.4	13.1	15.6	18.8	11.65	25
C46	9.7	7.5	10.8	8.9	11.9	15.2	14.4	13.4	11.9	10.3	11.6	13.6	19.6	12.6	12.3	12.6	13.5	18.3	12.67	25
C49	15.2	13.7	17.4	13.2	13.3	14.3	22.5	21.2	19.8	18.5	15.1	19.1	22.8	16.8	21.6	18.9	15.8	14.7	17.44	25
C50	8.5	9.1	10.3	8.3	14.4	15.6	16	13	11.2	10.2	13.3	12.4	16	15.1	13.9	14	15.7	21	13.22	25
C51	18.8	17.7	18.4	23.7	26	25.9	23.6	23.4	15.3	13.7	18.4	21.9	26.3	18.6	20.5	23.6	25.5	25	21.46	25
C57	12.7	16.7	16.7	14.5	17.8	19.2	18.4	20.3	25	17.3	19.9	18.3	21.1	15	19.2	18.8	16.4	19.4	18.14	25
C59	9.7	10	10.4	14	15.1	16.6	11.2	13.7	12.5	11	15.3	18.6	17.9	15.4	13.4	15.3	15.8	20	14.22	25

Table 8. AVERAGE SYMMETRIC MAPE   Long - Non-Seasonal

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	#Series
B01	14.1	17.9	16.6	18.2	14.5	21.4	21.2	21.9	22.1	18.6	19.4	19.8	22.2	23.4	24.7	24	22.5	27.7	20.58	25
B02	8.5	15	16	19.2	18.3	21.3	24.1	25.5	25.6	18.1	17.5	22.5	20.5	17.2	21.4	23.6	22.6	24.9	20.1	25
B03	5.8	11.9	11.7	15.3	13.3	15.1	19.6	23.2	21.2	15.6	14.9	17.5	13.7	16.2	21.8	21.5	21.9	22.2	16.8	25
B04	9.7	11	14.6	19.3	19.3	17.9	25.2	22.4	22.5	14.4	15.9	22.8	18.7	16.5	19.9	23.2	21.2	25.9	18.9	25
B05	9.7	11.8	15.2	13.3	11.5	20.8	22.6	24.9	21.9	16.6	21.1	24.2	19	16.5	23.6	18.7	20.8	22.3	18.58	25
B06	6.6	12.1	11.7	16.7	14.3	19.8	22.8	28.8	25.3	21.5	21.4	20.6	16.6	20.8	25.8	24.2	26.2	30.5	20.32	25
B07	6.6	11.1	11.1	14.8	15.2	16.6	22.4	23.6	21.9	14.2	13.5	19.7	16.5	14.6	19.5	23.4	20.8	24.9	17.24	25
B09	7.8	12.9	11.1	16.3	13.6	18.5	21.7	23.6	21.8	16.3	15.2	19.2	15.2	14.9	20.4	20.7	19.8	21.3	17.24	25
B10	13.7	13.8	15	17.6	15.9	24.5	21.9	25.4	25	22	16.7	26.9	21.2	13.9	20.1	22.6	25	24.8	20.34	25
B11	11.1	15.9	13	15.5	12.5	17	22.1	20.9	19.9	22	24.8	21.5	19.5	24.1	26.2	23.8	22.6	24.9	19.85	25
B12	17.1	22.5	18.7	19.4	19.5	26	21.8	26.8	29.6	24.9	18.2	25.8	23.8	24.3	19.4	24.9	20.1	27.9	22.81	25
B13	8.4	13.6	13.2	15.3	14.6	22.7	21.4	22.4	23	18.1	18.4	22.1	19.1	21.4	23.1	20.6	23.1	25.5	19.23	25
C03	7.4	11.9	12.1	14.8	13.5	16.6	20.9	22.7	24.7	14.1	15.6	17.6	13.5	17.7	22.8	22.2	23.2	25.5	17.61	25
C11	15.3	17.1	15.4	22	20.7	25.7	26.1	27.2	28	20.8	21.7	22.7	19.1	16.1	19.9	22.9	24.2	31.8	22.04	25
C13	8.7	12.9	12.4	12.5	14.9	18.2	20.5	24.8	27.2	18.3	19.1	21.3	18	14.4	19.1	22	18.4	22.3	18.05	25
C15	11.4	15.8	15.7	18.8	16.3	18.5	28.4	30.3	25.5	14.8	18	21.2	18.6	18.3	25.5	23.2	23.4	25.2	20.49	25
C17	13.8	16.3	16.7	22.8	20.5	22.3	24.2	26.6	26.1	17.8	17.4	25.9	19	17.9	19.4	22.8	20.3	25.8	20.87	25
C20	11.8	15.3	13.2	20.7	19.4	21.9	25.1	28.3	29.3	18.7	19.6	23.3	20.7	21.3	21.8	23.8	23.8	19.3	20.95	25
C24	13.3	12.5	13.7	14.4	12.8	23.4	22.7	26.4	26.4	18.5	19.6	19.7	17.2	14.5	21.5	20.3	19.9	25	18.99	25
C26	13.4	15.6	11.5	18.6	18.6	18.9	22.5	22.4	23.3	14.6	15.6	20.9	18.7	15.3	20.7	22.2	20.1	23.5	18.69	25
C27	10.2	17.5	13.8	18.9	16.2	19	22.7	24.5	22.6	18.9	16.6	20.2	17.3	15.4	21.6	19.2	20.2	21.6	18.71	25
C28	17.1	15	15	20.4	16.8	25.1	26.3	23.6	25.9	18.3	19.7	24.8	22.2	18.7	20.5	24.7	24.5	23.5	21.23	25
C30	14.6	23.2	17.6	19.9	24.2	24.2	32.4	35.2	27.2	25.9	22.9	29.9	23.9	19.8	19.2	27.7	27.6	33.4	24.94	25
C31	10.4	17.4	11.6	21.6	22.2	19	27.8	28.3	24.3	18.2	16.4	20.6	16.4	17.5	23.9	22.6	25.3	26.1	20.54	25
C36	9.5	15.5	11.5	17	16.4	22.4	22.4	26.6	21.4	25.8	25.2	24.6	23.8	19.4	27	20.8	19.5	25.9	20.83	25
C37	9.4	13.3	13.7	16.8	16.4	19.3	25.1	25.1	22.1	17	14.5	22.6	17.3	13.3	20	21.4	22.1	24.9	18.57	25
C38	8.7	16.9	16	19.1	15.8	21	22.7	23.9	24.7	17.2	13.9	22.3	18.6	17.5	20.3	21.3	21.4	25.6	19.28	25
C44	11.8	16.9	10.4	18	22.1	19.4	24.4	22.6	24.8	14.2	21.4	23	14.5	23.7	29.4	25.7	25.5	24.6	20.69	25
C46	12.9	14.4	16.5	18.6	16.3	23.2	23.7	27.5	26.8	21.4	21.5	21.8	20.8	18.7	23.6	20.1	20.7	24.4	20.71	25
C49	13.9	13.2	12.4	12.1	11.2	22.3	22.5	24.9	22.6	20.5	24	23.3	21.5	19.6	22.4	22.5	19.7	25.9	19.69	25
C50	10.1	10.5	13.1	14.4	12.2	22.8	22.3	28.1	23.9	26.9	25	21.1	19.8	22.9	30.7	29.5	24.3	31.3	21.6	25
C51	19.3	18.5	19.9	16.9	18.3	22.2	24.3	25	23.7	22.2	19.5	24	22.5	19.7	21.4	20.2	17.1	27.4	21.22	25
C57	40	38.1	38.4	38.1	36.4	45.9	47.4	47.1	46.3	49	50.6	46.1	47.7	48.8	53.2	50.5	49.4	50.6	45.76	25
C59	17.5	12.5	15.8	17.7	15.3	20.2	24.8	27.8	20.8	23.7	22.7	26	19.7	18.5	27.6	24.2	24.7	38.9	22.14	25

Table 9. AVERAGE SYMMETRIC MAPE
Short

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	#Series
B01	17.5	14.5	18.4	19.7	17.2	15.7	16.8	17.1	16.5	12.9	17.7	18.3	21.9	18	24.8	21.5	25.1	26.4	18.89	50
B02	18.6	14.9	19	22.1	17.9	16.1	15.2	18.2	13.7	13.4	19.2	17	21.2	15.8	21.8	19.2	18.6	23.5	18.08	50
B03	17.6	15.1	18.4	19.1	19.4	16.6	16.4	16.1	12.9	11.8	17.9	18.6	22.3	17.4	21.7	20.6	22.4	23.3	18.2	50
B04	27.4	22.5	26.8	28.2	22.3	21.9	24.3	22.4	21.4	21.5	22.8	21.7	30.4	22.4	23.2	26.9	24.1	26.1	24.23	50
B05	16	13.6	20.2	19.9	16.9	14.5	15.3	15.9	14.5	14.4	15.5	15.8	17.8	14.5	21.3	19.6	22	22.3	17.23	50
B06	20.3	18.5	21	23.5	18.3	14.6	19.1	18	17.4	17.6	17.1	17.5	23.9	18.9	20	20.2	20.6	25.4	19.55	50
B07	15.7	14.9	17.3	17.8	15.4	15	15	13.8	14	13.5	17.1	16.2	20.2	15.3	17.6	18.3	18.8	22	16.57	50
B09	15.1	14.7	15.6	18.1	14.2	14.3	13	14.7	12.3	13.1	16.2	16.7	20.5	15.7	20.3	18.9	16.7	22	16.23	50
B10	17.7	20.4	18.9	22.2	17	16.3	20.9	19.4	16.8	16.3	17.1	22.6	24.5	28.4	22.2	24.3	22.3	24.8	20.68	50
B11	21.4	19.4	19.5	19.5	16.8	17.6	17.6	15.1	15.9	17.7	21.6	20.7	23.3	17.3	25.9	20.3	22.4	28.4	20.02	50
B12	22.4	18.6	22.2	26.3	16.4	24.8	19	20.8	20.3	16.5	22.9	16.6	30.6	16.7	23.7	25.4	23.5	35.3	22.34	50
B13	16	14.3	18.3	17	16.6	14.9	15.7	15.2	13.7	13.1	14.8	16.7	19.9	15.7	19.5	19.1	20.6	22.2	16.85	50
C03	23.4	16.6	20.7	21	18.2	17.6	15.4	18.4	17.4	12.9	17.4	15.5	23.5	15.3	19.4	21.2	22	22.1	18.78	50
C11	17.7	18.8	19.9	22.9	17	15.5	14.4	16.8	16.7	14.7	20.3	21.5	26.7	19.8	26.3	26.4	23.1	28.4	20.38	50
C13	17	16	17.9	21.9	16.7	12.5	14.1	15.5	12.5	14.2	20.2	14.7	22.8	14.8	22.6	18.6	20.2	24.5	17.6	50
C15	25.1	23.3	24.4	23.9	23.2	21.4	23.2	19.6	21.1	17.9	20.2	17.8	26.4	22.2	23.8	22.1	24.3	27.6	22.63	50
C17	26	22	27.1	30.2	26.7	20.2	26	23.1	19.1	16.5	25.1	20.7	29.3	20	23.7	25.9	27	30	24.37	50
C20	19.5	19.5	17.9	16.3	16.8	17.8	18.2	14.5	15.9	17.8	18.5	20.3	24.5	19.7	23.4	25.9	25.1	26.1	19.87	50
C24	21.2	16.3	21.8	20.9	18.1	16.4	14.6	16.4	17.4	14	17.9	16.5	20.4	16.4	20.2	19.4	22.6	22.8	18.51	50
C26	19.3	18	19.5	21.8	15.8	15.9	15.8	16.7	16.8	16.3	16	18.1	21.8	16.9	20.3	21.9	20.3	23.5	18.59	50
C27	13.2	15.6	15.7	17.4	12.9	13.8	12.6	14	13	13	16.4	15.7	19.9	14.1	19.6	16.4	18.5	21.6	15.73	50
C28	22.4	15.5	22.7	20.7	15.8	19.8	18.5	18.8	17.3	19.4	21.1	20.3	22.4	20.7	26.3	24.1	23.5	26.1	20.87	50
C30	18.3	27.4	21.9	26.2	21.5	23.2	25.4	29	22	22.4	30.4	25.1	34.2	25.6	32	28.3	32.3	35.6	26.72	50
C31	17	17.8	18.9	20.6	16	17.2	17.3	17.4	14.4	15.4	20.4	17.8	23.3	19.4	22.3	21.1	21.3	25.4	19.05	50
C36	22.3	17.2	19.7	23.1	24	18.2	19.4	21.5	21.1	17	24.2	15.9	24.4	21.8	26.9	24.7	24.6	29.1	21.95	50
C37	24.8	18.1	24.2	27.8	19.5	18.2	25.4	17.7	18.3	17.9	20.3	17.2	27.9	22.1	21.9	23.7	25.2	27.4	22.09	50
C38	18.5	16.7	18.7	21.5	16.5	18.1	18.5	19.4	17.2	17.2	19.1	20.9	26.6	19.5	25.6	21.3	21.7	27.3	20.23	50
C44	21.8	20.3	19.3	26.8	16.5	19.2	21.8	18	15.2	16.9	24.1	23	24.2	22.3	29.1	25.5	26.7	26.6	22.07	50
C46	17.6	13.6	17.8	20	16.3	15.1	13.5	16.7	15	12.2	16.2	15	19.1	16.4	19.2	18.7	19.3	21.6	16.86	50
C49	21	13.1	18.1	18.6	16.9	17.1	14.1	17.4	16.2	14.7	18.5	19.1	21.5	16.5	20.7	20	19.7	27.1	18.36	50
C50	16	13.6	16.2	18.7	13.4	13	13.3	16.2	13	15	16.8	17.6	23.9	15.1	21.8	19.5	18.6	23.8	16.96	50
C51	25.7	20.4	25.2	25.4	23.9	21	23.2	20.4	22.5	17.5	21.1	21.5	26.5	22.2	22.4	24.3	22.9	25.8	22.87	50
C57	22.1	20.1	22	28.4	23.2	24.4	24.8	20.3	31.6	19.2	18	24.2	33.7	25.5	30.2	26	37.3	32.5	25.74	50
C59	19.6	14	18.4	22.1	17.7	17.3	18.9	18.4	17.1	15.3	20.5	19.7	22.1	22.4	24.1	23	27.6	28.1	20.36	50

Table 10. AVERAGE SYMMETRIC MAPE
Long

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	#Series
B01	11.8	14.9	15	15.2	15.3	20.6	19.5	19	18.7	15.1	16.6	19.6	21.5	21.8	21.1	20.5	20.3	23.9	18.36	50
B02	7.4	10.9	12.6	13.6	15.6	18.6	17.8	18.7	20.7	14.5	15.3	20.3	20.4	18.3	20.9	21	22.4	24.3	17.4	50
B03	6.2	8.8	9.7	10.7	11.9	14.4	15.4	16.3	14.5	10.7	11.8	13.6	11.3	12.5	15.8	14.7	16.8	20.7	13.11	50
B04	12	13.1	15.8	20.5	22.1	25.3	29	27.1	23	16.9	15.8	16.2	19	16.7	22.4	23.1	24.3	26.8	20.49	50
B05	8.4	9.9	13.1	10.7	12.1	17.7	16.8	18.7	15.4	12.8	15.8	17.8	16.5	14.6	19.2	16	17.5	20.9	15.21	50
B06	7.4	9	10.4	11.1	11.6	15.8	16.3	19.5	16.9	14.5	15.1	15.8	14.5	15.3	19.1	17.4	19	24.8	15.2	50
B07	6.4	8.5	10	10.9	13.1	14.3	17.5	16.2	15.8	10.1	11.2	14.9	14	12.4	14.3	16.3	15.9	20.7	13.46	50
B09	7	9.5	9.8	11.2	11	14.9	15.5	17.2	14.8	11.4	11.6	14.3	13.9	12	16.4	15.3	16.1	18.3	13.35	50
B10	12.4	11.8	14.7	13.9	14.6	22.7	24.6	20.4	18.7	15.9	15.7	20.5	20.2	14.3	19.5	19.4	19.8	25.7	18.05	50
B11	12.5	13	13.2	13.5	13.3	17	18.6	18.2	17.9	17.2	20.2	19.2	19.6	19.8	25	22.6	22.4	25.2	18.24	50
B12	20.7	20.6	21.5	20.3	23.6	25.3	25.7	24.8	29.5	23.1	21.8	23.9	26.1	24.3	22.3	26.9	22.1	30	24.03	50
B13	9.8	13.5	13.9	12.4	14.2	20.8	18.6	19.2	17	13.5	13.7	17.4	16.3	22.1	22.1	19.3	21.5	24.4	17.2	50
C03	7.9	9.8	11.4	11.5	10.7	14.2	16.3	17	17.6	11.4	11.9	13.7	14	14.2	17.1	17.3	18	20.1	14.12	50
C11	12.1	12.1	13.3	15.5	15.8	20.5	19.6	19.1	19.1	14.5	15.2	16.3	16.5	14	16.6	16.9	18.5	23.5	16.62	50
C13	8.5	10.5	10.6	9.6	11.3	15.6	17.2	20	19.6	12.9	14.1	16.1	15.9	13.5	16.7	17.3	16.2	19.2	14.69	50
C15	11	14.4	13.7	14.6	15.8	18.6	20.7	21.8	18.6	14.3	16.2	19.1	18.1	19.5	20.8	18.7	20.1	24.5	17.81	50
C17	18.9	18.3	19.9	25.1	24.4	27.8	28.3	25.5	21.4	14.8	18.1	24.3	22.9	19	20	23.4	22.3	27.6	22.33	50
C20	11.7	11.3	11.1	15.2	15.6	19.8	21.9	23.1	22.1	16.5	16.7	20.1	20.1	20	23.3	22.7	22.9	21.1	18.61	50
C24	12.7	11.3	12.8	12.7	14	21.1	19.3	19.9	20.5	15.2	16.9	17.4	18.1	14	16.3	18.1	18.4	23	16.77	50
C26	13.1	12.8	11.7	16.7	17.8	18.1	18.7	19.3	18.7	14	14.7	20.3	21.2	15	20.6	21.8	19.8	19.7	17.45	50
C27	9.3	12.2	13.1	14.1	14.2	16.1	15.5	16.9	16.4	13.1	13	15.3	14.8	13.1	16.8	15.7	17.1	20.2	14.84	50
C28	14.8	14.9	14.6	16.1	14.5	23.8	22.5	19.7	20.1	16.9	16.6	21.3	20.1	18.1	18.4	23.7	22.9	22.9	18.99	50
C30	13.3	20.1	15.1	20.9	23.7	25.4	28.9	23.4	22.3	24	21.3	25.8	25.1	23.6	24.8	24.5	25.9	26.5	23.04	50
C31	10.4	12.3	11.2	15.8	19.2	18	20.3	18.6	16.6	12.3	12.4	16.4	15.5	14.2	17.4	17.7	20.2	24.3	16.27	50
C36	9.9	13.2	11.3	13	14.9	20.3	19.7	18.7	16.2	18.4	20.1	20.3	20.7	17.8	21.2	18.1	19.2	23.6	17.59	50
C37	9.9	10.6	12.2	14.4	14.7	17.6	20.2	19.3	17.6	14.3	12.7	17.1	14.6	11.6	17.2	17.8	18.9	23.2	15.77	50
C38	8.5	14.2	12.8	13.5	13.4	17.6	17.7	19.3	20.2	12.8	12.6	18.7	15.8	19.2	18	16.9	17.7	20.9	16.11	50
C44	10.6	12.1	9.9	12.6	16.8	15.1	17.7	16.8	16.6	10.6	16.5	18.2	16.7	18.7	20.4	19.4	20.6	21.7	16.17	50
C46	11.3	11	13.6	13.7	14.1	19.2	19	20.5	19.3	15.8	16.6	17.7	20.2	15.6	17.9	16.4	17.1	21.4	16.69	50
C49	14.6	13.5	14.9	12.6	12.3	18.3	22.5	23.1	21.2	19.5	19.5	21.2	22.2	18.2	22	20.7	17.8	20.3	18.57	50
C50	9.3	9.8	11.7	11.3	13.3	19.2	19.1	20.5	17.6	18.5	19.2	16.8	17.9	19	22.3	21.7	20	26.1	17.41	50
C51	19	18.1	19.1	20.3	22.2	24	24	24.2	19.5	18	18.9	23	24.4	19.2	20.9	21.9	21.3	26.2	21.34	50
C57	26.4	27.4	27.5	26.3	27.1	32.5	32.9	33.7	35.6	33.1	35.3	32.2	34.4	31.9	36.2	34.6	32.9	35	31.95	50
C59	13.6	11.3	13.1	15.8	15.2	18.4	18	20.7	16.6	17.3	19	22.3	18.8	17	20.5	19.7	20.3	29.5	18.18	50

Table11. AVERAGE SYMMETRIC MAPE
Seasonal

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	#Series
B01	11.1	13.1	14.4	12.7	15.9	16.3	16	17.5	14.9	11.2	15.7	17.4	21.8	19.9	21.1	19.3	21.5	25.3	16.95	50
B02	10.1	9.2	11.5	12.7	14.1	13.4	12.4	14.3	13.3	10.9	15	14.8	21.2	16.9	19.6	18.2	18.2	23.8	14.97	50
B03	9.6	9.9	10.4	9.9	15.2	14	13.4	13.5	8.8	8.3	11.9	13	15.4	13.9	15.6	13.6	17.8	23.5	13.2	50
B04	21.3	20.7	20.6	25.5	23.6	27.3	28.2	27.3	22	20.2	19.6	14.7	27.7	21.3	23.6	26.7	26.3	29	23.65	50
B05	8.7	10.4	11.8	10.7	14.1	12.1	11.8	14.6	11.1	10.2	11.6	11.3	15.9	13.4	15.7	15.2	15.6	21.4	13.09	50
B06	12.1	11.8	13.8	13.5	13.6	11.6	14.9	13	12.5	11.4	11.8	12.3	18.3	15.1	12.9	16.4	14.4	20.6	13.87	50
B07	8.4	10.2	10.6	10.3	12.4	11.7	13.5	10.8	11	8.3	12.3	10.4	15.3	11.7	10.9	13.6	13.9	20.3	11.97	50
B09	8.3	9.7	10	9.3	9.7	10.6	10.7	12	8	7.4	10.7	9.2	16.2	10.6	14.1	13.9	13.2	18.4	11.22	50
B10	13.4	16.5	15.5	13.3	13.8	16.7	22.7	19	13.2	12.4	13.3	15.1	22.5	23.3	20.2	18.6	15.1	25.2	17.21	50
B11	14.4	13.4	13.3	12.5	15.2	15.1	15.3	13.9	14.3	12.1	16.6	14.8	20.4	14.7	20.9	18.1	20.6	27.1	16.27	50
B12	21.5	18	20.6	22.1	21.4	22.6	23	19	22.8	17.5	23.9	16.5	27.4	21	22.9	27.6	20.9	31	22.21	50
B13	11.5	13.8	14.2	10.7	14.5	14.6	14.6	16.2	11	9.9	10.4	12.2	16.5	19.1	20.4	18.3	19.1	24	15.04	50
C03	10.1	11.6	13	12	12.5	11.9	12.1	13.5	10.8	8.6	12	10.8	17.6	12.9	14.2	16	15	19.2	12.99	50
C11	12.9	11.2	12.4	12.9	12	11.9	12.9	13.3	11.7	8.7	12	11.5	17.9	13.4	16	14.3	15.4	18.8	13.29	50
C13	11	11.7	11.1	11.5	10.3	10.4	12.1	15.3	11.7	9.1	13.1	9.7	18.1	12.8	16.2	15.5	15.5	20.2	13.07	50
C15	15	15.1	15	15.6	16.8	17.6	16.1	14.5	13.6	13.7	16.3	16.4	22.2	21.1	18.3	15.9	16.7	26.6	17.02	50
C17	22.7	21.2	23.3	27.6	27.8	26.7	28	23.5	17.7	13.1	19	20.5	26.1	20.5	22.7	25.5	26.3	32	23.56	50
C20	13.5	12.7	10.8	10.8	14.4	15.4	19.4	14.2	14.4	13.2	14.6	14.7	21.8	18.2	21.1	21.4	21	23	16.37	50
C24	13.1	12.5	14.2	13	16	15.5	15.5	15.1	16.1	11.4	14.8	13.7	19.5	14.6	14.9	18.9	17.8	23.9	15.59	50
C26	15.3	13.8	13.8	15.6	14.9	15.2	13.9	15.7	14.7	13.3	12.9	15.9	22.7	13.7	19.1	21	18.2	21.1	16.15	50
C27	8.9	10.5	11.7	10.4	12	11.8	9.6	11.5	11.2	8.3	12	9.6	16.1	11.7	14.3	14	14.7	20.9	12.17	50
C28	15.7	14.5	16.4	16.3	14.6	19.6	17.2	16.3	14.2	16.3	16.1	15.8	19.3	17.5	18.7	24.3	20.8	24.8	17.69	50
C30	12.1	17.7	12.7	19	19.2	22.4	22	18.5	18.5	19.4	23.6	20.3	27.7	24.2	27.7	23.1	24.1	25	20.95	50
C31	11.1	11.4	11.6	11.1	16.2	15.7	14.2	12.2	10.4	10.3	12.5	12.3	18.4	14	14.1	15.5	17.4	22.1	13.92	50
C36	14.5	12.6	15.1	14.8	18.1	17.6	17.1	17.1	15.2	14.1	19.4	13.9	20.7	19.7	19.8	21.1	20.7	27.4	17.71	50
C37	14.6	12.6	12.4	17.7	15.2	14.8	19.6	15	13.2	15.5	13.3	12.6	19.6	15.4	15.8	18.5	18.5	24.8	16.08	50
C38	10.9	12.8	11.1	12.2	13	12	13.7	14.1	14.2	10.6	13.4	13.4	18.1	18.1	18.8	18	17.2	21.5	14.62	50
C44	12.4	12.8	11	14.4	13.5	12.8	13.2	13.7	11.1	10.9	16.6	16.3	22.1	19.2	17.2	17.2	20.5	22.7	15.42	50
C46	11.2	10.1	11.9	12.7	13.4	12.6	12.9	14.2	12.3	9.7	12.7	11.4	19.5	14.3	14.6	16	14.6	21.2	13.63	50
C49	16.8	13.1	14.5	13.7	14.7	13.5	17.5	18.3	17.9	15.1	15.8	15.6	21.6	15.5	20	19.3	16.5	22.1	16.76	50
C50	10.5	10.9	10.6	10.4	13.4	12	14.3	12.9	10.1	9.6	13.8	11.2	20.1	13.7	14.8	17	15.2	21.6	13.46	50
C51	22.8	21.5	22.1	25.8	26.2	23.3	25.5	23.7	21.1	17.8	19.9	21.8	27.5	22.2	21.2	26.2	23.7	27.5	23.31	50
C57	14.6	19.1	20.8	19.9	19.8	20.3	21.8	21.3	27.7	17.7	19	20.2	27.8	20.2	26.9	23.3	29.5	29.4	22.19	50
C59	13.4	11.8	13.6	15.5	15.6	15.4	12.8	16.9	13.9	11.2	16.2	17.5	18.5	17.9	18.7	16.1	18.2	23.3	15.91	50

Table 12. AVERAGE SYMMETRIC MAPE Non - Seasonal

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	#Series
B01	18.2	16.3	18.9	22.3	16.6	20	20.3	18.6	20.4	16.8	18.6	20.5	21.6	20	24.8	22.7	24	25	20.29	50
B02	15.9	16.6	20.2	23.1	19.4	21.3	20.6	22.7	21.1	16.9	19.5	22.5	20.5	17.2	23.2	22.1	22.8	23.9	20.52	50
B03	14.2	14.1	17.6	19.9	16.1	17	18.3	18.9	18.6	14.2	17.8	19.3	18.2	16	21.9	21.7	21.4	20.6	18.11	50
B04	18.2	14.9	21.9	23.1	20.8	19.9	25	22.2	22.3	18.1	19.1	23.2	21.7	17.8	21.9	23.2	22.1	23.9	21.07	50
B05	15.7	13	21.5	19.8	15	20.1	20.3	20	18.8	17	19.6	22.3	18.4	15.7	24.8	20.5	24	21.8	19.35	50
B06	15.6	15.7	17.6	21.1	16.3	18.8	20.6	24.5	21.8	20.7	20.4	21.1	20.2	19.2	26.2	21.2	25.3	29.6	20.87	50
B07	13.7	13.2	16.8	18.4	16.1	17.6	19	19.2	18.9	15.4	16	20.7	18.9	16	21	20.9	20.8	22.4	18.06	50
B09	13.8	14.5	15.5	20	15.4	18.7	17.7	19.9	19	17.2	17.1	21.8	18.2	17.1	22.7	20.3	19.6	21.9	18.36	50
B10	16.7	15.7	18	22.9	17.9	22.3	22.8	20.8	22.4	19.8	19.4	27.9	22.2	19.5	21.6	25.1	27	25.3	21.52	50
B11	19.5	19	19.4	20.5	14.9	19.5	21	19.5	19.5	22.7	25.3	25	22.4	22.4	30	24.8	24.2	26.4	22	50
B12	21.6	21.2	23	24.6	18.6	27.5	21.7	26.7	27	22.1	20.8	24	29.3	20	23.1	24.7	24.8	34.3	24.16	50
B13	14.4	14	18	18.6	16.3	21.1	19.6	18.3	19.7	16.7	18.2	21.9	19.7	18.7	21.2	20.2	23	22.6	19.02	50
C03	21.2	14.8	19.1	20.4	16.5	20	19.6	21.8	24.1	15.7	17.4	18.4	19.9	16.6	22.3	22.5	24.9	23.1	19.91	50
C11	16.9	19.7	20.8	25.4	20.8	24.1	21.1	22.6	24.1	20.5	23.6	26.4	25.2	20.4	26.9	29	26.1	33.1	23.71	50
C13	14.5	14.8	17.4	20	17.7	17.6	19.1	20.2	20.3	18	21.1	21.1	20.6	15.5	23.1	20.3	20.9	23.5	19.22	50
C15	21	22.6	23.1	23	22.3	22.4	27.8	26.8	26.1	18.4	20.1	20.5	22.3	20.7	26.4	24.9	27.6	25.4	23.41	50
C17	22.2	19.2	23.7	27.7	23.4	21.3	26.2	25.1	22.9	18.2	24.2	24.5	26.2	18.5	20.9	23.8	22.9	25.6	23.15	50
C20	17.7	18.1	18.2	20.8	18	22.2	20.8	23.4	23.6	21.1	20.6	25.7	22.8	21.5	25.5	27.1	26.9	24.2	22.12	50
C24	20.7	15.1	20.5	20.6	16.1	21.9	18.4	21.1	21.8	17.8	20	20.2	19	15.8	21.7	18.6	23.2	21.8	19.69	50
C26	17.1	16.9	17.4	23	18.7	18.8	20.6	20.3	20.8	17.1	17.8	22.5	20.3	18.1	21.7	22.8	21.9	22.1	19.89	50
C27	13.6	17.4	17.2	21.1	15	18.1	18.4	19.5	18.3	17.8	17.3	21.4	18.6	15.5	22.2	18.1	21	20.9	18.4	50
C28	21.5	15.9	20.9	20.5	15.8	24	23.7	22.3	23.1	20	21.7	25.8	23.2	21.3	26	23.6	25.7	24.1	22.17	50
C30	19.6	29.7	24.2	28.2	26	26.2	32.3	34	25.8	27.1	28.1	30.6	31.6	25.1	29.1	29.7	34.2	37.1	28.8	50
C31	16.2	18.7	18.5	25.3	19	19.5	23.4	23.8	20.5	17.3	20.4	21.9	20.5	19.7	25.6	23.4	24	27.6	21.4	50
C36	17.7	17.8	15.8	21.3	20.7	20.9	22	23.1	22.1	21.3	25	22.2	24.4	20	28.2	21.7	23.1	25.2	21.82	50
C37	20	16.2	24	24.5	19	21	26	22	22.6	16.7	19.7	21.7	22.9	18.3	23.3	22.9	25.6	25.8	21.79	50
C38	16.1	18.1	20.4	22.7	16.9	23.7	22.5	24.6	23.2	19.4	18.3	26.1	24.4	20.6	24.9	20.2	22.2	26.7	21.73	50
C44	20	19.6	18.2	25	19.8	21.5	26.3	21.1	20.7	16.6	23.9	24.9	18.8	21.8	32.4	27.7	26.9	25.6	22.82	50
C46	17.6	14.5	19.5	21.1	17.1	21.6	19.7	22.9	22	18.4	20.1	21.3	19.8	17.8	22.5	19.1	21.8	21.8	19.92	50
C49	18.8	13.4	18.6	17.5	14.5	21.9	19	22.1	19.4	19.1	22.2	24.7	22.1	19.2	22.7	21.4	21	25.3	20.17	50
C50	14.8	12.5	17.2	19.6	13.3	20.1	18.1	23.9	20.5	23.9	22.1	23.2	21.7	20.4	29.2	24.2	23.5	28.3	20.91	50
C51	21.9	16.9	22.3	19.9	19.9	21.7	21.6	20.9	20.9	17.7	20.2	22.7	23.3	19.1	22.2	20	20.5	24.6	20.9	50
C57	33.8	28.4	28.7	34.8	30.4	36.7	36	32.7	39.5	34.5	34.3	36.3	40.2	37.2	39.4	37.3	40.6	38.1	35.5	50
C59	19.8	13.5	17.9	22.5	17.4	20.3	24.1	22.3	19.8	21.5	23.3	24.6	22.4	21.5	26	26.6	29.7	34.3	22.63	50

Table 13. MEAN ABSOLUTE SCALED ERROR 111Series

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	# Series
B00	0.68	0.78	0.87	0.86	0.86	1.03	1.21	1.23	1.33	1.16	1.21	1.18	1.35	1.42	1.54	1.60	1.52	1.88	1.21	111
B01	1.06	1.23	1.44	1.40	1.43	1.54	1.70	1.65	1.94	1.78	2.06	2.19	2.57	2.81	3.32	3.90	4.38	4.97	2.30	111
B02	0.75	0.92	1.18	1.43	1.56	1.73	1.96	2.00	2.08	1.97	2.12	2.24	2.50	2.49	2.70	2.82	2.85	3.15	2.03	111
B03	0.61	0.73	0.82	0.89	0.96	1.01	1.24	1.18	1.21	1.11	1.14	1.13	1.28	1.31	1.45	1.52	1.61	1.88	1.17	111
B04	1.01	1.06	1.20	1.38	1.27	1.51	1.73	1.62	1.49	1.37	1.34	1.19	1.61	1.56	1.66	1.79	1.78	2.16	1.48	111
B05	0.60	0.69	0.89	0.88	0.86	1.04	1.23	1.25	1.32	1.19	1.23	1.23	1.26	1.28	1.43	1.51	1.57	1.86	1.18	111
B06	0.63	0.79	0.93	1.01	0.96	1.01	1.30	1.31	1.33	1.24	1.24	1.22	1.40	1.56	1.66	1.73	1.72	2.11	1.29	111
B07	0.63	0.70	0.80	0.85	0.91	0.97	1.26	1.17	1.30	1.10	1.11	1.12	1.27	1.25	1.30	1.44	1.43	1.81	1.13	111
B09	0.66	0.73	0.77	0.88	0.83	0.96	1.22	1.21	1.26	1.13	1.13	1.11	1.27	1.22	1.40	1.43	1.38	1.77	1.13	111
B10	0.84	0.97	1.06	1.07	1.15	1.31	1.52	1.62	1.51	1.32	1.30	1.46	1.60	1.56	1.59	1.67	1.75	2.06	1.41	111
B11	0.91	0.93	1.00	1.08	1.08	1.23	1.43	1.37	1.55	1.40	1.49	1.38	1.57	1.52	1.79	1.86	1.91	2.20	1.43	111
B12	1.61	1.50	1.50	1.58	1.53	1.86	1.73	1.81	2.01	1.68	1.93	1.69	2.05	1.80	1.81	1.91	1.79	2.56	1.80	111
B13	0.68	0.84	0.95	0.97	1.04	1.21	1.39	1.38	1.43	1.27	1.24	1.32	1.49	1.63	1.71	1.75	1.80	2.04	1.34	111
C03	0.69	0.77	0.89	0.94	0.91	1.03	1.25	1.26	1.36	1.09	1.16	1.12	1.30	1.34	1.43	1.55	1.55	1.89	1.20	111
C11	1.06	1.17	1.27	1.49	1.67	1.73	1.82	1.71	1.71	1.48	1.41	1.33	1.59	1.46	1.60	1.76	1.78	2.29	1.57	111
C13	0.80	0.91	0.96	1.07	0.99	1.08	1.30	1.34	1.46	1.23	1.26	1.17	1.34	1.28	1.45	1.52	1.59	1.89	1.26	111
C15	1.02	1.13	1.17	1.31	1.27	1.30	1.67	1.66	1.63	1.43	1.45	1.42	1.68	1.75	1.80	1.78	1.82	2.19	1.53	111
C17	1.86	1.64	1.58	1.91	1.78	1.91	2.04	1.75	1.81	1.57	1.73	1.68	1.78	1.75	1.68	1.95	1.81	2.39	1.81	111
C20	0.75	0.83	0.91	0.98	1.03	1.07	1.37	1.28	1.41	1.29	1.31	1.42	1.56	1.50	1.54	1.70	1.74	1.91	1.31	111
C24	0.96	1.05	1.12	1.19	1.14	1.32	1.45	1.42	1.68	1.42	1.45	1.35	1.48	1.55	1.59	1.77	1.75	2.07	1.43	111
C26	0.89	1.01	1.07	1.24	1.19	1.30	1.43	1.45	1.49	1.28	1.24	1.31	1.47	1.43	1.53	1.61	1.49	1.81	1.35	111
C27	0.71	0.88	0.96	1.09	1.06	1.10	1.32	1.28	1.42	1.26	1.23	1.20	1.34	1.33	1.55	1.47	1.51	1.86	1.25	111
C28	0.95	1.05	1.17	1.21	1.14	1.32	1.58	1.54	1.64	1.59	1.57	1.50	1.60	1.70	1.73	1.88	1.87	2.06	1.50	111
C30	1.06	1.36	1.23	1.45	1.42	1.57	1.85	1.89	1.82	1.74	1.93	1.83	1.97	1.76	1.86	1.87	2.17	2.43	1.73	111
C31	0.74	0.86	0.92	1.06	1.03	1.07	1.39	1.25	1.27	1.18	1.15	1.20	1.38	1.38	1.48	1.57	1.57	1.83	1.24	111
C36	0.91	0.97	1.00	1.18	1.23	1.38	1.53	1.56	1.51	1.35	1.44	1.33	1.52	1.62	1.63	1.69	1.70	2.05	1.42	111
C37	0.82	0.85	1.01	1.14	1.05	1.15	1.44	1.33	1.40	1.27	1.19	1.19	1.43	1.36	1.47	1.64	1.64	1.97	1.30	111
C38	0.80	0.98	1.01	1.17	1.08	1.24	1.42	1.35	1.49	1.25	1.31	1.37	1.48	1.45	1.63	1.60	1.64	1.98	1.35	111
C44	0.77	0.95	0.98	1.13	1.14	1.10	1.46	1.25	1.28	1.13	1.41	1.44	1.53	1.63	1.73	1.84	1.90	2.04	1.37	111
C46	0.91	0.95	1.12	1.16	1.11	1.24	1.34	1.41	1.54	1.30	1.34	1.29	1.50	1.48	1.50	1.55	1.55	1.88	1.34	111
C49	1.01	0.94	1.00	1.04	1.08	1.18	1.48	1.41	1.66	1.35	1.40	1.29	1.42	1.45	1.56	1.74	1.58	2.13	1.37	111
C50	0.68	0.79	0.89	0.93	0.98	1.19	1.37	1.39	1.38	1.36	1.37	1.36	1.49	1.45	1.51	1.57	1.51	1.88	1.28	111
C51	1.71	1.60	1.62	1.74	1.68	1.75	1.87	1.82	1.81	1.65	1.71	1.72	1.87	1.84	1.76	1.89	1.74	2.16	1.77	111
C57	3.13	3.33	3.18	3.42	3.28	3.40	3.59	3.56	3.93	3.62	3.52	3.53	3.89	3.72	3.93	3.91	4.09	3.99	3.61	111
C59	0.96	0.92	1.11	1.20	1.22	1.28	1.49	1.51	1.41	1.28	1.34	1.35	1.30	1.47	1.49	1.52	1.68	1.94	1.36	111

Table 14. MEAN ABSOLUTE SCALED ERROR - SHORT

Methods	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	# Series
B01	0.76	0.65	0.76	0.84	0.68	0.58	0.73	0.69	0.78	0.64	0.70	0.75	0.98	0.75	0.96	0.84	0.96	0.94	0.78	50
B02	0.80	0.63	0.77	0.94	0.69	0.57	0.64	0.73	0.62	0.66	0.75	0.64	0.90	0.66	0.89	0.87	0.79	0.92	0.75	50
B03	0.78	0.71	0.71	0.86	0.78	0.59	0.71	0.64	0.58	0.63	0.65	0.76	1.00	0.72	0.87	0.86	0.91	0.88	0.76	50
B04	1.22	0.99	1.05	1.22	0.88	0.93	1.01	0.90	0.85	0.92	0.95	0.88	1.36	0.94	0.96	1.11	1.00	1.18	1.02	50
B05	0.62	0.58	0.75	0.79	0.67	0.53	0.70	0.65	0.70	0.72	0.58	0.70	0.76	0.65	0.84	0.83	0.84	0.86	0.71	50
B06	0.75	0.70	0.77	0.95	0.76	0.53	0.74	0.73	0.64	0.73	0.65	0.74	0.98	0.79	0.81	0.87	0.85	1.06	0.78	50
B07	0.67	0.66	0.66	0.81	0.65	0.53	0.70	0.56	0.66	0.69	0.68	0.70	0.87	0.63	0.67	0.77	0.75	0.86	0.70	50
B09	0.68	0.63	0.61	0.81	0.59	0.47	0.60	0.58	0.55	0.59	0.62	0.68	0.91	0.60	0.78	0.77	0.65	0.85	0.67	50
B10	0.75	0.95	0.73	0.92	0.76	0.61	0.94	0.98	0.76	0.82	0.70	0.96	1.12	1.15	0.92	0.98	0.93	1.00	0.89	50
B11	0.91	0.82	0.75	0.85	0.77	0.69	0.72	0.61	0.64	0.74	0.90	0.89	1.10	0.73	0.94	0.84	0.91	1.08	0.83	50
B12	1.04	0.88	0.87	1.22	0.73	1.05	0.91	0.91	0.88	0.78	1.13	0.73	1.29	0.74	0.98	0.95	1.01	1.58	0.98	50
B13	0.71	0.63	0.72	0.71	0.69	0.51	0.70	0.65	0.67	0.68	0.58	0.73	0.87	0.72	0.82	0.82	0.83	0.88	0.72	50
C03	0.79	0.75	0.84	0.87	0.75	0.63	0.63	0.69	0.69	0.61	0.67	0.66	0.93	0.71	0.78	0.89	0.83	0.88	0.76	50
C11	0.70	0.68	0.67	0.80	0.69	0.54	0.62	0.66	0.75	0.67	0.76	0.84	1.15	0.80	1.10	1.16	1.01	1.17	0.82	50
C13	0.79	0.70	0.70	0.93	0.67	0.46	0.58	0.62	0.63	0.69	0.76	0.63	0.97	0.65	0.83	0.80	0.76	0.96	0.73	50
C15	1.14	1.01	0.99	1.15	0.92	0.76	0.97	0.84	0.96	0.85	0.84	0.85	1.24	0.99	1.04	0.90	0.95	1.17	0.98	50
C17	1.20	1.06	1.10	1.50	1.25	0.81	1.31	1.00	0.95	0.88	1.03	0.93	1.30	0.90	1.03	1.30	1.22	1.35	1.12	50
C20	0.80	0.81	0.67	0.66	0.65	0.60	0.78	0.68	0.73	0.79	0.81	0.98	1.23	0.89	0.93	1.09	1.05	1.10	0.85	50
C24	0.88	0.67	0.87	0.90	0.76	0.60	0.70	0.69	0.87	0.73	0.69	0.76	0.91	0.72	0.85	0.86	0.86	0.91	0.79	50
C26	0.77	0.75	0.80	0.92	0.65	0.61	0.69	0.68	0.85	0.77	0.67	0.71	0.97	0.67	0.85	0.93	0.79	0.93	0.78	50
C27	0.59	0.64	0.60	0.75	0.56	0.48	0.57	0.57	0.68	0.64	0.64	0.65	0.84	0.59	0.82	0.68	0.73	0.83	0.66	50
C28	0.91	0.67	0.82	0.85	0.75	0.66	0.81	0.76	0.81	0.90	0.91	0.79	0.94	0.87	1.06	0.96	0.88	1.03	0.85	50
C30	0.73	1.03	1.05	1.15	0.99	0.99	0.92	1.19	1.12	1.14	1.48	1.27	1.52	1.11	1.37	1.20	1.41	1.46	1.17	50
C31	0.79	0.79	0.69	0.87	0.61	0.62	0.77	0.63	0.54	0.64	0.69	0.74	0.96	0.73	0.83	0.85	0.82	0.87	0.75	50
C36	0.96	0.70	0.87	1.05	0.96	0.77	0.84	0.95	1.02	0.81	0.97	0.73	1.05	1.01	1.08	1.07	1.07	1.21	0.95	50
C37	1.08	0.83	0.92	1.16	0.79	0.80	1.02	0.83	0.77	0.80	0.81	0.79	1.22	0.84	0.85	1.04	1.05	1.14	0.93	50
C38	0.91	0.78	0.78	0.95	0.77	0.69	0.79	0.74	0.73	0.76	0.80	0.85	1.22	0.84	1.07	1.02	0.98	1.09	0.88	50
C44	0.83	0.85	0.80	1.07	0.72	0.69	0.90	0.71	0.70	0.79	1.01	1.10	1.12	1.12	1.14	1.16	1.13	1.09	0.94	50
C46	0.71	0.59	0.72	0.86	0.67	0.51	0.59	0.68	0.73	0.58	0.62	0.66	0.80	0.68	0.78	0.80	0.75	0.85	0.70	50
C49	0.98	0.55	0.70	0.81	0.72	0.62	0.64	0.73	0.88	0.72	0.81	0.72	0.92	0.70	0.84	0.90	0.75	1.14	0.79	50
C50	0.70	0.62	0.63	0.71	0.55	0.46	0.61	0.62	0.56	0.63	0.64	0.74	1.06	0.63	0.85	0.77	0.72	0.90	0.69	50
C51	1.06	0.86	1.00	1.06	1.00	0.79	0.99	0.87	1.03	0.81	0.87	0.89	1.08	0.89	0.96	1.04	0.90	1.16	0.96	50
C57	0.94	1.06	0.91	1.49	1.08	1.06	1.12	1.01	1.51	1.15	0.82	1.20	1.73	1.27	1.64	1.29	2.03	1.51	1.27	50
C59	0.68	0.61	0.79	0.83	0.74	0.69	0.78	0.77	0.77	0.67	0.77	0.93	0.80	0.92	0.98	0.91	1.03	1.08	0.82	50

Table 15. MEAN ABSOLUTE SCALED ERROR - LONG

Methods	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	# Series
B01	1.43	1.75	2.11	2.03	2.39	2.71	2.91	2.77	3.33	3.10	3.60	3.94	4.47	5.12	6.15	7.55	8.53	9.85	4.10	50
B02	0.72	1.17	1.64	1.95	2.55	3.07	3.45	3.50	3.79	3.49	3.60	4.00	4.26	4.51	4.81	5.03	5.25	5.74	3.47	50
B03	0.47	0.72	0.90	0.93	1.15	1.47	1.87	1.84	1.98	1.72	1.67	1.59	1.58	1.94	2.16	2.32	2.52	3.13	1.66	50
B04	0.89	0.92	1.23	1.45	1.72	2.12	2.60	2.41	2.29	1.93	1.73	1.60	1.91	2.02	2.32	2.47	2.66	3.33	1.98	50
B05	0.62	0.76	1.02	0.97	1.13	1.67	1.94	1.95	2.04	1.75	1.86	1.85	1.82	1.96	2.21	2.32	2.49	3.04	1.74	50
B06	0.51	0.74	1.02	1.00	1.15	1.51	1.97	1.99	2.11	1.85	1.80	1.75	1.80	2.04	2.33	2.47	2.63	3.27	1.77	50
B07	0.55	0.72	0.92	0.94	1.19	1.43	1.88	1.84	2.03	1.60	1.50	1.60	1.65	1.85	1.97	2.22	2.26	2.93	1.61	50
B09	0.68	0.81	0.91	0.97	1.14	1.52	1.94	1.92	2.03	1.75	1.59	1.61	1.67	1.84	2.13	2.20	2.27	2.87	1.66	50
B10	1.02	1.01	1.36	1.25	1.54	2.06	2.21	2.26	2.29	1.89	1.94	2.11	2.22	2.06	2.34	2.40	2.67	3.26	1.99	50
B11	0.97	0.99	1.19	1.24	1.40	1.75	2.18	2.15	2.51	2.15	2.17	2.01	2.13	2.38	2.77	3.07	3.19	3.60	2.10	50
B12	2.31	2.01	2.09	1.93	2.24	2.72	2.66	2.71	3.13	2.50	2.51	2.52	2.79	2.74	2.74	2.99	2.68	3.70	2.61	50
B13	0.70	1.00	1.16	1.21	1.43	1.97	2.19	2.19	2.34	1.99	1.91	2.03	2.16	2.58	2.71	2.79	2.93	3.42	2.04	50
C03	0.66	0.78	0.98	1.02	1.11	1.51	1.93	1.89	2.12	1.65	1.60	1.65	1.73	1.98	2.18	2.36	2.40	3.04	1.70	50
C11	1.51	1.80	2.03	2.37	2.85	3.19	3.26	2.92	2.78	2.43	2.07	1.93	2.08	2.22	2.24	2.51	2.80	3.69	2.48	50
C13	0.87	1.07	1.15	1.05	1.30	1.70	2.01	2.08	2.39	1.87	1.78	1.79	1.73	1.89	2.10	2.29	2.33	2.95	1.80	50
C15	0.99	1.22	1.37	1.51	1.71	2.00	2.45	2.44	2.39	2.03	2.04	2.02	2.06	2.42	2.55	2.64	2.80	3.43	2.12	50
C17	2.25	2.04	1.84	2.22	2.34	3.01	2.88	2.59	2.49	2.17	2.29	2.28	2.26	2.50	2.28	2.60	2.55	3.57	2.45	50
C20	0.78	0.86	1.13	1.28	1.42	1.59	2.07	1.95	2.19	1.92	1.83	1.98	1.94	2.06	2.23	2.36	2.55	2.81	1.83	50
C24	1.16	1.21	1.36	1.53	1.64	2.18	2.36	2.29	2.64	2.24	2.22	2.07	2.10	2.29	2.44	2.84	2.83	3.46	2.16	50
C26	1.05	1.20	1.31	1.58	1.86	2.05	2.22	2.24	2.23	1.87	1.78	1.99	2.06	2.12	2.31	2.42	2.37	2.81	1.97	50
C27	0.86	1.10	1.33	1.47	1.61	1.80	2.13	2.08	2.31	2.03	1.86	1.82	1.89	2.09	2.35	2.39	2.47	3.08	1.93	50
C28	1.04	1.31	1.48	1.64	1.65	2.02	2.50	2.30	2.59	2.36	2.27	2.35	2.30	2.48	2.55	3.00	3.08	3.28	2.23	50
C30	1.24	1.68	1.44	1.71	1.88	2.23	2.89	2.73	2.73	2.52	2.43	2.55	2.53	2.36	2.42	2.63	3.01	3.56	2.36	50
C31	0.73	0.88	1.12	1.25	1.48	1.58	2.11	1.96	2.15	1.80	1.63	1.75	1.80	1.98	2.18	2.34	2.47	3.03	1.79	50
C36	0.94	1.22	1.20	1.39	1.60	2.12	2.32	2.22	2.11	1.99	1.90	2.02	2.09	2.28	2.38	2.53	2.53	3.11	2.00	50
C37	0.67	0.84	1.14	1.16	1.36	1.60	2.01	1.94	2.14	1.86	1.56	1.70	1.69	1.86	2.14	2.31	2.37	2.97	1.74	50
C38	0.80	1.22	1.28	1.41	1.51	1.92	2.14	2.03	2.41	1.90	1.85	2.02	1.85	2.13	2.33	2.32	2.48	3.09	1.93	50
C44	0.76	0.99	1.16	1.25	1.60	1.60	2.15	1.90	2.05	1.64	1.92	1.97	2.07	2.19	2.49	2.72	2.95	3.24	1.93	50
C46	1.19	1.25	1.54	1.55	1.68	2.08	2.26	2.24	2.46	2.09	2.06	2.00	2.24	2.28	2.31	2.42	2.50	3.09	2.07	50
C49	1.11	1.16	1.29	1.27	1.46	1.74	2.31	2.15	2.49	2.05	1.98	1.93	1.98	2.12	2.45	2.75	2.51	3.24	2.00	50
C50	0.70	0.89	1.15	1.20	1.50	2.04	2.29	2.32	2.31	2.24	2.13	2.05	2.01	2.28	2.29	2.53	2.41	3.03	1.97	50
C51	2.42	2.32	2.25	2.48	2.53	2.81	2.91	2.85	2.67	2.52	2.48	2.57	2.64	2.68	2.58	2.80	2.69	3.28	2.64	50
C57	4.70	4.82	4.81	4.73	4.83	5.18	5.48	5.47	5.80	5.51	5.58	5.38	5.61	5.45	5.71	5.90	5.65	6.00	5.37	50
C59	1.33	1.26	1.51	1.70	1.80	2.02	2.37	2.34	2.21	2.05	1.98	1.87	1.88	2.04	2.11	2.31	2.55	3.08	2.02	50

Table 16. MEAN ABSOLUTE SCALED ERROR - seasonal

Methods	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	# Series
B01	0.73	0.86	0.88	0.86	1.01	0.92	0.90	0.89	1.10	0.80	0.99	1.11	1.33	1.27	1.19	1.10	1.16	1.19	1.02	50
B02	0.58	0.60	0.68	0.70	0.75	0.74	0.76	0.88	1.03	0.90	0.98	1.00	1.40	1.30	1.39	1.44	1.39	1.43	1.00	50
B03	0.56	0.71	0.57	0.60	0.76	0.73	0.74	0.69	0.64	0.62	0.62	0.75	0.87	0.84	0.78	0.74	0.92	1.03	0.73	50
B04	1.20	1.14	1.10	1.33	1.29	1.55	1.54	1.46	1.20	1.17	1.11	0.80	1.52	1.16	1.30	1.42	1.41	1.66	1.30	50
B05	0.53	0.64	0.64	0.63	0.74	0.73	0.67	0.79	0.81	0.73	0.66	0.74	0.86	0.84	0.81	0.79	0.85	1.02	0.75	50
B06	0.54	0.64	0.68	0.68	0.70	0.59	0.75	0.65	0.75	0.70	0.66	0.76	0.98	0.86	0.83	0.92	0.81	1.05	0.75	50
B07	0.53	0.66	0.58	0.61	0.68	0.62	0.71	0.59	0.76	0.59	0.64	0.70	0.87	0.76	0.57	0.76	0.72	0.89	0.68	50
B09	0.51	0.60	0.53	0.55	0.54	0.58	0.63	0.61	0.67	0.54	0.58	0.61	0.89	0.66	0.75	0.75	0.68	0.84	0.64	50
B10	0.80	1.07	0.81	0.78	0.92	0.84	1.38	1.23	0.97	0.91	0.88	1.03	1.41	1.34	1.15	1.14	1.02	1.30	1.05	50
B11	0.91	0.81	0.75	0.79	0.82	0.82	0.83	0.81	1.06	0.84	1.02	0.93	1.25	1.04	1.18	1.14	1.20	1.31	0.97	50
B12	1.40	1.24	1.15	1.32	1.22	1.38	1.42	1.09	1.42	1.11	1.56	1.23	1.53	1.30	1.24	1.54	1.21	1.73	1.34	50
B13	0.60	0.73	0.68	0.57	0.68	0.65	0.77	0.87	0.83	0.74	0.59	0.77	0.94	1.05	1.03	0.99	0.97	1.11	0.81	50
C03	0.62	0.72	0.71	0.71	0.68	0.74	0.67	0.71	0.81	0.65	0.69	0.68	0.95	0.86	0.77	0.99	0.83	0.97	0.76	50
C11	0.70	0.65	0.65	0.64	0.74	0.66	0.76	0.68	0.81	0.62	0.67	0.69	1.04	0.85	0.87	0.82	0.83	0.93	0.76	50
C13	0.66	0.75	0.60	0.66	0.58	0.62	0.69	0.83	0.88	0.69	0.67	0.63	0.98	0.84	0.88	0.95	0.88	1.01	0.77	50
C15	0.94	0.95	0.88	0.95	0.88	0.93	0.98	0.87	1.00	0.93	1.00	1.00	1.29	1.25	1.00	0.95	0.96	1.30	1.00	50
C17	1.43	1.41	1.31	1.72	1.64	1.54	1.84	1.39	1.21	0.93	1.09	1.28	1.43	1.32	1.21	1.44	1.46	1.74	1.41	50
C20	0.69	0.73	0.59	0.56	0.68	0.70	0.88	0.77	0.88	0.87	0.87	0.97	1.29	1.02	1.07	1.13	1.19	1.17	0.89	50
C24	0.79	0.81	0.85	0.87	0.93	0.87	0.96	0.85	1.21	0.88	0.89	0.92	1.08	1.01	0.86	1.15	1.00	1.18	0.95	50
C26	0.75	0.79	0.76	0.83	0.77	0.84	0.82	0.84	1.08	0.88	0.77	0.93	1.21	0.89	1.06	1.17	0.91	0.99	0.90	50
C27	0.53	0.66	0.61	0.63	0.62	0.64	0.65	0.66	0.86	0.64	0.70	0.64	0.88	0.76	0.80	0.80	0.83	0.99	0.72	50
C28	0.82	0.83	0.85	0.84	0.89	0.80	0.87	0.87	1.06	1.05	1.02	0.97	1.12	1.07	1.01	1.19	1.12	1.22	0.98	50
C30	0.73	1.00	0.79	1.08	1.05	1.32	1.29	1.15	1.27	1.26	1.49	1.40	1.62	1.36	1.47	1.26	1.35	1.45	1.24	50
C31	0.70	0.75	0.60	0.65	0.72	0.75	0.78	0.63	0.69	0.67	0.66	0.77	1.02	0.83	0.74	0.82	0.86	0.93	0.75	50
C36	0.80	0.79	0.92	0.91	0.99	1.02	1.00	1.02	1.09	0.93	1.05	0.92	1.16	1.27	1.11	1.18	1.10	1.34	1.03	50
C37	0.82	0.83	0.72	0.91	0.81	0.86	0.90	0.86	0.90	0.90	0.78	0.82	1.13	0.92	0.83	1.03	0.99	1.17	0.90	50
C38	0.71	0.74	0.66	0.78	0.81	0.76	0.78	0.71	0.97	0.77	0.84	0.86	1.09	1.06	1.06	1.15	1.03	1.14	0.88	50
C44	0.59	0.72	0.59	0.73	0.68	0.68	0.77	0.73	0.75	0.72	0.93	1.03	1.27	1.19	0.98	1.13	1.28	1.24	0.89	50
C46	0.62	0.69	0.71	0.78	0.78	0.72	0.74	0.76	0.97	0.70	0.74	0.77	1.01	0.94	0.84	0.94	0.83	0.99	0.81	50
C49	1.08	0.82	0.80	0.81	0.82	0.70	0.99	0.95	1.38	0.93	0.95	0.95	1.18	1.02	1.02	1.20	0.87	1.17	0.98	50
C50	0.63	0.69	0.63	0.61	0.71	0.69	0.79	0.68	0.78	0.70	0.81	0.78	1.21	0.96	0.86	0.97	0.87	1.02	0.80	50
C51	1.30	1.26	1.18	1.37	1.39	1.21	1.38	1.27	1.24	1.03	1.14	1.27	1.43	1.30	1.20	1.44	1.25	1.48	1.29	50
C57	0.88	1.28	1.14	1.37	1.20	1.18	1.27	1.33	1.73	1.15	1.14	1.38	1.64	1.33	1.69	1.50	1.89	1.68	1.38	50
C59	0.69	0.73	0.80	0.77	0.85	0.84	0.77	0.97	1.01	0.75	0.90	1.10	0.93	1.09	0.99	0.92	1.00	1.09	0.90	50

Table 17. MEAN ABSOLUTE SCALED ERROR - Non-Seasonal

Methods	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	# Series
B01	1.47	1.54	1.99	2.01	2.05	2.37	2.74	2.57	3.02	2.95	3.30	3.58	4.12	4.61	5.92	7.29	8.33	9.60	3.86	50
B02	0.93	1.19	1.72	2.18	2.49	2.91	3.33	3.34	3.38	3.25	3.37	3.64	3.76	3.88	4.31	4.46	4.64	5.23	3.22	50
B03	0.68	0.72	1.04	1.18	1.18	1.33	1.85	1.79	1.92	1.73	1.69	1.61	1.70	1.82	2.24	2.43	2.52	2.98	1.69	50
B04	0.90	0.77	1.17	1.34	1.31	1.50	2.06	1.84	1.94	1.67	1.57	1.68	1.76	1.81	1.97	2.16	2.25	2.84	1.70	50
B05	0.72	0.70	1.14	1.13	1.06	1.47	1.97	1.81	1.94	1.74	1.78	1.80	1.71	1.77	2.24	2.36	2.49	2.89	1.71	50
B06	0.71	0.79	1.11	1.27	1.21	1.45	1.96	2.07	2.00	1.88	1.79	1.73	1.80	1.97	2.31	2.42	2.67	3.28	1.80	50
B07	0.69	0.72	1.00	1.14	1.16	1.34	1.87	1.81	1.94	1.70	1.54	1.60	1.65	1.71	2.07	2.22	2.29	2.90	1.63	50
B09	0.85	0.84	0.99	1.23	1.19	1.42	1.91	1.88	1.92	1.80	1.63	1.69	1.69	1.78	2.17	2.23	2.24	2.89	1.69	50
B10	0.97	0.89	1.27	1.39	1.37	1.84	1.78	2.01	2.08	1.81	1.77	2.04	1.93	1.88	2.11	2.24	2.58	2.96	1.83	50
B11	0.97	1.00	1.19	1.30	1.35	1.62	2.07	1.95	2.10	2.06	2.05	1.98	1.98	2.07	2.54	2.77	2.90	3.38	1.96	50
B12	1.95	1.65	1.81	1.83	1.75	2.39	2.15	2.52	2.59	2.17	2.08	2.02	2.55	2.18	2.48	2.39	2.48	3.55	2.25	50
B13	0.80	0.90	1.21	1.35	1.44	1.83	2.12	1.97	2.18	1.94	1.90	1.99	2.09	2.25	2.50	2.62	2.79	3.19	1.95	50
C03	0.84	0.81	1.11	1.18	1.18	1.40	1.89	1.87	1.99	1.61	1.58	1.63	1.71	1.83	2.19	2.26	2.40	2.96	1.69	50
C11	1.51	1.83	2.05	2.53	2.80	3.07	3.13	2.91	2.73	2.48	2.17	2.08	2.18	2.17	2.47	2.85	2.97	3.93	2.55	50
C13	1.00	1.03	1.25	1.32	1.40	1.53	1.91	1.88	2.14	1.87	1.87	1.79	1.72	1.69	2.05	2.14	2.22	2.90	1.76	50
C15	1.18	1.27	1.48	1.72	1.75	1.83	2.44	2.42	2.35	1.96	1.88	1.87	2.01	2.16	2.58	2.59	2.79	3.30	2.09	50
C17	2.02	1.69	1.62	2.00	1.95	2.28	2.35	2.20	2.23	2.12	2.22	1.94	2.13	2.07	2.10	2.47	2.32	3.18	2.16	50
C20	0.89	0.94	1.21	1.38	1.39	1.48	1.97	1.86	2.04	1.84	1.76	1.99	1.89	1.92	2.09	2.33	2.41	2.74	1.79	50
C24	1.25	1.07	1.38	1.56	1.46	1.90	2.10	2.13	2.30	2.08	2.02	1.91	1.93	2.00	2.44	2.55	2.70	3.19	2.00	50
C26	1.08	1.16	1.35	1.67	1.74	1.82	2.08	2.08	2.00	1.76	1.68	1.77	1.82	1.90	2.10	2.19	2.25	2.75	1.85	50
C27	0.92	1.09	1.32	1.59	1.55	1.64	2.06	1.99	2.13	2.02	1.79	1.83	1.85	1.92	2.37	2.26	2.37	2.91	1.87	50
C28	1.13	1.15	1.45	1.65	1.51	1.88	2.44	2.19	2.34	2.21	2.15	2.17	2.11	2.28	2.60	2.77	2.84	3.09	2.11	50
C30	1.24	1.71	1.70	1.78	1.82	1.90	2.52	2.77	2.58	2.40	2.42	2.41	2.44	2.11	2.31	2.56	3.06	3.56	2.29	50
C31	0.82	0.93	1.21	1.48	1.37	1.44	2.10	1.95	2.01	1.78	1.65	1.72	1.74	1.88	2.28	2.37	2.44	2.97	1.79	50
C36	1.09	1.13	1.14	1.52	1.57	1.88	2.16	2.15	2.04	1.87	1.82	1.83	1.98	2.02	2.35	2.42	2.50	2.98	1.91	50
C37	0.92	0.84	1.34	1.40	1.34	1.54	2.12	1.91	2.01	1.76	1.59	1.67	1.77	1.78	2.16	2.32	2.43	2.94	1.77	50
C38	1.00	1.26	1.39	1.59	1.46	1.85	2.16	2.06	2.17	1.89	1.81	2.01	1.98	1.91	2.34	2.19	2.44	3.05	1.92	50
C44	1.01	1.12	1.37	1.59	1.65	1.62	2.28	1.89	2.00	1.70	2.00	2.04	1.91	2.11	2.65	2.75	2.81	3.09	1.98	50
C46	1.28	1.15	1.54	1.63	1.57	1.87	2.11	2.16	2.22	1.97	1.94	1.90	2.03	2.03	2.25	2.28	2.41	2.95	1.96	50
C49	1.01	0.90	1.19	1.28	1.36	1.67	1.96	1.93	1.98	1.85	1.84	1.70	1.72	1.81	2.27	2.44	2.39	3.21	1.81	50
C50	0.78	0.82	1.16	1.31	1.34	1.81	2.11	2.26	2.09	2.17	1.96	2.01	1.86	1.95	2.28	2.34	2.26	2.91	1.86	50
C51	2.19	1.92	2.07	2.16	2.14	2.39	2.52	2.45	2.46	2.30	2.21	2.19	2.29	2.27	2.34	2.39	2.34	2.96	2.31	50
C57	4.76	4.60	4.58	4.85	4.72	5.06	5.33	5.15	5.58	5.51	5.26	5.20	5.70	5.40	5.66	5.69	5.79	5.83	5.26	50
C59	1.32	1.15	1.50	1.76	1.68	1.87	2.38	2.14	1.97	1.97	1.85	1.70	1.74	1.87	2.10	2.30	2.58	3.07	1.94	50

Table 18. Median RAE 111 series

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average	#Series
B00	0.86	1.09	0.84	0.76	0.76	0.84	0.73	0.84	0.88	0.91	1.04	0.99	1.01	0.93	0.99	0.97	0.88	1.00	0.91	111
B01	1.09	1.39	0.91	0.89	0.95	0.95	0.80	1.11	1.04	0.91	1.04	1.05	1.34	1.14	1.21	1.06	1.02	1.17	1.06	111
B02	0.90	0.92	0.91	0.97	1.01	0.87	0.92	0.92	1.00	0.93	1.00	1.06	1.04	0.88	1.09	1.03	0.94	1.04	0.97	111
B03	0.74	0.91	0.87	0.84	0.92	0.87	0.85	0.79	0.84	0.72	0.95	0.94	0.90	0.86	1.00	0.98	1.04	1.00	0.89	111
B04	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	111
B05	0.74	0.99	0.93	0.83	0.76	0.90	0.71	0.94	0.89	1.00	1.03	1.00	1.09	0.86	1.03	1.00	0.90	1.07	0.93	111
B06	0.79	0.92	0.88	0.88	0.88	0.72	0.77	0.96	0.94	1.00	1.00	1.00	0.96	0.94	0.99	0.93	0.98	1.02	0.92	111
B07	0.83	0.86	0.74	0.77	0.85	0.82	0.89	0.78	0.92	0.90	0.91	0.99	0.98	0.92	0.91	0.93	0.89	0.97	0.88	111
B09	0.77	0.88	0.66	0.74	0.71	0.79	0.73	0.80	0.85	0.95	0.90	0.91	0.91	0.71	0.91	0.87	0.79	0.96	0.82	111
B10	0.98	1.14	0.99	0.86	0.99	0.96	0.94	1.05	1.08	1.06	0.98	1.26	1.16	1.04	1.12	1.00	0.96	1.16	1.04	111
B11	1.20	1.21	0.98	0.76	0.83	1.06	0.86	0.90	1.04	1.04	1.09	1.05	1.16	0.89	1.30	1.14	1.11	1.02	1.04	111
B12	1.78	1.81	1.07	1.21	1.12	1.38	1.13	1.41	1.43	1.50	1.68	1.11	1.54	1.31	1.26	1.18	1.02	1.36	1.35	111
B13	0.80	1.15	0.86	0.71	0.88	0.83	0.83	0.88	1.03	0.95	0.89	1.04	1.02	1.05	1.20	0.97	1.03	1.17	0.96	111
C03	0.86	1.00	0.82	0.76	0.76	0.85	0.87	0.99	1.02	0.95	1.00	0.96	1.00	0.93	0.93	0.94	0.91	1.12	0.93	111
C11	0.95	1.15	0.76	0.77	0.97	0.84	0.68	1.02	0.96	0.97	0.93	0.91	1.11	0.95	0.89	0.85	0.85	1.09	0.92	111
C13	0.97	0.97	0.83	0.79	0.72	0.81	0.82	1.01	1.09	0.98	0.97	0.88	0.97	0.89	1.03	0.87	0.82	1.01	0.91	111
C15	1.41	1.24	1.00	0.93	1.04	1.03	1.29	1.10	1.12	1.02	1.01	1.00	1.20	1.23	1.20	1.15	1.06	1.04	1.12	111
C17	1.69	1.69	1.47	1.33	1.49	1.39	1.28	1.43	1.33	1.09	1.27	1.45	1.36	1.16	1.09	1.28	1.24	1.26	1.35	111
C20	0.90	1.01	0.83	0.75	0.84	0.84	0.91	1.00	0.98	1.01	1.09	1.20	1.21	0.95	1.04	1.08	0.98	1.17	0.99	111
C24	1.18	1.26	1.00	0.93	0.91	0.92	0.83	1.03	1.09	1.04	1.03	0.98	0.97	1.06	1.06	1.12	0.92	0.96	1.02	111
C26	0.91	1.10	0.94	0.86	0.86	1.00	0.84	1.19	1.05	1.08	0.85	0.97	1.16	1.05	1.11	1.09	0.98	0.92	1.00	111
C27	0.87	0.98	0.76	0.84	0.78	0.75	0.77	0.85	0.75	0.91	0.86	0.87	0.92	0.72	0.94	0.77	0.79	0.92	0.84	111
C28	1.16	1.14	1.08	0.96	0.77	1.09	1.14	1.09	1.06	1.40	1.28	1.15	1.20	1.17	1.30	1.12	1.10	1.15	1.13	111
C30	1.10	1.59	1.02	1.14	1.33	1.28	1.18	1.43	1.36	1.54	1.80	1.56	1.57	1.35	1.36	1.20	1.51	1.25	1.36	111
C31	0.83	1.27	0.83	0.97	0.98	0.83	0.96	1.01	0.87	0.93	0.95	1.00	1.00	0.94	1.01	1.05	0.90	0.98	0.96	111
C36	1.12	1.30	1.02	0.93	1.10	1.07	0.89	1.30	1.08	1.05	1.20	1.10	1.27	1.16	1.10	1.14	1.17	1.21	1.12	111
C37	0.96	0.96	1.03	0.98	0.91	1.01	0.93	1.01	0.99	1.00	0.98	1.00	1.07	0.99	1.02	1.04	1.04	1.00	1.00	111
C38	1.02	1.06	0.86	0.91	0.86	1.16	0.91	0.93	1.03	0.95	1.07	1.01	1.10	0.93	1.08	0.94	1.03	1.06	1.00	111
C44	1.03	1.26	0.95	0.88	1.04	0.88	1.03	0.92	0.80	0.97	1.07	1.19	1.14	1.24	1.16	1.30	1.15	1.07	1.06	111
C46	1.03	0.92	0.93	0.77	0.85	0.80	0.76	0.98	0.99	0.97	0.90	1.00	1.11	1.07	0.90	0.98	0.89	1.00	0.94	111
C49	1.23	0.98	0.91	0.78	0.92	0.89	0.78	1.14	1.43	1.09	1.25	1.16	1.36	0.94	1.05	1.01	0.88	1.18	1.05	111
C50	0.85	0.78	0.77	0.78	0.79	0.84	0.69	1.03	0.95	0.99	0.97	1.01	1.09	0.92	0.91	0.91	0.90	1.07	0.90	111
C51	1.88	1.53	1.18	1.04	1.28	1.08	0.99	1.34	1.20	1.46	1.38	1.38	1.43	1.19	1.12	1.16	1.05	1.21	1.27	111
C57	1.50	1.72	1.38	1.35	1.40	1.19	1.16	1.30	1.82	1.65	1.54	1.51	1.71	1.64	1.59	1.41	1.75	1.66	1.52	111
C59	0.93	1.00	1.00	0.91	1.04	0.96	0.89	1.07	0.91	0.87	1.00	1.00	1.00	1.07	1.03	1.14	1.02	1.04	0.99	111

Table 19. Average Ranking 111 Series - All methods

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average
B00	16.0	16.4	16.6	14.7	16.0	16.4	15.3	16.7	15.7	15.9	16.8	16.5	16.2	17.6	16.8	17.5	16.3	16.7	16.3
B01	18.7	18.9	18.6	19.0	17.8	18.0	16.7	17.0	17.7	16.4	18.0	17.8	19.2	18.9	18.8	18.2	19.1	18.3	18.2
B02	16.9	16.3	17.5	18.5	18.5	17.4	16.2	18.0	17.6	16.9	17.8	17.7	17.2	16.8	18.5	17.6	18.5	18.0	17.5
B03	13.8	14.9	15.0	15.1	17.4	15.5	15.7	15.3	13.2	14.6	15.2	15.2	14.9	14.8	16.0	15.5	17.4	15.9	15.3
B04	21.7	19.6	20.9	22.6	20.5	22.3	21.2	20.4	19.4	20.1	18.8	17.2	20.7	19.7	20.1	21.2	19.7	19.8	20.3
B05	14.3	15.1	17.2	15.6	16.2	16.6	15.2	16.6	15.9	16.7	16.4	17.0	15.0	15.5	16.3	16.1	17.5	16.3	16.1
B06	13.7	15.4	16.8	16.8	16.1	14.8	16.5	16.3	15.5	18.0	16.5	16.6	16.6	17.1	17.4	16.5	17.5	18.4	16.5
B07	14.2	14.8	14.8	14.4	16.0	15.1	15.8	14.6	15.2	14.7	14.9	15.8	14.5	15.0	14.2	14.9	15.1	15.2	15.0
B09	14.4	14.4	13.9	14.9	13.9	14.6	13.9	15.1	14.2	15.9	15.2	15.0	14.9	13.8	15.4	14.5	13.1	14.6	14.5
B10	18.1	18.8	19.3	17.6	18.8	19.1	19.3	19.4	18.3	18.5	17.2	20.0	19.0	17.9	17.8	18.7	17.5	19.0	18.6
B11	19.7	18.4	17.9	17.4	17.4	18.6	17.2	16.6	18.2	18.4	19.6	18.3	18.5	17.3	20.1	18.9	19.0	19.3	18.4
B12	23.6	23.4	21.4	22.4	20.2	23.4	21.0	20.8	22.9	22.1	23.2	20.3	22.3	20.6	19.6	21.2	19.5	22.0	21.7
B13	16.0	17.2	17.6	14.5	17.4	16.5	16.6	17.3	16.4	16.3	15.6	17.5	16.4	18.5	18.2	17.2	17.9	16.5	16.9
C03	15.0	16.2	16.8	16.4	16.3	16.5	15.9	16.6	16.7	15.7	15.6	15.1	15.8	16.4	15.6	16.8	16.7	16.7	16.2
C11	18.3	16.1	16.0	16.1	17.6	16.5	16.7	16.9	18.0	17.1	16.1	16.2	17.9	16.8	17.6	16.7	16.2	18.0	16.9
C13	17.3	17.8	16.3	16.3	16.2	15.8	16.0	18.3	17.7	16.8	16.8	16.0	16.6	16.4	17.0	16.1	16.3	17.2	16.7
C15	20.6	21.3	19.3	19.6	19.6	18.9	22.6	20.5	19.1	18.8	18.9	18.0	18.8	20.8	19.4	18.0	18.7	19.4	19.6
C17	24.8	23.9	23.4	25.3	23.4	22.4	24.0	21.7	21.5	19.6	21.3	21.7	22.3	21.4	18.8	21.6	20.8	21.8	22.2
C20	16.5	17.1	17.1	15.7	16.9	17.2	18.7	16.8	17.9	19.0	18.7	19.9	19.0	18.6	19.0	18.7	19.2	18.5	18.0
C24	19.9	18.3	19.2	18.9	18.5	18.1	17.6	17.5	19.9	18.2	18.2	17.5	17.2	17.1	16.7	18.2	18.6	16.6	18.1
C26	18.0	18.9	18.6	19.6	18.2	18.0	17.6	18.7	19.3	17.5	16.9	18.0	18.8	18.0	18.7	19.3	17.1	16.5	18.2
C27	14.0	16.7	15.8	16.2	15.4	15.5	14.9	15.2	16.0	16.0	15.3	15.9	15.2	14.8	17.2	13.7	15.4	15.1	15.5
C28	19.9	19.6	19.3	19.2	16.9	19.3	20.4	19.1	19.8	22.2	20.3	19.8	18.7	20.6	19.7	19.3	18.9	18.7	19.5
C30	18.6	22.4	19.8	20.4	21.2	21.5	22.4	21.4	20.4	21.8	23.5	22.9	21.8	21.3	21.8	21.0	22.0	20.7	21.4
C31	16.6	17.1	17.3	18.5	16.8	16.5	18.4	16.2	14.3	16.7	16.4	16.7	17.4	16.8	16.6	17.2	16.7	16.7	16.8
C36	18.6	19.0	17.6	18.5	19.5	19.9	18.7	20.1	19.2	18.6	20.1	18.0	19.0	19.5	18.0	18.8	18.8	18.8	18.9
C37	18.4	17.4	18.9	19.8	17.6	18.2	19.9	18.6	17.5	18.6	16.7	16.3	18.3	16.6	17.4	19.0	19.0	18.2	18.1
C38	16.8	17.7	18.0	18.5	17.8	18.5	18.3	18.1	18.7	17.3	17.0	18.3	17.6	17.4	17.7	17.0	17.6	17.4	17.8
C44	17.1	18.6	16.6	18.0	18.3	16.7	18.7	16.0	15.1	16.6	18.7	18.8	17.4	19.9	19.2	19.2	18.9	17.4	17.9
C46	16.9	15.5	17.0	17.0	16.7	16.7	14.4	16.9	17.9	16.6	16.7	16.7	15.8	16.5	15.5	15.6	16.1	16.0	16.4
C49	20.7	17.0	17.7	17.1	17.9	17.2	18.6	19.0	20.6	18.9	20.2	17.5	18.5	17.6	17.4	19.4	16.5	19.8	18.4
C50	15.5	14.7	15.5	14.2	15.1	16.2	15.6	17.5	16.0	18.0	17.3	17.7	18.4	16.5	17.5	16.6	16.6	17.6	16.5
C51	25.1	22.7	22.6	21.3	23.2	20.9	20.9	20.6	20.8	20.6	20.8	21.1	21.3	20.7	19.1	19.9	18.6	19.8	21.1
C57	22.6	22.3	22.1	22.5	22.6	22.8	21.8	21.5	25.9	23.2	21.7	22.9	22.9	23.8	22.7	22.8	24.0	21.5	22.8
C59	17.7	16.2	17.6	17.6	18.3	18.3	17.5	19.1	17.7	17.7	17.7	20.1	16.4	19.1	18.3	17.2	19.6	17.8	18.0

Table 20. Average Ranking 111 Series - All Benchmarks

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average
B00	6.7	6.6	6.6	6.1	6.4	6.7	6.4	6.8	6.6	6.6	6.8	6.6	6.6	7.2	6.5	7.0	6.4	6.6	6.6
B01	7.7	7.7	7.3	7.7	7.1	7.1	6.9	6.9	7.5	6.6	7.3	7.2	7.7	7.6	7.6	7.1	7.6	7.3	7.3
B02	7.1	6.8	7.0	7.6	7.5	6.9	6.7	7.2	7.1	6.9	7.3	7.2	7.0	6.8	7.3	6.9	7.3	7.1	7.1
B03	5.9	6.2	6.2	6.3	7.1	6.4	6.6	6.3	5.4	5.9	6.2	6.2	6.1	6.1	6.4	6.3	7.0	6.5	6.3
B04	8.8	7.9	8.3	8.9	8.2	8.6	8.5	8.3	7.8	8.1	7.5	7.0	8.2	8.0	7.9	8.3	7.8	7.7	8.1
B05	6.0	6.3	6.9	6.3	6.5	6.6	6.4	6.9	6.7	6.7	6.8	7.0	6.1	6.6	6.6	6.4	7.1	6.5	6.6
B06	5.7	6.2	6.7	6.8	6.5	6.1	6.7	6.6	6.5	7.3	6.6	6.7	6.7	6.8	6.9	6.8	7.0	7.2	6.7
B07	5.9	6.0	6.0	6.1	6.5	6.1	6.5	6.0	6.3	6.0	6.1	6.4	6.1	6.0	5.6	6.1	6.1	6.0	6.1
B09	6.1	6.1	5.6	6.1	5.6	5.8	5.8	6.2	6.1	6.6	6.3	6.1	6.2	5.7	6.2	5.9	5.2	5.9	6.0
B10	7.4	7.7	7.9	7.3	7.6	7.5	7.8	7.8	7.6	7.5	6.9	8.3	7.6	7.2	7.0	7.4	7.0	7.5	7.5
B11	7.9	7.4	7.2	7.0	7.0	7.4	7.1	6.7	7.5	7.3	7.8	7.4	7.4	7.1	8.3	7.5	7.6	7.6	7.4
B12	9.3	9.2	8.5	8.9	8.0	9.1	8.5	8.2	9.2	8.8	9.1	8.0	8.8	8.3	7.7	8.2	7.8	8.5	8.6
B13	6.7	7.0	7.0	6.1	7.0	6.6	7.0	7.0	6.9	6.7	6.5	7.1	6.7	7.6	7.2	7.0	7.2	6.6	6.9

Table 21. Average Ranking 111 Series - All Competitors

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average
C03	9.3	10.0	10.6	10.1	10.3	10.4	9.6	10.2	10.3	9.8	9.7	9.3	9.9	10.1	9.9	10.5	10.6	10.5	10.1
C11	11.3	10.2	10.3	10.1	11.1	10.4	10.3	10.5	11.0	10.7	10.1	10.2	11.1	10.3	11.1	10.7	10.3	11.2	10.6
C13	10.8	11.0	10.2	10.1	10.1	9.9	9.7	11.3	10.8	10.5	10.5	10.1	10.4	10.2	10.7	10.1	10.2	11.1	10.4
C15	12.7	13.1	12.3	12.2	12.3	11.9	13.9	12.9	11.7	11.8	11.8	11.3	11.9	13.1	12.2	11.2	11.7	12.2	12.2
C17	15.5	15.1	14.6	15.9	14.7	14.1	14.9	13.5	13.4	12.4	13.5	13.7	13.9	13.5	12.0	13.5	13.0	13.7	13.9
C20	10.2	10.6	10.6	9.8	10.6	10.9	11.7	10.5	11.2	12.0	11.7	12.5	12.0	11.7	12.0	11.9	12.1	11.9	11.3
C24	12.3	11.4	12.1	11.8	11.5	11.5	11.0	10.9	12.2	11.2	11.2	11.0	10.7	10.5	10.6	11.4	11.6	10.5	11.3
C26	11.2	11.6	11.7	12.1	11.4	11.3	10.8	11.4	12.0	10.8	10.6	11.3	11.8	11.1	11.8	12.2	10.8	10.3	11.4
C27	8.7	10.4	9.9	10.1	9.7	9.8	9.3	9.5	9.9	10.0	9.6	9.9	9.4	9.2	10.9	8.7	9.7	9.6	9.7
C28	12.5	12.3	12.3	12.1	10.8	12.2	12.7	11.9	12.2	13.8	12.7	12.4	11.6	12.9	12.4	12.1	11.9	11.7	12.2
C30	11.6	14.0	12.6	12.8	13.2	13.6	13.9	13.4	12.7	13.6	14.6	14.3	13.5	13.3	13.7	13.2	13.8	13.2	13.4
C31	10.2	10.4	10.6	11.4	10.5	10.4	11.2	10.1	8.9	10.3	10.2	10.5	10.8	10.6	10.3	11.0	10.5	10.6	10.5
C36	11.4	11.8	11.0	11.5	12.3	12.6	11.6	12.4	11.7	11.5	12.6	11.1	11.9	12.1	11.5	11.7	11.9	11.8	11.8
C37	11.5	10.8	12.0	12.2	10.8	11.5	12.3	11.5	10.9	11.6	10.5	10.1	11.4	10.2	11.0	11.9	12.0	11.5	11.3
C38	10.4	11.1	11.3	11.5	11.2	11.6	11.1	11.3	11.5	10.8	10.6	11.4	10.9	10.8	11.3	10.8	11.0	10.9	11.1
C44	10.4	11.6	10.4	11.1	11.5	10.5	11.6	10.2	9.3	10.4	11.7	11.6	11.0	12.3	12.0	12.0	11.9	11.1	11.1
C46	10.3	9.7	10.8	10.5	10.4	10.5	8.8	10.6	10.9	10.3	10.1	10.4	9.9	10.2	9.9	9.7	10.1	10.1	10.2
C49	12.9	10.7	11.1	10.7	11.2	10.9	11.4	11.9	12.8	11.8	12.6	10.9	11.4	11.0	11.0	12.3	10.4	12.6	11.5
C50	9.6	9.2	9.8	8.8	9.4	10.0	9.7	10.9	9.8	11.3	10.9	11.0	11.5	10.3	11.0	10.5	10.5	11.1	10.3
C51	15.6	14.1	14.1	13.3	14.5	13.3	13.2	12.9	13.0	12.8	13.0	13.2	13.4	13.0	12.0	12.5	11.7	12.5	13.2
C57	13.9	13.9	13.9	14.1	14.1	14.3	13.6	13.5	16.0	14.4	13.8	14.3	14.4	15.0	14.3	14.3	15.1	13.6	14.2
C59	11.0	10.2	11.0	10.9	11.4	11.5	10.8	11.8	10.8	11.1	11.2	12.6	10.4	11.8	11.5	10.8	12.2	11.4	11.3

Table 22. Average Ranking 111 Series - All STAT Benchmarks

METHODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Average
B04	6.2	5.6	5.9	6.2	5.8	6.0	6.0	5.8	5.5	5.6	5.3	4.9	5.8	5.7	5.6	5.9	5.5	5.4	5.7
B05	4.3	4.4	4.8	4.5	4.7	4.6	4.4	4.8	4.6	4.7	4.8	4.9	4.3	4.6	4.7	4.5	5.0	4.6	4.6
B06	4.1	4.4	4.7	4.8	4.7	4.3	4.7	4.8	4.5	5.0	4.7	4.8	4.7	4.9	4.8	4.8	5.0	5.1	4.7
B07	4.2	4.3	4.2	4.3	4.7	4.4	4.6	4.3	4.4	4.1	4.4	4.5	4.3	4.3	3.9	4.3	4.5	4.3	4.3
B09	4.3	4.3	3.9	4.3	4.0	4.2	4.1	4.5	4.2	4.6	4.4	4.3	4.3	4.0	4.4	4.1	3.8	4.1	4.2
B10	5.2	5.4	5.4	5.2	5.4	5.3	5.6	5.4	5.2	5.2	4.9	5.8	5.4	5.2	5.0	5.2	5.0	5.3	5.3
B11	5.5	5.2	5.2	5.0	4.9	5.2	5.0	4.7	5.3	5.1	5.6	5.2	5.3	5.1	5.9	5.4	5.5	5.4	5.2
B12	6.4	6.5	5.9	6.3	5.8	6.4	5.9	5.8	6.4	6.2	6.4	5.5	6.2	5.8	5.5	5.8	5.5	6.0	6.0
B13	4.8	5.0	5.0	4.5	5.1	4.7	4.9	4.9	4.8	4.7	4.7	5.0	4.8	5.3	5.2	5.0	5.1	4.7	4.9

Table 23. Multiple Comparison with the Mean (ANOM) Average Ranking 111 Series - All Methods

$H_{0.05,35}$ =3.135 $r'_{0.05,35,111}$ = 3.049 Interval = [18.-3.049; 18.+3.049] = [14.951;21.049]

	METHODS	Average	Min Endpoint of the Interval	Max Endpoint of the Interval	Significantly Worse than Average	Significantly Better than Average
1	B00	16.33	14.951	21.049	No	No
2	B01	18.17			No	No
3	B02	17.54			No	No
4	B03	15.30			No	No
5	B04	20.33			No	No
6	B05	16.07			No	No
7	B06	16.48			No	No
8	B07	14.96			No	No
9	B09	14.53			No	**Yes**
10	B10	18.57			No	No
11	B11	18.37			No	No
12	B12	21.65			**Yes**	No
13	B13	16.87			No	No
14	C03	16.15			No	No
15	C11	16.94			No	No
16	C13	16.70			No	No
17	C15	19.57			No	No
18	C17	22.20			**Yes**	No
19	C20	18.03			No	No
20	C24	18.11			No	No
21	C26	18.20			No	No
22	C27	15.47			No	No
23	C28	19.54			No	No
24	C30	21.39			**Yes**	No
25	C31	16.80			No	No
26	C36	18.92			No	No
27	C37	18.14			No	No
28	C38	17.75			No	No
29	C44	17.85			No	No
30	C46	16.35			No	No
31	C49	18.41			No	No
32	C50	16.48			No	No
33	C51	21.11			**Yes**	No
34	C57	22.75			**Yes**	No
35	C59	17.98			No	No

Figure 1.

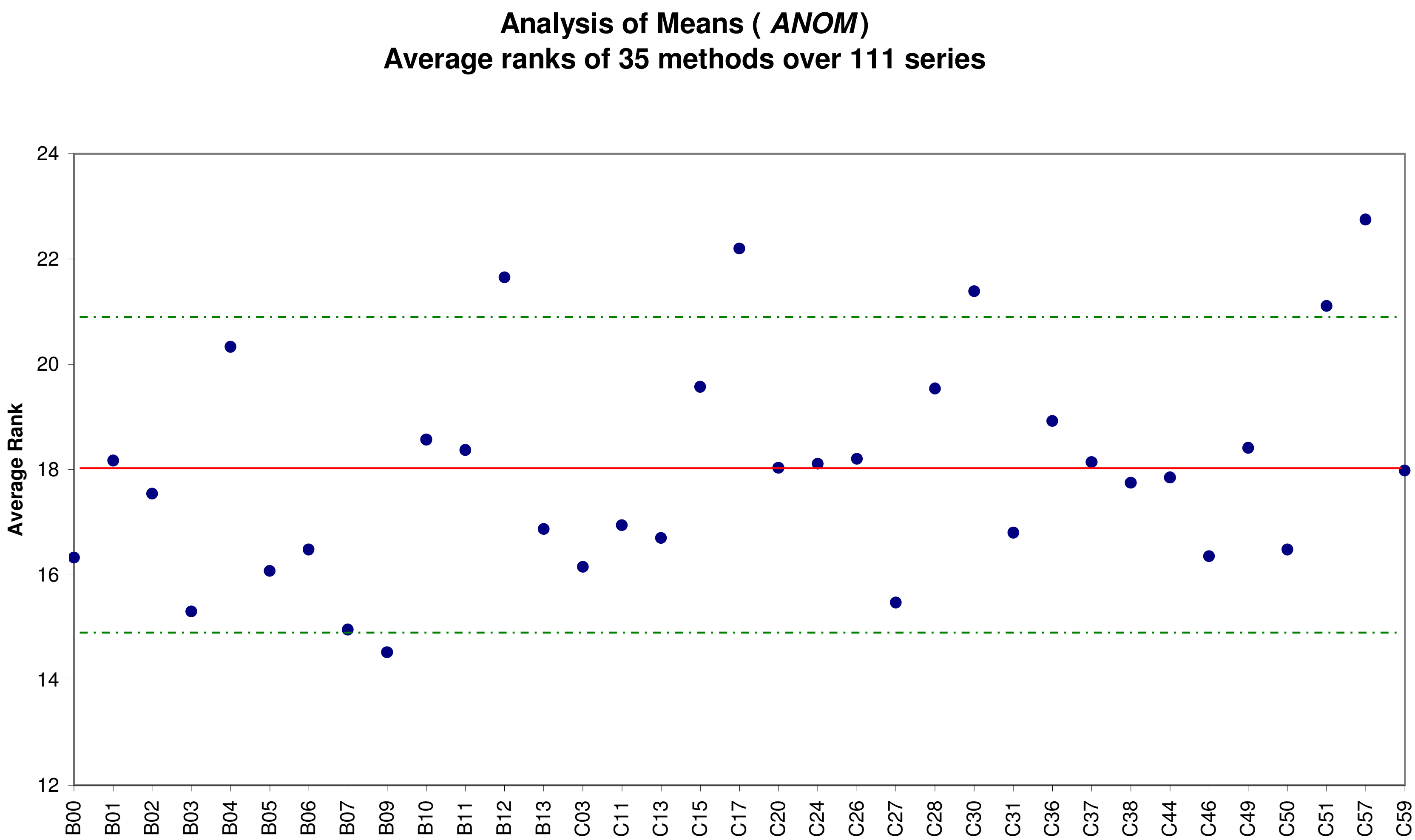

Analysis of Means (ANOM)
Average ranks of 35 methods over 111 series
Average Rank
24
22
20
18
16
14
12
B00
B01
B02
B03
B04
B05
B06
B07
B09
B10
B11
B12
B13
C03
C11
C13
C15
C17
C20
C24
C26
C27
C28
C30
C31
C36
C37
C38
C44
C46
C49
C50
C51
C57
C59

Table 24. Multiple Comparison with the Mean (ANOM) Average Ranking 111 Series - All Competitors

$H_{0.05,22} = 2.973$ $r'_{0.05,22,111} = 1.832$ Interval = [11.5-1.832; 11.5+1.832] = [9.668;13.332]

	METHODS	Average	Min Endpoint of the Interval	Max Endpoint of the Interval	Significantly Worse than Average	Significantly Better than Average
1	C03	10.06	9.668	13.332	No	No
2	C11	10.59			No	No
3	C13	10.42			No	No
4	C15	12.24			No	No
5	C17	13.92			**Yes**	No
6	C20	11.32			No	No
7	C24	11.30			No	No
8	C26	11.35			No	No
9	C27	9.68			No	No
10	C28	12.24			No	No
11	C30	13.39			**Yes**	No
12	C31	10.47			No	No
13	C36	11.80			No	No
14	C37	11.31			No	No
15	C38	11.08			No	No
16	C44	11.13			No	No
17	C46	10.18			No	No
18	C49	11.52			No	No
19	C50	10.29			No	No
20	C51	13.22			No	No
21	C57	14.24			**Yes**	No
22	C59	11.25			No	No

Figure 2.

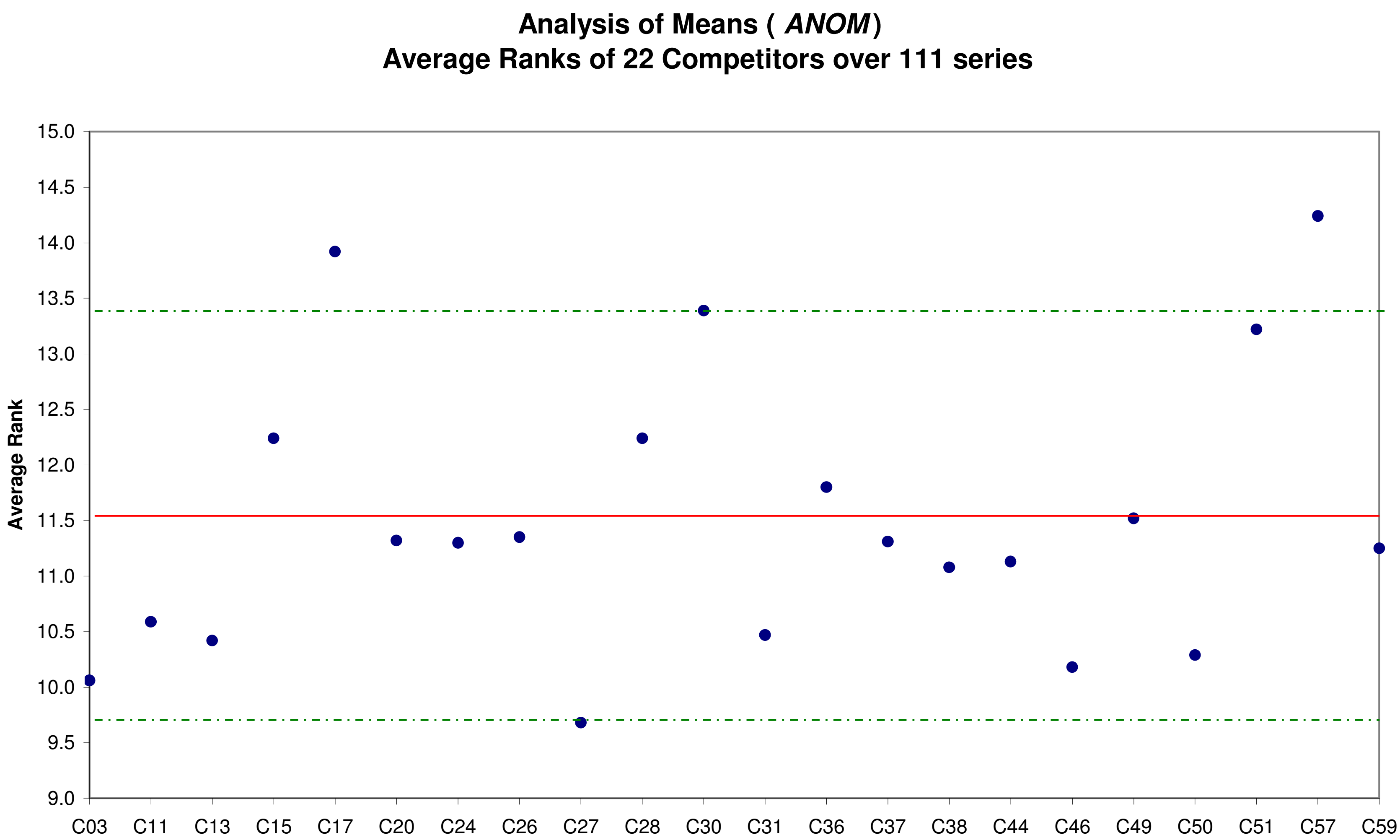

Analysis of Means (ANOM)
Average Ranks of 22 Competitors over 111 series
Average Rank
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
C03
C11
C13
C15
C17
C20
C24
C26
C27
C28
C30
C31
C36
C37
C38
C44
C46
C49
C50
C51
C57
C59

Table 25. Multiple Comparison with the Mean (ANOM) Average Ranking 111 Series - All Benchmarks

$H_{0.05,13}$ =2.757 $r'_{0.05,13,111}$ = 1.019 Interval = [7-1.019; 7+1.019] = [5.981;8.019]

	METHODS	Average	Min Endpoint of the Interval	Max Endpoint of the Interval	Significantly Worse than Average	Significantly Better than Average
1	B00	6.62	5.981	8.019	No	No
2	B01	7.33			No	No
3	B02	7.09			No	No
4	B03	6.28			No	No
5	B04	8.10			**Yes**	No
6	B05	6.57			No	No
7	B06	6.66			No	No
8	B07	6.09			No	No
9	B09	5.97			No	**Yes**
10	B10	7.49			No	No
11	B11	7.41			No	No
12	B12	8.55			**Yes**	No
13	B13	6.86			No	No

Figure 3.

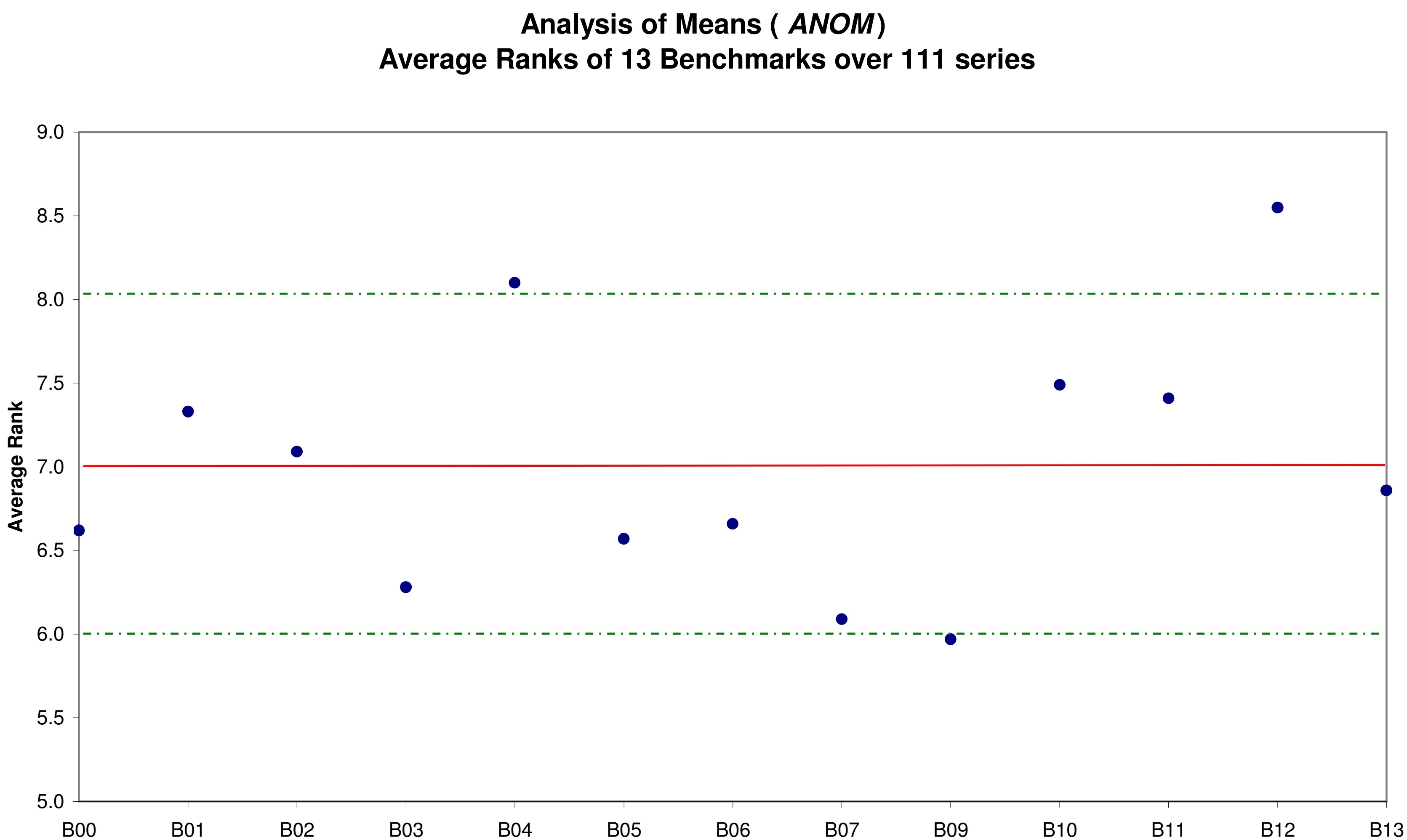

Analysis of Means (ANOM)
Average Ranks of 13 Benchmarks over 111 series
Average Rank
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
B00
B01
B02
B03
B04
B05
B06
B07
B09
B10
B11
B12
B13

Table 26. Multiple Comparison with the Best (MCB) Average Ranks 35 methods - 111 Series - Horizon 12

$q_{0.05,35} = 5.408$ $r_{0.05,35,111} = 5.26$ Interval +/- 5.26/2

	METHODS	Min Interval	Rank Horizon12	Max Interval		Sig.worse than the best
1	B00	13.87	16.50	19.13		NO
2	B01	15.19	17.82	20.45		NO
3	B02	15.07	17.70	20.33		NO
4	B03	12.60	15.23	17.86		NO
5	B04	14.61	17.24	19.87		NO
6	B05	14.36	16.99	19.62		NO
7	B06	14.00	16.63	19.26		NO
8	B07	13.20	15.83	18.46		NO
9	B09	12.33	14.96	17.59		NO
10	B10	17.40	20.03	22.66		NO
11	B11	15.67	18.30	20.93		NO
12	B12	17.62	20.25	22.88	B12	**YES**
13	B13	14.87	17.50	20.13		NO
14	C03	12.44	15.07	17.70		NO
15	C11	13.58	16.21	18.84		NO
16	C13	13.35	15.98	18.61		NO
17	C15	15.39	18.02	20.65		NO
18	C17	19.10	21.73	24.36	C17	**YES**
19	C20	17.30	19.93	22.56		NO
20	C24	14.90	17.53	20.16		NO
21	C26	15.41	18.04	20.67		NO
22	C27	13.29	15.92	18.55		NO
23	C28	17.15	19.78	22.41		NO
24	C30	20.30	22.93	25.56	C30	**YES**
25	C31	14.05	16.68	19.31		NO
26	C36	15.34	17.97	20.60		NO
27	C37	13.69	16.32	18.95		NO
28	C38	15.64	18.27	20.90		NO
29	C44	16.14	18.77	21.40		NO
30	C46	14.02	16.65	19.28		NO
31	C49	14.90	17.53	20.16		NO
32	C50	15.04	17.67	20.30		NO
33	C51	18.47	21.10	23.73	C51	**YES**
34	C57	20.22	22.85	25.48	C57	**YES**
35	C59	17.44	20.07	22.70		NO
		BEST	14.96	17.59	**B09**	

Figure 4.

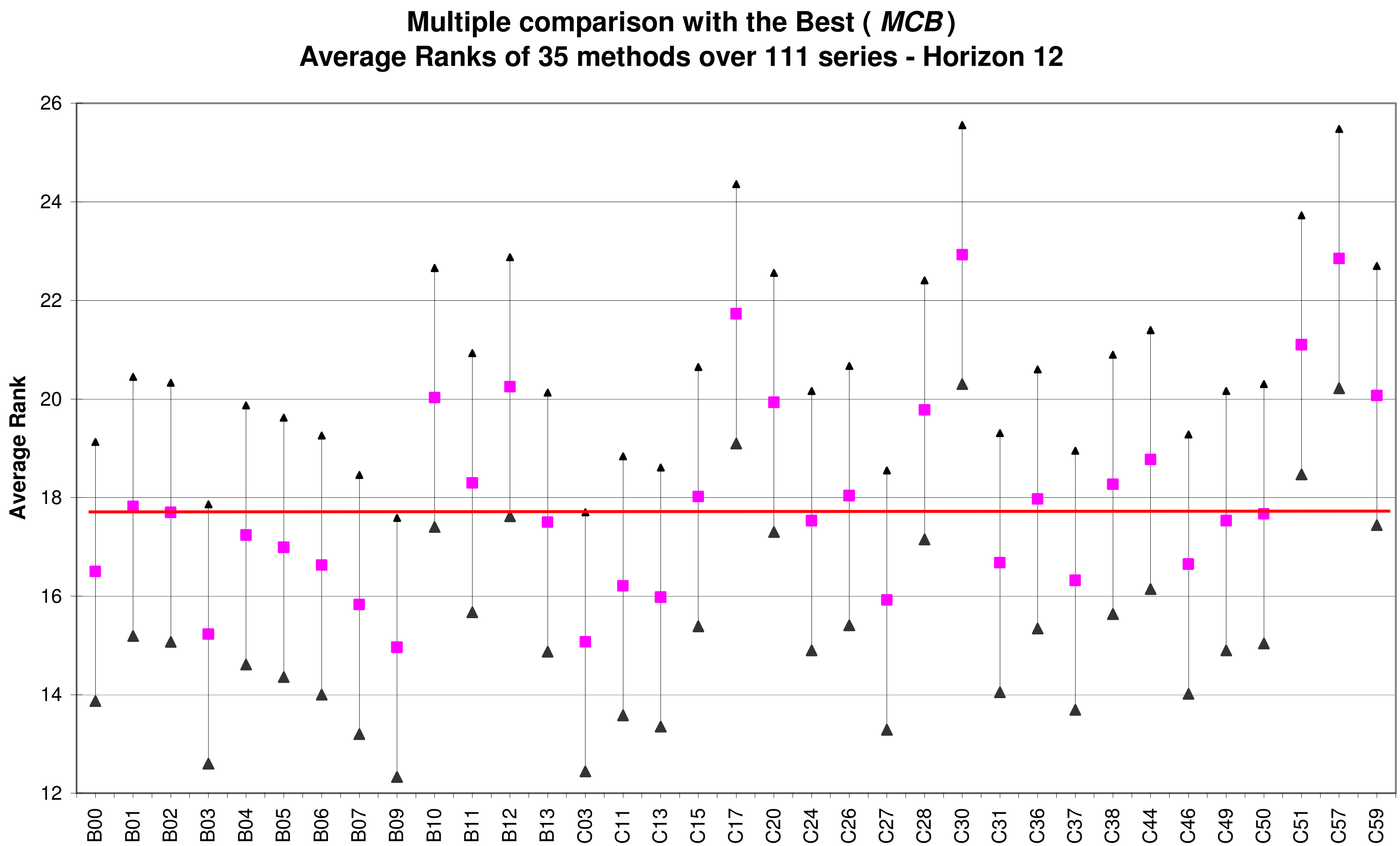
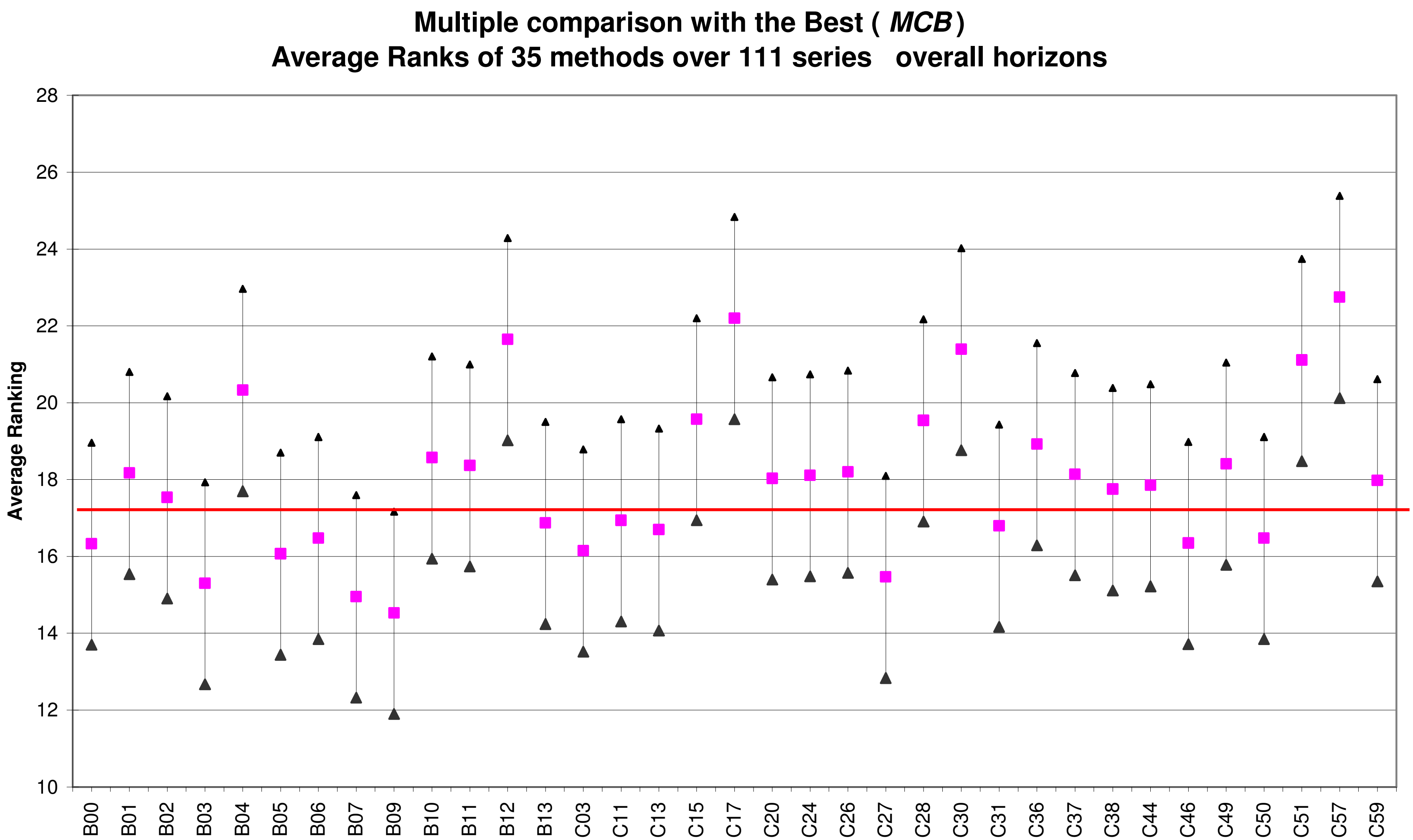

Multiple comparison with the Best (*MCB*)
Average Ranks of 35 methods over 111 series - Horizon 12
Average Rank
26
24
22
20
18
16
14
12
B00
B01
B02
B03
B04
B05
B06
B07
B09
B10
B11
B12
B13
C03
C11
C13
C15
C17
C20
C24
C26
C27
C28
C30
C31
C36
C37
C38
C44
C46
C49
C50
C51
C57
C59

Table 27. Multiple Comparison with the Best (MCB) Average Ranks 35 methods - 111 Series - overall Horizons

$q_{0.05,35}=5.408$ $r_{0.05,35,111} = 5.26$ Interval +/- 5.26/2

	METHODS	Min Interval	Average Rank	Max Interval		Sig. worse than the best
1	B00	13.70	16.33	18.96		NO
2	B01	15.54	18.17	20.80		NO
3	B02	14.91	17.54	20.17		NO
4	B03	12.67	15.30	17.93		NO
5	B04	17.70	20.33	22.96	B04	**YES**
6	B05	13.44	16.07	18.70		NO
7	B06	13.85	16.48	19.11		NO
8	B07	12.33	14.96	17.59		NO
9	B09	11.90	14.53	17.16		NO
10	B10	15.94	18.57	21.20		NO
11	B11	15.74	18.37	21.00		NO
12	B12	19.02	21.65	24.28	B12	**YES**
13	B13	14.24	16.87	19.50		NO
14	C03	13.52	16.15	18.78		NO
15	C11	14.31	16.94	19.57		NO
16	C13	14.07	16.70	19.33		NO
17	C15	16.94	19.57	22.20		NO
18	C17	19.57	22.20	24.83	C17	**YES**
19	C20	15.40	18.03	20.66		NO
20	C24	15.48	18.11	20.74		NO
21	C26	15.57	18.20	20.83		NO
22	C27	12.84	15.47	18.10		NO
23	C28	16.91	19.54	22.17		NO
24	C30	18.76	21.39	24.02	C30	**YES**
25	C31	14.17	16.80	19.43		NO
26	C36	16.29	18.92	21.55		NO
27	C37	15.51	18.14	20.77		NO
28	C38	15.12	17.75	20.38		NO
29	C44	15.22	17.85	20.48		NO
30	C46	13.72	16.35	18.98		NO
31	C49	15.78	18.41	21.04		NO
32	C50	13.85	16.48	19.11		NO
33	C51	18.48	21.11	23.74	C51	**YES**
34	C57	20.12	22.75	25.38	C57	**YES**
35	C59	15.35	17.98	20.61		NO
		BEST	14.53	17.16	**B09**	

Figure 5.


Multiple comparison with the Best (MCB)
Average Ranks of 35 methods over 111 series overall horizons
Average Ranking
28
26
24
22
20
18
16
14
12
10
B00
B01
B02
B03
B04
B05
B06
B07
B09
B10
B11
B12
B13
C03
C11
C13
C15
C17
C20
C24
C26
C27
C28
C30
C31
C36
C37
C38
C44
C46
C49
C50
C51
C57
C59