MONASH University

MONASH BUSINESS SCHOOL

What makes a good prediction interval or probabilistic forecast?

Beinan Xu

(supervisor:Professor Rob Hyndman)

24 May 2018

Introduction

Scoring Rules

- Interval scores
- Distribution scores

Case study

There are two case studies * ASX 200 * M3 datasets

Scoring Rules

- Introdution
  - Concept
  - Functions

Interval forecast

Winkler loss scoring rule is selected to evaluate interval forecasts.

- Introduction
- Reasons for choosing it

Winkler loss scoring rules

$$S_{\alpha}^{int}(l,u;x) = (u-l) + \frac{2}{\alpha}(l-x)1\{x<l\} + \frac{2}{\alpha}(x-u)1\{x>u\}$$

Probabilistic forecast

Three scoring are chosen to evaluate probabilistic forecasts

Logarithmic score

$$LogS(F, y) = logF(y)$$

Continuous Ranked Probability Score

$$CRPS(F, y) = \int_{-\infty}^{\infty} (F(x) - 1\{y \leq x\})^2 dx$$

Dawid-Sebastianti score

$$DSS(F, y) = \frac{(y - \mu_F)^2}{\sigma_F^2} + 2log\sigma_F$$

Case study one: ASX200

- Data information
  - Introduction
  - Feature

Evaluating by interval score

- Models selection
- Evaluation results

ARIMA model select

Finding method

- auto.arima
  - How to work
  - AIC

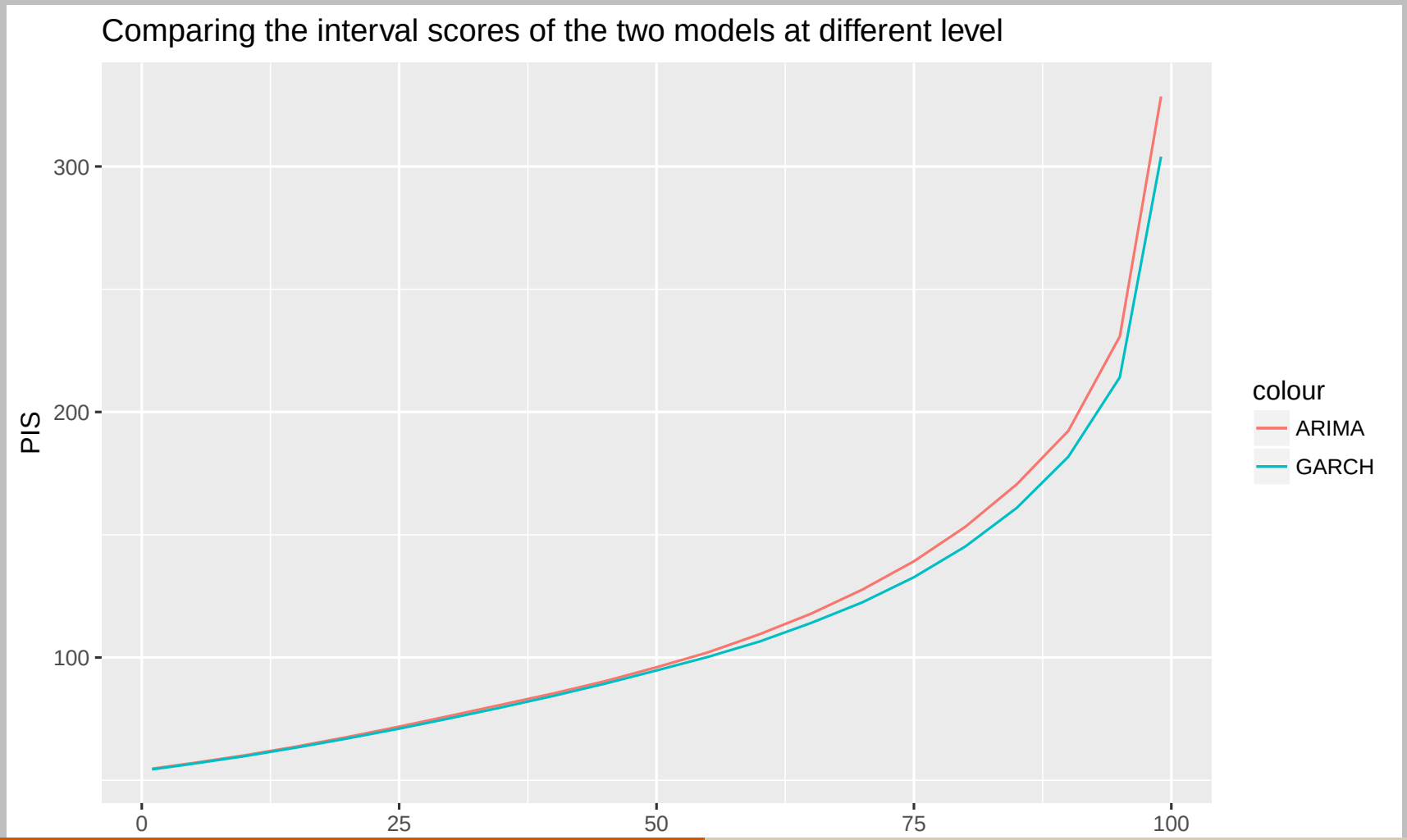
GARCH model select

Table 1: Garch model select

	AIC	BIC	SIC	HQIC
garch11	10.608	10.623	10.608	10.614
garch12	10.609	10.626	10.609	10.615
garch21	10.609	10.626	10.609	10.616
garch22	10.610	10.629	10.610	10.617
arch1	10.779	10.791	10.779	10.783
arch2	10.729	10.744	10.729	10.734

Evaluating interval forecasts for two models

Comparing two models



Evaluation of probablisitic forecasts

- how to forecast and evaluation.

Result of evaluation

Table 2: Scoring Rules for MA model and GARCH model

	CRPS	LogS	DSS
GARCH	20.70	5.10	8.36
ARIMA	21.13	5.14	8.45

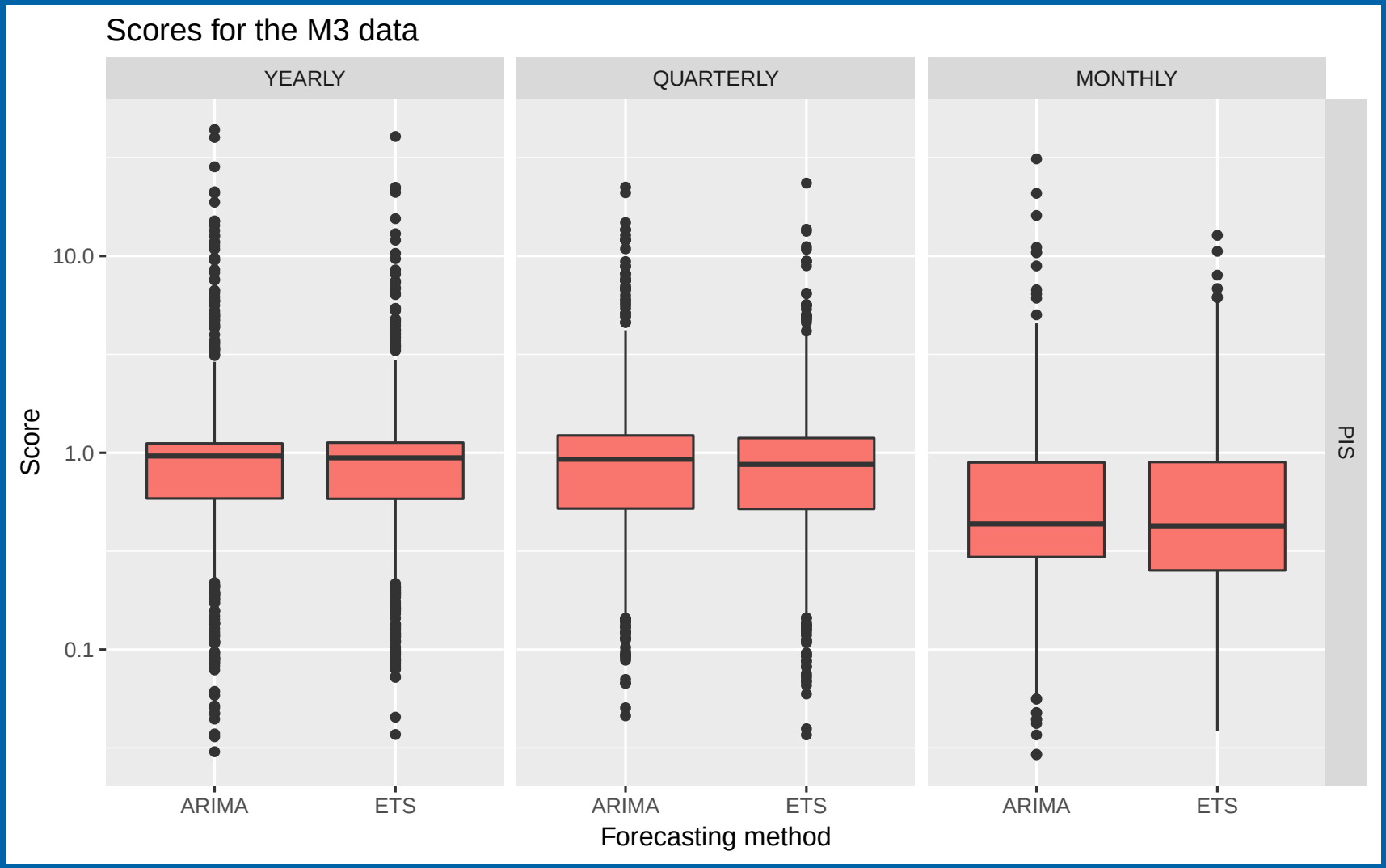
Case study two: M3 data set

- The information of M3 dataset

Evaluating by interval forecast

- Models selection
- Standardization for data

Evaluating interval scores



Evaluating by probilistic forecasts

- Models selection
- Standardization for data

conclusion

- Conclusion
- Further discussion

Q & A

Question and Answer

Reference

- Almutaz, Ibrahim ; Ajbar, Abdelhamid ; Khalid, Yasir ; Ali, Emad Desalination, A probabilistic forecast of water demand for a tourist and desalination dependent city: Case of Mecca, Saudi Arabia, 2012*Peer Reviewed Journal* Vol.294, pp.53-59
- Edgar C. Merkle, Mark Steyvers (2013) Choosing a Strictly Proper Scoring Rule. *Decision Analysis* 10(4):292-304.
- Gneiting T, Balabdaoui F, Raftery AE. 2007. Probabilistic forecasts, calibration and sharpness. *J. R. Stat. Soc. B* 67:243-68
- Gneiting, T., & Katzfuss, M. (2014). Probabilistic forecasting. *Annual Review of Statistics and Its Application*, 1(1), 125-151.
- Gneiting T, Raftery AE. 2007. Strictly proper scoring rules, prediction, and estimation. *J. Am. Stat. Assoc.* 102:359???78
- Hersbach, H. (2000), “Decomposition of the Continuous Ranked Probability Score for Ensemble Prediction Systems,??? *Weather and Forecasting*, 15,559-570.
- Hyndman, R. J. (2018). forecast: Forecasting functions for time series and linear models (R package version 8.3). https://CRAN.R-project.org/package=forecast
- Hyndman, R. J., & Athanasopoulos, G. (2018). Forecasting: principles and practice. 2nd ed., Melbourne, Australia: OTexts. https://OTexts.org/fpp2/

Reference

- Lowe, Rachel ; Coelho, Caio As ; Barcellos, Christovam ; Carvalho, Marilia Sá ; Catão, Rafael De Castro ; Coelho, Giovanini E ; Ramalho, Walter Massa ; Bailey, Trevor C ; Stephenson, David B ; Rodó, Xavier eLife, 2016, *Peer Reviewed Journal* Vol.5
- Matheson, J. E., and Winkler, R. L. (1976), “Scoring Rules for Continuous Probability Distributions,??? *Management Science*, 22, 1087-1096.
- Raftery, A. E. (2016). Use and communication of probabilistic forecasts. *Statistical Analysis and Data Mining: The ASA Data Science Journal*, 9(6), 397-410.
- Roulston, M. S., and Smith, L. A. (2002), “Evaluating Probabilistic Forecasts Using Information Theory,??? *Monthly Weather Review*, 130, 1653-1660.