VIOLATING ASSUMPTION ONE: WRONG REGRESSORS pdf

1: Estimation of Linear Regression Model with Correlated Regressors in the Presence of Autocorrelation

(Violation of this assumption is serious one because when the true mapping between the regressand and regressors are non-linear and we try to find the linear function which maps the dependent and independent variables.

Introduction In a linear regression model there are situations where the regressors may be correlated and the error terms may be autocorrelated. This phenomenon is known as autocorrelated model with multi collinearity. It is well known that when there is multicollinearity, the ordinary least square OLS estimator for regression coefficients or the predictor based on these estimates may give poor results [1]. For overcoming the problem of multicollinearity several methods are available such as Principal component regression, Ridge regression and Partial least squares. These methods are useful when the errors are non autocorrelated. But in the presence of autocorrelated model with multicollinearity, appropriate modifications needs to be incorporated in the estimation. Accordingly a new estimator called generalized ridge estimator is proposed and its performance is compared with Ordinary ridge estimator. Ridge estimator involves unknown ridge parameter. In the literature several methods have been discussed for the choice of ridge parameter. Simulation study has been carried out to find the appropriate method for estimating the ridge parameter which gives minimum MSE for the proposed ridge estimator. It is not necessary that assumptions mentioned above hold good in real life situation. The regressors may be nearly correlated and the responses may also be correlated. In such instances the OLS estimator mentioned above do not possess the optimum statistical property. Hence there is a need to develop a new estimator which takes care of this situation. The violation of the assumption of independent regressors leads to multicollinearity. If X is less than full rank then such a situation is known as perfect multicollinearity. In this case OLS estimator does not exist. This situation is very rare in practice. In most of the real life situations, some regressors are nearly related to the remainining regressors. This is known as near multicollinearity. In case of near multicollinearity, rank of the regressor matrix X is equal to k and hence OLS estimator exist, but they are too imprecise to be of much use [2]. With multicollinearity, the estimated OLS coefficients may be statistically insignificant too large, too small and even have wrong sign. Hence interpretation given to the regression coefficients may no longer be valid. As the constant k increases from zero and continues up to infinity, the regression estimates tend towards zero. Though these estimators result in biased estimates, for certain positive values of k, this estimator yields minimum mean squared error MMSE compared to OLS. Several methods for estimating k has been proposed by Hoerl and Kennard [3], Hoerl et al. Autocorrelation is said to exist when the successive observations in linear regression model are correlated. The existence of autocorrelated errors has been rationalized in a variety of ways, as noted by Maddala [9]. The successive dependence of the error term is represented by 3 ut are independent and identically distributed random variable with mean zero and variance [10]. When the error satisfies the relation 3 , the observations follow first order autocorrelation. Generalised Ridge Type Estimator Consider a general linear regressive model 1 with errors satisfying relation 3 and the regressors exhibiting near multicollinearity. As seen earlier, in case of autocorrelation. Hence autocorrelation is a particular case of heteroscedasticity. In the case of heteroscedasticity, GLS is an appropriate method of estimation as given in 4. Further, when there is multicollinearity, often used method is the ridge regression as mentioned in 2. Combining these two methods, we propose for the autocorrelated model with multicollinearity a generalized ridge type estimator represented as where is as defined in 5. Hence the model under consideration contains the unknown parameters k, , In the following [11] we present some existing methods for estimating ridge parameter k 1. Hoerl and Kennard method 6 2. Hoerl, Kennard and Baldwin method 7 3. Hocking, Speed and Lynn method 8 are the eigen values of. The Monte Carlo Simulation Study A simulation study is carried out to find out the appropriate estimate for the ridge parameter among 6 , 7 , 8 mentioned above which gives minimum MSE for the proposed estimator. To generate normally distributed random variables X1, X2, X3 with specified intercorrelations we use the following equations [12, 13]. The autocorrelation coefficient in 3 is ranging from Taking sixteen different levels of intercorrelation multicollinearity among the regressors are taken as With the above setup a sample of observations are generated and replicated times. For each choice of the k, the MSE for the generalized ridge estimator is computed. The estimator of the ridge parameter k which gives minimum MSE is recorded for different choice of the parameters and the results are presented in Table 1. Results and Discussions of the Simulation Study The first column of Table 1 contains 9 levels of autocorrelation and the first row represents different levels of intercorrelation between the regressors. The other elements in Table 1 represents the choice of the ridge parameter which gives minimum MSE for the proposed generalized ridge estimator. Also as multicollinearity is positive and increases with the autocorrelation being low, then it is observed that Hoerl and Kennard HK estimator performs better than the other estimators. When the intercorrelation among regressors is high and autocorrelation is also high, the ridge parameter proposed by Hoerl Kennard and Baldwin B is superior compared to the other estimates. Therefore in the presence of autocorrelation with multicollinearity the proposed ridge estimator is superior to ordinary ridge estimator. Hence use of ordinary ridge estimator leads to larger MSE if autocorrelation is ignored. Conclusions There are a number of articles where multicollinearity and autocorrelation are dealt separately. However limited studies are available which describes these two problems together. Hence in this article, an attempt has been made to address these 2 issues. It is observed through simulation that the use of ordinary ridge estimator leads to larger MSE if autocorrelation is ignored. Therefore while conducting research in the field of Social Sciences or Epidemiological studies, there is a critical need to check data for the existence of multicollinearity between the regressors as well as the presence of autocorrelation. This will avoid misinterpretation of the results and will also ensure that the emerging problems involving the inter relationships between a number of variables of interest may be addressed appropriately and effectively. References [1] Gunst, R.. F and Manson, R. L, , Some considerations in the evaluation of alternate prediction equations, Technometrics, W, , Ridge regression: Communications in Statistics, 4: C and Galarneau, D. I, , A Monte carlo evaluation of some ridge type estimators. Journal of American statistical Association, 70 Lynn, , A class of biased estimators in linear regression. Communications in Statistics- Theory and Methods, Carter Hill, Stanley R. Adegboye, , Equations for generating normally distributed random variables with specified intercorrelation. Journal of Mathematical Sciences, Alaba, , Estimators of Linear Regression model and prediction under some assumptions violation. Journal of Statistics, 2:

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Multicollinearity (M) is the violation of the Full Rank assumption of the CLRM which states that there are no linear relationships between the regressors. M is present only in a Multivariate regression when the regressors are highly correlated one with another, thus the information from the correlated regressors overlap and we cannot.

So, it means that errors are Heteroskedastic, i. For example in the presence of H: Thus, if we use OLS in the presence of H then our Standard Errors will be inappropriate and our conclusions will not be valid. Remedies-What should we do if we detect heteroscedasticity? Potential sources of autocorrelation Omitted variables: The error term represents the influence of omitted variables and because of that an error term in one period many have a relation with the error terms in successive periods. Thus the problem of autocorrelation arises Misspecification of the mathematic form: It we have adopted a mathematical form which differs from the true form of the relationship, then the disturbance term is the must be show serial correlation. Disturbance term may be autocorrelated because it contains measurement errors of the regressors. Consequences of the existence of H Autocorrelation influences the properties of the estimated parameters. In the presence of serial autocorrelation between the errors, the OLS estimators are not efficient but they are still unbiased and consistent. Therefore, the parameters do not have the minimum variance from all the linear estimators, they are not BLUE Best, Linear, Unbiased and therefore they are not correct. M is present only in a Multivariate regression when the regressors are highly correlated one with another, thus the information from the correlated regressors overlap and we cannot distinguish the effect of each regressor to the dependent variable. Consequences of multicollinearity If collinearity is not perfect, but high, several consequences ensue: The OLS estimators are still BLUE, but one or more regression coefficients have large standard errors relative to the values of the coefficients, thereby making the t ratios small. Even though some regression coefficients are statistically insignificant, the R2 value may be very high. What should we do if we detect multicollinearity? Nothing, for we often have no control over the data. Redefine the model by excluding variables may attenuate the problem, provided we do not omit relevant variables. Construct artificial variables from the regressors such that they are orthogonal to one another. These principal components become the regressors in the model. Yet the interpretation of the coefficients on the principal components is not as straightforward. Normality The assumption is that the error terms follow a Normal distribution with 0 mean and constant variance. However, the Parameter Stability assumption may not be realistic since there might be some significant events that could alter our parameters; e. If we prove that the parameters are not constant for the whole sample then there is a Structural Break in We can test the Parameter Stability assumption either using the Chow test or the Predictive failure tests but we focus only on the former. Read more on Linear regression.

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