Supplementary Material for

Evaluation of Statistical and Machine Learning Models for Time Series Prediction: Identifying the State-of-the-art and the Best Conditions for the Use of Each Model

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This supplementary material consists of two pieces of information organized as follows: Section 1 reports the systematic review protocol, including the selected publications and a detailed interpretation of the related work. In Section 2, we briefly described the public files that store, for each predictor and dataset, the values of Mean Square Error (MSE), Theil's U (TU) coefficient, Prediction Of Change In Direction (POCID), as well as the parameters used to obtain such results. The direct links to these files are listed throughout this section.

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1. Systematic Review Protocol

The systematic review consists of a method for literature exploration that allows answer research questions by explicit procedures for the identification, selection, and evaluation of publications (Kitchenham, 2007).

In sound scientific studies, which require novelty and originality, reviewing the literature plays a major role. Therefore, surveying pieces of work in a systematic way is a right decision when one desires to improve his background in productive sectors and/or discover areas with research opportunity. We should note that a systematic review may also include a meta-analysis, which corresponds to a synthesis of the results using statistical techniques.

In this section, from the formulation of ten research questions, we describe the planning, conduction, and reporting of a systematic review of papers developed in the last ten years within the time series prediction field. A meta-analysis of the selected publications was prepared to facilitate the scope identification and current status of the addressed topic.

1.1. Planning

This review aims to answer the following Research Question (RQ):

RQ 1 A robust empirical evaluation aiming at the objective and subjective comparison between parametric and non-parametric methods has already been performed?

From the above main RQ, we formulate some specific research questions, as described next.

RQ 1.1 What are the most used methods for the time series prediction task?

RQ 1.2 Which approach, parametric or non-parametric, is often adopted in real applications?

RQ 1.3 What measures are usually employed to evaluate the performance of prediction algorithms?

RQ 1.4 How are the parameter settings of the predictive models adopted in these studies?

RQ 1.5 What are the time series prediction methods used as baseline in empirical studies?

RQ 1.6 What are the datasets selected for these studies?

RQ 1.7 Are artificial (synthetic) datasets constructed in these studies?

RQ 1.8 What are the disadvantages and/or limitations of the time series prediction methods ascertained in these studies?

RQ 1.9 Are advantages highlighted in the use of machine learning models for time series prediction?

We must emphasize that the research questions were formulated based on the authors' background and refined during the study of the publications found from the systematic review.

In this work, we built a global Search Expression (SE) through the use of Boolean operators on four lists of Related Terms (RT) to the research questions. In what follows, we indicate these RT and the SE.

RT 1 "time series", "time-series", "timeseries";

RT 2 "prediction", "forecasting", "statistics", "statistical", "moving average", "exponential smoothing", "holt", "holt winters", "autoregressive model", "gaussian process", "ARIMA", "SARIMA", "artificial intelligence", "machine learning", "data mining", "knowledge discovery in databases", "ANN", "MLP", "LSTM", "SVM", "kNN", "fuzzy", "wavelet";

RT 3 "evaluation measure", "error measure", "prediction error", "MSE", "RMSE", "MAPE", "SMAPE", "Theil's U", "POCID", "correlation coefficient";

RT 4 "data", "synthetic data", "artificial data", "real data", "dataset", "synthetic dataset", "artificial dataset", "real dataset", "datasets", "synthetic datasets", "artificial datasets", "real datasets", "data set", "synthetic data set", "artificial data set", "real data set", "data sets", "synthetic data sets", "artificial data sets", "real data sets";

SE ("time series" OR "time-series" OR "timeseries") **AND** ("prediction" OR "forecasting" OR "statistics" OR "statistical" OR "moving average" OR "exponential smoothing" OR "holt" OR "holt winters" OR "autoregressive model" OR "gaussian process" OR "ARIMA" OR

"SARIMA" OR "artificial intelligence" OR "machine learning" OR "data mining" OR "knowledge discovery in databases" OR "ANN" OR "MLP" OR "LSTM" OR "SVM" OR "kNN" OR "fuzzy" OR "wavelet") **AND** ("evaluation measure" OR "error measure" OR "prediction error" OR "MSE" OR "RMSE" OR "MAPE" OR "SMAPE" OR "Theil's U" OR "POCID" OR "correlation coefficient") **AND** ("data" OR "synthetic data" OR "artificial data" OR "real data" OR "dataset" OR "synthetic dataset" OR "artificial dataset" OR "real dataset" OR "datasets" OR "synthetic datasets" OR "artificial datasets" OR "real datasets" OR "data set" OR "synthetic data set" OR "artificial data set" OR "real data set" OR "data sets" OR "synthetic data sets" OR "artificial data sets" OR "real data sets").

Currently, there are several electronic databases in which search keys can be submitted. In this context, ACM Digital Library[1], DBLP Computer Science Bibliography[2], Google Scholar[3], IEEE Xplore[4], Scopus[5], and Web of Science[6] are the sources considered in our systematic literature review.

In many cases, the search key must be adapted to suit database limitations, such as the maximum number of topics. The adaptations may include decomposition of the search key into smaller ones and the posterior union of the results.

After searching the sources with the SE, we should apply selection criteria on the identified pieces of work. Next, we specify seven selection criteria. We need to note that all of them are exclusion criteria, such that if a piece of work accomplishes a criterion, it is discarded from the remaining systematic literature review activities.

1. Papers whose the publication year precedes 2009;
2. Pieces of work that perform multivariate time series prediction;
3. Papers that do not suit the research questions;

[1] http://dl.acm.org.
[2] http://dblp.uni-trier.de.
[3] http://scholar.google.com.
[4] http://ieeexplore.ieee.org.
[5] http://www.scopus.com.
[6] http://webofknowledge.com.

4. Duplicated pieces of work written by the same authors. In this case, we kept only the complete one;
5. 1-page abstracts, editorials, presentations, prefaces, awards notes, conference summaries, keynote talks, and tutorials;
6. Publications hosted in web pages which are not accessible through the account of the University of São Paulo or the Brazilian Coordination of Higher Education Personnel Improvement (CAPES);
7. Papers written in a language other than English.

To apply these criteria, we will first need to read the title and abstract of the retrieved publication. If this information is not enough to select the paper, other sections of the publication must be read to make a decision.

Afterward, specific criteria need to be applied in the selected papers to evaluate their methodological quality. In what follows, we described the six quality criteria adopted in this work.

1. Is the paper an empirical study or a review article?
2. Is time series prediction directly related to the publication goal?
3. Are the computational frameworks or datasets used in the study publicly available?
4. Is the parameter setting of the predictive models applied in the publication justified?
5. Does the publication mention any advantage, disadvantage, limitation, and/or implementation issue regarding the use of statistical or machine learning methods for time series prediction?

To take into account the quality criteria, we extract information from each selected paper. Examples of information items include title, journal/proceedings name, publication year, and specific observations associated with each research question.

Finally, we carried out a synthesis of the extracted information to answer the research questions.

1.2. Conducting

We use the systematic review protocol presented in Section 1.1 to select papers developed in the last ten years, *i.e.*, pieces of work published from January 2009 to December 2018.

A total of 3,282 publications were identified and reduced to 1,012 after applying the exclusion criteria. Afterward, we used the selection criteria to

keep only relevant papers. We extracted information from 117 publications obtained at the end of the said procedure. The quality assessment and the synthesis of the extracted information provided the answers to the ten RQ.

Table 1 summarizes the publication information of the selected papers through the systematic review protocol.

Table 1: Summary of information on the identified papers

ID	Item of Interest	Extracted Information
1	Title	A comparative evaluation of nonlinear dynamics methods for time series prediction
	Authors	Francesco Camastra; Maurizio Filippone
	Name of Journal/Proceedings	Neural Computing and Applications
	Publication Year	2009
2	Title	An integrated fuzzy time series forecasting system
	Authors	Hao-TienLiu
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2009
3	Title	Applying wavelets to short-term load forecasting using PSO-based neural networks
	Authors	Z. A. Bashir; M. E. El-Hawary
	Name of Journal/Proceedings	IEEE Transactions on Power Systems
	Publication Year	2009
4	Title	Comparison of direct and iterative artificial neural network forecast approaches in multi-periodic time series forecasting
	Authors	Coskun Hamzacebi; Diyar Akay; Fevzi Kutay
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2009
5	Title	Financial time series forecasting using independent component analysis and support vector regression
	Authors	Chi-Jie Lu; Tian-Shyug Lee; Chih-Chou Chiu
	Name of Journal/Proceedings	Decision Support Systems
	Publication Year	2009
6	Title	Gaussian process for long-term time-series forecasting
	Authors	Weizhong Yan; Hai Qiu; Ya Xue
	Name of Journal/Proceedings	International Joint Conference on Neural Networks
	Publication Year	2009
7	Title	Non-stationary and stationary prediction of financial time series using dynamic ridge polynomial neural network
	Authors	Rozaida Ghazali; Abir Jaafar Hussain; Nazri Mohd Nawi; Baharuddin Mohamad
	Name of Journal/Proceedings	Neurocomputing

	Publication Year	2009
8	Title	Predicting solar radiation at high resolutions: A comparison of time series forecasts
	Authors	Gordon Reikard
	Name of Journal/Proceedings	Solar Energy
	Publication Year	2009
9	Title	Short-term prediction of wind farm power: A data mining approach
	Authors	Andrew Kusiak; Haiyang Zheng; Zhe Song
	Name of Journal/Proceedings	IEEE Transactions on Energy Conversion
	Publication Year	2009
10	Title	A 24-h forecast of solar irradiance using artificial neural network: Application for performance prediction of a grid-connected PV plant at Trieste, Italy
	Authors	Adel Mellit; Alessandro Massi Pavan
	Name of Journal/Proceedings	Solar Energy
	Publication Year	2010
11	Title	A comparative study of reservoir computing strategies for monthly time series prediction
	Authors	F. Wyffels; B. Schrauwen
	Name of Journal/Proceedings	Neurocomputing
	Publication Year	2010
12	Title	A comparison of time series forecasting using support vector machine and artificial neural network model
	Authors	R. Samsudin; A. Shabri; P. Saad
	Name of Journal/Proceedings	Journal of Applied Sciences
	Publication Year	2010
13	Title	A comparison of time series models for forecasting outbound air travel demand
	Authors	Yu-Wei Chang; Meng-Yuan Liao
	Name of Journal/Proceedings	Journal of Aeronautics, Astronautics and Aviation
	Publication Year	2010
14	Title	A comparison of univariate time series methods for forecasting cocoa bean prices
	Authors	K. Assis; A. Amran; Y. Remali; H. Affendy
	Name of Journal/Proceedings	Trends in Agricultural Economics
	Publication Year	2010
15	Title	A neural network-based fuzzy time series model to improve forecasting
	Authors	Tiffany Hui-Kuang Yu; Kun-Huang Huarng
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2010
16	Title	An artificial neural network (p, d, q) model for timeseries forecasting
	Authors	Mehdi Khashei; Mehdi Bijari
	Name of Journal/Proceedings	Expert Systems with Applications

	Publication Year	2010
17	Title	An empirical comparison of machine learning models for time series forecasting
	Authors	Nesreen K. Ahmed; Amir F. Atiya; Neamat El Gayar; Hisham El-Shishiny
	Name of Journal/Proceedings	Econometric Reviews
	Publication Year	2010
18	Title	An experimental study of fitness function and time series forecasting using artificial neural networks
	Authors	Aranildo R. Lima Junior; David A. Silva; Paulo S. Mattos Neto; Tiago A. E. Ferreira
	Name of Journal/Proceedings	Genetic and Evolutionary Computation Conference
	Publication Year	2010
19	Title	An improved fuzzy forecasting method for seasonal time series
	Authors	Hao-Tien Liu; Mao-Len Wei
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2010
20	Title	Combination of long term and short term forecasts, with application to tourism demand forecasting
	Authors	Robert R. Andrawis; Amir F. Atiya; Hisham El-Shishiny
	Name of Journal/Proceedings	International Journal of Forecasting
	Publication Year	2010
21	Title	Conditionally dependent strategies for multiple-step-ahead prediction in local learning
	Authors	Gianluca Bontempi; Souhaib Ben Taieb
	Name of Journal/Proceedings	International Journal of Forecasting
	Publication Year	2010
22	Title	Integrated time series forecasting approaches using moving average; grey prediction, support vector regression and bagging for NNGC
	Authors	Chihli Hung; Xin-Yi Huang; Hao-Kai Lin; Yen-Hsu Hou
	Name of Journal/Proceedings	International Joint Conference on Neural Networks
	Publication Year	2010
23	Title	Meta-learning for time series forecasting and forecast combination
	Authors	Christiane Lemke; Bogdan Gabrys
	Name of Journal/Proceedings	Neurocomputing
	Publication Year	2010
24	Title	Multiple-output modeling for multi-step-ahead time series forecasting
	Authors	Souhaib Ben Taieb; Antti Sorjamaa; Gianluca Bontempi
	Name of Journal/Proceedings	Neurocomputing
	Publication Year	2010
25	Title	Performance of radial basis function and support vector machine in time series forecasting
	Authors	Mazlina Mamat; Salina Abdul Samad
	Name of Journal/Proceedings	International Conference on Intelligent and Advanced Systems

	Publication Year	2010
26	Title	Prediction of daily patient numbers for a regional emergency medical center using time series analysis
	Authors	Hye Jin Kam; Jin Ok Sung; Rae Woong Park
	Name of Journal/Proceedings	Healthcare Informatics Research
	Publication Year	2010
27	Title	Sensitivity analysis for time lag selection to forecast seasonal time series using neural networks and support vector machines
	Authors	Paulo Cortez
	Name of Journal/Proceedings	International Joint Conference on Neural Networks
	Publication Year	2010
28	Title	A comparison study between fuzzy time series model and ARIMA model for forecasting Taiwan export
	Authors	Chi-Chen Wang
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2011
29	Title	A feed-forward neural networks-based nonlinear autoregressive model for forecasting time series
	Authors	Julián A. Pucheta; Cristian M. Rodríguez Rivero; Martín R. Herrera; Carlos A. Salas; H. Daniel Patiño; Benjamín R. Kuchen
	Name of Journal/Proceedings	Computación y Sistemas
	Publication Year	2011
30	Title	A heuristic method for parameter selection in LS-SVM: Application to time series prediction
	Authors	Ginés Rubio; Héctor Pomares; Ignacio Rojas; Luis Javier Herrera
	Name of Journal/Proceedings	International Journal of Forecasting
	Publication Year	2011
31	Title	Advances in forecasting with neural networks? Empirical evidence from the NN3 competition on time series prediction
	Authors	Sven F. Crone; Michèle Hibon; Konstantinos Nikolopoulos
	Name of Journal/Proceedings	International Journal of Forecasting
	Publication Year	2011
32	Title	Forecast combinations of computational intelligence and linear models for the NN5 time series forecasting competition
	Authors	Robert R. Andrawis; Amir F. Atiya; Hisham El-Shishiny
	Name of Journal/Proceedings	International Journal of Forecasting
	Publication Year	2011
33	Title	Hybrid models for future event prediction
	Authors	Giuseppe Amodeo; Roi Blanco; Ulf Brefeld
	Name of Journal/Proceedings	Conference on Information and Knowledge Management
	Publication Year	2011
34	Title	Modified wavelet neural network in function approximation and its application in prediction of time-series pollution data

	Authors	Zarita Zainuddin; Pauline Ong
	Name of Journal/Proceedings	Applied Soft Computing
	Publication Year	2011
35	Title	Recursive multi-step time series forecasting by perturbing data
	Authors	Souhaib Ben Taieb; Gianluca Bontempi
	Name of Journal/Proceedings	International Conference on Data Mining
	Publication Year	2011
36	Title	Time series forecasting by using seasonal autoregressive integrated moving average subset multiplicative or additive model
	Authors	Suhartono
	Name of Journal/Proceedings	Journal of Mathematics and Statistics
	Publication Year	2011
37	Title	The adaptive fuzzy time series model with an application to Taiwan's tourism demand
	Authors	Ruey-Chyn Tsaur; Ting-Chun Kuo
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2011
38	Title	A comparative analysis of alternative univariate time series models in forecasting Turkish inflation
	Authors	A. Nazif Çatik; Mehmet Karaçuka
	Name of Journal/Proceedings	Journal of Business Economics and Management
	Publication Year	2012
39	Title	A comparative study on the forecast of fresh food sales using logistic regression; moving average and BPNN methods
	Authors	Wan-I Lee; Cheng-Wu Chen; Kung-Hsing Chen; Tsung-Hao Chen; Chia-Chi Liu
	Name of Journal/Proceedings	Journal of Marine Science and Technology
	Publication Year	2012
40	Title	A comparison of various forecasting methods for autocorrelated time series
	Authors	Karin Kandananond
	Name of Journal/Proceedings	International Journal of Engineering Business Management
	Publication Year	2012
41	Title	A new class of hybrid models for time series forecasting
	Authors	Mehdi Khashei; Mehdi Bijari
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2012
42	Title	A review and comparison of strategies for multi-step ahead time series forecasting based on the NN5 forecasting competition
	Authors	Souhaib Ben Taieb; Gianluca Bontempi; Amir F. Atiya; Antti Sorjamaa
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2012
43	Title	Application of fuzzy time series models for forecasting pollution concentrations

	Authors	D. Domańska; Marek Wojtylak
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2012
44	Title	Bayesian model for time series with trend; autoregression and outliers
	Authors	Pitsanu Tongkhow; Nantachai Kantanantha
	Name of Journal/Proceedings	International Conference on ICT and Knowledge Engineering
	Publication Year	2012
45	Title	Comparative analysis of machine learning techniques in sale forecasting
	Authors	Suresh Kumar Sharma; Vinod Sharma
	Name of Journal/Proceedings	International Journal of Computer Applications
	Publication Year	2012
46	Title	Hydrological time series modeling: A comparison between adaptive neuro-fuzzy, neural network and autoregressive techniques
	Authors	A. K. Lohani; Rakesh Kumar; R. D. Singh
	Name of Journal/Proceedings	Journal of Hydrology
	Publication Year	2012
47	Title	A Bayesian regularized artificial neural network for stock market forecasting
	Authors	Jonathan L. Ticknor
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2013
48	Title	A homogeneous ensemble of artificial neural networks for time series forecasting
	Authors	Ratnadip Adhikari; R. K. Agrawal
	Name of Journal/Proceedings	International Journal of Computer Applications
	Publication Year	2013
49	Title	A hybrid annual power load forecasting model based on generalized regression neural network with fruit fly optimization algorithm
	Authors	Hong-ze Li; Sen Guo; Chun-jie Li; Jing-qi Sun
	Name of Journal/Proceedings	Knowledge-Based Systems
	Publication Year	2013
50	Title	A time-dependent enhanced support vector machine for time series regression
	Authors	Goce Ristanoski; Wei Liu; James Bailey
	Name of Journal/Proceedings	Conference on Knowledge Discovery and Data Mining
	Publication Year	2013
51	Title	An efficient time series forecasting model based on fuzzy time series
	Authors	Pritpal Singh; Bhogeswar Borah
	Name of Journal/Proceedings	Engineering Applications of Artificial Intelligence
	Publication Year	2013
52	Title	Comparative study of four time series methods in forecasting typhoid fever incidence in China

	Authors	Xingyu Zhang; Yuanyuan Liu; Min Yang; Tao Zhang; Alistair A. Young; Xiaosong Li
	Name of Journal/Proceedings	PLOS ONE
	Publication Year	2013
53	Title	Design of experiments on neural network's parameters optimization for time series forecasting in stock markets
	Authors	Mu-Yen Chen; Min-Hsuan Fan; Young-Long Chen; Hui-Mei Wei
	Name of Journal/Proceedings	International Journal on Non-Standard Computing and Artificial Intelligence
	Publication Year	2013
54	Title	Forecasting models for wind speed using wavelet, wavelet packet, time series and artificial neural networks
	Authors	Hui Liu; Hong-qi Tian; Di-fu Pan; Yan-fei Li
	Name of Journal/Proceedings	Applied Energy
	Publication Year	2013
55	Title	Machine learning methods to forecast temperature in buildings
	Authors	Fernando Mateo; Juan José Carrasco; Abderrahim Sellami; Mónica Millán-Giraldo; Manuel Domínguez; Emilio Soria-Olivas
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2013
56	Title	Monthly rainfall prediction using wavelet neural network analysis
	Authors	R. Venkata Ramana; B. Krishna; S. R. Kumar; N. G. Pandey
	Name of Journal/Proceedings	Water Resources Management
	Publication Year	2013
57	Title	SARIMA (Seasonal ARIMA) implementation on time series to forecast the number of Malaria incidence
	Authors	Adhistya Erna Permanasari; Indriana Hidayah; Isna Alfi Bustoni
	Name of Journal/Proceedings	International Conference on Information Technology and Electrical Engineering
	Publication Year	2013
58	Title	Study of short-term water quality prediction model based on wavelet neural network
	Authors	Longqin Xu; Shuangyin Liu
	Name of Journal/Proceedings	Mathematical and Computer Modelling
	Publication Year	2013
59	Title	Time series analysis of household electric consumption with ARIMA and ARMA models
	Authors	Pasapitch Chujai; Nittaya Kerdprasop; Kittisak Kerdprasop
	Name of Journal/Proceedings	International MultiConference of Engineers and Computer Scientists
	Publication Year	2013
60	Title	A combination of artificial neural network and random walk models for financial time series forecasting
	Authors	Ratnadip Adhikari; R. K. Agrawal
	Name of Journal/Proceedings	Neural Computing and Applications

	Publication Year	2014
61	Title	A comparative study of artificial neural network, adaptive neuro fuzzy inference system and support vector machine for forecasting river flow in the semiarid mountain region
	Authors	Zhibin He; Xiaohu Wen; Hu Liu; Jun Du
	Name of Journal/Proceedings	Journal of Hydrology
	Publication Year	2014
62	Title	A comparison of machine learning techniques for modeling river flow time series: The case of upper Cauvery river basin
	Authors	Shivshanker Singh Patel; Parthasarathy Ramachandran
	Name of Journal/Proceedings	Water Resources Management
	Publication Year	2014
63	Title	A hybrid forecasting approach for HRG parameters based on output time series
	Authors	Qi Ziyang; Li Qinghua; Yi Guoxing; Fang Haibin
	Name of Journal/Proceedings	Chinese Control and Decision Conference
	Publication Year	2014
64	Title	Applications and comparisons of four time series models in epidemiological surveillance data
	Authors	Xingyu Zhang; Tao Zhang; Alistair A. Young; Xiaosong Li
	Name of Journal/Proceedings	PLOS ONE
	Publication Year	2014
65	Title	Employing time-series forecasting to historical medical data: An application towards early prognosis within elderly health monitoring environments
	Authors	Antonis S. Billis; Panagiotis D. Bamidis
	Name of Journal/Proceedings	International Workshop on Artificial Intelligence and Assistive Medicine
	Publication Year	2014
66	Title	Forecasting tourism demand to Catalonia: Neural networks vs. time series models
	Authors	Oscar Claveria; Salvador Torra
	Name of Journal/Proceedings	Economic Modelling
	Publication Year	2014
67	Title	Investigation of empirical mode decomposition in forecasting of hydrological time series
	Authors	Ozgur Kisi; Levent Latifoğlu; Fatma Latifoğlu
	Name of Journal/Proceedings	Water Resources Management
	Publication Year	2014
68	Title	Time series forecasting using least square support vector machine for Canadian Lynx data
	Authors	Shuhaida Ismail; Ani Shabri
	Name of Journal/Proceedings	Jurnal Teknologi
	Publication Year	2014
69	Title	A 24h forecast of solar irradiance using echo state neural networks

	Authors	Tibor Kmet; Maria Kmetova
	Name of Journal/Proceedings	International Conference on Engineering Applications of Neural Networks
	Publication Year	2015
70	Title	A committee of machine learning techniques for load forecasting in a smart grid environment
	Authors	G. Sideratos; A. Ikonomopoulos; N. D. Hatziargyriou
	Name of Journal/Proceedings	International Journal of Energy and Power
	Publication Year	2015
71	Title	A comparative study of empirical mode decomposition-based short-term wind speed forecasting methods
	Authors	Ye Ren; P. N. Suganthan; Narasimalu Srikanth
	Name of Journal/Proceedings	IEEE Transactions on Sustainable Energy
	Publication Year	2015
72	Title	A neural network based linear ensemble framework for time series forecasting
	Authors	Ratnadip Adhikari
	Name of Journal/Proceedings	Neurocomputing
	Publication Year	2015
73	Title	A prediction model for high-frequency financial time series
	Authors	Ricardo de A. Araújo; Adriano L. I. Oliveira; Silvio Meira
	Name of Journal/Proceedings	International Joint Conference on Neural Networks
	Publication Year	2015
74	Title	A study of the use of complexity measures in the similarity search process adopted by kNN algorithm for time series prediction
	Authors	Antonio Rafael Sabino Parmezan; Gustavo E. A. P. A. Batista
	Name of Journal/Proceedings	IEEE International Conference on Machine Learning and Applications
	Publication Year	2015
75	Title	Back propagation neural network with adaptive differential evolution algorithm for time series forecasting
	Authors	Lin Wang; Yi Zeng; Tao Chen
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2015
76	Title	Can Google data improve the forecasting performance of tourist arrivals? Mixed-data sampling approach
	Authors	P. F. Bangwayo-Skeete; R. W. Skeete
	Name of Journal/Proceedings	Tourism Management
	Publication Year	2015
77	Title	Development of statistical time series models for solar power prediction
	Authors	V. Prema; K. Uma Rao
	Name of Journal/Proceedings	Renewable Energy
	Publication Year	2015
78	Title	Forecasting of time series significant wave height using wavelet decomposed neural network

	Authors	R. Prahlada; P. C. Deka
	Name of Journal/Proceedings	Aquatic Procedia
	Publication Year	2015
79	Title	Forecasting stock market indexes using principle component analysis and stochastic time effective neural networks
	Authors	Jie Wang; Jun Wang
	Name of Journal/Proceedings	Neurocomputing
	Publication Year	2015
80	Title	Long-term runoff study using SARIMA and ARIMA models in the United States
	Authors	Mohammad Valipour
	Name of Journal/Proceedings	Meteorological Applications
	Publication Year	2015
81	Title	Maximum and minimum stock price forecasting of Brazilian power distribution companies based on artificial neural networks
	Authors	Leonel A. Laboissiere; Ricardo A. S. Fernandes; Guilherme G. Lage
	Name of Journal/Proceedings	Applied Soft Computing
	Publication Year	2015
82	Title	Support vector regression based prediction of global solar radiation on a horizontal surface
	Authors	Kasra Mohammadi; Shahaboddin Shamshirband; Mohammad Hossein Anisi; Khubaib Amjad Alam; Dalibor Petkovic
	Name of Journal/Proceedings	Energy Conversion and Management
	Publication Year	2015
83	Title	Time series forecasting for nonlinear and non-stationary processes: A review and comparative study
	Authors	Changqing Cheng; Akkarapol Sa-Ngasoongsong; Omer Beyca; Trung Le; Hui Yang; Zhenyu Kong; Satish T. S. Bukkapatnam
	Name of Journal/Proceedings	IIE Transactions
	Publication Year	2015
84	Title	Tourism demand forecasting with neural network models: Different ways of treating information
	Authors	Oscar Claveria; Enric Monte; Salvador Torra
	Name of Journal/Proceedings	International Journal of Tourism Research
	Publication Year	2015
85	Title	A bias and variance analysis for multistep-ahead time series forecasting
	Authors	Souhaib Ben Taieb; Amir F. Atiya
	Name of Journal/Proceedings	IEEE Transactions on Neural Networks and Learning Systems
	Publication Year	2016
86	Title	A comparative analysis of univariate time series methods for estimating and forecasting daily spam in United States
	Authors	Jie Zhang; Gene Moo Lee; Jingguo Wang
	Name of Journal/Proceedings	Americas Conference on Information Systems

	Publication Year	2016
87	Title	A comparison of the performance of ANN and SVM for the prediction of traffic accident duration
	Authors	B. Yu; Y. T. Wang; J. B. Yao; J. Y. Wang
	Name of Journal/Proceedings	Neural Network World
	Publication Year	2016
88	Title	A hybrid ANFIS model based on empirical mode decomposition for stock time series forecasting
	Authors	Liang-Ying Wei
	Name of Journal/Proceedings	Applied Soft Computing
	Publication Year	2016
89	Title	A variational mode decompoisition approach for analysis and forecasting of economic and financial time series
	Authors	Salim Lahmiri
	Name of Journal/Proceedings	Expert Systems with Applications: An International Journal
	Publication Year	2016
90	Title	Artificial neural networks architectures for stock price prediction: comparisons and applications
	Authors	L. Di Persio; O. Honchar
	Name of Journal/Proceedings	International Journal of Circuits, Systems and Signal Processing
	Publication Year	2016
91	Title	Comparison of China's primary energy consumption forecasting by using ARIMA (the autoregressive integrated moving average) model and GM (1; 1) model
	Authors	C. Yuan; S. Liu; Z. Fang
	Name of Journal/Proceedings	Energy
	Publication Year	2016
92	Title	Estimation of the daily global solar radiation based on Box-Jenkins and ANN models: A combined approach
	Authors	Kacem Gairaa; Abdallah Khellaf; Youcef Messlem; Farouk Chellali
	Name of Journal/Proceedings	Renewable and Sustainable Energy Reviews
	Publication Year	2016
93	Title	k-Nearest neighbor model for multiple-time-step prediction of short-term traffic condition
	Authors	Bin Yu; Xiaolin Song; Feng Guan; Zhiming Yang; Baozhen Yao
	Name of Journal/Proceedings	Journal of Transportation Engineering
	Publication Year	2016
94	Title	Modeling river discharge time series using support vector machine and artificial neural networks
	Authors	Mohammad Ali Ghorbani; Rahman Khatibi; Arun Goel; Mohammad Hasan FazeliFard; Atefeh Azani
	Name of Journal/Proceedings	Environmental Earth Sciences
	Publication Year	2016

95	Title	Travel time prediction with LSTM neural network
	Authors	Yanjie Duan; Yisheng Lv; Fei-Yue Wang
	Name of Journal/Proceedings	IEEE International Conference on Intelligent Transportation Systems
	Publication Year	2016
96	Title	A Bayesian approach to demand forecasting for new equipment programs
	Authors	Jennifer J. Bergmana; James S. Noblea; Ronald G. McGarveya; Randolph L. Bradley
	Name of Journal/Proceedings	Robotics and Computer-Integrated Manufacturing
	Publication Year	2017
97	Title	A Bayesian network model for prediction of weather-related failures in railway turnout systems
	Authors	Guang Wang; Tianhua Xu; Tao Tang; Tangming Yuan; Haifeng Wang
	Name of Journal/Proceedings	Expert Systems with Applications
	Publication Year	2017
98	Title	An improved neural network-based approach for short-term wind speed and power forecast
	Authors	G. W. Chang; H. J. Lu; Y. R. Chang; Y. D. Lee
	Name of Journal/Proceedings	Renewable Energy
	Publication Year	2017
99	Title	Boosted neural networks for improved short-term electric load forecasting
	Authors	A. S. Khwaja; X. Zhang; A. Anpalagan; B. Venkatesh
	Name of Journal/Proceedings	Electric Power Systems Research
	Publication Year	2017
100	Title	Hybrid regression model for near real-time urban water demand forecasting
	Authors	Bruno M. Brentan; Edevar Luvizotto Jr.; Manuel Herrera; Joaquín Izquierdo; Rafael Pérez-García
	Name of Journal/Proceedings	Journal of Computational and Applied Mathematics
	Publication Year	2017
101	Title	Long short-term memory neural network for air pollutant concentration predictions: Method development and evaluation
	Authors	X. Li; L. Peng; X. Yao; S. Cui; Y. Hu; C. You; T. Chi
	Name of Journal/Proceedings	Environmental Pollution
	Publication Year	2017
102	Title	LSTM network: a deep learning approach for short-term traffic forecast
	Authors	Zheng Zhao; Weihai Chen; Xingming Wu; Peter C. Y. Chen; Jingmeng Liu
	Name of Journal/Proceedings	IET Intelligent Transport Systems
	Publication Year	2017
103	Title	Multi-step ahead electricity price forecasting using a hybrid model based on two-layer decomposition technique and BP neural network optimized by firefly algorithm
	Authors	D. Wang; H. Luo; O. Grunder; Y. Lin; H. Guo
	Name of Journal/Proceedings	Applied Energy

	Publication Year	2017
104	Title	Multi-step ahead time series forecasting for different data patterns based on LSTM recurrent neural network
	Authors	Liu Yunpeng; Hou Di; Bao Junpeng; Qi Yong
	Name of Journal/Proceedings	Web Information Systems and Applications
	Publication Year	2017
105	Title	Prediction of functional ARMA processes with an application to traffic data
	Authors	J. Klepsch; C. Klüppelberg; T. Wei
	Name of Journal/Proceedings	Econometrics and Statistics
	Publication Year	2017
106	Title	Short-term trafc speed prediction for an urban corridor
	Authors	Baozhen Yao; Chao Chen; Qingda Cao; Lu Jin; Mingheng Zhang; Hanbing Zhu; Bin Yu
	Name of Journal/Proceedings	Computer-Aided Civil and Infrastructure Engineering
	Publication Year	2017
107	Title	Forecasting accuracy evaluation of tourist arrivals
	Authors	Hossein Hassani; Emmanuel Sirimal Silva; Nikolaos Antonakakis; George Filis; Rangan Gupta
	Name of Journal/Proceedings	Annals of Tourism Research
	Publication Year	2017
108	Title	Short-term residential load forecasting based on LSTM recurrent neural network
	Authors	Weicong Kong; Zhao Yang Dong; Youwei Jia; David J. Hill; Yan Xu; Yuan Zhang
	Name of Journal/Proceedings	IEEE Transactions on Smart Grid
	Publication Year	2017
109	Title	Short-term traffic flow prediction with LSTM recurrent neural network
	Authors	Danqing Kang; Yisheng Lv; Yuan-yuan Chen
	Name of Journal/Proceedings	IEEE International Conference on Intelligent Transportation Systems
	Publication Year	2017
110	Title	Combining LSTM network ensemble via adaptive weighting for improved time series forecasting
	Authors	Jae Young Choi; Bumshik Lee
	Name of Journal/Proceedings	Mathematical Problems in Engineering
	Publication Year	2018
111	Title	Design and implementation of the SARIMA-SVM time series analysis algorithm for the improvement of atmospheric environment forecast accuracy
	Authors	Nam-Uk Lee; Jae-Sung Shim; Yong-Wan Ju; Seok-Cheon Park
	Name of Journal/Proceedings	Soft Computing
	Publication Year	2018
112	Title	Empirical mode decomposition, extreme learning machine and long short-term memory for time series prediction: A comparative study
	Authors	Elivelto Ebermam; Gabriel De Angelo; Helder Knidel; Renato Krohling

	Name of Journal/Proceedings	Brazilian Conference on Intelligent Systems
	Publication Year	2018
113	Title	Financial time series prediction based on deep learning
	Authors	Hongju Yan; Hongbing Ouyang
	Name of Journal/Proceedings	Wireless Personal Communications
	Publication Year	2018
114	Title	Forecasting air quality time series using deep learning
	Authors	Brian S. Freeman; Graham Taylor; Bahram Gharabaghi; Jesse Thé
	Name of Journal/Proceedings	Journal of the Air & Waste Management Association
	Publication Year	2018
115	Title	Hourly day-ahead solar irradiance prediction using weather forecasts by LSTM
	Authors	Xiangyun Qing; Yugang Niu
	Name of Journal/Proceedings	Energy
	Publication Year	2018
116	Title	Time series analysis of malaria in Kumasi: Using ARIMA models to forecast future incidence
	Authors	Reindolf Anokye; Enoch Acheampong; Isaac Owusu; Edmund Isaac Obeng
	Name of Journal/Proceedings	Cogent Social Sciences
	Publication Year	2018
117	Title	Time-series prediction of wind speed using machine learning algorithms: A case study Osorio wind farm, Brazil
	Authors	A. Khosravi; L. Machado; R. O. Nunes
	Name of Journal/Proceedings	Applied Energy
	Publication Year	2018

1.3. Reporting

The analysis of the 117 papers found in the systematic review allowed us to elaborate the subsequent meta-analysis:

Time series prediction methods: Considering the frequency with which the methods appeared in the publications, 61.54% of the papers employed Artificial Neural Networks (ANN), 52.14% built Autoregressive Integrated Moving Average (ARIMA) or Seasonal Autoregressive Integrated Moving Average (SARIMA) models, 36.75% applied Support Vector Machines (SVM), 26.50% used hybrid techniques, 12.82% comprised variations of the k-Nearest Neighbors (kNN) algorithm, 11.97% contemplated Fuzzy Logic-based methods (FL), 11.11% employed Deep

Learning (DL), 10.26% built Moving Average (MA) models, 8.55% used Bayesian Neural Networks (BNN), 7.69% applied Simple Exponential Smoothing (SES) and Wavelet Transform (WT), 6.84% adopted Holt-Winters (HW) models, and 3.42% considered Gaussian Process (GP);

Time series prediction approaches: Real applications were the subject of 68 papers, of which 54.41% used algorithms derived from the non-parametric approach, 25.00% employed parametric approach methods, and 20.59% built hybrid models based on both approaches;

Performance measures: Figure 1 presents the frequency with which the measures were considered in the publications. The following listing provides the acronyms meaning used in this figure: Mean Absolute Percent Error (MAPE), Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Squared Error (MSE), Symmetric Mean Absolute Error (SMAPE), Determination Coefficient (R2), Mean Bias Error (MBE), Absolute Average Scale Error (MASE), Correlation Coefficient (R), Mean Absolute Deviation (MAD), Normalized Mean Square Error (NMSE), Average Relative Variance (ARV), Normalized Root Mean Square Error (NRMSE), Relative Absolute Error (RAE), and Sum Squared Error (SSE);

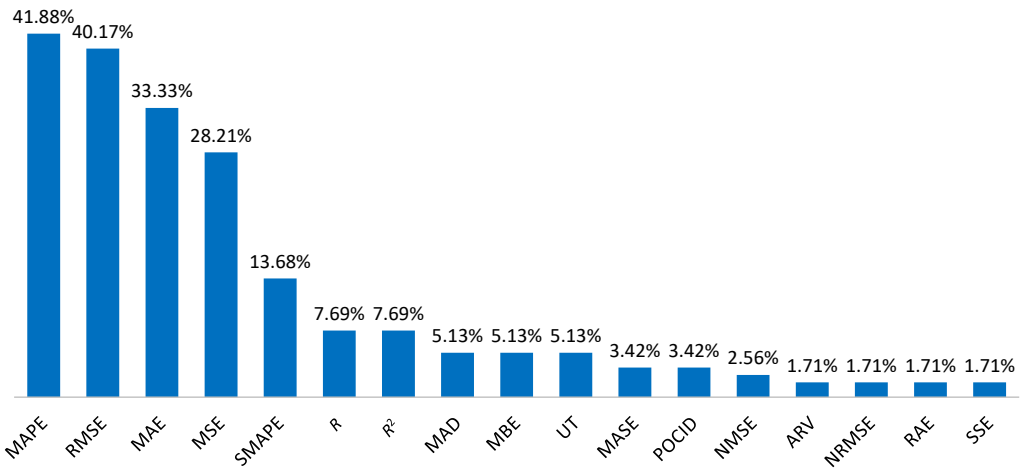

Figure 1: Percentage of the number of publications which adopted a specific performance measure

Parameters setting: 89.74% of the selected papers applied some search technique for parameters setting. Among these techniques are the training-test – also called split-sample or holdout validation –, the cross-validation, and the one developed by Box et al. (2015), which is addressed to the ARIMA category models;

Baseline methods: Empirical evaluations involving both statistical and machine learning predictors were explored in 29 papers, of which 65.52% employed the ARIMA model as baseline method, 20.69% applied the MA method, 10.34% used the SES algorithm, and 3.45% considered the HW model;

Real datasets: The use of real datasets was present in 115 publications, of which 62.61% applied data produced by institutions, companies or industries, 9.56% analyzed data granted in performance competitions, and 27.83% investigated data maintained by repositories, such as UCI Machine Learning Repository (Bache and Lichman, 2013), ICMC-USP Time Series Prediction Repository (Parmezan and Batista, 2014), and Time Series Data Library[7];

Synthetic datasets: 7.69% of the selected papers constructed synthetic datasets to evaluate the performance of prediction algorithms. These datasets were generated to contain specific properties, such as the presence or absence of trend and/or seasonality;

Tools for time series prediction: Among the computational environments used in the publications are MATLAB[8], R[9] programming language, Microsoft Excel[10], SPSS[11], MINITAB[12], Python[13] programming language, WEKA (Witten et al., 2011), Mathematica[14], Phicast[15], and

[7] http://robjhyndman.com/TSDL.
[8] http://www.mathworks.com/products/matlab.
[9] http://www.r-project.org.
[10] https://products.office.com/excel.
[11] http://www.ibm.com/software/analytics/spss.
[12] http://www.minitab.com.
[13] https://www.python.org.
[14] https://www.wolfram.com/mathematica/.
[15] http://phicast.software.informer.com.

STATISTICA[16]. The graph in Figure 2 shows how often these tools appeared on the pieces of work.

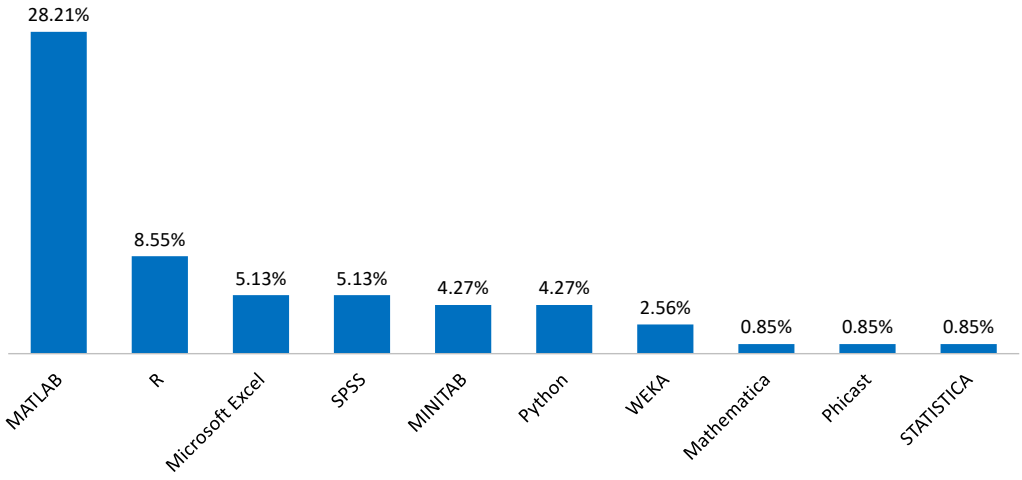

Figure 2: Percentage of the number of publications that included a particular computational tool

During the preparation of the meta-analysis, we verified that 11 pieces of works, out of a total of 117, involved experimental evaluations focused on the behavior interpretation of the most popular prediction methods. Next, we present a summary of the 11 publications identified.

1. Different methods for supply chain demand forecasting was investigated in Carbonneau et al. (2008). The experiments included three variations of SES, Naïve forecasting, Multiple Linear Regression, and three machine learning models: ANN, Recurrent Neural Networks (RNN), and SVM. The authors evaluate two datasets: one obtained from the simulated supply chain, and another one from actual Canadian Foundries orders. The results with respect to MAE suggest that while RNN and SVM made the best predictions, their performance was not statistically significantly better than that of the regression algorithm;
2. Taylor (2008) performs a comparison of methods for forecasting intraday arrivals at a call center. From five time series of intraday arrivals

[16] http://www.statsoft.com/Products/STATISTICA.

for call centers operated by a retail bank in the United Kingdom and considering a time horizon of one half-hour ahead to two weeks ahead, this study evaluated an extension of HW, two variations of ARIMA (seasonal and periodic), Robust Exponential Smoothing, and Dynamic Harmonic Regression. The results regarding three prediction measures – MAE, MAPE, and Root Mean Squared Percentage Error – indicate strong potential for the use of seasonal ARIMA modeling and the HW variation for predicting up to about two to three days ahead. According to the authors, for longer lead times, a simplistic historical average is difficult to beat;

3. A comparative study of eight machine learning regression algorithms was presented in Ahmed et al. (2010). The investigated models were Multilayer Perceptron (MLP), GP, SVM, kNN, BNN, Generalized Regression Neural Networks, CART Regression Trees, and Radial Basis Functions (RBF). The predictors were evaluated on datasets provided by the M3 Competition and had their parameters estimated through cross-validation with ten partitions. The results showed that besides the influence of preprocessing techniques in the performance of the methods, the MLP and GP models were significantly more promising. The authors explained that this is an interesting result since the potential of GP remained unexplored in recent years;
4. Cortez (2010) proposes an algorithm for the determination of the non-parametric model, ANN or SVM, more suitable for multi-step-ahead time series prediction. This predictor seeks the suboptimal value of a lag variable (time lag) using the grid search strategy and backward selection search direction guided by a sensitivity analysis. The experimental protocol covered eight seasonal time series and two measures for performance evaluation, MSE and SMAPE. The researchers compared the machine learning methods against the parametric HW model. The results demonstrated the effectiveness of the SVM model adjusted by the estimates of the time lag parameter;
5. An experimental comparison involving two machine learning regression methods (ANN and SVM) and a conventional statistical algorithm (ARIMA) was carried out in Kandananond (2012). The authors evaluate six real datasets concerning the demand for consumer products in Thailand. Each one of these datasets was previously analyzed to the models' construction, according to the Q statistic of Ljung-Box to verify the existence of autocorrelation of the residues. According to

the MAPE measure, SVM provided the best predictions for all product categories. The ARIMA method, which is based on an autocorrelation structure, exhibited the worst results. Besides, the authors noticed that autocorrelated data affect the SVM's performance, since the higher autocorrelation degree implied in a smaller number of support vectors;

6. The research conducted in Ristanoski et al. (2013) emphasized that integrating time elements into the learning process is the major challenge in the use of SVM for prediction since they are susceptible to errors when distribution changes frequently occur over the time series. To assist in this issue, the authors investigated the errors distribution of SVM projections. Once the samples that produced the largest errors were identified, their correlation with the changes that occurred in the distribution of the historical series was observed. The understanding of this behavior motivated the authors to propose a time-dependent loss function, which enables the inclusion of information about the distribution changes of the series in the learning process. The experiments contemplated real data – 35 time series referring to stock market values and measurements of physical and chemical phenomena –, and synthetic data – five versions of a dataset with different distribution levels. The authors compared the proposed algorithm with its alternative version, which adopts quadratic average, and with six other predictors: ANN, kNN, SVM, RBF, Robust Regression, and SARIMA. The RMSE results suggested that the use of a time-dependent loss function can reduce the overall error variance and lead to more accurate predictions;
7. Claveria and Torra (2014) investigated the predictive performance of the following methods: ANN, ARIMA, and Self-Exciting Threshold Autoregressive (SETAR). Preprocessed monthly data of overnight stays and arrivals of international tourists to Catalonia between 2001 and 2009 were adopted as official indicators of tourism demand. In a comparison considering different prediction horizons, the ARIMA model overcame the ANN and SETAR algorithms, especially for shorter horizons. The ANN results showed a trade-off between the degree of preprocessing and the quality of the predictions, which were more accurate in the presence of nonlinearity in the data. Due to the different patterns of the consumer conduct in tourism, the researchers verified that the predictions of arrivals were more precise than those of overnight stays of foreigners;

8. An empirical study that covered four time series prediction methods, *i.e.*, Linear Regression, SES, SARIMA, and SVM, was conceived in Zhang et al. (2014). Nine datasets on infectious diseases were collected from a national public health surveillance system in China. The results achieved according to the MAE, MAPE and MSE measures, showed that although the SVM exceeded the performance of the statistical models in most cases, none investigated method was significantly better than the others;
9. Parmezan and Batista (2015) proposed the k-Nearest Neighbors – Time Series Prediction with Invariances (kNN-TSPI) algorithm. This method is a modification of the well-known kNN to deal with amplitude and offset invariance, complexity invariance, and treatment of trivial matches. The authors evaluated kNN-TSPI on 55 datasets from real domains. In comparison with two machine learning regression models (MLP and SVM), kNN-TSPI outperformed MLP and did not present statistically significant difference concerning SVM;
10. A comparative analysis of univariate time series methods for estimating and predicting daily spam in the United States was carried out in Zhang et al. (2016). This case study explored the following models: ARIMA, HES, SES, and Neutral Network Autoregressive (NNAR). The results regarding MAE, MAPE, RMSE, and SSE suggest that HES and NNAR can lead to more accurate spam prediction;
11. Hassani et al. (2017) evaluated nine algorithms for the prediction task of tourism demand in European countries: ARIMA, Fractionalized ARIMA, Trigonometric Box-cox ARMA Trend Seasonal, MA, SES, Weighted Moving Average, ANN, and two versions of Singular Spectrum Analysis. The experimental protocol included datasets concerning the number of international tourist arrivals in 10 European countries, as well two performance measures: RMSE and POCID. The authors concluded that no single model could provide the best forecasts for any of the countries in the short, medium and long horizons.

As can be seen from the related work, machine learning predictors for time series prediction have provided very competitive results, often outperforming state-of-the-art statistical methods.

2. Raw Results

The files containing the raw results concerning MSE, TU and POCID measures for ten predictors and 95 datasets can be downloaded as XLSX in the following links:

- https://goo.gl/k8mQXk: This file covers the values of the three performance indexes applied on the predictions computed from the multi-step-ahead projection strategy with approximate iteration;
- https://goo.gl/9uZIIQ: This file contemplates the results of the three performance measures executed on the predictions obtained from the multi-step-ahead projection strategy with updated iteration.

Both files are composed of 14 spreadsheets. The first eleven report, for each prediction algorithm and dataset, the values of MSE, TU and POCID, as well as the parameters used to obtain such results. The last three summarize, considering all predictive models and datasets, the results of each performance measure.

References

Ahmed, N. K., Atiya, A. F., Gayar, N. E., El-Shishiny, H., 2010. An empirical comparison of machine learning models for time series forecasting. Econometric Reviews 29 (5-6), 594–621.

Bache, K., Lichman, M., 2013. UCI machine learning repository. School of Information and Computer Sciences, University of California, Irvine, United States of America.
URL http://archive.ics.uci.edu/ml

Box, G. E. P., Jenkins, G. M., Reinsel, G. C., Ljung, G. M., 2015. Time series analysis: Forecasting and control, 5th Edition. Wiley Series in Probability and Statistics. Wiley, New Jersey, United States of America.

Carbonneau, R., Laframboise, K., Vahidov, R., 2008. Application of machine learning techniques for supply chain demand forecasting. European Journal of Operational Research 184 (3), 1140–1154.

Claveria, O., Torra, S., 2014. Forecasting tourism demand to Catalonia: Neural networks vs. time series models. Economic Modelling 36 (C), 220–228.

Cortez, P., 2010. Sensitivity analysis for time lag selection to forecast seasonal time series using neural networks and support vector machines. In: International Joint Conference on Neural Networks. IEEE, Barcelona, Spain, pp. 3694–3701.

Hassani, H., Silva, E. S., Antonakakis, N., Filis, G., Gupta, R., 2017. Forecasting accuracy evaluation of tourist arrivals. Annals of Tourism Research 63, 112–127.

Kandananond, K., 2012. A comparison of various forecasting methods for autocorrelated time series. International Journal of Engineering Business Management 4, 1–6.

Kitchenham, B. A., 2007. Guidelines for performing systematic literature reviews in software engineering. Tech. rep., Evidence-based Software Engineering, EBSE-2007-01, United Kingdom.

Parmezan, A. R. S., Batista, G. E. A. P. A., 2014. ICMC-USP time series prediction repository. Instituto de Ciências Matemáticas e de Computação, Universidade de São Paulo, São Carlos, Brasil.
URL https://goo.gl/uzxGZJ

Parmezan, A. R. S., Batista, G. E. A. P. A., 2015. A study of the use of complexity measures in the similarity search process adopted by kNN algorithm for time series prediction. In: International Conference on Machine Learning and Applications. IEEE, Miami, United States of America, pp. 45–51.

Ristanoski, G., Liu, W., Bailey, J., 2013. A time-dependent enhanced support vector machine for time series regression. In: International Conference on Knowledge Discovery and Data Mining. ACM, Chicago, United States of America, pp. 946–954.

Taylor, J. W., 2008. A comparison of univariate time series methods for forecasting intraday arrivals at a call center. Management Science 54 (2), 253–265.

Witten, I. H., Frank, E., Hall, M. A., 2011. Data mining: Practical machine learning tools and techniques, 3rd Edition. The Morgan Kaufmann Series in Data Management Systems. Morgan Kaufmann, San Francisco, United States of America.

Zhang, J., Lee, G. M., Wang, J., 2016. A comparative analysis of univariate time series methods for estimating and forecasting daily spam in United States. In: Twenty-second Americas Conference on Information Systems. San Diego, United States of America, pp. 1–10.

Zhang, X., Zhang, T., Young, A. A., Li, X., 2014. Applications and comparisons of four time series models in epidemiological surveillance data. PLOS ONE 9 (2).