Guo, Xu; Zhu, Lixing

A review on dimension-reduction based tests for regressions. (English) Zbl 1383.62130

Ferger, Dietmar (ed.) et al., From statistics to mathematical finance. Festschrift in honour of Winfried Stute. Cham: Springer (ISBN 978-3-319-50985-3/hbk; 978-3-319-50986-0/ebook). 105-125 (2017).

Summary: Curse of dimensionality is a big obstacle for constructing efficient goodness-of-fit tests for regression models with large or moderate number of covariates. To alleviate this difficulty, numerous efforts have been devoted in the last two decades. This review intends to collect and comment on the developments in this aspect. To make the paper self-contained, basic ideas on goodness-of-fit testing for regression models are also briefly reviewed, and the main classes of methods and their advantages and disadvantages are presented. Further, the difficulty caused by the dimensionality (number of covariates) is then discussed. The relevant dimension reduction methodologies are presented. Further, as a dedication to Stute's 70th birthday, we also include a section to summarize his great contributions other than the results in dimension reduction-based tests.

For the entire collection see [Zbl 1383.62010].

MSC:

62G10 Nonparametric hypothesis testing
62G20 Asymptotic properties of nonparametric inference

Keywords:

dimension-reduction; regressions; response; predictors

Biographic references:

Stute, Winfried

Full Text: DOI

References:

[1] Bierens, H. J. (1982). Consistent model especification tests. $ Journal of Econometrics$, 20 , 105-134. · Zbl 0549.62076

[2] Bierens, H. J. (1990). A consistent conditional moment test of functional form. $ Ecomometrica$, 58 , 1443-1458. · Zbl 0737.62058

[3] Conde-Amboage, M. and González-Manteiga, W. (2015). A lack-of-fit test for quantile regression models with high-dimensional covariates. $ Computational Statistics \& Data Analysis$, 88 , 128-138. · Zbl 06921450

[4] Delgado, M. A. and Gonzáles-Manteiga, W. (2001). Significance testing in nonparametric regression based on the bootstrap. $ Annals of Statistics$, 29 , 1469-1507. · Zbl 1043.62032

[5] Dette, H. (1999). A consistent test for the functional form of a regression based on a difference of variance estimates. $ Annals of Statistics$, 27 , 1012-1050. · Zbl 0957.62036

[6] Dette, H., Neumeyer, N. and Van Keilegom, I. (2007). A new test for the parametric form of the variance function in nonparametric regression. $ Journal of the Royal Statistical Society: Series B (Statistical Methodology)$, 69 , 903-917.

[7] Escanciano, J. C. (2006). A consistent diagnostic test for regression models using projections. $ Econometric Theory$, 22 , 1030-1051. · Zbl 1170.62318

[8] Fan, J. and Jiang, J. (2007). Nonparametric inference with generalized likelihood ratio tests. $ Test$, 16 , 409-444. · Zbl 1131.62035

[9] Fan, J., Zhang, C. and Zhang, J. (2001) Generalized likelihood ratio statistics and Wilks phenomenon. $ Annals of Statistics$, 29 , 153-193. · Zbl 1029.62042

[10] Fan, Y. and Li, Q. (1996). Consistent model specifiation tests: omitted variables and semiparametric functional forms. $ Econometrica$, 64 , 865-890. · Zbl 0854.62038

[11] Fan, Y. and Li, Q. (2000). Consistent Model Specification Tests: Kernel-Based Tests Versus Bierens' ICM Tests. $ Econometric Theory$, 16 , 1016-1041. · Zbl 1180.62071

[12] Feng, Z., Wen, X., Yu Z. and Zhu, L. X. (2013). On partial sufficient dimension reduction with applications to partially linear multi-index models. $ Journal of the American Statistical Association$, 501 , 237-246. · Zbl 06158339

[13] Ferreira, E. and Stute, W. (2004). Testing for differences between conditional means in a time series context. $ Journal of the American Statistical Association$, 99 , 169-174. · Zbl 1089.62516

[14] González-Manteiga, W. and Crujeiras, R. M. (2013a). An updated review of Goodness-of-Fit tests for regression models. $ Test$, 22 , 361-411. · Zbl 1273.62086

[15] González-Manteiga, W. and Crujeiras, R. M. (2013b). Rejoinder on: An updated review of Goodness-of-Fit tests for regression models. $ Test$, 22 , 442-447. · Zbl 1367.62120

[16] Guo, X., Wang, T. and Zhu, L. X. (2016). Model checking for parametric single-index models: a dimension reduction model-adaptive approach. $ Journal of the Royal Statistical Society: Series B (Statistical Methodology)$, 78 , 1013-1035. · Zbl 1414.62131

[17] Härdle, W. and Mammen, E. (1993). Comparing nonparametric versus parametric regression fits. $ Annals of Statistics$, 21 , 1926-1947. · Zbl 0795.62036

[18] Hart, J. (1997). $ Nonparametric smoothing and lack-of-fit tests.$ Springer, Berlin. · Zbl 0886.62043

[19] Huber, J. P. (1985). Projection Pursuit, $ Annals of Statistics$, 13 , 435-475. · Zbl 0595.62059

[20] Huskova, M. and Meintanis, S. (2009). Goodness-of-fit tests for parametric regression models based on empirical characteristic functions. $ Kybernetika$, 45 , 960-971. · Zbl 1186.62029

[21] Huskova, M. and Meintanis, S. (2010). Test for the error distribution in nonparametric possibly heterocedastic regression models. $ Test$, 19 , 92-112. · Zbl 1203.62069

[22] Khmaladze, E. V. (1981). Martingale Approach in the Theory of Goodness-of-fit Tests. $ Theor. Prob. Appl.$, 26 , 240-257. · Zbl 0481.60055

[23] Khmaladze, E. V. and Koul, H. L. (2009). Goodness-of-fit problem for errors in nonparametric regression: distribution free approach. $ Annals of Statistics$, 37 , 3165-3185. · Zbl 1369.62073

[24] Koul, H. L. and Ni, P. P. (2004). Minimum distance regression model checking. $ Journal of Statistical Planning and Inference$, 119 ,109-141. · Zbl 1032.62036

[25] Koul, H. L. and Song, W. X. (2009). Minimum distance regression model checking with Berkson measurement errors. $ Annals of Statistics$, 37 , 132-156. · Zbl 1155.62028

[26] Koul, H. L. and Stute, W. (1999). Nonparametric model checks for time series. $ Annals of Statistics$, 27 , 204-236. · Zbl 0955.62089

[27] Koul, H. L., Stute, W. and Li, F. (2005). Model diagnosis for setar time series. $ Statistica Sinica$, 15 , 795-817. · Zbl 1086.62099

[28] Koul, H. L., Xie, C. L. and Zhu, L. X. (2016). An adaptive-to-model test for parametric single-index errors-in-variables models. Submitted. · Zbl 1430.62047

[29] Kumbhakar, S. C., Park, B. U., Simar, L. and Tsionas, E. G. (2007), Nonparametric stochastic frontiers: a local likelihood approach. $ Journal of Econometrics$, 137 , 1-27. · Zbl 1360.62131

[30] Lavergne, P., Maistre, S. and Patilea, V. (2015). A significance test for covariates in nonparametric regression. $ Electronic Journal of Statistics$, 9 , 643-678. · Zbl 1309.62076

[31] Lavergne, P. and Patilea, V. (2008). Breaking the curse of dimensionality in nonparametric testing. $ Journal of Econometrics$, 143 , 103-122. · Zbl 1418.62199

[32] Lavergne, P. and Patilea, V. (2012). One for all and all for One: regression checks with many regressors. $ Journal of Business \& Economic Statistics$, 30 , 41-52.

[33] Lavergne, P. and Vuong, Q. (2000). Nonparametric significance testing. $ Econometric Theory$, 16 , 576-601. · Zbl 0968.62047

[34] Lin, Z. J., Li, Q. and Sun. Y. G. (2014), A consistent nonparametric test of parametric regression functional form in fixed effects panel data models. $ Journal of Econometrics$, 178(1) , 167-179. · Zbl 1293.62196

[35] Ma, S. J., Zhang. J., Sun, Z. H. and Liang, H. (2014). Integrated conditional moment test for partially linear single index models incorporating dimension-reduction. $ Electronic Journal of Statistics$, 8 , 523-542. · Zbl 1348.62141

[36] Maistre, S., Lavergne, P. and Patilea, V. (2017). Powerful nonparametric checks for quantile regression. $ Journal of Statistical Planning and Inference$, 180 , 13-29. · Zbl 1358.62048

[37] Maistre, S. and Patilea, V. (2017). Nonparametric model checks of single-index assumptions. $ Statistica Sinica$, Online. · Zbl 1358.62048

[38] Niu, C. Z., Guo, X. and Zhu, L. X. (2016). Enhancements of nonparametric generalized likelihood ratio test: bias-correction and dimension reduction. Working paper. · Zbl 1411.62115

[39] Niu, C. Z. and Zhu, L. X. (2016). A robust adaptive-to-model enhancement test for parametric single-index models. Working paper. · Zbl 1407.62064

[40] Srihera, R. and Stute, W. (2010). Nonparametric comparison of regression functions. $ Journal of Multivariate Analysis$, 101 , 2039-2059. · Zbl 1194.62056

[41] Stute, W. (1984). Asymptotic normality of nearest neighbor regression function estimates. $ Annals of Statistics$, 12 , 917-926. · Zbl 0539.62026

[42] Stute, W. (1997). Nonparametric model checks for regression. $ Annals of Statistics$, 25 , 613-641. · Zbl 0926.62035

[43] Stute, W. and Gonzáles-Manteiga, W. (1996). NN goodness-of-fit tests for linear models. $ Journal of Statistical Planning and Inference$, 53 , 75-92. · Zbl 0847.62036

[44] Stute, W., Gonzáles-Manteiga, W. and Presedo-Quindimil, M. (1993). Boostrap based goodness-of-fit tests. $ Metrika$, 40 , 243-256. · Zbl 0770.62016

[45] Stute, W., Gonzáles-Manteiga, W. and Presedo-Quindimil, M. (1998a). Bootstrap approximation in model checks for regression. $ Journal of the American Statistical Association$, 93 , 141-149. · Zbl 0902.62027

[46] Stute, W., Gonzáles-Manteiga, Sánchez-Sellero, C. (2000). Nonparametric model checks in censored regression. $ Communication in Statistics-Theory and Methods$, 29 , 1611-1629. · Zbl 1018.62030

[47] Stute, W., Presendo-Quindimil, M., Gonzáles-Manteiga, W. and Koul, H. L. (2006). Model checks for higher order time series. $ Statistics \& Probability Letters$, 76 , 1385-1396. · Zbl 1094.62117

[48] Stute, W., Thies, S. and Zhu, L. X. (1998b). Model checks for regression: An innovation process approach. $ Annals of Statistics$, 26 , 1916-1934. · Zbl 0930.62044

[49] Stute, W., Xu, W.L. and Zhu, L. X. (2008). Model diagnosis for parametric regression in high dimensional spaces. $ Biometrika$, 95 , 451-467. · Zbl 1437.62614

[50] Stute, W. and Zhu, L. X. (2002). Model checks for generalized linear models. $ Scandinavian Journal of Statistics$, 29 , 535-546. · Zbl 1035.62073

[51] Stute, W. and Zhu, L. X. (2005). Nonparametric checks for single-index models. $ Annals of Statistics$, 33 , 1048-1083. · Zbl 1080.62023

[52] Su, J. Q. and Wei, L. J. (1991). A lack of fit test for the mean function in a generalized linear model. $ Journal of the American Statistical Association$, 86 , 420-426.

[53] Tan, F. L., Zhu, X. H. and Zhu, L. X. (2017). A projection-based adaptive-to-model test for regressions. $ Statistica Sinica$, Online. · Zbl 1382.62039

[54] Van Keilegom, I., Gonzáles-Manteiga, W. and Sánchez Sellero, C. (2008). Goodness-of-fit tests in parametric regression based on the estimation of the error distribution. $ Test$, 17 , 401-415. · Zbl 1196.62049

[55] Xia, Q., Xu, W. L. and Zhu. L. X. (2015). Consistently determining the number of factors in multivariate volatility modelling. $ Statistica Sinica$, 25 , 1025-1044. · Zbl 1415.62067

[56] Xia, Y. C. (2009). Model check for multiple regressions via dimension reduction. $ Biometrika$, 96 , 133-148. · Zbl 1162.62036

[57] Xia, Y. C., Tong, H., Li, W. K. and Zhu, L. X. (2002). An adaptive estimation of dimension reduction space. $ Journal of the Royal Statistical Society: Series B (Statistical Methodology)$, 64 , 363-410. · Zbl 1091.62028

[58] Zhang, C. and Dette, H. (2004). A power comparison between nonparametric regression tests. $ Statistics and Probability Letters$, 66 , 289-301. · Zbl 1102.62049

[59] Zhang, T. and Wu, W. B. (2011). Testing parametric assumptions of trends of a nonstationary time series. $ Biometrika$, 98 , 599-614. · Zbl 1231.62166

[60] Zheng, J. X. (1996). A consistent test of functional form via nonparametric estimation techniques. $ Journal of Econometrics$, 75 , 263-289. · Zbl 0865.62030

[61] Zhu, L. P., Wang, T., Zhu, L.X. and Ferré, L. (2010). Sufficient dimension reduction through discretization-expectation estimation. $ Biometrika$, 97 , 295-304. · Zbl 1205.62048

[62] Zhu, L. X. (2003), Model checking of dimension-reduction type for regression. $ Statistica Sinica$, 13 , 283-296. · Zbl 1015.62042

[63] Zhu, L. X. and An, H. Z. (1992). A test method for nonlinearity of regression model. $ Journal of Math.$, 12 , 391-397. In Chinese · Zbl 0786.62067

[64] Zhu, L. X. and Li, R. (1998). Dimension-reduction type test for linearity of a stochastic model. $ Acta Mathematicae Applicatae Sinica$, 14 , 165-175. · Zbl 0927.62044

[65] Zhu, X. H., Guo, X. and Zhu, L. X. (2017). An adaptive-to-model test for partially parametric single-index models. $ Statistics and Computing$, 27 , 1193-1204. · Zbl 06737706

[66] Zhu, X. H., Chen, F., Guo, X. and Zhu, L. X. (2016). Heteroscedasticity checks for regression models: A dimension-reduction based model adaptive approach. $ Computational Statistics \& Data Analysis$, 103 , 263-283. · Zbl 06918228

[67] Zhu, X. H. and Zhu, L. X. (2016). Dimension-reduction based significance testing in nonparametric regression. · Zbl 1454.62134