PREDICTING INFLATION IN INDONESIA USING BI-PREDICTORS SEMIPARAMETRIC MODEL BASED ON LOCAL POLYNOMIAL ESTIMATOR

Abdul Aziz, Nur Chamidah, Toha Saifudin
abdulaziz@mat.uin-malang.ac.id

INTRODUCTION

- Time series regression as a parametric regression requires error assumptions to validate the model. A good error is the smallest possible error normally distributed and satisfies randomness properties. The ARIMA model is a parametric regression that takes into account error assumptions.
- Nonparametric regression is a regression that does not use assumptions and rules like parametric regression. So, it can be said that nonparametric regression is more flexible than parametric regression.
- A more complex regression model, namely semiparametric, which combines parametric and non-parametric models, has been carried out by several researchers. Among them, local polynomial estimators were used in a single-response semiparametric model.
- Local polynomial estimators can be utilized by minimizing Weighted Least Squares (WLS). In local polynomial regression, the bandwidth determines how smooth the function is. The Generalized cross-validation (GCV) method can be used to determine optimum bandwidth, which can be determined from the minimum GCV value.

METHODS

- Bi-predictor semiparametric regression estimation cannot be carried out simultaneously but one by one continuously. From estimating parametric component parameters, nonparametric functions based on local polynomial estimators are solved using WLS with kernel function weighting. The function on the nonparametric component can be approximated via a Taylor series of order k, assuming the parameter values on the parametric component are known.
- Apart from depending on the bandwidth value h, the parameter λ also depends on the polynomial order k. So many estimated values of the parameter λ are obtained from repetition for a combination of the two (polynomial order k and bandwidth h). Therefore, cross-validation criteria are needed to determine the optimum bandwidth value with a certain polynomial order by selecting the minimum GCV value.
- This research uses programming tools, such as open-source software R-studio.

RESULT AND DISCUSSION
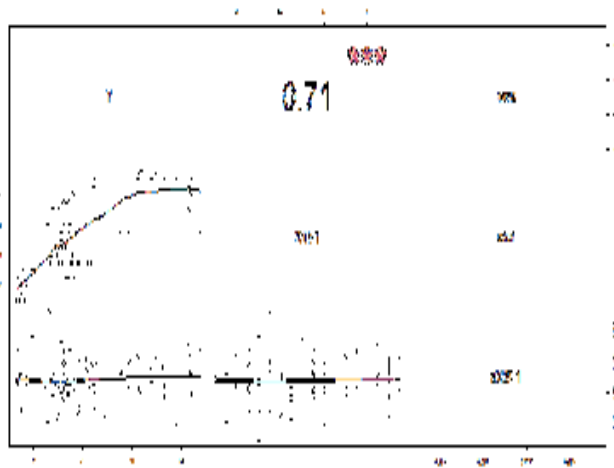
- The correlation coefficient value between the inflation variable in a period (Y) and the BI interest rate in the previous period (X1t-1) is 0.71, which is significant with an alpha of 0.1% (signed with three stars) so that it can be said that there is a positive and quite strong relationship with an ascending linear relationship pattern.

- The correlation coefficient value between the inflation variable in one period (Y) and the change rate of JUB in the previous period (dX2t-1) is 0.075, which is not significant, so it can be said that there is no linear relationship.

RESULT AND DISCUSSION

- The correlation coefficient value between the BI interest rate in the previous period (X1t-1) and the change rate of money supply in the previous period (dX2t-1) is 0.039, which is also not significant, so it can be said that there is no linear relationship between both variables.

- From the results of this correlation analysis, two variables, inflation and BI interest rate in the previous period (Y and X1t-1), have a significant linear relationship. The two variables and two variables that is inflation and change rate of money supply in the previous period (Y and dX2t-1), do not have a linear relationship; they can be modeled semi-parametrically, with Y as the response variable, X1t-1 as the predictor variable in the parametric component (herein after symbolized as Z), and dX2t-1 is the predictor variable in the nonparametric component (herein after symbolized as X). Both predictor variables have no significant multicollinearity (Z and X).

RESULT AND DISCUSSION
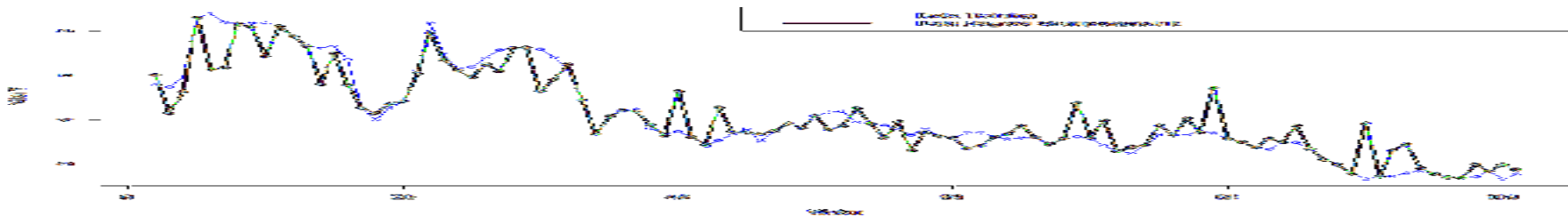
- The local polynomial estimator implementation of polynomial order 1, 2, and 3 with many simulations bandwidth values on 100 training data (March 2013 to June 2021), produced a bandwidth value of 0.0001 with the smallest GCV 7.915212 on polynomial order 1. The parametric parameter estimator (β) that resulted is 0.75144, and every local point (x_0) on data has a nonparametric parameter estimator (λ) result.

RESULT AND DISCUSSION
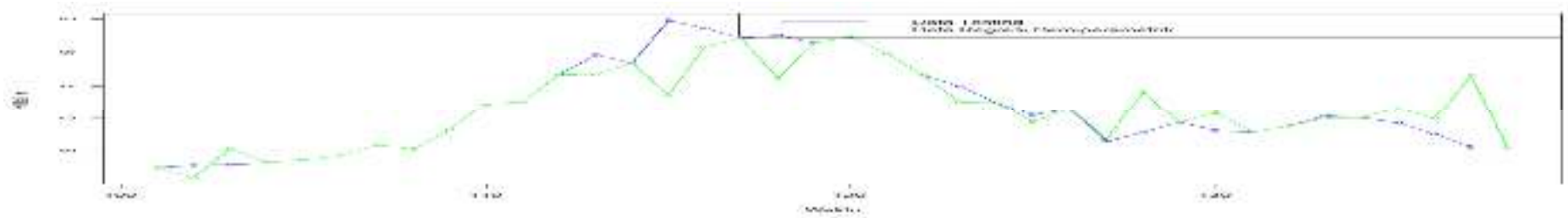
- The optimum bandwidth value obtained from estimating semiparametric regression parameters can be used to estimate the semiparametric model to the testing data (July 2021 to August 2024). With the bandwidth optimum value 0.0001 on polynomial order 1 on the testing data, the MAPE value resulted in 9.61%, so it can be said that the model is highly accurate because it is less than 10%.

- The prediction for inflation value in September 2024, where the inflation value data is not yet known, is that the BI rate for August 2024 will be 6.25%. Using the semiparametric regression model, the inflation prediction value obtained in September 2024 is 1.84%.

CONCLUSION

- Implementation of the bi-predictor semiparametric model using a local polynomial estimator approach to the inflation rate in Indonesia with two predictors, BI interest rate in previous period and change rate of JUB in previous period month, resulted in a semiparametric regression model with an optimum bandwidth value is 0.00001 of polynomial order 1 with high accuracy. Predictions for September 2024, where the inflation value data is not yet known, using semiparametric based on local polynomial order 1 estimator, the obtained value is 1.84%.

REFERENCES

1) F. Z. Habbab and M. Kampouridis, "An in-depth investigation of five machine learning algorithms for optimizing mixed-asset portfolios including REITs," *Expert Syst Appl*, **235**, 2024.
2) V. P. Ariyanti and Tristyanti Yusnitasari, "Comparison of ARIMA and SARIMA for Forecasting Crude Oil Prices," *Jurnal RESTI (Rekayasa Sistem dan Teknologi Informasi)*, **7**, no. 2, 2023.
3) M. Abdelaziz, A. Ahmed, A. Riad, G. Abderrezak, and A. A. Djida, "Forecasting daily confirmed COVID-19 cases in Algeria using ARIMA models," *Eastern Mediterranean Health Journal*, **29**, no. 7, 2023.
4) C. D. Setiawan, W. Sulandari, and Y. Susanti, "Peramalan Harga Saham PT Unilever Indonesia Menggunakan Metode Hibrida ARIMA-Neural Network," *Semnas Ristek (Seminar Nasional Riset dan Inovasi Teknologi)*, **7**, no. 1, 2023.
5) S. R. Gusman, S. Suparti, and A. Rusgiyono, "Perbandingan Model Arima Dengan Model Nonparametrik Polinomial Lokal Dan Spline Truncated Untuk Peramalan Harga Minyak Mentah West Texas Intermediate (WTI) Dilengkapi GUI R," *Jurnal Gaussian*, **12**, no. 1, 2023.
6) R. Pratiwi and H. Yundari, "Model Arima Semiparametrik," *Buletin Ilmiah Math. Stat. dan Terapannya (Bimaster)*, **11**, no. 1, pp. 129–138, 2022.
7) J. Iqbalullah and W. S. Winahju, "Peramalan Jumlah Penumpang Pesawat Terbang di Pintu Kedatangan Bandar Udara Internasional Lombok dengan Metode ARIMA Box-Jenkins, ARIMAX, dan Regresi Time Series," *Jurnal Sains dan Seni ITS;* **3**, no 2, 2014.
8) F. Bravo, "Local polynomial estimation of nonparametric general estimating equations," *Stat Probab Lett*, **197**, 2023.
9) M. Ulya, N. Chamidah, and T. Saifudin, "Prediction Of pH And Total Soluble Solids Content Of Mango Using Biresponse Multipredictor Local Polynomial Nonparametric Regression," *Communications in Mathematical Biology and Neuroscience*, 2023.
10) S. E. Ahmed, D. Aydın, and E. Yılmaz, "Penalty and Shrinkage Strategies Based on Local Polynomials for Right-Censored Partially Linear Regression," *Entropy*, vol. 24, no. 12, 2022.

REFERENCES

11) Y. Wang, Y. Wu, and S. S. Du, "Near-Linear Time Local Polynomial Nonparametric Estimation with Box Kernels," *INFORMS J Comput*, **33**, no. 4, 2021.

12) V. Fibriyani and N. Chamidah, "Prediction of Inflation Rate in Indonesia Using Local Polynomial Estimator for Time Series Data," in *Journal of Physics: Conference Series*, IOP Publishing Ltd, Feb. 2021.

13) N. S. Rahmi, "Peramalan Inflow Uang Kartal Bank Indonesia KPW Tasikmalaya Jawa Barat Dengan Metode Klasik Dan Modern," *Jurnal Statistika Universitas Muhammadiyah Semarang; **8**, no 2, 2020, Jurnal Statistika; 166-174 ; 2528-1070 ; 2338-3216*, Jul. 2020.

14) N. Chamidah and B. Lestari, "Estimation Of Covariance Matrix Using Multi-Response Local Polynomial Estimator For Designing Children Growth Charts: A Theoretically Discussion," in *Journal of Physics: Conference Series*, Institute of Physics Publishing, Dec. 2019.

15) V. Fibriyani, N. Chamidah, and T. Saifudin, "Modeling Case Fatality Rate Of COVID-19 In Indonesia Using Time Series Semiparametric Regression Based On Local Polynomial Estimator," *Commun. Math. Biol. Neurosci.*, 2024.

16) S. E. Ahmed, D. Aydin, and E. Yilmaz, "Semiparametric Time-Series Model Using Local Polynomial: An Application on the Effects of Financial Risk Factors on Crop Yield," *Journal of Risk and Financial Management*, **15,** no. 141, pp. 1–12, Mar. 2022.

17) G. Aryal, M. F. Gabrielli, and Q. Vuong, "Semiparametric Estimation of First-Price Auction Models," *Journal of Business & Economic Statistics*, **39**, no. 2, pp. 373–385, Apr. 2021.

18) A. H. Welsh and T. W. Yee, "Local regression for vector responses," *J Stat Plan Inference*, **136**, no. 9, pp. 3007–3031, Sep. 2006.

19) N. G. Zia, S. Suparti, and D. Safitri, "Pemodelan Regresi Spline Menggunakan Metode Penalized Spline Pada Data Longitudinal," *Jurnal Gaussian*, **6**, no. 2, 2017.

The 14th International Conference
on Green Technology – ICGT 2024

THANK YOU!