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# Robust weighted ridge regression based on S – estimator

Taiwo Stephen Fayose[a,*], Kayode Ayinde[b,c], Olatayo Olusegun Alabi[b], Abimbola Hamidu Bello[b]

[a] *Department of Statistics, Federal Polytechnic, Ado – Ekiti, 360101, Nigeria*
[b] *Department of Statistics, Federal University of Technology, Akure, 340106, Nigeria*
[c] *Department of Mathematics and Statistics, Northwest Missouri State University, Maryville, Missouri, 64468, USA*

## Abstract

Ordinary least squares (OLS) estimator performance is seriously threatened by correlated regressors often called multicollinearity. Multicollinearity is a situation when there is strong relationship between any two exogenous variables. In this case, the ridge estimator offers more reliable estimations when such scenario occurs. Outliers can have significant impact on the estimation of regression parameters leading to biased results. However, both OLS and Ridge estimators are sensitive to outlaying observations (outliers). The outlier – prone dataset in the endogenous variable has been efficiently solved utilizing the Robust M estimator in our recent paper. In recent studies, Robust M estimator has some drawbacks despite its efficient performances with outlier – prone dataset in the dependent (endogenous) variable hence the consideration of the Robust S estimator. The Robust S estimator is less sensitive to outliers in both endogenous and exogenous variables and utilizes standard deviation rather than the median in the case of Robust M estimator to handle outliers in the endogenous variable. The Robust ridge based on the S estimator was well suited to model dataset with multicollinearity and outliers problems in the endogenous variable. Also, it was noted in literature that outliers are one of the causes of heteroscedasticity and non – robust weighted least squares were initially employed to figure out for them. In this study, we introduced proposed Robust S weighted ridge estimator by adding a novel weighting method to address the three problems in a linear regression model. The selected Ridge estimators and Robust S estimator in two weighted versions (True weight (Wo) and suggested new weight ($W_1$)) were combined to respectively develop the Robust S Ridge and Robust S Weighted Ridge estimators. Monte – Carlo simulation experiments were conducted on a linear regression model with three and six exogenous variables exhibiting different degrees of Multicollinearity, with heteroscedasticity structure of powers, size of outlier in endogenous variable and error variances and five levels of sample sizes. The Mean Square Error (MSE) was used as a criterion to evaluate the performances of the new and existing estimators. Simulation findings show categorically that the new approach is preferred over previous approach and hereby recommended.

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## 1. Introduction

Multiple Linear regression is a statistical technique used to simulate relationship between two or more exogenous variables and an endogenous variable [1]. The model is simply defined as follows:

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots\ldots\ldots + \beta_k x_{ik} + u_i, \quad i = 1, \ldots, n, \tag{1}$$

*Corresponding author: Tel.: +234-816-526-4106;
*Email address:* fayose_ts@fedpolyado.edu.ng (Taiwo Stephen Fayose )

where $y_i$ is the endogenous variable, $x_{i1}, \ldots, x_{ik}$ are the exogenous variables, $\beta_0, \beta_1, \ldots, \beta_k$ are the unknown coefficients needed to be computed, $u_i$ denotes the disturbance term and it is believed to be normally distributed with mean zero and unity variance $\sigma^2$. The Technique of Least Squares (TLS) is widely used to calculate the parameters in Model (1). When conventional assumptions are made for linear regression models, the technique of least squares has several appealing qualities [2, 3]. These include the covariates not sharing a linear relationship; the distribution of the error terms is normal and unscattered variances among others [4].

Most of the aforementioned presumptions are easily violated in real–world situations. For instance, literature has demonstrated multicollinearity, or the habitual existence of linear dependency among regressors [5]. The covariates have a propensity for perfect, strong, or moderate linear dependency [5, 6]. When there is linear dependency among the covariates, the least squares technique is unbiased yet inefficient [7]. Regression coefficients are produced, however their absolute values are too high and their signs could even shift with small data changes [8]. When there is high multicollinearity, estimates of the regression coefficients can still be calculated, but they produce enormous standard errors [7]. Since regression coefficients with significant sampling error have an impact on both inference and forecasting outcomes from the model, the interpretation of the regression coefficients may ceased to be valid [9].

There are several strategies for dealing with multicollinearity, such as the Ridge estimator [10], Liu estimator [11], Partial least square regression [12], Principal component regression [13], Liu–type estimator [14], Modified ridge–type estimator [15], Modified Liu–estimator [16], Kibria–Lukman estimator [17], Jackknife Kibra–Lukman estimator [18], and others. However, these estimators (Ridge, Liu, K – L estimators etc) are not sensitive to outlier problem.

Outliers are observations that stand out from the rest of the observations being considered [19]. All of the aforementioned techniques behave differently when an outlier is present. It results in a discernible modification of model estimations, including forecasted values, estimated variation, and others [20–22]. Additionally, the presence of an outlier observation violates the premise of normality assumptions [20, 21]. Knowing that the estimator's breakdown point is extremely low, for example, one outlier figure had a significant impact on TLS's performance [20–22]. When the LRM is tainted by extreme values or significant observations, robust approach is a viable alternative to TLS. The M estimator is the most frequently used robust methods for dealing with outlier in the explained variable [23]. The weakness of M estimator led to the introduction of S estimator. Others include the MM estimator, the Least Trimmed Squared estimator, Least Absolute Deviation estimator, Least Quantile of Squares estimator [24–28] etc.

Multicollinearity and outliers can coexist in a model, according to recent studies. By combining some of the existing strategies for tackling each problem separately, efforts have been made to reduce the two separate problems [22, 29–34]. For instance, the robust ridge [33] was created by fusing the ridge estimator for multicollinearity with the M–estimator for controlling outliers. The robust Jackknife ridge estimator was proposed to handle both problems [29].

Weighted least squares have up till now been used in the literature as a solution to the heteroscedasticity problem. A model's heteroscedasticity may be caused by an outlier, since outlier is an error problem [35]. By combining the weighted ridge regression with certain reliable robust estimators, we chose to provide a novel method for managing the three problems simultaneously i.e. multicollinearity, heteroscedasticity and outliers.

The efficiency of this novel estimator was compared to various currently used methods in this study Section 2 contains the methodology. Section 3 contains simulation studies, Section 4 contains simulation results and also in appendix while Section 5 contains conclusion.

## 2. Robust weighted ridge estimator

The matrix form of a linear regression models is defined as:

$$y = X\beta + U, \tag{2}$$

where $y_{(nx1)}$ is vector of dependent variable, $X_{(nxp)}$ is matrix of regressors, $\beta_{(nx1)}$ is vector of the model parameters, and $U_{(nx1)}$ is vector of error terms/disturbance. The model in canonical form is given by:

$$y = W\alpha + U, \tag{3}$$

where $W = XQ$, $\alpha = Q'\beta$ and $Q$ is the orthogonal matrix whose columns constitute the eigen vectors of $X'X$. Then, $W'W = Q'X'XQ = \Lambda = diag\left(\lambda_1, \ldots, \lambda_p\right)$.

### 2.1. Some alternative ridge estimators to OLSE

The ridge estimator [11] is defined as:

$$\hat{\beta}_{RIDGE} = (W'W + kI)^{-1}W'y, \tag{4}$$

where $k$ is the impacting parameter which is not negative. There are several ways to derive $k$ in the literature. These include:

$$\hat{k}_i(HK) = \frac{\hat{\sigma}^2}{\hat{\alpha}_i^2}, \quad i = 1, 2, 3, \ldots, p, \tag{5}$$

where $\hat{\sigma}^2 = \frac{\sum_{i=1}^{n} e_i^2}{n-p}$ is the mean square error from the MLS, $\alpha_i$ is the i$^{th}$ element of the vector, and is the regression coefficient from the MLS.

Following Ref. [36], $k$ is given by:

$$KGRFA = \hat{k}_i^{Min}(FA) = \frac{\hat{\sigma}^2}{\hat{\alpha}_i^2}\left\{\left[\left(\frac{\hat{\alpha}_i^4\lambda_{Min}^2}{4\hat{\sigma}^2}\right) + \left(\frac{6\hat{\alpha}_i^4\lambda_{Min}}{\hat{\sigma}^2}\right)\right]^{\frac{1}{2}} - \left(\frac{\hat{\alpha}_i^2\lambda_{Min}}{2\hat{\sigma}^2}\right)\right\}, \tag{6}$$

where $\lambda_{Min} = Min(\lambda_i) = 1, 2, 3, \ldots, p$.

Following Ref. [17], $k$ is given by:

$$KGRKL = \hat{k}_i^{Min}(KL) = \min\left(\frac{\hat{\sigma}^2}{2\hat{\alpha}_i^2 + \left(\frac{\hat{\sigma}}{\lambda_i}\right)}\right). \tag{7}$$

In this study, we also obtain the ridge parameter using the cross–validation approach [37, 38].

### 2.2. Proposed robust S weighted ridge estimator

In this research, the proposed estimator called robust S weighted ridge estimator is defined as:

$$\hat{\alpha}_{KVT}(k, v, g) = (W_k^I\Omega_v^{-I}W_k + k_gI)^{-1}(W_k^I\Omega_v^{-I}y_k), \tag{8}$$

where $W_k$ is canonical matrix associated ridge parameter $k$ for solving multicollinearity. $\Omega_w^{-1} = P_w^{-1}P_w^{-1}$ , $\Omega_w = P_w^{|}P_w$ measures the heteroscedastic structure of the error variance with weight w, and $k_g$ is the robust ridge parameter to handle multicollinearity and outlier. The robust ridge parameters are defined based on the S–estimator. In the previous study, M–estimator was adopted to handle outlier but the weakness of M–estimator which is the lack of consideration on data distribution and that M–estimator only uses Median as weighted value. The weakness of M–estimator led to this new study by suggesting S–estimator which uses residual standard deviation to overcome the weakness of the median approach in M–estimation technique. The S–estimator is defined as

$$\min\hat{\sigma}\left(e_i\left(\hat{\beta}\right), ...., e_n\left(\hat{\beta}\right)\right). \tag{9}$$

Therefore, the robust ridge parameter based on S–estimator is defined as follows:

$$KGRHK_S = \frac{\Omega_S}{\hat{\alpha}_{i,S}^2}, \tag{10}$$

where $\Omega_S$ is the variance for the S – estimate, $\hat{\alpha}_{i,S}^2$is the S–estimate.

$$KGRFA_S = \hat{k}_i^{Min}(FA) = \frac{\Omega_S}{\hat{\alpha}_i^2}\left\{\left[\left(\frac{\hat{\alpha}_i^4\lambda_{Min}^2}{4\Omega_S}\right) + \left(\frac{6\hat{\alpha}_i^4\lambda_{Min}}{\Omega_S}\right)\right]^{\frac{1}{2}} - \left(\frac{\hat{\alpha}_i^2\lambda_{Min}}{2\Omega_S}\right)\right\}, \tag{11}$$

$$KGRKL_S = \hat{k}_i^{Min}(KL) = \min\left(\frac{\Omega_S}{2\hat{\alpha}_i^2 + \left(\Omega_S/\lambda_i\right)}\right). \tag{12}$$

As earlier mentioned, we adopted the weighted method defined in equation (8) to handle multicollinearity, heteroscedasticity and outlier in this study. Since the weight $\Omega_S$ is not always known in practice, there is a need to estimate the weight. The Weighted Least Squares (WLS) procedure is explained in previous research. The following scenarios allow the proposed estimator to revert to Generalized Least Squares (GLS), Robust Ridge, and OLS estimators:

$$\hat{\beta}_{RWR}(0, \Omega, 0) = (X'\Omega^{-1}X)^{-1}X'\Omega^{-1}y = \hat{\beta}_{GLS}\text{, the GLS estimator} \tag{13}$$

$$\hat{\beta}_{RWR}(k_R, 1, 0) = (X'X + k_RI)^{-1}X'y = \hat{\beta}_{RR}\text{, the Robust Ridge estimator,} \tag{14}$$

$$\hat{\beta}_{RWR}(k, \Omega, 0) = (X'\Omega^{-1}X + kI)^{-1}(X'\Omega^{-1}y) = \hat{\beta}_{WRE}\text{, the Weighted Ridge estimator,} \tag{15}$$

$$\hat{\beta}_{RWR}(0, 1, 0) = (X'X)^{-1}X'y = \hat{\beta}\text{, the OLS estimator.} \tag{16}$$

## 3. Simulation procedure and studies

The study uses a Monte Carlo simulation to compare the performance of the suggested estimator to some other existing estimators from the literature.

Utilize the linear regression model stated as follow:

$$y_t = \beta_0 + \beta_1 X_{m1} + \beta_2 X_{m2} + ... + \beta_p X_{mp} + U_m, \tag{17}$$

where $m = 1, 2,\ldots,$ n; $p = 3, 6$, $U_t \approx N(0, \sigma^2 I_n)$, $X_{ti,}$, m = 1,2,. . . ,n; i = 1,2,. . . ,p are fixed regressors. The regressors are generated using the following procedure [36]:

$$X_{ti} = (1 - \rho^2)^{\frac{1}{2}} Z_{ti} + \rho Z_{tp}, \tag{18}$$

where $\rho$ represents the correlation between any two regressors, and $Z_{ti}$ is a distinct standard normal distribution with a mean of 0 and unit variance and p is the number of exposure variables. The error terms $U_t$ were generated to be normally distributed with mean zero and variance$\sigma_i^2$. The heteroscedasticity problem was introduced into the model with the equation:

$$u_i = z\sigma \sqrt{E(y_i)^{2\delta}}. \tag{19}$$

$\delta_t^2$ symbolizes the heteroscedasticity variance and $U_t$ denotes the error term. The experiment was run using Monte Carlo simulation with a range of settings, including sample sizes (n = 15, 20, 30, 50, 100); level of multicollinearity ($\rho$ = 0, 0.8, 0.9, 0.95, 0.99, 0.999) and delta ($\delta$= 1, 2). In the study, $\sigma^2$ values were 1, 25 and 100. $E(y_i)$ = expected value of the regression under consideration.$y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + u_i$ for p = 3 and $y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + u_i$for p = 6. Outliers were introduced into the $y$ direction.

1. Employing the Equal Probability Selection Method (EPSM), a random sample of the produced data including a predetermined number of outliers (10%) is taken. Then, in accordance with step 3, it was inflated with outliers.
2. Determine the outlier magnitude, which is expressed as the degree of outlier (k). In the research, k equals 1 and 5.
3. A typical instance of a regularly distributed random variable is $y_1$, $y_2$,..., $y_n$. as appropriate, Y. Then,

$$y_i^* = k[\max(y)] + y_i,$$

where $_{y_i^*=}$ inflated observation replace $y_i$, $yi$ = substituted sampled observation, and $K$ = the size of the magnitude of an outlier.

For more detail on the generating the outliers see Refs. [22, 39]. The experiment was repeated 1000 times (number of replication). Using the Mean Square Error specifications, the efficiency of the estimators were compared. For any estimator$\hat{\beta}$, MSE is defined as follows:

$$MSE(\hat{\beta}) = \frac{1}{1000} \sum_{i=1}^{p} \sum_{j=1}^{1000} \left(\hat{\beta}_{ij} - \beta_i\right)^2 \tag{20}$$

where $\hat{\beta}_{ij}$ is $i^{th}$ element of the estimator β in the $j^{th}$ replication which gives the estimate of $\beta_i$. $\beta_i$ are the true value of the parameter previously mentioned. Estimator with the minimum MSE was considered best. We compare the following:

1. OLS
2. Robust ridge using $KGRFA_S$ as the ridge parameter. We abbreviate this as SFA
3. Robust ridge using $KGRHK_S$ as the ridge parameter. We abbreviate this as SHK
4. Robust ridge using $KGRKL_S$ as the ridge parameter. We abbreviate this as SKL
5. Robust ridge using CV as the ridge parameter. We abbreviate this as SCV
6. Robust weighted ridge using $KGRFA_S$ as the ridge parameter and adopting the initial weight. We abbreviate this as SWOFA.
7. Robust weighted ridge using $KGRHK_S$ as the ridge parameter and adopting the initial weight. We abbreviate this as SWOHK
8. Robust weighted ridge using $KGRKL_S$ as the ridge parameter and adopting the initial weight. We abbreviate this as SWOKL
9. Robust weighted ridge using CV as the ridge parameter and adopting the initial weight. We abbreviate this as SWOCV
10. Robust weighted ridge using $KGRFA_S$ as the ridge parameter and adopting the new weight in previous study. We abbreviate this as SW1FA.
11. Robust weighted ridge using $KGRHK_S$ as the ridge parameter and adopting the new weight in previous study. We abbreviate this as SW1HK.
12. Robust weighted ridge using $KGRKL_S$ as the ridge parameter and adopting the new weight in previous study. We abbreviate this as SW1KL.
13. Robust weighted ridge using CV as the ridge parameter and adopting the new weight in previous study. We abbreviate this as SW1CV.

Each estimator's MSE was rated for each level of multicollinearity, heteroscedasticity, outliers, and error variance. Multicollinearity, heteroscedasticity, outliers, and error variance levels were taken into account when counting the instances in which each estimator had a minimal MSE (rank 1 and 5). The largest number of counts in an estimator makes it the best.

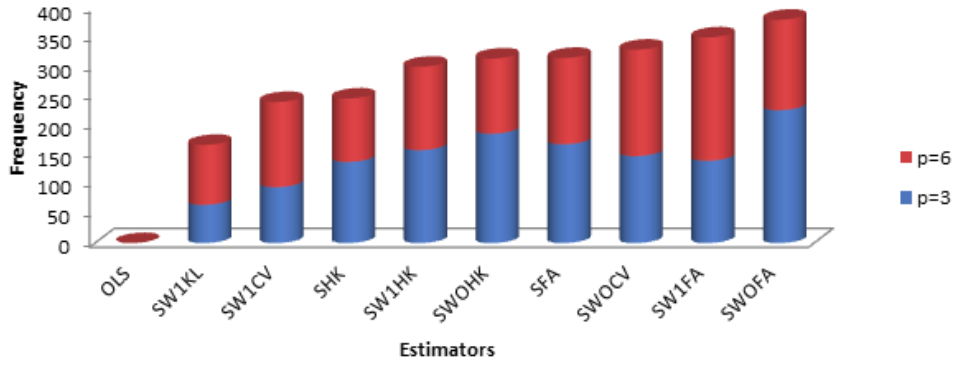



Figure 1: Component Bar Chart showing frequency of counts at which MSE is minimum ranking between 1 and 5 at $p = 3$ and $p = 6$ for both OLS and Robust S Estimation Methods.




Figure 2: Multiple Bar Chart displaying the performance of the estimators at different number of samples.

## 4. Results and discussion

We summarized the results graphically and in Tables.

Figure 1 shows that the SWOFA is the best (most efficient) estimator with Multicollinearity, Heteroscedasticity, and Outlier problems (Y direction) i.e. proposed Robust S Weighted Least Squares with Real Weight and One parameter ridge estimator of Fayose and Ayinde [36] followed by SWIFA i.e. proposed Robust S Weighted Least Squares with Weight One and One parameter ridge estimator of Fayose and Ayinde [36] while SWOCV i.e. proposed Robust S Weighted Least Squares with Real Weight and 'k' parameter from Cross Validation came third, respectively.

From Figure 2, SWOFA estimator's performance improved as sample size increase from 15 to 100 at $p = 3$ and $p = 6$, respectively. SW1FA performed majorly at small sample sizes while its performance reduced at large sample sizes at $p = 3$ and $p = 6$. Finally, OLS estimator didn't perform at all sample sizes in Figures 1 and 2.

From Figure 3, SWOFA i.e. proposed Robust S Weighted Least Squares with Real Weight and One parameter ridge estimator of Fayose and Ayinde [36] is the most efficient estimator followed by SWOHK i.e. proposed Robust S Weighted Least Squares with Real Weight and One parameter ridge estimator of Hoerl and Kennard [11] while OLS is inefficient at $p = 3$ but when $p = 6$, SW1FA i.e. proposed Robust S Weighted Least Squares with Weight One and One parameter ridge estimator of Fayose and Ayinde [36] is the most efficient estimator followed by SWOCV i.e. proposed Robust S Weighted Least Squares with Real Weight and 'k' parameter from Cross Validation. Finally, OLS estimator is inefficient in Figures 1, 2 and 3, respectively.

The appendix contains the simulation results (Tables A. 1 to A. 60). However for the sake of comparison, the findings are provided in Table 1.

From Table 1, when $p = 3$, we observed that the most efficient estimator is SWOFA as observed in Figure 1. The proposed robust S weighted ridge estimator with the ridge parameter SWOHK is ranked second but when $p = 6$, we also observed that the most efficient estimator is SW1FA but SWOCV ranked second. The OLSE is impacted by the presence of heteroscedasticity, multicollinearity, and outliers as predicted in the model.




Figure 3: A line graph displaying the performance of the estimators at $p = 3$ and $p = 6$.

Table 1: Tally of Estimators that found Minimum MSE if Multicollinearity, Heteroscedasticity, Outlier (y direction), and Error Variance were taken into account.

| p | Estimators | Sample Size (n) | | | | | TOTAL | RANK |
|---|---|---|---|---|---|---|---|---|
| | | 15 | 20 | 30 | 50 | 100 | | |
| 3 | OLS | 0 | 0 | 0 | 0 | 0 | 0 | $10^{th}$ |
| | SW1KL | 22 | 15 | 20 | 6 | 2 | 65 | $9^{th}$ |
| | SW1CV | 36 | 34 | 15 | 8 | 2 | 95 | $8^{th}$ |
| | SHK | 20 | 28 | 21 | 33 | 36 | 138 | $7^{th}$ |
| | SW1HK | 21 | 25 | 37 | 30 | 45 | 158 | $4^{th}$ |
| | SWOHK | 20 | 24 | 38 | 48 | 56 | 186 | $2^{nd}$ |
| | SFA | 37 | **42** | 27 | 37 | 25 | 168 | $3^{rd}$ |
| | SWOCV | **42** | 32 | 20 | 28 | 26 | 148 | $5^{th}$ |
| | SW1FA | 33 | 39 | 32 | 21 | 15 | 140 | $6^{th}$ |
| | SWOFA | 27 | 30 | **53** | **56** | **60** | 226 | $1^{st}$ |
| 6 | OLS | 0 | 0 | 0 | 0 | 0 | 0 | $10^{th}$ |
| | SW1KL | 37 | 32 | 19 | 11 | 3 | 102 | $9^{th}$ |
| | SW1CV | **57** | 41 | 35 | 9 | 3 | 145 | $5^{th}$ |
| | SHK | 4 | 2 | 24 | 37 | 41 | 108 | $8^{th}$ |
| | SW1HK | 9 | 38 | 25 | 35 | 35 | 142 | $6^{th}$ |
| | SWOHK | 9 | 9 | 24 | 42 | 44 | 128 | $7^{th}$ |
| | SFA | 38 | 7 | 37 | 36 | 29 | 147 | $4^{th}$ |
| | SWOCV | 43 | 33 | 34 | 33 | 38 | 181 | $2^{nd}$ |
| | SW1FA | 46 | **45** | **57** | 34 | 28 | 210 | $1^{st}$ |
| | SWOFA | 7 | 8 | 32 | **49** | **58** | 154 | $3^{rd}$ |

**NOTE:** Estimator with highest frequency at each sample size is bolded at $p = 3$ and $p = 6$.

## 5. Conclusion

Linear regression models (LRMs) are widely used to predict the response variable from a set of regressors. It is well known that multicollinearity reduce the efficiency of the ordinary least square method. In this case, ridge estimator and other estimation methods give better estimates. However, most of these methods (OLS, ridge and others) are susceptible to outliers. When there is an outlier in the outcome variable in LRMs, robust estimators (e.g., S – estimator) provide more efficient predictions. Also, weighted least square estimators solve heteroscedasticity problem in LRMs. In practice, the three problems can simulteaously exist in models. Robust S weighted ridge estimator is popularly employed to account for them. In this study, we adopted the robust weighted ridge and considered the real weight and proposed a new weight for the purpose of handling the three threats. We conducted a simulation study and observed that the proposed methods fit well to the model than the existing ones. Though robust S Ridge estimator competes favorably with the Robust S Weighted Ridge estimator.

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## Appendix A.

Table A. 1: MSE result when the magnitude of outlier is 1, $\rho = 0.8$ and $\sigma^2 = 1$.

| | | $\sigma^2$=1 | $\delta^2 = 1$ | $k = 1$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.8$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 4.50169 | 6.458829 | 1.201181 | 1.890803 | 1.081163 | 6.007301 | 5.819461 | 3.811372 | 2.557778 | 1.7415706 |
| SR1HK | 3.314989 | 2.993766 | 2.677258 | 3.481925 | 3.708931 | 1.818055 | 1.62409 | 1.190666 | 0.827849 | 1.5957913 |
| SR1FA | 3.628507 | 3.955671 | 3.008939 | 3.971442 | 3.776615 | 1.590842 | 2.338454 | 1.578103 | 1.188732 | 2.2365225 |
| SR1KL | 4.295335 | 4.533444 | 3.416131 | 5.02066 | 4.648185 | 2.147098 | 2.432728 | 1.6521 | 1.541446 | 2.737242 |
| SR1CV | 5.530373 | 6.784212 | 3.941243 | 5.965915 | 5.076776 | 3.052615 | 5.064937 | 2.452427 | 2.424014 | 3.5934578 |
| SWLSWOR1HK | 2.250537 | 0.827742 | 0.949691 | 1.447443 | 0.469781 | 2.110115 | 1.080036 | 0.806271 | 1.133704 | 1.6512363 |
| SWLSWOR1FA | 2.601202 | 0.687959 | 0.964838 | 1.356678 | 0.593823 | 2.031027 | 0.974205 | 0.738774 | 1.280033 | 1.5636396 |
| SWLSWOR1KL | 3.032024 | 1.261062 | 1.12407 | 2.526035 | 0.414326 | 2.199378 | 1.369205 | 0.782933 | 1.876724 | 3.101439 |
| SWLSWOR1CV | 2.973501 | 1.772216 | 1.113776 | 2.115585 | 0.630176 | 2.25487 | 1.642822 | 1.070847 | 1.399063 | 2.4051876 |
| SWLSW2R1HK | 1.067715 | 1.06934 | 0.971767 | 1.068376 | 0.933299 | 1.03146 | 0.853047 | 1.003436 | 0.996712 | 1.0018321 |
| SWLSW2R1FA | 1.036241 | 1.077231 | 0.979898 | 1.111266 | 0.95362 | 1.016272 | 0.863774 | 1.010906 | 1.004178 | 1.0235355 |
| SWLSW2R1KL | 1.130558 | 1.157685 | 1.00345 | 1.362236 | 1.163451 | 1.062639 | 0.926507 | 1.031836 | 1.043388 | 1.1325469 |
| SWLSW2R1CV | 1.203577 | 1.246444 | 1.016412 | 1.509814 | 1.251114 | 1.08115 | 0.878108 | 1.052272 | 1.049873 | 1.1668974 |

NOTE: k = Magnitude of outlier, $\rho$= multicollinearity level, $\sigma^2$= error variance value and $\delta^2$= delta

Table A. 2: MSE result when the magnitude of outlier is 5, $\rho = 0.8$ and $\sigma^2 = 1$.

| | | $\sigma^2$=1 | $\delta^2 = 1$ | k= 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.8$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 52.00884 | 98.36983 | 21.3197 | 35.04379 | 22.60642 | 64.33209 | 46.10931 | 59.37381 | 49.62696 | 36.366823 |
| SR1HK | 2.544669 | 2.052589 | 2.028937 | 2.314723 | 2.572908 | 1.553657 | 1.603365 | 0.819236 | 0.672125 | 1.1855052 |
| SR1FA | 4.442728 | 5.75627 | 4.230906 | 4.659828 | 4.52206 | 2.282934 | 3.39754 | 2.211486 | 1.588029 | 3.5273747 |
| SR1KL | 7.951281 | 10.22866 | 8.45424 | 12.72945 | 13.08096 | 5.097245 | 5.990662 | 4.06269 | 6.983972 | 10.090352 |
| SR1CV | 7.235819 | 20.84119 | 8.673325 | 15.23117 | 15.2395 | 2.753741 | 1.103655 | 7.08072 | 9.640026 | 17.22504 |
| SWLSWOR1HK | 1.859705 | 0.948444 | 0.946766 | 1.086474 | 0.751389 | 1.611758 | 1.052444 | 0.997042 | 1.073943 | 1.2677606 |
| SWLSWOR1FA | 2.873202 | 1.085492 | 0.866782 | 1.232416 | 0.925951 | 2.950339 | 1.555953 | 1.186336 | 1.319122 | 1.4520885 |
| SWLSWOR1KL | 5.047901 | 3.343474 | 1.158542 | 3.755666 | 1.537486 | 3.725964 | 2.434962 | 1.973269 | 2.481385 | 4.3747365 |
| SWLSWOR1CV | 3.438348 | 3.893347 | 1.692762 | 2.677813 | 1.387342 | 2.045886 | 0.988359 | 1.706715 | 1.629082 | 2.9278209 |
| SWLSW2R1HK | 1.059574 | 1.039924 | 0.990078 | 1.029012 | 0.922396 | 1.025037 | 0.825404 | 1.00185 | 1.006136 | 1.0240809 |
| SWLSW2R1FA | 1.084013 | 1.121163 | 1.00602 | 1.190645 | 1.019273 | 1.011955 | 0.799655 | 1.020483 | 1.033222 | 1.065936 |
| SWLSW2R1KL | 1.407511 | 1.800193 | 1.275617 | 3.248363 | 3.384867 | 1.056206 | 0.819739 | 1.214289 | 1.678663 | 2.6017512 |
| SWLSW2R1CV | 1.457169 | 1.925988 | 1.211026 | 4.06371 | 4.323043 | 1.095821 | 0.816159 | 1.239093 | 1.672322 | 2.9833541 |

MSE result when the magnitude of outlier is 5, $\rho = 0.99$ and $\sigma^2$=25

Table A. 3: MSE result when the magnitude of outlier is 1, $\rho = 0.8$ and $\sigma^2$=1.

| | | $\sigma^2$=1 | $\delta^2 = 2$ | $k = 1$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.8$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 22.24595 | 58.26637 | 3.791314 | 12.39324 | 6.63006 | 22.94177 | 28.51651 | 22.07614 | 17.03481 | 10.043072 |
| SR1HK | 3.101573 | 2.554975 | 2.541758 | 2.776711 | 3.134293 | 3.119267 | 2.204757 | 1.15001 | 0.763155 | 1.3801764 |
| SR1FA | 3.850231 | 5.387466 | 3.244433 | 4.110786 | 3.921034 | 1.928724 | 3.683394 | 2.207045 | 1.503735 | 2.7361554 |
| SR1KL | 6.091004 | 8.603312 | 4.447036 | 8.140546 | 7.539257 | 4.250438 | 5.15581 | 2.921814 | 3.371354 | 4.9016905 |
| SR1CV | 7.258617 | 16.13311 | 4.958244 | 8.876564 | 8.099095 | 4.616592 | 11.98725 | 3.686011 | 4.992499 | 7.2375705 |
| SWLSWOR1HK | 1.482451 | 1.106208 | 0.978009 | 1.007903 | 1.006945 | 0.949635 | 0.867707 | 0.978713 | 1.018095 | 1.0005258 |
| SWLSWOR1FA | 1.445427 | 1.172453 | 0.987278 | 1.025931 | 1.002641 | 1.288566 | 0.918663 | 0.97599 | 1.012167 | 1.0035295 |
| SWLSWOR1KL | 1.84102 | 1.873642 | 0.916613 | 1.139488 | 1.085111 | 1.030704 | 1.079307 | 0.975318 | 1.172727 | 1.1058006 |
| SWLSWOR1CV | 1.719949 | 2.166535 | 0.944861 | 1.181872 | 1.075015 | 2.014234 | 1.155523 | 0.99521 | 1.024857 | 1.045428 |
| SWLSW2R1HK | 1.156495 | 1.061551 | 0.980006 | 0.959096 | 0.875094 | 1.160226 | 0.859537 | 1.003155 | 0.996694 | 0.9995406 |
| SWLSW2R1FA | 1.191641 | 1.114648 | 0.988737 | 1.029996 | 0.921442 | 1.078871 | 0.857002 | 1.017257 | 1.010117 | 1.0050653 |
| SWLSW2R1KL | 1.439048 | 1.611386 | 1.009011 | 1.583951 | 1.144119 | 1.238337 | 0.929376 | 1.098375 | 1.157376 | 1.2183613 |
| SWLSW2R1CV | 1.742033 | 2.10619 | 1.018635 | 1.970799 | 1.26589 | 1.265726 | 0.893075 | 1.11745 | 1.145992 | 1.2356316 |

Table A. 4: MSE result when the magnitude of outlier is 5, $\rho = 0.8$ and $\sigma^2$=1.

| | | $\sigma^2$=1 | $\delta^2 = 2$ | $k = 5$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.8$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 233.5211 | 664.5821 | 66.64768 | 212.9523 | 135.458 | 186.4178 | 167.1862 | 299.8078 | 308.0865 | 203.70151 |
| SR1HK | 2.12386 | 1.494992 | 1.752943 | 1.552082 | 1.627454 | 2.628431 | 0.565064 | 0.81721 | 0.708425 | 1.0473196 |
| SR1FA | 4.656806 | 6.589177 | 4.388636 | 4.848867 | 4.780733 | 2.709996 | 4.148674 | 3.094603 | 2.121799 | 4.2963759 |
| SR1KL | 12.76119 | 17.94861 | 12.46281 | 23.416 | 26.14568 | 11.50744 | 7.49305 | 8.732668 | 17.62926 | 17.758636 |
| SR1CV | 12.49331 | 50.29177 | 15.43932 | 39.44814 | 39.73157 | 3.369098 | 1.421541 | 16.81247 | 29.86211 | 49.400615 |
| SWLSWOR1HK | 1.500907 | 1.031218 | 0.986911 | 1.009092 | 1.000102 | 1.046057 | 0.504484 | 0.984356 | 1.007153 | 0.9955721 |
| SWLSWOR1FA | 1.550691 | 1.151336 | 0.986255 | 1.030835 | 0.995699 | 2.707668 | 0.472125 | 0.971412 | 1.015895 | 0.996153 |
| SWLSWOR1KL | 3.616461 | 2.825035 | 0.870131 | 1.304071 | 1.190057 | 2.292663 | 0.456592 | 1.165388 | 1.427631 | 1.3585582 |
| SWLSWOR1CV | 2.882964 | 3.657522 | 0.936283 | 1.520966 | 1.205987 | 4.826092 | 0.503544 | 1.094413 | 1.051588 | 1.1136607 |
| SWLSW2R1HK | 1.099089 | 1.039624 | 0.986689 | 0.996083 | 0.948618 | 1.198029 | 0.499374 | 1.000548 | 1.003263 | 0.9989011 |
| SWLSW2R1FA | 1.25314 | 1.187937 | 0.994963 | 1.149842 | 0.965745 | 1.05378 | 0.486603 | 1.054378 | 1.034816 | 1.016357 |
| SWLSW2R1KL | 2.193856 | 3.109492 | 1.276914 | 5.278103 | 4.379571 | 1.23992 | 0.591094 | 1.663994 | 2.444737 | 3.4741153 |
| SWLSW2R1CV | 2.065159 | 4.89184 | 1.295727 | 9.923065 | 7.317136 | 1.350185 | 2.604988 | 1.609221 | 2.552101 | 3.9592507 |

Table A. 5: MSE result when the magnitude of outlier is 1, $\rho = 0.8$ and $\sigma^2 = 25$

| | | $\sigma^2 = 25$ | $\delta^2 = 1$ | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.8$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 87.0185 | 106.9423 | 19.77245 | 30.25489 | 14.80351 | 118.3384 | 127.1504 | 64.80306 | 39.35466 | 26.140892 |
| SR1HK | 17.69692 | 10.28218 | 4.708681 | 7.033089 | 4.193689 | 17.13534 | 5.342367 | 5.632581 | 2.805858 | 3.7765772 |
| SR1FA | 4.288381 | 5.7815 | 3.563813 | 3.898316 | 3.777176 | 3.150251 | 5.078233 | 3.024357 | 1.736388 | 3.0006066 |
| SR1KL | 26.38973 | 24.15974 | 10.98673 | 19.76192 | 12.47717 | 22.53812 | 14.45089 | 14.1732 | 11.98931 | 14.358953 |
| SR1CV | 24.40211 | 22.65387 | 8.749561 | 18.27715 | 9.543194 | 14.24966 | 9.713587 | 9.074336 | 8.563345 | 11.219275 |
| SWLSWOR1HK | 129.4051 | 63.6823 | 7.429497 | 7.092531 | 5.04136 | 693.7204 | 0.586098 | 18.64489 | 3.020206 | 11.958392 |
| SWLSWOR1FA | 29.22076 | 23.6693 | 2.621153 | 6.087617 | 5.581903 | 59.59061 | 0.533085 | 8.658229 | 4.28721 | 9.6641712 |
| SWLSWOR1KL | 31.26016 | 29.96545 | 7.953947 | 14.13514 | 15.13756 | 35.32478 | 2.951534 | 17.77563 | 9.469399 | 28.532516 |
| SWLSWOR1CV | 13.39298 | 28.33621 | 9.368658 | 6.158961 | 14.06961 | 11.96685 | 0.519952 | 18.91635 | 4.930311 | 14.423278 |
| SWLSW2R1HK | 72.09918 | 25.47578 | 3.732004 | 23.78472 | 10.28193 | 16.4218 | 3.075204 | 5.376926 | 3.662304 | 6.2769469 |
| SWLSW2R1FA | 8.640429 | 5.670173 | 2.514695 | 8.996006 | 11.62058 | 3.571649 | 0.663332 | 2.400353 | 2.749666 | 5.3583541 |
| SWLSW2R1KL | 17.4729 | 15.23919 | 6.088381 | 28.43973 | 27.19342 | 9.12932 | 2.551231 | 6.160025 | 8.001286 | 18.897761 |
| SWLSW2R1CV | 28.69083 | 6.784751 | 6.220485 | 7.58201 | 32.30569 | 4.774148 | 0.486926 | 6.178117 | 7.714864 | 18.701135 |

Table A. 6: MSE result when the magnitude of outlier is 5, $\rho = 0.8$ and $\sigma^2 = 25$

| | | $\sigma^2 = 25$ | $\delta^2 = 1$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.8$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 944.6 | 1033.357 | 273.8835 | 425.2101 | 275.866 | 766.0531 | 618.4721 | 758.0026 | 621.3506 | 469.48631 |
| SR1HK | 19.78767 | 8.619342 | 4.27221 | 4.928746 | 2.959173 | 17.12005 | 9.607931 | 4.838678 | 2.331926 | 2.7234453 |
| SR1FA | 6.239098 | 7.007825 | 4.719787 | 5.074095 | 4.885157 | 3.831429 | 6.348085 | 4.318029 | 2.474844 | 4.7375011 |
| SR1KL | 108.3146 | 79.1675 | 43.30848 | 80.60107 | 74.30696 | 64.93635 | 49.76001 | 57.72837 | 70.53402 | 100.76361 |
| SR1CV | 18.74693 | 85.12834 | 35.93076 | 77.92898 | 57.82115 | 9.386662 | 1.486186 | 37.90116 | 51.57363 | 86.771471 |
| SWLSWOR1HK | 339.8273 | 59.48868 | 2.327043 | 5.242688 | 1.863157 | 448.6577 | 24.35948 | 14.06608 | 2.333949 | 6.316898 |
| SWLSWOR1FA | 76.73524 | 32.23053 | 2.940182 | 11.82102 | 7.275689 | 120.3114 | 23.90167 | 20.17744 | 8.700549 | 15.350718 |
| SWLSWOR1KL | 177.8481 | 81.1633 | 13.90401 | 46.98562 | 35.06214 | 117.5447 | 53.95833 | 62.00576 | 34.00789 | 88.895666 |
| SWLSWOR1CV | 4.05496 | 81.6676 | 55.62319 | 43.07297 | 33.58374 | 9.559537 | 5.063321 | 26.05358 | 9.295594 | 44.470693 |
| SWLSW2R1HK | 45.24017 | 7.766906 | 2.95493 | 7.40504 | 5.892561 | 13.61239 | 2.037689 | 4.69273 | 2.888395 | 4.0058006 |
| SWLSW2R1FA | 10.15841 | 6.419819 | 3.263916 | 15.79929 | 24.2141 | 2.522977 | 1.813662 | 3.625127 | 5.004156 | 10.426296 |
| SWLSW2R1KL | 36.80842 | 32.85055 | 19.47884 | 96.65765 | 150.7916 | 7.818136 | 4.676207 | 18.0537 | 37.75531 | 109.58305 |
| SWLSW2R1CV | 30.98819 | 11.83197 | 15.94755 | 86.01896 | 222.9143 | 4.710485 | 0.842584 | 13.53707 | 51.08159 | 141.731 |

Table A. 7: MSE result when the magnitude of outlier is 1, $\rho = 0.8$ and $\sigma^2$=25

| | | $\sigma^2 = 25$ | $\delta^2 = 2$ | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.8$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 746.8849 | 1339.619 | 76.05578 | 233.8772 | 138.3861 | 516.7328 | 729.6907 | 487.4434 | 370.7037 | 208.08249 |
| SR1HK | 27.66552 | 16.01123 | 4.876252 | 6.745871 | 2.496785 | 52.53379 | 16.53368 | 7.426467 | 1.864855 | 1.813023 |
| SR1FA | 7.803896 | 10.05643 | 3.989671 | 4.833351 | 4.205506 | 4.496998 | 11.09282 | 6.004492 | 3.183759 | 4.1407226 |
| SR1KL | 86.21478 | 125.272 | 21.05769 | 60.19062 | 40.06946 | 75.4741 | 59.74691 | 45.33199 | 37.03447 | 40.794114 |
| SR1CV | 35.70418 | 52.61367 | 16.34358 | 52.07891 | 32.46001 | 32.73968 | 81.22528 | 25.59554 | 35.73305 | 42.49483 |
| SWLSWOR1HK | 64.7294 | 8.422662 | 0.96974 | 1.060886 | 1.008669 | 46.64584 | 1.964292 | 1.178223 | 1.040882 | 1.0142486 |
| SWLSWOR1FA | 11.74987 | 5.829562 | 0.90685 | 1.52626 | 1.035368 | 53.03748 | 6.399397 | 1.558252 | 1.215557 | 1.2686339 |
| SWLSWOR1KL | 19.54268 | 18.8768 | 0.977821 | 3.373709 | 1.56889 | 21.59035 | 8.250522 | 3.658251 | 2.518199 | 4.2628742 |
| SWLSWOR1CV | 49.68652 | 30.10543 | 1.220906 | 2.715314 | 2.687969 | 4.977833 | 14.2823 | 2.519399 | 1.116174 | 1.7228685 |
| SWLSW2R1HK | 309.5563 | 62.19892 | 1.596352 | 4.531346 | 1.453788 | 106.105 | 3.968474 | 6.923102 | 1.832169 | 1.6723073 |
| SWLSW2R1FA | 118.9354 | 25.72628 | 1.932083 | 13.19728 | 7.818506 | 8.292995 | 1.085893 | 3.986415 | 3.089402 | 3.5533675 |
| SWLSW2R1KL | 136.9098 | 85.73236 | 4.351804 | 41.51991 | 30.17624 | 28.81485 | 5.593323 | 12.95026 | 14.11474 | 23.199632 |
| SWLSW2R1CV | 39.04353 | 138.0522 | 6.891212 | 75.09527 | 68.78992 | 10.69298 | 0.823131 | 8.358862 | 14.64589 | 27.541175 |

Table A. 8: MSE result when the magnitude of outlier is 5, $\rho = 0.8$ and $\sigma^2$=25.

| | | $\sigma^2 = 25$ | $\delta^2 = 2$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.8$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 4079.272 | 15151.6 | 1157.383 | 4076.122 | 2918.119 | 3181.833 | 2711.559 | 6057.684 | 6328.32 | 4000.9242 |
| SR1HK | 11.38767 | 3.434172 | 3.549405 | 2.616134 | 1.331376 | 45.32884 | 0.685702 | 4.156508 | 1.095278 | 1.10369 |
| SR1FA | 6.393734 | 7.66688 | 4.867888 | 5.165399 | 5.139502 | 4.89148 | 6.244925 | 6.383863 | 3.316371 | 5.4272945 |
| SR1KL | 157.0732 | 216.1463 | 75.7161 | 221.1934 | 160.4406 | 209.3285 | 50.16823 | 157.996 | 148.03 | 167.43319 |
| SR1CV | 31.86896 | 597.1265 | 82.88772 | 309.9083 | 293.4214 | 22.60137 | 1.380817 | 126.9532 | 208.6905 | 367.29428 |
| SWLSWOR1HK | 67.62375 | 4.885298 | 0.981156 | 1.07871 | 0.993314 | 34.11595 | 0.624147 | 1.415756 | 1.018067 | 0.9877328 |
| SWLSWOR1FA | 23.9478 | 8.990407 | 0.859597 | 2.075064 | 1.008123 | 132.9118 | 1.750308 | 2.7587 | 1.578944 | 1.4635254 |
| SWLSWOR1KL | 64.3417 | 36.62274 | 1.469462 | 8.38088 | 2.8063 | 85.04866 | 8.253842 | 15.77743 | 6.159587 | 15.533297 |
| SWLSWOR1CV | 26.26713 | 107.4967 | 3.123851 | 23.09762 | 19.02175 | 7.848491 | 0.528485 | 10.32234 | 2.539361 | 4.259754 |
| SWLSW2R1HK | 175.9315 | 5.788195 | 1.403168 | 1.765747 | 0.970632 | 145.5347 | 0.49924 | 4.066498 | 1.197388 | 1.072337 |
| SWLSW2R1FA | 40.77409 | 11.65833 | 2.558362 | 17.72155 | 11.59036 | 8.170877 | 0.445861 | 6.241108 | 5.034708 | 5.1401274 |
| SWLSW2R1KL | 93.8674 | 106.1175 | 14.75117 | 102.0232 | 95.75434 | 23.58381 | 9.712536 | 47.28358 | 52.34157 | 93.608453 |
| SWLSW2R1CV | 4.375896 | 111.0363 | 20.49519 | 347.2447 | 523.0954 | 11.36777 | 20.41041 | 22.19775 | 92.16863 | 197.15714 |

Table A. 9: MSE result when the magnitude of outlier is 1, $\rho = 0.8$ and $\sigma^2$=100.

| | | $\sigma^2 = 100$ | $\delta^2 = 1$ | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.8$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 409.7383 | 369.1567 | 73.73116 | 114.5864 | 55.22656 | 460.3995 | 503.7327 | 253.2391 | 151.2933 | 98.882335 |
| SR1HK | 68.05379 | 43.08903 | 11.4358 | 21.2202 | 7.950503 | 61.0217 | 15.73186 | 21.22667 | 9.559665 | 10.469901 |
| SR1FA | 5.54993 | 7.452244 | 3.806296 | 3.885259 | 3.998016 | 4.430728 | 8.011244 | 4.578031 | 2.381545 | 3.5727267 |
| SR1KL | 107.1988 | 84.76512 | 30.59054 | 63.68904 | 33.76725 | 83.21479 | 42.49236 | 56.13961 | 45.97473 | 48.948075 |
| SR1CV | 78.7145 | 54.75993 | 17.05043 | 47.62538 | 18.99035 | 34.8428 | 18.40896 | 23.77393 | 20.36858 | 24.810807 |
| SWLSWOR1HK | 2166.193 | 1313.879 | 60.38539 | 56.8054 | 29.08268 | 9365.468 | 4.029226 | 267.3109 | 28.25006 | 103.80923 |
| SWLSWOR1FA | 154.5302 | 126.3291 | 10.02539 | 27.52814 | 19.76934 | 352.6621 | 0.901812 | 47.13519 | 18.04261 | 38.392578 |
| SWLSWOR1KL | 67.05088 | 118.0787 | 28.68524 | 60.59063 | 61.36196 | 99.11538 | 9.456673 | 91.19693 | 46.41774 | 141.58942 |
| SWLSWOR1CV | 56.71211 | 102.07 | 53.3907 | 30.98378 | 46.92271 | 51.77785 | 0.563602 | 133.0731 | 16.83076 | 49.992079 |
| SWLSW2R1HK | 1694.444 | 324.3053 | 42.90756 | 199.1981 | 119.7424 | 336.0351 | 80.11304 | 51.71736 | 38.59485 | 73.730104 |
| SWLSW2R1FA | 85.98151 | 29.91198 | 9.123853 | 43.59131 | 71.40649 | 18.0949 | 7.176274 | 11.15424 | 12.65486 | 28.944628 |
| SWLSW2R1KL | 120.4534 | 83.72821 | 36.26168 | 163.9827 | 189.0177 | 48.17969 | 29.72814 | 38.21954 | 53.34464 | 141.01279 |
| SWLSW2R1CV | 166.4339 | 46.60393 | 27.3465 | 8.818574 | 188.8115 | 23.28566 | 0.48924 | 31.67884 | 49.44076 | 117.70524 |

Table A. 10: MSE result when the magnitude of outlier is 5, $\rho = 0.8$ and $\sigma^2$=100.

| | | $\sigma^2 = 100$ | $\delta^2 = 1$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.8$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 3430.129 | 4637.822 | 1002.401 | 1739.427 | 1045.632 | 2833.318 | 2524.786 | 2901.678 | 2332.625 | 1732.9088 |
| SR1HK | 69.19832 | 31.69079 | 11.29945 | 17.74673 | 6.541152 | 65.66981 | 32.59251 | 19.65135 | 7.844914 | 7.6999794 |
| SR1FA | 6.974735 | 7.510011 | 5.021787 | 6.238184 | 5.014488 | 4.934423 | 8.263883 | 5.847565 | 3.002637 | 5.2352188 |
| SR1KL | 383.1831 | 311.4926 | 153.5968 | 393.1188 | 250.6213 | 244.6649 | 179.2123 | 235.486 | 269.4849 | 370.82526 |
| SR1CV | 53.3564 | 302.9163 | 77.19865 | 661.813 | 138.0889 | 20.90723 | 1.726621 | 92.51856 | 122.8039 | 209.32438 |
| SWLSWOR1HK | 4972.183 | 641.6288 | 18.55152 | 51.19175 | 15.60702 | 7301.725 | 407.4873 | 200.344 | 19.36414 | 58.524083 |
| SWLSWOR1FA | 363.2856 | 146.0144 | 17.26382 | 60.70236 | 39.22412 | 658.5633 | 135.3413 | 100.871 | 42.00876 | 69.254919 |
| SWLSWOR1KL | 326.9465 | 256.7193 | 73.458 | 213.7287 | 213.97 | 478.7546 | 269.5196 | 333.3171 | 195.1802 | 491.30658 |
| SWLSWOR1CV | 4.708791 | 233.7681 | 231.1791 | 414.9622 | 132.8331 | 26.55822 | 10.31372 | 118.8603 | 29.79455 | 191.4178 |
| SWLSW2R1HK | 695.7721 | 146.3439 | 22.7765 | 489.683 | 71.4404 | 201.7812 | 21.24887 | 59.87453 | 29.23394 | 44.818182 |
| SWLSW2R1FA | 53.99196 | 21.01139 | 12.79556 | 106.2652 | 126.8772 | 12.41398 | 4.615138 | 16.79862 | 23.7553 | 54.385279 |
| SWLSW2R1KL | 88.94464 | 190.42 | 99.30983 | 970.1109 | 883.3566 | 39.99363 | 19.0751 | 114.8619 | 235.8829 | 719.22349 |
| SWLSW2R1CV | 136.4912 | 33.1077 | 74.90899 | 149.3027 | 1170.912 | 16.52962 | 0.839722 | 59.07629 | 256.771 | 722.59307 |

Table A. 11: MSE result when the magnitude of outlier is 1, $\rho = 0.8$ and $\sigma^2$=100.

| | | $\sigma^2 = 100$ | $\delta^2 = 2$ | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.8$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 1928.163 | 4981.912 | 284.3038 | 881.7713 | 547.3737 | 1964.663 | 2932.92 | 1926.075 | 1461.751 | 814.36743 |
| SR1HK | 74.66687 | 44.51886 | 12.06913 | 21.39321 | 4.448118 | 252.6358 | 46.9116 | 29.26698 | 5.23423 | 3.5316095 |
| SR1FA | 6.62549 | 11.35787 | 4.197 | 4.990325 | 4.383328 | 9.116712 | 15.03843 | 9.368266 | 4.384082 | 4.9117618 |
| SR1KL | 212.3936 | 365.1553 | 62.87781 | 205.6148 | 129.3252 | 340.171 | 223.1512 | 182.809 | 142.9259 | 147.21 |
| SR1CV | 90.60103 | 225.1944 | 32.18654 | 171.9836 | 83.46039 | 95.85862 | 194.2289 | 65.66808 | 85.10944 | 107.60318 |
| SWLSWOR1HK | 725.3437 | 70.43338 | 1.048694 | 1.279264 | 1.016067 | 1802.85 | 10.05287 | 4.896185 | 1.238961 | 1.3204332 |
| SWLSWOR1FA | 53.93073 | 25.07107 | 0.895394 | 3.183305 | 1.282631 | 562.8955 | 25.62699 | 5.231646 | 2.037785 | 2.9095712 |
| SWLSWOR1KL | 95.56906 | 67.78509 | 1.813437 | 11.92447 | 3.396372 | 163.0831 | 26.38098 | 21.17413 | 7.652656 | 23.794059 |
| SWLSWOR1CV | 19.63151 | 63.40236 | 3.347472 | 4.674823 | 7.83515 | 2.112847 | 1.076072 | 12.10074 | 1.785828 | 4.1604913 |
| SWLSW2R1HK | 3265.27 | 284.4994 | 16.30486 | 41.90381 | 5.976796 | 2193.727 | 12.26522 | 76.90522 | 13.04421 | 10.048026 |
| SWLSW2R1FA | 203.6008 | 91.51989 | 6.944796 | 68.05325 | 44.69403 | 49.11119 | 1.534105 | 20.63296 | 13.68209 | 17.910112 |
| SWLSW2R1KL | 196.6872 | 205.2317 | 25.90176 | 187.9669 | 144.7359 | 169.3649 | 22.92784 | 82.82484 | 85.4276 | 152.86503 |
| SWLSW2R1CV | 113.1357 | 260.8425 | 50.24236 | 360.9449 | 365.1604 | 74.45767 | 0.883258 | 40.54052 | 72.5009 | 161.95573 |

Table A. 12: MSE result when the magnitude of outlier is 5, $\rho$ = 0.8 and $\sigma^2$=100.

| | | $\sigma^2$ = 100 | | $\delta^2$ = 2 | k = 5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.8 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 15797.64 | 43056.21 | 4090.158 | 12842.92 | 10950.06 | 12189.14 | 10239.38 | 23733.11 | 24793.94 | 15545.079 |
| SR1HK | 33.55882 | 24.68349 | 10.67473 | 6.937745 | 1.81287 | 181.9799 | 1.128843 | 16.70479 | 2.016502 | 1.3636616 |
| SR1FA | 5.755001 | 10.21132 | 5.015125 | 5.071404 | 5.137704 | 6.11811 | 6.862931 | 8.064252 | 3.739039 | 5.7362246 |
| SR1KL | 485.1507 | 781.7437 | 268.6864 | 853.5411 | 557.0868 | 814.738 | 167.4021 | 640.3466 | 543.9568 | 617.13984 |
| SR1CV | 57.71504 | 2207.458 | 193.8069 | 1485.857 | 653.8703 | 43.50842 | 1.413769 | 287.1727 | 440.7581 | 851.53836 |
| SWLSWOR1HK | 1377.389 | 236.0032 | 1.018773 | 1.258207 | 0.983121 | 492.4784 | 1.447207 | 8.897155 | 1.088499 | 1.0475817 |
| SWLSWOR1FA | 89.55137 | 49.95281 | 0.897212 | 5.451184 | 1.558102 | 751.4276 | 7.748087 | 11.8842 | 4.010602 | 4.5659399 |
| SWLSWOR1KL | 508.2007 | 381.7188 | 3.687231 | 39.68535 | 8.087475 | 489.1723 | 33.05391 | 93.16166 | 22.8632 | 87.860144 |
| SWLSWOR1CV | 7.664474 | 1610.71 | 32.85384 | 5.390736 | 126.887 | 13.97583 | 0.556208 | 44.16233 | 3.620449 | 20.339378 |
| SWLSW2R1HK | 1056.339 | 32.48564 | 5.32136 | 4.705187 | 1.394065 | 2530.315 | 0.500567 | 51.96089 | 3.620566 | 1.8027498 |
| SWLSW2R1FA | 126.6523 | 48.37258 | 9.0124 | 94.9697 | 61.5181 | 52.56017 | 0.504089 | 28.19328 | 22.22772 | 25.925475 |
| SWLSW2R1KL | 266.0899 | 879.8027 | 77.46521 | 519.3074 | 354.4973 | 108.7971 | 42.69132 | 275.2733 | 268.3543 | 464.22119 |
| SWLSW2R1CV | 44.40597 | 1907.399 | 74.14841 | 758.739 | 1757.539 | 44.2003 | 27.99372 | 78.64363 | 357.5244 | 896.08431 |

Table A. 13: MSE result when the magnitude of outlier is 1, $\rho$ = 0.9 and $\sigma^2$ = 1.

| | | $\sigma^2$=1 | | $\delta^2$ = 1 | $k$ = 1 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.9 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 22.76808 | 16.21462 | 1.909198 | 3.427396 | 1.665241 | 11.20494 | 7.052194 | 8.831754 | 4.69497 | 3.006493 |
| SR1HK | 6.600193 | 3.222219 | 2.64001 | 3.478751 | 3.675316 | 2.612415 | 0 | 1.376839 | 1.171774 | 1.697311 |
| SR1FA | 4.85561 | 4.412823 | 3.265604 | 4.317532 | 4.133223 | 2.441831 | 0 | 1.735545 | 1.788919 | 2.364694 |
| SR1KL | 7.82016 | 4.977718 | 3.456086 | 5.243731 | 4.842057 | 2.901689 | 0 | 1.962543 | 2.137178 | 2.953609 |
| SR1CV | 16.63113 | 9.232894 | 4.290199 | 6.828675 | 5.550324 | 4.025414 | 0 | 3.565451 | 4.157864 | 4.402914 |
| SWLSWOR1HK | 1.751609 | 2.393346 | 0.519885 | 1.508909 | 0.944148 | 1.785438 | 0 | 1.661673 | 1.00031 | 1.607013 |
| SWLSWOR1FA | 0.814352 | 2.610654 | 0.490562 | 1.77337 | 1.02016 | 2.101551 | 0 | 2.277993 | 1.059917 | 1.315323 |
| SWLSWOR1KL | 1.555984 | 3.745108 | 0.425096 | 2.455876 | 1.579425 | 1.943569 | 0 | 2.467152 | 1.248912 | 3.033577 |
| SWLSWOR1CV | 1.889901 | 3.662984 | 0.731988 | 2.393682 | 1.810546 | 3.19828 | 0 | 2.725192 | 1.213509 | 1.971321 |
| SWLSW2R1HK | 1.270857 | 1.169069 | 0.963281 | 1.237643 | 0.942389 | 1.007203 | 0 | 1.014149 | 1.008429 | 1.009182 |
| SWLSW2R1FA | 1.247503 | 1.167882 | 0.968249 | 1.318206 | 0.982984 | 1.012823 | 0 | 1.022607 | 1.029159 | 1.035243 |
| SWLSW2R1KL | 1.767763 | 1.268264 | 1.014004 | 1.71471 | 1.228875 | 1.042236 | 0 | 1.072756 | 1.113368 | 1.163421 |
| SWLSW2R1CV | 2.134267 | 1.567296 | 1.071417 | 1.94004 | 1.36644 | 1.172881 | 0 | 1.123517 | 1.164011 | 1.222396 |

Table A. 14: MSE result when the magnitude of outlier is 5, $\rho$ = 0.9 and $\sigma^2$ = 1.

| | | $\sigma^2$=1 | | $\delta^2$ = 1 | k= 5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.9 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 126.5072 | 271.4696 | 34.65088 | 62.63977 | 30.79532 | 123.2034 | 101.1998 | 138.9451 | 87.081 | 60.85179 |
| SR1HK | 2.745186 | 2.421559 | 2.077594 | 2.445085 | 2.368809 | 2.347796 | 0 | 1.061262 | 0.849651 | 1.212618 |
| SR1FA | 5.509065 | 6.488417 | 4.958319 | 6.190092 | 6.399279 | 3.326297 | 0 | 2.876482 | 2.399716 | 4.857579 |
| SR1KL | 8.811236 | 11.98677 | 7.796867 | 14.1504 | 13.91303 | 6.343378 | 0 | 5.505361 | 7.311386 | 10.87857 |
| SR1CV | 11.15462 | 46.86524 | 11.92931 | 21.79971 | 17.60531 | 4.334026 | 0 | 14.45482 | 16.39178 | 24.7288 |
| SWLSWOR1HK | 1.348766 | 1.535235 | 0.775281 | 1.112638 | 0.924742 | 1.159475 | 0 | 1.235229 | 1.012911 | 1.115373 |
| SWLSWOR1FA | 1.450637 | 2.61729 | 0.699268 | 1.41255 | 0.96108 | 2.794458 | 0 | 2.279357 | 1.091508 | 1.131859 |
| SWLSWOR1KL | 3.732671 | 5.855286 | 1.332321 | 4.284498 | 2.330501 | 2.909554 | 0 | 3.299098 | 1.47141 | 3.685402 |
| SWLSWOR1CV | 2.080868 | 6.455767 | 1.856018 | 4.28503 | 2.441005 | 2.681098 | 0 | 2.633244 | 1.277161 | 2.216335 |
| SWLSW2R1HK | 1.237123 | 1.195251 | 0.98287 | 1.092729 | 0.893457 | 1.023338 | 0 | 1.007418 | 1.009411 | 1.016857 |
| SWLSW2R1FA | 1.137956 | 1.245596 | 1.001936 | 1.468654 | 1.077511 | 1.0202 | 0 | 1.052533 | 1.068194 | 1.109278 |
| SWLSW2R1KL | 1.607961 | 2.324983 | 1.45664 | 4.086184 | 3.866699 | 1.067764 | 0 | 1.37831 | 1.874584 | 2.997354 |
| SWLSW2R1CV | 1.704117 | 1.648387 | 1.69708 | 5.634366 | 5.76243 | 1.156797 | 0 | 1.851041 | 1.976678 | 3.640637 |

Table A. 15: MSE result when the magnitude of outlier is 1, $\rho = 0.9$ and $\sigma^2$=1.

| | | $\sigma^2$=1 | $\delta^2 = 2$ | $k = 1$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.9$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 60.15271 | 164.3035 | 5.995922 | 28.58405 | 11.08328 | 41.28731 | 54.56183 | 67.82922 | 32.08975 | 19.25399 |
| SR1HK | 3.424231 | 2.953136 | 2.479217 | 2.798421 | 2.955303 | 4.317628 | 0 | 1.564743 | 0.954229 | 1.380678 |
| SR1FA | 4.935176 | 6.887222 | 3.655458 | 5.14977 | 4.977746 | 2.846358 | 0 | 2.823293 | 2.121575 | 3.342905 |
| SR1KL | 7.170568 | 10.99237 | 4.352516 | 9.618285 | 8.364518 | 5.11053 | 0 | 4.494522 | 3.891073 | 5.814013 |
| SR1CV | 10.75881 | 18.8396 | 5.489049 | 12.4107 | 10.03292 | 4.69784 | 0 | 6.740133 | 8.403519 | 10.50187 |
| SWLSWOR1HK | 0.96232 | 1.151584 | 1.044502 | 1.138612 | 1.024101 | 1.279484 | 0 | 0.973575 | 1.000322 | 0.987309 |
| SWLSWOR1FA | 0.842333 | 1.366708 | 1.024321 | 1.06518 | 1.020842 | 1.013665 | 0 | 0.978932 | 1.001721 | 0.996755 |
| SWLSWOR1KL | 1.138872 | 1.913774 | 1.115049 | 1.874425 | 1.291069 | 1.057351 | 0 | 0.999684 | 1.003667 | 0.914657 |
| SWLSWOR1CV | 0.978475 | 2.407159 | 1.042967 | 1.361647 | 1.193904 | 1.252523 | 0 | 2.306297 | 1.002162 | 0.953223 |
| SWLSW2R1HK | 1.310381 | 1.294235 | 0.953387 | 0.976421 | 0.870191 | 1.375147 | 0 | 1.041498 | 1.003147 | 0.996896 |
| SWLSW2R1FA | 1.433378 | 1.357885 | 0.957844 | 1.142345 | 0.912546 | 1.103339 | 0 | 1.062431 | 1.035223 | 1.019547 |
| SWLSW2R1KL | 1.614259 | 1.953387 | 1.01737 | 2.047446 | 1.232058 | 1.578206 | 0 | 1.233557 | 1.273352 | 1.331519 |
| SWLSW2R1CV | 1.817937 | 2.511519 | 1.05809 | 3.224304 | 1.456821 | 1.447689 | 0 | 1.272567 | 1.332827 | 1.39106 |

Table A. 16: MSE result when the magnitude of outlier is 5, $\rho = 0.9$ and $\sigma^2$=1.

| | | $\sigma^2$=1 | $\delta^2 = 2$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.9$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 527.637 | 1521.928 | 105.7107 | 483.5593 | 222.0108 | 342.6009 | 373.6179 | 909.6077 | 560.8414 | 374.6429 |
| SR1HK | 2.134514 | 1.615495 | 1.692504 | 1.606331 | 1.498209 | 4.168489 | 0 | 1.020921 | 0.749741 | 1.049577 |
| SR1FA | 6.541465 | 7.743069 | 5.597277 | 7.240142 | 7.972341 | 3.898162 | 0 | 4.598773 | 3.500392 | 6.972476 |
| SR1KL | 14.22528 | 21.54033 | 11.08666 | 30.1594 | 29.57305 | 14.4411 | 0 | 13.80641 | 19.26455 | 18.26063 |
| SR1CV | 13.07091 | 106.1975 | 19.77014 | 75.99461 | 61.4164 | 5.269135 | 0 | 42.31172 | 55.14109 | 83.53823 |
| SWLSWOR1HK | 1.141262 | 1.047886 | 1.029397 | 1.075922 | 1.011221 | 1.033489 | 0 | 0.988197 | 1.000331 | 0.993274 |
| SWLSWOR1FA | 1.560799 | 1.472832 | 1.019932 | 1.077 | 1.025324 | 1.483509 | 0 | 1.124911 | 1.005248 | 0.996246 |
| SWLSWOR1KL | 4.124645 | 2.960456 | 1.290954 | 4.545632 | 1.759863 | 1.611224 | 0 | 1.411287 | 1.021953 | 0.923004 |
| SWLSWOR1CV | 1.461089 | 7.055677 | 1.150346 | 4.030173 | 1.55826 | 5.564704 | 0 | 4.039759 | 1.015005 | 0.932481 |
| SWLSW2R1HK | 1.161439 | 1.092826 | 0.976017 | 0.996792 | 0.963178 | 1.650585 | 0 | 1.035823 | 1.0018 | 1.000981 |
| SWLSW2R1FA | 1.921259 | 1.451309 | 0.981789 | 1.442211 | 1.009543 | 1.071728 | 0 | 1.157792 | 1.114646 | 1.041631 |
| SWLSW2R1KL | 3.203627 | 3.951767 | 1.480894 | 7.040479 | 5.395069 | 1.711173 | 0 | 2.318158 | 3.128892 | 4.391438 |
| SWLSW2R1CV | 1.289718 | 6.819929 | 1.69964 | 23.4075 | 10.62038 | 1.395424 | 0 | 2.326254 | 3.995519 | 6.2914 |

Table A. 17: MSE result when the magnitude of outlier is 1, $\rho = 0.9$ and $\sigma^2 = 25$.

| | | $\sigma^2 = 25$ | $\delta^2 = 1$ | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.9$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 189.6321 | 203.6889 | 30.39673 | 59.78889 | 49.45181 | 220.2571 | 143.4782 | 145.9341 | 75.71812 | 46.45243 |
| SR1HK | 34.05336 | 13.50702 | 5.619421 | 9.469015 | 11.84175 | 20.59735 | 0 | 11.6291 | 4.376048 | 4.5527 |
| SR1FA | 5.696584 | 8.962259 | 4.243019 | 6.093491 | 10.65523 | 4.294462 | 0 | 3.672108 | 2.472317 | 3.894576 |
| SR1KL | 35.67062 | 24.87894 | 11.32783 | 24.16246 | 31.22107 | 24.15318 | 0 | 22.97978 | 16.15152 | 18.85515 |
| SR1CV | 35.82937 | 40.95644 | 10.18566 | 26.65644 | 33.41801 | 18.8798 | 0 | 16.46571 | 14.85473 | 16.62009 |
| SWLSWOR1HK | 250.8488 | 263.6681 | 22.42785 | 38.84098 | 15.55334 | 220.3704 | 0 | 47.13992 | 2.924566 | 9.627426 |
| SWLSWOR1FA | 32.31797 | 69.6719 | 4.127839 | 16.87356 | 12.86888 | 50.45178 | 0 | 22.39358 | 2.823664 | 5.088871 |
| SWLSWOR1KL | 28.09174 | 98.62182 | 16.91667 | 44.30807 | 38.56337 | 19.74813 | 0 | 28.74484 | 7.381693 | 22.43238 |
| SWLSWOR1CV | 14.96199 | 14.28487 | 15.65959 | 18.76724 | 24.57415 | 12.68965 | 0 | 18.70371 | 3.914921 | 9.568044 |
| SWLSW2R1HK | 56.22945 | 13.21596 | 8.979338 | 28.14306 | 48.92162 | 35.30199 | 0 | 8.748207 | 5.7252 | 8.215408 |
| SWLSW2R1FA | 11.44279 | 8.676975 | 3.836473 | 17.58415 | 25.21631 | 3.584117 | 0 | 3.38904 | 3.743074 | 6.664281 |
| SWLSW2R1KL | 19.49481 | 16.75331 | 8.868249 | 39.3596 | 78.98005 | 11.18968 | 0 | 9.431866 | 11.61578 | 23.30045 |
| SWLSW2R1CV | 21.84824 | 16.45911 | 10.17233 | 9.507797 | 74.21939 | 5.54312 | 0 | 7.68063 | 10.41786 | 25.0277 |

Table A. 18: MSE result when the magnitude of outlier is 5, $\rho = 0.9$ and $\sigma^2 = 25$.

| | $\sigma^2 = 25$ | | $\delta^2 = 1$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.9$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 1055.301 | 3729.398 | 424.3013 | 877.12 | 415.0778 | 1522.008 | 1140.489 | 1675.407 | 1125.057 | 795.0179 |
| SR1HK | 22.38889 | 13.01775 | 5.761052 | 13.82289 | 3.457389 | 25.76236 | 0 | 11.49762 | 4.504101 | 2.7638 |
| SR1FA | 7.119323 | 9.633084 | 6.416151 | 8.663594 | 8.965002 | 5.617178 | 0 | 6.291164 | 4.297221 | 8.130857 |
| SR1KL | 74.37686 | 124.4702 | 45.79935 | 134.2676 | 107.9846 | 78.05658 | 0 | 90.03897 | 87.01681 | 113.0351 |
| SR1CV | 37.45921 | 324.4886 | 41.3958 | 226.2519 | 56.83516 | 9.834296 | 0 | 77.21315 | 96.09993 | 145.052 |
| SWLSWOR1HK | 227.1944 | 212.7108 | 12.29985 | 11.02649 | 4.836677 | 158.5063 | 0 | 33.92423 | 2.165487 | 5.059092 |
| SWLSWOR1FA | 57.0205 | 64.89292 | 6.766086 | 17.31819 | 13.3921 | 105.0385 | 0 | 44.15497 | 5.017472 | 6.948653 |
| SWLSWOR1KL | 75.77072 | 175.2463 | 39.43126 | 108.6712 | 66.75626 | 87.83386 | 0 | 85.87198 | 25.6239 | 64.46821 |
| SWLSWOR1CV | 1.488544 | 91.27381 | 52.385 | 76.06793 | 31.88124 | 41.03244 | 0 | 27.47115 | 18.76579 | 32.89162 |
| SWLSW2R1HK | 23.58226 | 17.87547 | 6.414737 | 23.88628 | 4.286358 | 18.47518 | 0 | 8.550606 | 4.170546 | 6.117731 |
| SWLSW2R1FA | 11.40606 | 8.631714 | 5.955889 | 28.62704 | 38.13603 | 3.580232 | 0 | 5.432627 | 7.650502 | 15.35506 |
| SWLSW2R1KL | 36.46722 | 67.93167 | 29.01872 | 179.6793 | 167.2061 | 8.633316 | 0 | 29.29191 | 52.43416 | 136.9824 |
| SWLSW2R1CV | 20.14303 | 89.48301 | 29.02853 | 482.857 | 294.3529 | 5.032015 | 0 | 36.24597 | 45.83913 | 166.9612 |

Table A. 19: MSE result when the magnitude of outlier is 1, $\rho = 0.9$ and $\sigma^2$=25.

| | $\sigma^2 = 25$ | | $\delta^2 = 2$ | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.9$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 2729.977 | 4903.716 | 120.7831 | 606.204 | 229.0869 | 934.1785 | 1331.899 | 1504.727 | 714.4881 | 409.8633 |
| SR1HK | 10.94764 | 18.34546 | 6.264346 | 10.1845 | 2.561075 | 64.96975 | 0 | 18.84716 | 3.857486 | 2.162705 |
| SR1FA | 11.65773 | 17.19201 | 5.392464 | 7.553514 | 7.180416 | 6.530008 | 0 | 9.750567 | 4.891148 | 6.636137 |
| SR1KL | 89.22805 | 184.591 | 23.86901 | 90.28548 | 47.44104 | 80.09299 | 0 | 89.19366 | 54.24515 | 53.06016 |
| SR1CV | 182.9283 | 140.7146 | 19.70562 | 73.16186 | 51.24103 | 26.40986 | 0 | 51.64666 | 63.43286 | 75.61729 |
| SWLSWOR1HK | 190.5003 | 11.11433 | 0.949434 | 1.840531 | 1.07718 | 224.1229 | 0 | 3.25813 | 1.000885 | 1.031044 |
| SWLSWOR1FA | 17.37066 | 14.06791 | 0.896979 | 2.236332 | 1.430333 | 24.67193 | 0 | 5.54943 | 1.017505 | 1.045932 |
| SWLSWOR1KL | 26.75292 | 24.71817 | 1.644949 | 12.6491 | 3.902094 | 10.97507 | 0 | 8.48658 | 1.149211 | 1.922585 |
| SWLSWOR1CV | 25.22554 | 30.11735 | 1.342931 | 25.72677 | 7.110766 | 31.98026 | 0 | 12.18992 | 1.100619 | 1.59722 |
| SWLSW2R1HK | 91.93206 | 80.43442 | 2.849536 | 12.11072 | 1.714538 | 112.8281 | 0 | 22.28375 | 3.316963 | 2.182061 |
| SWLSW2R1FA | 24.66261 | 29.12863 | 3.564178 | 22.03642 | 11.08125 | 8.780556 | 0 | 7.517081 | 5.713952 | 5.590545 |
| SWLSW2R1KL | 29.01038 | 53.17583 | 7.296634 | 65.35361 | 35.87868 | 33.55234 | 0 | 28.89981 | 22.11124 | 34.74958 |
| SWLSW2R1CV | 15.44575 | 24.6912 | 8.803649 | 158.0511 | 101.5956 | 13.38361 | 0 | 12.15484 | 23.63009 | 51.80483 |

Table A. 20: MSE result when the magnitude of outlier is 5, $\rho = 0.9$ and $\sigma^2$=25.

| | $\sigma^2 = 25$ | | $\delta^2 = 2$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.9$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 14244.9 | 37023.13 | 1894.636 | 9297.181 | 4412.545 | 6058.079 | 6552.54 | 18371.55 | 11830.7 | 7553.105 |
| SR1HK | 5.261481 | 6.46734 | 4.26911 | 4.750834 | 1.358361 | 68.30244 | 0 | 11.07718 | 1.847294 | 1.206973 |
| SR1FA | 17.07889 | 12.69743 | 7.032635 | 8.586069 | 9.862603 | 7.332938 | 0 | 11.23643 | 6.4147 | 10.6136 |
| SR1KL | 189.8896 | 480.7864 | 89.95433 | 382.7837 | 195.7555 | 256.768 | 0 | 304.6689 | 236.3512 | 185.1919 |
| SR1CV | 212.56 | 1289.06 | 107.9158 | 768.3917 | 430.8836 | 13.93747 | 0 | 280.1593 | 396.5251 | 690.7206 |
| SWLSWOR1HK | 258.6649 | 2.202894 | 1.027806 | 1.413401 | 1.056222 | 195.4035 | 0 | 2.992613 | 1.000433 | 1.018382 |
| SWLSWOR1FA | 67.60587 | 17.73359 | 0.937755 | 2.73943 | 1.860587 | 54.78283 | 0 | 15.41257 | 1.064936 | 1.069345 |
| SWLSWOR1KL | 149.786 | 49.49891 | 4.580609 | 31.9987 | 9.593941 | 38.8328 | 0 | 36.41845 | 2.176043 | 5.750021 |
| SWLSWOR1CV | 286.2247 | 42.62516 | 5.052491 | 96.00223 | 52.67815 | 74.5822 | 0 | 27.65442 | 1.926121 | 3.148855 |
| SWLSW2R1HK | 31.57588 | 11.44742 | 1.470636 | 3.02228 | 0.985936 | 350.513 | 0 | 15.73563 | 1.658678 | 1.188499 |
| SWLSW2R1FA | 47.65766 | 27.10245 | 5.279625 | 34.96734 | 18.98658 | 9.812461 | 0 | 12.65171 | 10.80651 | 9.238361 |
| SWLSW2R1KL | 77.57521 | 163.236 | 21.40917 | 188.2205 | 104.6791 | 42.04224 | 0 | 103.4877 | 79.02371 | 140.3545 |
| SWLSW2R1CV | 1.248725 | 422.1907 | 28.34448 | 885.1639 | 688.8557 | 13.15957 | 0 | 55.1124 | 165.1589 | 365.9968 |

Table A. 21: MSE result when the magnitude of outlier is 1, $\rho$ = 0.9 and $\sigma^2$=100

| | $\sigma^2$= 100 | | $\delta^2$ = 1 | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.9 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 881.9768 | 541.8924 | 107.5139 | 223.7241 | 199.4628 | 868.5866 | 564.1753 | 567.1471 | 292.4386 | 176.9839 |
| SR1HK | 174.4792 | 54.80677 | 16.01286 | 32.33735 | 26.47312 | 76.94431 | 0 | 44.35329 | 15.58231 | 13.59277 |
| SR1FA | 7.91616 | 14.11088 | 5.024873 | 5.721083 | 13.30385 | 6.353541 | 0 | 6.014425 | 3.518724 | 5.219808 |
| SR1KL | 162.0503 | 78.12745 | 37.30422 | 75.80783 | 84.02518 | 90.60959 | 0 | 90.7807 | 62.43793 | 67.66135 |
| SR1CV | 95.009 | 56.24565 | 20.22443 | 29.7323 | 85.90103 | 41.97303 | 0 | 45.18071 | 37.52605 | 39.82692 |
| SWLSWOR1HK | 5610.908 | 4832.369 | 467.8208 | 476.083 | 78.79046 | 3350.22 | 0 | 665.3942 | 22.15792 | 78.48758 |
| SWLSWOR1FA | 195.0132 | 317.3287 | 30.91193 | 66.12176 | 47.98883 | 309.0298 | 0 | 115.7507 | 8.269475 | 18.37184 |
| SWLSWOR1KL | 77.33398 | 194.4394 | 87.27562 | 162.7122 | 143.2918 | 54.84987 | 0 | 119.1645 | 31.08573 | 106.2242 |
| SWLSWOR1CV | 10.39197 | 3.683858 | 59.62883 | 23.20775 | 74.2858 | 31.38267 | 0 | 55.52006 | 17.16906 | 29.54462 |
| SWLSW2R1HK | 1181.142 | 424.6562 | 123.1597 | 1261.198 | 527.7587 | 399.5764 | 0 | 162.6092 | 68.338 | 107.3 |
| SWLSW2R1FA | 128.861 | 95.43228 | 22.48832 | 88.727 | 151.6822 | 18.36344 | 0 | 17.83666 | 18.44574 | 36.56396 |
| SWLSW2R1KL | 122.6944 | 215.5119 | 57.45406 | 217.2017 | 547.6605 | 53.94251 | 0 | 58.41169 | 73.22935 | 169.7641 |
| SWLSW2R1CV | 160.8188 | 49.09306 | 50.11613 | 12.5379 | 772.3035 | 20.59211 | 0 | 36.83013 | 56.02841 | 143.507 |

Table A. 22: MSE result when the magnitude of outlier is 5, $\rho$ = 0.9 and $\sigma^2$=100.

| | $\sigma^2$ = 100 | | $\delta^2$ = 1 | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.9 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 7145.058 | 10584.24 | 1561.812 | 3416.594 | 2682.773 | 5679.139 | 4034.094 | 6329.663 | 4238.588 | 2955.893 |
| SR1HK | 194.6182 | 63.1714 | 15.12998 | 42.46297 | 9.025942 | 96.44545 | 0 | 48.01035 | 16.84281 | 7.553261 |
| SR1FA | 12.5671 | 10.93803 | 7.317072 | 9.528932 | 14.75089 | 7.568573 | 0 | 9.26899 | 5.63888 | 9.776381 |
| SR1KL | 567.3813 | 402.2974 | 170.3179 | 459.0608 | 450.4914 | 293.1808 | 0 | 364.8329 | 341.2184 | 420.6755 |
| SR1CV | 129.2662 | 445.3448 | 146.6748 | 623.1101 | 732.7627 | 16.42659 | 0 | 184.5312 | 232.9968 | 361.5027 |
| SWLSWOR1HK | 5100.492 | 2312.634 | 105.7123 | 171.9338 | 40.83388 | 2517.087 | 0 | 504.5329 | 14.47653 | 51.10303 |
| SWLSWOR1FA | 515.3989 | 296.8296 | 39.79572 | 79.32387 | 78.5688 | 601.2074 | 0 | 239.2003 | 18.68628 | 31.27943 |
| SWLSWOR1KL | 272.5777 | 532.5274 | 171.9386 | 526.5291 | 448.4866 | 368.7583 | 0 | 464.4145 | 128.3502 | 372.1425 |
| SWLSWOR1CV | 2.002183 | 190.6288 | 255.9694 | 139.4793 | 206.4736 | 93.91173 | 0 | 83.02723 | 124.389 | 141.3343 |
| SWLSW2R1HK | 3566.916 | 438.2498 | 33.68342 | 397.9409 | 100.5863 | 244.872 | 0 | 121.8386 | 49.42542 | 71.78692 |
| SWLSW2R1FA | 134.8153 | 44.59237 | 26.28499 | 142.2385 | 267.5613 | 22.20154 | 0 | 26.53663 | 37.96285 | 80.66667 |
| SWLSW2R1KL | 357.3943 | 384.1638 | 166.751 | 997.1188 | 1510.765 | 51.1535 | 0 | 189.5382 | 327.2538 | 901.5031 |
| SWLSW2R1CV | 300.1788 | 8.935628 | 70.91006 | 1503.293 | 5016.002 | 16.20732 | 0 | 60.03894 | 190.0457 | 778.3097 |

Table A. 23: MSE result when the magnitude of outlier is 1, $\rho$ = 0.9 and $\sigma^2$=100

| | $\sigma^2$ = 100 | | $\delta^2$ = 2 | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.9 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 10779.03 | 9274.591 | 468.1704 | 2427.271 | 905.5901 | 3702.41 | 5318.201 | 5941.763 | 2825.767 | 1611.052 |
| SR1HK | 39.45203 | 149.8054 | 17.06805 | 32.9364 | 4.598498 | 262.5223 | 0 | 76.30152 | 13.88644 | 4.92917 |
| SR1FA | 14.42023 | 24.4969 | 6.029913 | 8.842118 | 8.167922 | 10.59791 | 0 | 17.08344 | 7.40472 | 8.806244 |
| SR1KL | 337.3813 | 520.5659 | 74.27252 | 324.823 | 160.2044 | 319.3189 | 0 | 360.055 | 217.0201 | 196.4367 |
| SR1CV | 355.852 | 244.7637 | 36.8303 | 245.8424 | 138.5835 | 57.342 | 0 | 125.8952 | 154.0345 | 190.4776 |
| SWLSWOR1HK | 2670.16 | 49.70794 | 2.584912 | 7.594567 | 1.286455 | 3522.334 | 0 | 38.91858 | 1.006041 | 1.159614 |
| SWLSWOR1FA | 92.50939 | 41.00957 | 1.231851 | 5.541306 | 3.024343 | 144.5017 | 0 | 30.9361 | 1.126708 | 1.224455 |
| SWLSWOR1KL | 59.16585 | 88.58482 | 7.110937 | 49.06592 | 12.72409 | 36.25771 | 0 | 51.33754 | 2.165953 | 6.080298 |
| SWLSWOR1CV | 61.18003 | 2.65176 | 5.048456 | 162.1206 | 45.3562 | 78.66326 | 0 | 27.68638 | 1.929684 | 3.165688 |
| SWLSW2R1HK | 634.1748 | 2057.247 | 27.69835 | 156.2432 | 9.705248 | 3638.868 | 0 | 309.56 | 40.46999 | 17.35802 |
| SWLSW2R1FA | 116.6983 | 504.106 | 18.8194 | 115.5864 | 64.40602 | 46.58458 | 0 | 41.5783 | 28.9983 | 30.50774 |
| SWLSW2R1KL | 114.2989 | 217.3632 | 36.86617 | 365.0675 | 175.1831 | 162.8794 | 0 | 175.2547 | 135.8943 | 239.2708 |
| SWLSW2R1CV | 92.11613 | 44.66249 | 50.15945 | 702.8678 | 559.1243 | 45.22823 | 0 | 57.93213 | 115.9383 | 309.1911 |

Table A. 24: MSE result when the magnitude of outlier is 5, $\rho = 0.9$ and $\sigma^2$=100.

| | $\sigma^2$ = 100 | | $\delta^2$ = 2 | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.9$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 126857.8 | 90192.74 | 7338.8 | 35158.52 | 17392.51 | 23410.74 | 24983.1 | 71771.01 | 46530.32 | 29489.14 |
| SR1HK | 40.18885 | 47.91126 | 11.7717 | 13.77017 | 1.758217 | 269.1813 | 0 | 46.88318 | 5.650724 | 1.709764 |
| SR1FA | 10.93605 | 14.53014 | 7.371821 | 9.257778 | 10.27767 | 9.564964 | 0 | 15.42514 | 7.648454 | 11.81216 |
| SR1KL | 977.7839 | 1113.308 | 320.058 | 1528.244 | 688.039 | 1000.944 | 0 | 1239.161 | 914.4758 | 695.3696 |
| SR1CV | 1018.908 | 1842.424 | 236.9853 | 1590.433 | 1091.048 | 23.54379 | 0 | 575.4726 | 833.1481 | 1609.615 |
| SWLSWOR1HK | 3000.58 | 22.12205 | 3.432529 | 4.192937 | 1.168694 | 3302.904 | 0 | 33.52322 | 1.0046 | 1.115942 |
| SWLSWOR1FA | 107.5449 | 71.80846 | 1.661392 | 7.268096 | 5.325068 | 308.4708 | 0 | 81.20408 | 1.459475 | 1.401482 |
| SWLSWOR1KL | 1048.485 | 171.6922 | 23.23397 | 117.6234 | 39.60783 | 166.2519 | 0 | 217.7956 | 8.56255 | 28.84373 |
| SWLSWOR1CV | 2.258981 | 12.34219 | 22.54329 | 303.7808 | 278.733 | 122.643 | 0 | 70.51381 | 6.464733 | 8.219759 |
| SWLSW2R1HK | 189.9031 | 183.3015 | 10.61421 | 40.56731 | 1.365099 | 4560.627 | 0 | 256.5763 | 11.29386 | 3.323062 |
| SWLSW2R1FA | 367.0123 | 174.4393 | 22.9758 | 151.5187 | 92.87297 | 58.80077 | 0 | 63.56253 | 50.59081 | 45.90233 |
| SWLSW2R1KL | 1322.807 | 528.0794 | 101.5414 | 1061.821 | 391.6904 | 146.8149 | 0 | 613.1461 | 451.7342 | 757.512 |
| SWLSW2R1CV | 1.964474 | 1510.146 | 78.15244 | 1826.438 | 2726.841 | 39.22716 | 0 | 179.9893 | 564.3441 | 1540.325 |

Table A. 25: MSE result when the magnitude of outlier is 1, $\rho = 0.95$ and $\sigma^2 = 1$.

| | $\sigma^2$=1 | | $\delta^2 = 1$ | $k = 1$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.95$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 25.82383 | 41.19524 | 3.39362 | 6.228496 | 2.730412 | 14.63984 | 23.64717 | 19.13465 | 8.864903 | 5.409046 |
| SR1HK | 5.758791 | 4.410425 | 2.754969 | 3.556645 | 2.844743 | 1.045827 | 2.888539 | 1.808987 | 1.294345 | 1.158666 |
| SR1FA | 4.348275 | 4.94431 | 3.525389 | 4.628973 | 3.241198 | 2.01143 | 2.152658 | 1.957401 | 1.791798 | 1.599787 |
| SR1KL | 5.761378 | 6.168717 | 3.613584 | 5.375132 | 3.792557 | 1.543353 | 2.924016 | 2.431616 | 2.258323 | 2.143112 |
| SR1CV | 10.91812 | 13.24478 | 4.961022 | 8.346139 | 5.143279 | 6.776569 | 12.48514 | 5.665428 | 5.715523 | 4.552602 |
| SWLSWOR1HK | 1.326869 | 0.925682 | 2.144435 | 0.801574 | 0.944421 | 2.464139 | 2.297028 | 2.042325 | 1.023849 | 0.539005 |
| SWLSWOR1FA | 0.752025 | 0.934862 | 1.949109 | 0.703789 | 0.93245 | 2.682114 | 1.036066 | 2.303891 | 1.040359 | 0.598706 |
| SWLSWOR1KL | 1.383278 | 1.399016 | 3.326527 | 1.234678 | 1.491792 | 1.836601 | 1.608948 | 2.833803 | 1.259563 | 0.497599 |
| SWLSWOR1CV | 1.308438 | 2.294525 | 2.968775 | 1.290909 | 1.308328 | 0.490327 | 1.092442 | 3.470223 | 1.288378 | 0.712415 |
| SWLSW2R1HK | 1.186263 | 1.17137 | 0.989041 | 1.242876 | 0.899537 | 0.474939 | 0.802435 | 1.058473 | 1.030959 | 1.059284 |
| SWLSW2R1FA | 1.168542 | 1.14938 | 0.98337 | 1.375423 | 0.969561 | 0.490951 | 0.814399 | 1.044711 | 1.049998 | 1.093898 |
| SWLSW2R1KL | 1.459211 | 1.445502 | 1.054078 | 1.819894 | 1.231254 | 0.491755 | 0.782851 | 1.166763 | 1.205735 | 1.342243 |
| SWLSW2R1CV | 1.423904 | 1.661653 | 1.113554 | 2.225666 | 1.445339 | 0.495188 | 0.764618 | 1.213781 | 1.282488 | 1.45851 |

Table A. 26: MSE result when the magnitude of outlier is 5, $\rho = 0.95$ and $\sigma^2 = 1$.

| | $\sigma^2$=1 | | $\delta^2 = 1$ | k= 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.95$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 279.4719 | 547.6205 | 60.3767 | 112.2528 | 51.77151 | 349.9056 | 167.2501 | 301.0641 | 158.3323 | 106.5982 |
| SR1HK | 3.174033 | 5.840844 | 2.222257 | 2.811384 | 1.832621 | 1.601887 | 0 | 1.408567 | 0.982642 | 1.276001 |
| SR1FA | 6.601659 | 10.4373 | 5.964909 | 8.155469 | 5.651904 | 3.278296 | 0 | 3.729393 | 3.076556 | 5.728794 |
| SR1KL | 9.652775 | 16.24524 | 7.655848 | 15.40908 | 12.95489 | 3.597518 | 0 | 7.177803 | 7.879547 | 12.79478 |
| SR1CV | 10.75399 | 107.6259 | 15.674 | 34.21896 | 21.27025 | 7.337256 | 0 | 27.2183 | 28.08082 | 36.59578 |
| SWLSWOR1HK | 1.507792 | 0.685241 | 1.294774 | 0.766316 | 0.833154 | 0.947071 | 0 | 1.304911 | 1.019853 | 0.887103 |
| SWLSWOR1FA | 1.969421 | 2.356708 | 1.573873 | 0.589988 | 0.805128 | 3.08236 | 0 | 2.539198 | 1.099747 | 0.929809 |
| SWLSWOR1KL | 4.937471 | 3.830652 | 4.015298 | 2.785208 | 1.733519 | 2.393518 | 0 | 4.460027 | 2.307031 | 2.170286 |
| SWLSWOR1CV | 2.996997 | 45.8615 | 4.007882 | 3.009004 | 1.304813 | 0.794405 | 0 | 3.729363 | 1.932193 | 1.488185 |
| SWLSW2R1HK | 1.212123 | 1.49219 | 1.016636 | 1.136144 | 0.91282 | 1.165264 | 0 | 1.028262 | 1.018533 | 1.040409 |
| SWLSW2R1FA | 1.222415 | 1.898541 | 1.04778 | 1.728357 | 1.287696 | 1.058808 | 0 | 1.091856 | 1.145473 | 1.255976 |
| SWLSW2R1KL | 1.880692 | 4.446461 | 1.547105 | 4.283649 | 4.065171 | 1.151041 | 0 | 1.659685 | 2.199902 | 3.683377 |
| SWLSW2R1CV | 1.671325 | 1.953051 | 1.69814 | 8.102978 | 6.990758 | 0.812509 | 0 | 1.768834 | 2.989072 | 5.344174 |

Table A. 27: MSE result when the magnitude of outlier is 1, $\rho = 0.95$ and $\sigma^2$=1.

| | $\sigma^2$=1 | $\delta^2 = 2$ | $k = 1$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.95$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 841.4762 | 353.8744 | 10.41818 | 59.47076 | 18.33196 | 69.42589 | 206.1847 | 170.0379 | 59.702 | 36.4549 |
| SR1HK | 4.572612 | 4.573143 | 2.633202 | 2.921521 | 2.276192 | 7.082772 | 2.742569 | 2.114391 | 1.144724 | 1.155824 |
| SR1FA | 11.34034 | 8.454695 | 4.101063 | 6.461481 | 4.089798 | 3.420255 | 3.750662 | 3.568939 | 2.407864 | 3.227389 |
| SR1KL | 18.82696 | 12.99674 | 4.516105 | 10.63005 | 6.86326 | 6.812088 | 3.777734 | 5.757177 | 4.152095 | 5.712755 |
| SR1CV | 312.5708 | 28.8258 | 6.505675 | 17.46516 | 10.81024 | 6.461521 | 21.01178 | 11.94736 | 12.99011 | 14.53161 |
| SWLSWOR1HK | 1.970309 | 0.849671 | 0.833274 | 0.999204 | 1.006673 | 0.847387 | 0.691157 | 1.201972 | 0.993913 | 1.010252 |
| SWLSWOR1FA | 1.878632 | 0.71754 | 0.925007 | 0.99619 | 0.997459 | 0.781442 | 0.718658 | 1.607597 | 0.993952 | 1.007398 |
| SWLSWOR1KL | 2.018036 | 1.024758 | 0.686275 | 1.153591 | 1.074405 | 0.825979 | 0.793398 | 1.897248 | 0.995924 | 1.205945 |
| SWLSWOR1CV | 6.266542 | 1.222904 | 0.810057 | 1.061661 | 1.030362 | 0.801262 | 0.744299 | 3.661596 | 1.037189 | 1.076761 |
| SWLSW2R1HK | 1.384423 | 1.563023 | 0.942487 | 1.01945 | 0.866868 | 4.202728 | 0.738967 | 1.117843 | 1.006603 | 0.994946 |
| SWLSW2R1FA | 2.873107 | 1.375626 | 0.956957 | 1.296286 | 0.923696 | 1.404104 | 0.772132 | 1.121023 | 1.086179 | 1.037061 |
| SWLSW2R1KL | 4.110823 | 2.455479 | 1.036929 | 2.347264 | 1.279058 | 2.3436 | 0.82737 | 1.478009 | 1.447383 | 1.504132 |
| SWLSW2R1CV | 1.403355 | 2.885972 | 1.105122 | 4.415981 | 1.737948 | 1.518523 | 0.78497 | 1.696838 | 1.634372 | 1.818828 |

Table A. 28: MSE result when the magnitude of outlier is 5, $\rho = 0.95$ and $\sigma^2$=1.

| | $\sigma^2$=1 | $\delta^2 = 2$ | k = 5 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.95$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 2350.055 | 3396.892 | 180.2293 | 847.4789 | 363.9542 | 623.2816 | 1392.116 | 2251.034 | 1012.893 | 688.4754 |
| SR1HK | 10.25481 | 3.161855 | 1.896998 | 1.686535 | 1.133647 | 5.6519 | 2.512092 | 1.385262 | 0.857395 | 1.017827 |
| SR1FA | 16.60408 | 12.39743 | 7.355536 | 11.46743 | 8.768725 | 4.371122 | 8.050573 | 6.915462 | 5.325856 | 10.23679 |
| SR1KL | 73.63738 | 35.19224 | 11.03171 | 34.13583 | 37.89511 | 14.55894 | 10.64535 | 18.62323 | 20.49479 | 25.79193 |
| SR1CV | 104.0724 | 155.1418 | 28.58156 | 131.9739 | 94.79384 | 3.916164 | 1.807043 | 88.82319 | 97.25453 | 145.8482 |
| SWLSWOR1HK | 1.309025 | 0.906777 | 0.899454 | 0.997157 | 0.992465 | 0.962894 | 0.926271 | 1.083413 | 0.995658 | 1.002434 |
| SWLSWOR1FA | 2.07752 | 0.90646 | 0.970792 | 0.975731 | 0.98766 | 1.233577 | 1.471515 | 2.195195 | 0.999018 | 1.009038 |
| SWLSWOR1KL | 3.12765 | 2.06716 | 0.835313 | 1.291007 | 1.170208 | 1.627224 | 1.859853 | 3.659764 | 1.288448 | 1.601574 |
| SWLSWOR1CV | 10.42538 | 1.939681 | 0.920245 | 1.112546 | 1.109895 | 1.563364 | 0.824116 | 7.111905 | 1.779165 | 1.268199 |
| SWLSW2R1HK | 1.226985 | 1.228951 | 0.975114 | 1.004119 | 0.967955 | 2.935463 | 0.734791 | 1.068706 | 1.004072 | 1.000386 |
| SWLSW2R1FA | 1.262242 | 1.821509 | 1.025035 | 1.868203 | 1.100261 | 1.342454 | 0.678485 | 1.307557 | 1.288632 | 1.131997 |
| SWLSW2R1KL | 2.592619 | 6.983733 | 1.594732 | 7.325214 | 5.176593 | 1.988677 | 0.669245 | 3.230477 | 3.577069 | 4.996789 |
| SWLSW2R1CV | 1.218008 | 12.23321 | 2.288284 | 23.94594 | 14.01959 | 1.49029 | 0.704147 | 4.117921 | 7.024915 | 11.66609 |

Table A. 29: MSE result when the magnitude of outlier is 1, $\rho = 0.95$ and $\sigma^2 = 25$.

| | $\sigma^2 = 25$ | $\delta^2 = 1$ | k = 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.95$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 999.2906 | 358.3931 | 56.37191 | 142.0389 | 41.97131 | 387.6867 | 368.5126 | 314.2485 | 147.7398 | 85.28695 |
| SR1HK | 169.4585 | 41.69195 | 6.692057 | 11.45064 | 4.064874 | 34.02895 | 17.05879 | 24.07891 | 8.261846 | 7.558231 |
| SR1FA | 7.409559 | 11.70415 | 5.197951 | 7.715189 | 4.60749 | 5.584959 | 5.675475 | 4.437064 | 2.987142 | 4.213477 |
| SR1KL | 106.3529 | 43.27533 | 12.44088 | 28.40403 | 13.46778 | 32.1801 | 19.9659 | 33.91449 | 24.39837 | 24.81982 |
| SR1CV | 127.868 | 15.39606 | 13.77282 | 56.2332 | 16.84552 | 8.230272 | 46.76965 | 31.19758 | 26.685 | 25.28052 |
| SWLSWOR1HK | 637.7599 | 90.28983 | 35.04081 | 36.89191 | 11.2632 | 753.499 | 124.7182 | 185.6304 | 15.13417 | 15.89702 |
| SWLSWOR1FA | 52.95457 | 21.18143 | 12.76537 | 14.49789 | 3.095251 | 69.00091 | 15.68515 | 41.0274 | 6.46407 | 6.000072 |
| SWLSWOR1KL | 21.9857 | 57.94018 | 27.61243 | 37.87718 | 24.59528 | 19.28262 | 17.75715 | 40.65888 | 21.98137 | 30.46011 |
| SWLSWOR1CV | 23.36721 | 1.055089 | 20.15915 | 33.48221 | 6.530388 | 22.57577 | 26.49186 | 22.68004 | 9.458208 | 5.83856 |
| SWLSW2R1HK | 91.56493 | 8.862656 | 13.57726 | 39.6624 | 15.78385 | 253.4587 | 3.172306 | 23.41467 | 11.61188 | 16.64781 |
| SWLSW2R1FA | 24.48176 | 11.42317 | 5.402387 | 14.77578 | 18.77948 | 7.279927 | 1.158223 | 4.584716 | 4.978862 | 8.988244 |
| SWLSW2R1KL | 18.46095 | 14.09471 | 9.734673 | 38.12254 | 35.80291 | 16.84066 | 5.102813 | 13.74987 | 15.62662 | 32.62797 |
| SWLSW2R1CV | 83.09508 | 4.080932 | 10.4813 | 22.0098 | 54.0789 | 2.169201 | 0.915661 | 11.09656 | 14.96881 | 34.94179 |

Table A. 30: MSE result when the magnitude of outlier is 5, $\rho = 0.95$ and $\sigma^2 = 25$.

| | | $\sigma^2 = 25$ | $\delta^2 = 1$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.95$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 4254.415 | 4186.674 | 735.8582 | 1745.721 | 633.529 | 1934.47 | 1853.756 | 3551.762 | 2091.73 | 1401.845 |
| SR1HK | 82.53714 | 34.92163 | 7.943179 | 14.64969 | 2.279594 | 0.548256 | 0 | 22.77494 | 6.8171 | 9.482253 |
| SR1FA | 14.23108 | 16.6088 | 9.356415 | 14.01258 | 9.98952 | 8.721672 | 0 | 9.323743 | 7.001875 | 12.71421 |
| SR1KL | 191.9935 | 115.1209 | 50.08693 | 149.96 | 89.12795 | 7.09252 | 0 | 123.2954 | 112.1201 | 166.962 |
| SR1CV | 122.5255 | 315.5223 | 68.07826 | 396.8408 | 127.2811 | 37.20354 | 0 | 150.3441 | 171.5684 | 243.5474 |
| SWLSWOR1HK | 388.9212 | 96.86572 | 31.57733 | 7.942881 | 2.515964 | 551.8002 | 0 | 176.0305 | 14.2311 | 10.14939 |
| SWLSWOR1FA | 144.4925 | 117.3323 | 19.18629 | 12.80468 | 4.283144 | 245.6331 | 0 | 106.3321 | 12.66228 | 12.1343 |
| SWLSWOR1KL | 87.29544 | 121.0331 | 64.75244 | 79.25239 | 57.01757 | 72.00805 | 0 | 181.1637 | 85.90003 | 126.4048 |
| SWLSWOR1CV | 2.308975 | 6.050675 | 64.70402 | 245.7337 | 27.47254 | 0.500283 | 0 | 40.44871 | 54.84632 | 18.21763 |
| SWLSW2R1HK | 42.91775 | 44.48553 | 8.378344 | 48.10802 | 7.110496 | 1.254372 | 0 | 19.91617 | 8.901807 | 16.2302 |
| SWLSW2R1FA | 24.40306 | 12.79845 | 9.21996 | 47.80912 | 54.03376 | 0.952864 | 0 | 7.622347 | 12.11615 | 27.27059 |
| SWLSW2R1KL | 33.11892 | 107.1477 | 32.60534 | 271.9555 | 183.6969 | 1.29713 | 0 | 48.35504 | 68.82 | 186.8419 |
| SWLSW2R1CV | 60.45934 | 4.518249 | 41.07988 | 411.949 | 441.801 | 0.376367 | 0 | 20.75008 | 75.03912 | 232.8756 |

Table A. 31: MSE result when the magnitude of outlier is 1, $\rho = 0.95$ and $\sigma^2$=25.

| | | $\sigma^2 = 25$ | $\delta^2 = 2$ | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.95$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 19070.05 | 6731.915 | 220.2151 | 1329.063 | 413.8749 | 1619.763 | 4894.754 | 3799.145 | 1346.352 | 788.5684 |
| SR1HK | 22.19957 | 49.93614 | 7.620291 | 14.55599 | 2.441126 | 142.4112 | 13.48932 | 34.32779 | 7.434141 | 4.71696 |
| SR1FA | 32.27764 | 28.64762 | 7.152921 | 12.25537 | 8.491227 | 10.65601 | 27.79435 | 14.88065 | 7.012864 | 9.535554 |
| SR1KL | 262.3699 | 177.139 | 24.42714 | 116.6333 | 47.81356 | 127.3616 | 55.13656 | 127.7677 | 71.25457 | 79.34394 |
| SR1CV | 1373.614 | 109.0771 | 25.79331 | 138.1376 | 81.73082 | 73.47104 | 146.1919 | 84.43648 | 110.9672 | 130.4444 |
| SWLSWOR1HK | 2.237911 | 9.054998 | 1.262992 | 1.104371 | 0.96711 | 40.85896 | 9.973661 | 40.85632 | 1.099548 | 1.034381 |
| SWLSWOR1FA | 2.654318 | 15.18621 | 1.194072 | 1.085151 | 0.900644 | 20.25263 | 11.8126 | 19.57059 | 1.312897 | 1.053176 |
| SWLSWOR1KL | 8.826037 | 34.36524 | 2.776766 | 3.787568 | 2.615952 | 11.37165 | 15.79037 | 32.09558 | 4.964459 | 4.503378 |
| SWLSWOR1CV | 311.9626 | 0.992696 | 3.862599 | 2.330158 | 3.023474 | 2.331147 | 1.171923 | 11.826 | 7.69824 | 2.725142 |
| SWLSW2R1HK | 64.37592 | 241.1251 | 2.812416 | 22.39734 | 1.45255 | 2531.653 | 0.843587 | 63.59243 | 6.65706 | 3.758545 |
| SWLSW2R1FA | 84.50529 | 64.2909 | 6.417462 | 35.72023 | 14.56723 | 35.45163 | 1.027874 | 11.49247 | 9.991913 | 10.10001 |
| SWLSW2R1KL | 109.9125 | 163.0651 | 8.918539 | 92.5074 | 30.29371 | 50.49576 | 1.977948 | 39.60996 | 32.80991 | 50.93374 |
| SWLSW2R1CV | 23.04431 | 182.4114 | 10.43083 | 246.8419 | 125.6473 | 6.311749 | 0.765879 | 31.94207 | 54.65063 | 89.72328 |

Table A. 32: MSE result when the magnitude of outlier is 5, $\rho = 0.95$ and $\sigma^2$=25.

| | | $\sigma^2 = 25$ | $\delta^2 = 2$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.95$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 80790.99 | 94589.88 | 3282.983 | 19670.99 | 7646.277 | 8251.99 | 41604.27 | 45771.11 | 21663.91 | 14113.22 |
| SR1HK | 11.68134 | 21.52023 | 7.737589 | 7.7658 | 1.150685 | 0.840579 | 39.03801 | 24.73124 | 3.881018 | 2.167293 |
| SR1FA | 15.33335 | 22.78129 | 11.05954 | 15.59482 | 13.88111 | 15.75019 | 31.07223 | 19.45183 | 11.91246 | 19.25302 |
| SR1KL | 377.7424 | 741.081 | 100.0126 | 568.0727 | 246.4265 | 26.6785 | 135.7976 | 459.1654 | 302.29 | 413.867 |
| SR1CV | 614.4763 | 1221.404 | 139.1046 | 1569.43 | 851.5546 | 92.101 | 2.256119 | 506.7677 | 643.0686 | 1307.31 |
| SWLSWOR1HK | 7.488096 | 3.285674 | 1.147239 | 1.131497 | 0.974947 | 4.50099 | 65.3483 | 24.21517 | 1.035043 | 1.002144 |
| SWLSWOR1FA | 12.06446 | 24.99048 | 1.750367 | 1.07994 | 0.830412 | 5.360125 | 27.55443 | 53.52041 | 1.785369 | 1.102306 |
| SWLSWOR1KL | 128.3199 | 56.98643 | 7.845284 | 10.41946 | 9.256449 | 2.012453 | 98.33896 | 118.9652 | 21.91823 | 19.15538 |
| SWLSWOR1CV | 2.288561 | 17.459 | 32.23824 | 64.31486 | 21.39099 | 0.479667 | 1.450298 | 14.88856 | 40.4135 | 12.28207 |
| SWLSW2R1HK | 5.258934 | 84.98053 | 2.381704 | 7.854622 | 0.987317 | 4.556851 | 0.877776 | 27.16237 | 2.959068 | 1.732358 |
| SWLSW2R1FA | 120.2837 | 56.3191 | 10.74222 | 55.39465 | 26.46604 | 4.351105 | 1.196502 | 22.21744 | 23.09389 | 19.92719 |
| SWLSW2R1KL | 168.5805 | 319.6771 | 29.08237 | 284.9898 | 85.4073 | 4.469297 | 7.679762 | 179.0701 | 132.0264 | 228.7876 |
| SWLSW2R1CV | 1.409053 | 135.5718 | 55.44491 | 900.0186 | 922.1003 | 0.499251 | 0.703003 | 76.61312 | 221.686 | 630.7708 |

Table A. 33: MSE result when the magnitude of outlier is 1, $\rho$ = 0.95 and $\sigma^2$=100.

| | $\sigma^2$= 100 | $\delta^2$ = 1 | k = 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.95 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 1949.825 | 1392.281 | 167.5946 | 425.7147 | 290.9479 | 1151.681 | 1497.892 | 1219.32 | 572.632 | 326.2483 |
| SR1HK | 346.6516 | 134.8608 | 31.07836 | 27.66256 | 14.10559 | 56.71968 | 54.33464 | 96.51299 | 32.66237 | 26.95933 |
| SR1FA | 11.52074 | 18.44282 | 9.136932 | 10.94641 | 15.51026 | 8.361565 | 10.90922 | 7.870482 | 4.728776 | 6.702023 |
| SR1KL | 211.0057 | 144.5116 | 43.30536 | 79.24802 | 116.4486 | 66.01981 | 75.8711 | 134.748 | 97.22711 | 93.44324 |
| SR1CV | 122.1406 | 27.02117 | 19.33258 | 88.93317 | 118.1333 | 16.93453 | 80.33363 | 79.41839 | 69.75775 | 66.86249 |
| SWLSWOR1HK | 6630.912 | 1071.862 | 545.5354 | 367.889 | 42.1374 | 4344.806 | 1796.885 | 2844.114 | 211.3897 | 206.8851 |
| SWLSWOR1FA | 261.5044 | 113.2186 | 77.02127 | 57.28141 | 14.4084 | 557.128 | 96.88981 | 268.4442 | 31.34092 | 33.15812 |
| SWLSWOR1KL | 71.23787 | 132.1938 | 101.2444 | 137.4829 | 71.68407 | 62.79932 | 50.34487 | 179.5702 | 119.9618 | 188.0124 |
| SWLSWOR1CV | 14.8783 | 2.861217 | 174.8401 | 44.31971 | 1.23731 | 0.789727 | 13.64702 | 77.66305 | 44.00586 | 21.61162 |
| SWLSW2R1HK | 573.0414 | 307.753 | 337.2965 | 567.1959 | 245.7848 | 3928.566 | 12.53032 | 308.9738 | 176.0165 | 234.6082 |
| SWLSW2R1FA | 78.43978 | 130.5882 | 37.22297 | 121.1326 | 162.2887 | 75.76724 | 2.300704 | 26.56655 | 27.59217 | 55.598 |
| SWLSW2R1KL | 80.28067 | 138.6021 | 61.53856 | 280.0032 | 390.1929 | 51.01151 | 14.33795 | 76.46323 | 98.22353 | 227.9628 |
| SWLSW2R1CV | 206.8272 | 2.373267 | 3.359275 | 202.8553 | 323.2047 | 21.92522 | 0.917308 | 50.97149 | 77.84794 | 204.6144 |

Table A. 34: MSE result when the magnitude of outlier is 5, $\rho$ = 0.95 and $\sigma^2$=100.

| | $\sigma^2$ = 100 | $\delta^2$ = 1 | k = 5 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.95 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 8139.562 | 18505.19 | 2128.833 | 7784.265 | 2378.37 | 6280.245 | 6539.082 | 13354.63 | 7906.36 | 5232.164 |
| SR1HK | 124.7881 | 122.7695 | 118.2376 | 52.65245 | 5.202255 | 0.535945 | 0 | 95.23613 | 26.66918 | 35.8969 |
| SR1FA | 13.46312 | 18.56905 | 14.05987 | 17.11969 | 12.18234 | 15.59545 | 0 | 14.73528 | 10.00738 | 16.77403 |
| SR1KL | 281.571 | 557.4442 | 341.2578 | 536.0495 | 317.6206 | 17.54464 | 0 | 494.3344 | 442.3108 | 630.9956 |
| SR1CV | 148.132 | 617.9035 | 18.43332 | 1251.73 | 337.361 | 68.33625 | 0 | 362.349 | 404.9384 | 635.7097 |
| SWLSWOR1HK | 6791.035 | 1333.997 | 808.7749 | 161.1982 | 26.75202 | 9409.322 | 0 | 2866.857 | 207.9051 | 152.2035 |
| SWLSWOR1FA | 380.9598 | 402.8421 | 71.41058 | 67.95944 | 23.78257 | 1715.999 | 0 | 664.888 | 59.07534 | 60.7976 |
| SWLSWOR1KL | 174.5393 | 560.0543 | 570.8628 | 399.5098 | 284.6152 | 191.6164 | 0 | 1022.185 | 461.7327 | 757.1683 |
| SWLSWOR1CV | 1.313162 | 82.49106 | 1.487212 | 1377.863 | 155.2451 | 0.500192 | 0 | 105.5145 | 203.7043 | 74.2459 |
| SWLSW2R1HK | 893.3656 | 907.9743 | 527.202 | 1037.255 | 93.27301 | 15.75251 | 0 | 300.7469 | 121.9026 | 266.5898 |
| SWLSW2R1FA | 72.39676 | 49.32949 | 120.3136 | 247.6786 | 278.8723 | 5.74721 | 0 | 42.73915 | 63.76556 | 149.7683 |
| SWLSW2R1KL | 159.2002 | 394.9789 | 431.1504 | 1820.453 | 1044.3 | 10.29859 | 0 | 304.8137 | 435.9435 | 1318.282 |
| SWLSW2R1CV | 115.8486 | 35.11156 | 7.628445 | 2037.194 | 1997.062 | 0.664786 | 0 | 79.02219 | 297.6182 | 968.1664 |

Table A. 35: MSE result when the magnitude of outlier is 1, $\rho$ = 0.95 and $\sigma^2$=100.

| | $\sigma^2$ = 100 | $\delta^2$ = 2 | k = 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.95 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 75328.53 | 47248.16 | 902.2884 | 4906.749 | 1608.822 | 6828.32 | 22468.46 | 15011.39 | 5334.685 | 3106.076 |
| SR1HK | 94.53431 | 193.5367 | 23.2148 | 49.87258 | 5.051639 | 651.0225 | 25.69465 | 140.3392 | 28.24638 | 15.92879 |
| SR1FA | 47.54084 | 43.37565 | 9.283324 | 16.98486 | 11.11965 | 13.98713 | 57.23163 | 28.37241 | 11.70952 | 14.26548 |
| SR1KL | 1004.263 | 1033.356 | 87.41775 | 434.7779 | 175.2829 | 550.201 | 170.5111 | 518.3868 | 287.0049 | 305.3558 |
| SR1CV | 2330.588 | 115.3565 | 51.44451 | 321.2626 | 215.057 | 35.40893 | 244.7179 | 187.253 | 268.4524 | 349.1784 |
| SWLSWOR1HK | 9.403005 | 110.7806 | 4.069445 | 3.046089 | 0.936609 | 302.8976 | 109.5347 | 630.041 | 2.78825 | 1.449327 |
| SWLSWOR1FA | 4.25434 | 102.8518 | 3.414833 | 2.036184 | 0.95865 | 57.31945 | 47.82272 | 116.7622 | 2.913133 | 1.591332 |
| SWLSWOR1KL | 27.21612 | 141.612 | 10.85948 | 18.81102 | 11.71434 | 14.91115 | 57.42256 | 175.2881 | 29.63012 | 25.47362 |
| SWLSWOR1CV | 834.8236 | 2.826814 | 4.425547 | 76.19881 | 15.50761 | 533.867 | 5.459244 | 21.01613 | 35.58101 | 10.99293 |
| SWLSW2R1HK | 1019.053 | 4254.827 | 30.21708 | 382.7175 | 6.15042 | 95109.25 | 6.06756 | 1057.665 | 100.8004 | 44.35037 |
| SWLSW2R1FA | 474.739 | 275.4844 | 38.28788 | 191.8423 | 85.40017 | 321.0916 | 7.644554 | 70.34966 | 56.61555 | 58.81591 |
| SWLSW2R1KL | 674.7926 | 612.8017 | 49.01609 | 603.0582 | 152.8992 | 218.2664 | 25.39511 | 243.9199 | 213.6247 | 357.986 |
| SWLSW2R1CV | 86.39468 | 239.9679 | 38.47058 | 929.9931 | 622.2283 | 27.56381 | 0.819603 | 119.3714 | 220.8756 | 428.4253 |

Table A. 36: MSE result when the magnitude of outlier is 5, $\rho$ = 0.95 and $\sigma^2$=100.

| | | $\sigma^2$ = 100 | | $\delta^2$ = 2 | k = 5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.95 | | | | $p$ = 3 | | | | | $p$ = 6 | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 160832.4 | 497221.7 | 7144.786 | 66667.86 | 30138.33 | 47159.72 | 170356.7 | 178855.7 | 85406.04 | 55237.64 |
| SR1HK | 204.7277 | 74.71619 | 54.6752 | 27.53628 | 1.572812 | 411.3372 | 141.1428 | 104.8732 | 13.87278 | 6.053326 |
| SR1FA | 22.59397 | 31.48894 | 12.79498 | 17.68374 | 15.23428 | 14.29062 | 43.59115 | 28.48769 | 15.14452 | 22.74871 |
| SR1KL | 2198.925 | 3152.707 | 458.6342 | 2220.523 | 863.0537 | 1095.841 | 480.9819 | 1870.087 | 1186.753 | 1612.295 |
| SR1CV | 116.4844 | 3342.569 | 59.70453 | 2255.512 | 2226.118 | 14.88207 | 2.57696 | 976.8057 | 1354.691 | 3137.265 |
| SWLSWOR1HK | 2662.734 | 20.88809 | 19.05046 | 5.173929 | 0.954145 | 1362.227 | 1031.674 | 369.9986 | 1.710902 | 1.208858 |
| SWLSWOR1FA | 193.3638 | 123.6902 | 6.080452 | 2.150551 | 1.006967 | 381.3796 | 132.9854 | 305.1733 | 5.124741 | 2.194634 |
| SWLSWOR1KL | 347.5972 | 405.531 | 43.34077 | 51.90992 | 39.86561 | 355.7314 | 514.762 | 642.156 | 125.4605 | 125.1533 |
| SWLSWOR1CV | 10.95935 | 8.686531 | 5.991879 | 366.8695 | 121.6107 | 67.25375 | 20.17789 | 28.57928 | 166.3841 | 48.27982 |
| SWLSW2R1HK | 4278.03 | 542.4113 | 62.03952 | 88.02919 | 1.235642 | 26781.14 | 5.532105 | 463.2632 | 28.62045 | 14.26207 |
| SWLSW2R1FA | 252.5641 | 313.1704 | 50.1211 | 244.2598 | 127.8171 | 216.2929 | 8.295669 | 117.1356 | 112.4033 | 98.65375 |
| SWLSW2R1KL | 1391.014 | 1531.731 | 162.6276 | 1584.955 | 307.5308 | 263.9652 | 46.72718 | 1166.311 | 781.4276 | 1299.928 |
| SWLSW2R1CV | 123.3266 | 448.0669 | 20.06209 | 1788.819 | 3434.155 | 34.5655 | 0.719794 | 250.4239 | 758.4709 | 2385.87 |

Table A. 37: MSE result when the magnitude of outlier is 1, $\rho$ = 0.99 and $\sigma^2$ = 1.

| | | $\sigma^2$=1 | | $\delta^2$ = 1 | $k$ = 1 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.99 | | | | $p$ = 3 | | | | | $p$ = 6 | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 127.6661 | 143.53789 | 15.42542 | 31.45909 | 10.9140423 | 92.27772 | 72.52779 | 104.3742 | 41.82327 | 24.1967 |
| SR1HK | 10.10588 | 6.2340661 | 3.219232 | 3.947399 | 2.89505561 | 8.819169 | 3.47098 | 4.706753 | 2.516189 | 2.636771 |
| SR1FA | 4.902072 | 5.5113118 | 3.91678 | 5.435665 | 3.62218861 | 2.980695 | 2.125181 | 2.638054 | 2.092144 | 2.716893 |
| SR1KL | 5.262594 | 5.9187306 | 3.815244 | 5.555074 | 3.83763838 | 3.327364 | 2.127457 | 3.490848 | 3.061057 | 4.030286 |
| SR1CV | 11.81537 | 12.749365 | 7.89777 | 18.48818 | 10.0928264 | 7.060171 | 19.35536 | 13.4594 | 16.12756 | 14.5251 |
| SWLSWOR1HK | 7.076677 | 10.257121 | 2.182707 | 2.753722 | 0.8119612 | 11.36968 | 8.053991 | 3.073084 | 1.282677 | 0.73101 |
| SWLSWOR1FA | 1.889667 | 6.4538036 | 2.353214 | 2.918321 | 1.16618838 | 1.844262 | 1.271164 | 2.196311 | 1.23563 | 0.522414 |
| SWLSWOR1KL | 3.467194 | 7.3572001 | 3.456756 | 4.54719 | 1.35789803 | 1.703835 | 1.948179 | 2.811451 | 1.77376 | 1.161369 |
| SWLSWOR1CV | 5.148283 | 13.739083 | 3.556805 | 4.57924 | 1.49947876 | 1.552088 | 1.7988 | 2.271238 | 1.954922 | 1.470383 |
| SWLSW2R1HK | 2.515197 | 3.4751469 | 1.10043 | 1.438662 | 1.0891799 | 1.909933 | 1.055567 | 1.293039 | 1.246554 | 1.237097 |
| SWLSW2R1FA | 1.325601 | 1.5202996 | 1.055813 | 1.526466 | 1.22830519 | 1.193395 | 0.986117 | 1.13642 | 1.167351 | 1.229904 |
| SWLSW2R1KL | 1.848679 | 2.2667718 | 1.217486 | 2.168134 | 1.69920176 | 1.586713 | 1.102166 | 1.491013 | 1.697145 | 1.985962 |
| SWLSW2R1CV | 2.080302 | 1.9523779 | 1.492217 | 4.445579 | 2.7876397 | 1.213693 | 1.11421 | 1.514761 | 2.25772 | 2.91484 |

Table A. 38: MSE result when the magnitude of outlier is 5, $\rho$ = 0.99 and $\sigma^2$ = 1.

| | | $\sigma^2$=1 | | $\delta^2$ = 1 | k= 5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.99 | | | | $p$ = 3 | | | | | $p$ = 6 | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 1659.391 | 1481.7961 | 257.9108 | 486.6457 | 193.008118 | 924.6522 | 474.3652 | 1631.081 | 712.0266 | 460.624 |
| SR1HK | 5.081102 | 8.9726289 | 3.097479 | 4.72852 | 2.30253099 | 8.656189 | 14.49336 | 4.323287 | 2.075624 | 2.558239 |
| SR1FA | 10.07405 | 14.676571 | 8.520554 | 14.08502 | 10.1987824 | 4.221393 | 4.579544 | 6.591448 | 5.280892 | 10.81596 |
| SR1KL | 10.68134 | 17.752484 | 8.171925 | 17.87654 | 12.0588277 | 7.723548 | 9.790621 | 11.36261 | 9.563052 | 16.46367 |
| SR1CV | 17.03242 | 41.489493 | 35.45593 | 91.8371 | 60.1075458 | 10.31988 | 20.39933 | 95.64058 | 102.5876 | 128.2426 |
| SWLSWOR1HK | 6.130253 | 15.692044 | 1.531952 | 1.421475 | 0.9211716 | 9.106306 | 1.783352 | 2.17376 | 1.274125 | 0.869948 |
| SWLSWOR1FA | 4.302639 | 15.590721 | 2.016482 | 2.202517 | 1.12747711 | 3.667873 | 1.267305 | 3.370565 | 2.059572 | 0.852166 |
| SWLSWOR1KL | 8.140939 | 19.898473 | 4.626251 | 5.228887 | 2.37358665 | 4.431802 | 2.325657 | 6.317732 | 5.477055 | 4.680315 |
| SWLSWOR1CV | 7.127797 | 18.361196 | 5.85749 | 8.509535 | 3.68098415 | 1.469741 | 1.001531 | 3.725152 | 6.836886 | 7.309985 |
| SWLSW2R1HK | 3.949981 | 1.3429103 | 1.040431 | 1.314221 | 1.03797094 | 1.753702 | 0.908993 | 1.252079 | 1.108944 | 1.175742 |
| SWLSW2R1FA | 1.485849 | 1.990564 | 1.168096 | 2.525206 | 2.22886825 | 1.187557 | 0.912928 | 1.268437 | 1.360141 | 1.89791 |
| SWLSW2R1KL | 2.950233 | 2.8714301 | 1.696634 | 4.456722 | 4.43048692 | 1.529836 | 0.982159 | 2.677186 | 3.311324 | 5.650839 |
| SWLSW2R1CV | 1.278059 | 2.3785026 | 2.816813 | 12.22125 | 17.0264131 | 1.243873 | 0.913345 | 2.721865 | 7.04383 | 19.71016 |

Table A. 39: MSE result when the magnitude of outlier is 1, $\rho = 0.99$ and $\sigma^2$=1.

| | | $\sigma^2$=1 | $\delta^2 = 2$ | $k = 1$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.99$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 808.4389 | 2174.3502 | 48.84546 | 303.6173 | 76.4078836 | 295.7185 | 784.7439 | 1060.703 | 266.3795 | 168.2606 |
| SR1HK | 10.57222 | 10.854927 | 2.945329 | 4.405273 | 2.30821031 | 20.42494 | 5.395167 | 5.593923 | 2.263471 | 1.956614 |
| SR1FA | 8.238148 | 13.370952 | 4.885006 | 10.14482 | 5.84508578 | 3.717704 | 5.249772 | 5.767527 | 3.102673 | 5.34438 |
| SR1KL | 9.040881 | 19.753963 | 4.615442 | 12.75191 | 6.46162122 | 6.669903 | 5.685967 | 8.930663 | 5.136429 | 7.299053 |
| SR1CV | 32.27095 | 15.389762 | 12.79373 | 33.98492 | 27.6512787 | 10.83246 | 24.12031 | 25.38623 | 39.90613 | 48.1624 |
| SWLSWOR1HK | 1.218313 | 5.662085 | 1.123322 | 0.882201 | 0.92762418 | 8.954689 | 1.032656 | 1.412861 | 0.98879 | 0.996308 |
| SWLSWOR1FA | 1.267529 | 2.018241 | 1.132533 | 0.876928 | 0.9768692 | 2.736584 | 1.12851 | 1.424615 | 0.995665 | 0.989594 |
| SWLSWOR1KL | 1.68178 | 3.3301596 | 1.489919 | 0.814249 | 0.77003208 | 1.836955 | 1.065942 | 2.089081 | 1.254548 | 1.110258 |
| SWLSWOR1CV | 1.935012 | 4.5138046 | 1.254277 | 1.00839 | 0.85194411 | 1.6843 | 1.001685 | 1.164436 | 1.082351 | 1.007606 |
| SWLSW2R1HK | 2.172247 | 3.6558742 | 0.946551 | 1.064336 | 0.87394651 | 6.687954 | 0.933125 | 1.592683 | 1.159382 | 1.049119 |
| SWLSW2R1FA | 2.92305 | 1.522377 | 1.003087 | 1.723881 | 1.03973594 | 1.6178 | 0.938284 | 1.307475 | 1.261045 | 1.190337 |
| SWLSW2R1KL | 3.008249 | 3.2001171 | 1.094926 | 2.458503 | 1.49630241 | 2.688646 | 1.080377 | 2.218634 | 1.981719 | 2.218941 |
| SWLSW2R1CV | 3.24204 | 4.2184304 | 1.418298 | 8.187676 | 3.71271509 | 1.49016 | 1.056227 | 2.47768 | 4.171861 | 4.903926 |

Table A. 40: MSE result when the magnitude of outlier is 5, $\rho = 0.99$ and $\sigma^2$=1.

| | | $\sigma^2$=1 | $\delta^2 = 2$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.99$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 12904.86 | 33630.163 | 767.5325 | 4813.744 | 1391.39814 | 2351.233 | 4333.814 | 13751.77 | 4329.779 | 3081.567 |
| SR1HK | 30.66227 | 8.4075891 | 2.423757 | 3.527341 | 1.27788253 | 19.62513 | 2.793325 | 5.353015 | 2.012218 | 1.453424 |
| SR1FA | 27.43481 | 34.48934 | 12.70923 | 28.39302 | 25.9040909 | 5.782618 | 10.52805 | 17.5762 | 13.03925 | 27.59098 |
| SR1KL | 93.87784 | 78.992853 | 11.59426 | 60.43918 | 37.5145291 | 17.01014 | 10.09708 | 40.23654 | 26.22496 | 33.47376 |
| SR1CV | 39.38078 | 205.2569 | 69.58878 | 348.2497 | 285.571382 | 12.92804 | 37.8555 | 233.9353 | 300.8887 | 527.8465 |
| SWLSWOR1HK | 2.025613 | 2.4362804 | 1.071912 | 0.962591 | 0.9806397 | 3.883514 | 1.217092 | 1.304086 | 1.02179 | 1.000588 |
| SWLSWOR1FA | 3.185419 | 4.358809 | 1.102813 | 0.908688 | 0.98836879 | 4.482928 | 2.253726 | 2.374041 | 1.146011 | 1.016587 |
| SWLSWOR1KL | 8.352213 | 10.953973 | 1.919681 | 1.657718 | 1.07910097 | 2.729034 | 2.205023 | 5.258696 | 3.116991 | 1.938894 |
| SWLSWOR1CV | 15.72276 | 2.3083407 | 1.789396 | 3.810252 | 1.00253065 | 2.967328 | 1.13423 | 3.321571 | 1.938242 | 1.121746 |
| SWLSW2R1HK | 3.713129 | 1.6087142 | 0.978704 | 1.013057 | 0.97381971 | 5.906758 | 0.936341 | 1.433808 | 1.053686 | 1.012082 |
| SWLSW2R1FA | 3.234292 | 3.626219 | 1.284367 | 4.193593 | 2.14893095 | 1.642097 | 0.90479 | 2.018419 | 2.058217 | 2.018596 |
| SWLSW2R1KL | 13.81317 | 12.257446 | 1.711224 | 8.841144 | 5.16518476 | 2.710016 | 0.948021 | 5.878054 | 4.86268 | 6.547656 |
| SWLSW2R1CV | 1.671813 | 22.991008 | 4.056267 | 40.05868 | 36.7647862 | 1.49063 | 0.909863 | 7.75767 | 18.1827 | 38.56318 |

Table A. 41: MSE result when the magnitude of outlier is 1, $\rho = 0.99$ and $\sigma^2 = 25$.

| | | $\sigma^2 = 25$ | $\delta^2 = 1$ | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.99$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 15565.68 | 1847.1344 | 272.7699 | 502.1547 | 178.064546 | 1915.269 | 1894.615 | 1717.806 | 722.5572 | 390.2003 |
| SR1HK | 338.5779 | 77.830395 | 12.91782 | 16.89259 | 7.73776192 | 165.5045 | 28.53697 | 89.15379 | 38.75578 | 28.28897 |
| SR1FA | 23.12203 | 12.900972 | 7.587683 | 11.5672 | 7.92439537 | 6.719978 | 7.820545 | 6.829106 | 4.532217 | 7.495655 |
| SR1KL | 144.7974 | 35.407164 | 14.67084 | 29.34963 | 18.77708 | 38.81608 | 22.72889 | 51.80864 | 44.23141 | 48.63193 |
| SR1CV | 797.712 | 31.811689 | 36.01831 | 69.75492 | 47.4267859 | 29.36149 | 64.48426 | 73.70817 | 88.92094 | 91.57897 |
| SWLSWOR1HK | 32416.71 | 1418.2083 | 68.26178 | 39.48065 | 29.7406327 | 4647.695 | 1142.199 | 1064.794 | 200.5366 | 125.3431 |
| SWLSWOR1FA | 90.68086 | 224.63755 | 17.22636 | 22.86646 | 15.7215133 | 90.92952 | 50.1521 | 59.28532 | 32.49938 | 20.70544 |
| SWLSWOR1KL | 30.49234 | 115.36778 | 35.37418 | 39.321 | 40.0804021 | 27.7609 | 23.28482 | 38.01032 | 57.36084 | 73.10426 |
| SWLSWOR1CV | 11.12458 | 106.36494 | 30.98811 | 4.385868 | 35.8646118 | 9.816493 | 2.308615 | 14.51998 | 35.72298 | 51.81807 |
| SWLSW2R1HK | 7207.427 | 168.7523 | 41.55076 | 120.7667 | 37.7473679 | 393.5018 | 0.918383 | 145.647 | 83.56407 | 85.65007 |
| SWLSW2R1FA | 50.5638 | 26.256277 | 9.131346 | 34.43519 | 33.1083625 | 14.12368 | 0.895263 | 9.19815 | 8.890893 | 17.45498 |
| SWLSW2R1KL | 64.80218 | 31.898215 | 12.19507 | 42.01932 | 47.4625414 | 19.79924 | 1.010469 | 21.95751 | 30.05984 | 58.86795 |
| SWLSW2R1CV | 66.70738 | 10.989032 | 16.6509 | 70.61578 | 109.733369 | 4.392263 | 1.646894 | 14.77755 | 42.10383 | 98.82825 |

Table A. 42: MSE result when the magnitude of outlier is 5, $\rho = 0.99$ and $\sigma^2 = 25$.

| | | $\sigma^2 = 25$ | $\delta^2 = 1$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.99$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 59255.5 | 8686.2815 | 3439.462 | 6806.986 | 2903.68441 | 12839.46 | 9522.68 | 19002.54 | 9636.743 | 6097.519 |
| SR1HK | 181.1548 | 79.210092 | 18.69612 | 40.02313 | 10.7490516 | 209.3945 | 375.4772 | 103.3511 | 37.359 | 32.56285 |
| SR1FA | 26.5887 | 27.924399 | 21.41884 | 36.33459 | 34.9408885 | 11.88289 | 16.63781 | 23.73187 | 20.19768 | 38.47403 |
| SR1KL | 173.5488 | 95.115639 | 64.41269 | 183.1375 | 127.656715 | 122.3254 | 219.9557 | 201.2298 | 175.7242 | 245.0947 |
| SR1CV | 1410.159 | 7.3385646 | 142.3388 | 629.2305 | 373.072708 | 30.69807 | 259.0352 | 364.8383 | 566.6757 | 866.4252 |
| SWLSWOR1HK | 3922.778 | 2804.0616 | 115.9891 | 113.3386 | 9.59463834 | 4002.873 | 1190.577 | 1141.209 | 189.7729 | 94.68231 |
| SWLSWOR1FA | 231.5354 | 764.93133 | 25.93542 | 36.23919 | 24.6594427 | 234.9192 | 131.5045 | 179.7169 | 92.30869 | 54.0745 |
| SWLSWOR1KL | 445.5333 | 539.14447 | 113.9206 | 168.3337 | 84.1677329 | 129.2297 | 109.6419 | 241.3177 | 270.312 | 256.185 |
| SWLSWOR1CV | 1.939972 | 502.00277 | 75.7086 | 259.7879 | 31.0075192 | 5.643793 | 29.18365 | 24.02484 | 118.0281 | 245.8693 |
| SWLSW2R1HK | 878.9767 | 39.980357 | 28.80127 | 88.85639 | 37.0884756 | 356.5285 | 1.369793 | 131.9962 | 62.85843 | 94.75796 |
| SWLSW2R1FA | 43.34077 | 44.307315 | 22.86316 | 111.534 | 141.338136 | 14.10419 | 1.344272 | 21.10653 | 31.82963 | 92.70937 |
| SWLSW2R1KL | 96.04233 | 60.765399 | 49.28883 | 287.8711 | 267.937349 | 19.82666 | 3.389706 | 86.50971 | 139.2507 | 349.6027 |
| SWLSW2R1CV | 5.032583 | 16.703603 | 46.38501 | 413.2307 | 428.160126 | 5.619295 | 0.910467 | 25.37422 | 134.8383 | 642.7275 |

Table A. 43: MSE result when the magnitude of outlier is 1, $\rho = 0.99$ and $\sigma^2$=25.

| | | $\sigma^2 = 25$ | $\delta^2 = 2$ | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.99$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 53579.8 | 72353.994 | 1036.698 | 6375.459 | 1633.88531 | 7045.549 | 16009.1 | 23911.13 | 6087.991 | 3697.42 |
| SR1HK | 642.9098 | 188.4928 | 13.03636 | 40.95208 | 6.28762445 | 444.4784 | 63.24436 | 119.7666 | 35.83226 | 15.36971 |
| SR1FA | 85.0401 | 78.362992 | 14.2284 | 36.01532 | 24.4346791 | 13.1895 | 30.20417 | 33.58369 | 14.90791 | 24.64247 |
| SR1KL | 589.6452 | 376.90501 | 30.67231 | 170.7861 | 65.5421582 | 124.6165 | 78.94465 | 201.5643 | 111.1231 | 121.2833 |
| SR1CV | 390.8676 | 59.852893 | 67.01801 | 200.0736 | 229.736025 | 45.07157 | 84.68517 | 130.4799 | 289.4145 | 456.18 |
| SWLSWOR1HK | 188.7267 | 6125.1558 | 2.047972 | 2.536091 | 0.92359216 | 4210.568 | 65.58 | 124.2116 | 10.36691 | 2.702725 |
| SWLSWOR1FA | 51.00442 | 55.423901 | 2.305379 | 0.95332 | 0.8756595 | 79.28609 | 12.60571 | 28.16506 | 3.826698 | 1.982019 |
| SWLSWOR1KL | 40.75769 | 92.769772 | 4.962639 | 11.91691 | 3.76927825 | 11.55973 | 8.502005 | 41.32715 | 38.43227 | 21.36876 |
| SWLSWOR1CV | 74.07664 | 6.8516459 | 8.831927 | 13.26259 | 3.62180381 | 8.292719 | 2.246108 | 9.994343 | 5.378519 | 1.877571 |
| SWLSW2R1HK | 513.0642 | 1446.4524 | 8.226763 | 43.41887 | 3.99528479 | 2731.119 | 12.76767 | 271.4188 | 79.94808 | 24.5187 |
| SWLSW2R1FA | 156.3619 | 75.489367 | 17.43834 | 88.88094 | 42.2464573 | 54.67595 | 1.414389 | 26.43437 | 26.08222 | 30.37307 |
| SWLSW2R1KL | 180.3769 | 117.31947 | 12.38316 | 121.2413 | 47.2198659 | 52.23251 | 10.16294 | 68.12667 | 66.77118 | 102.1831 |
| SWLSW2R1CV | 82.11433 | 104.43868 | 19.19355 | 246.5705 | 293.257528 | 8.517236 | 0.893189 | 22.88619 | 103.7309 | 264.0213 |

Table A. 44: MSE result when the magnitude of outlier is 5, $\rho = 0.99$ and $\sigma^2$=25.

| | | $\sigma^2 = 25$ | $\delta^2 = 2$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.99$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 489495.7 | 319439.31 | 13969.51 | 92780.13 | 28688.2594 | 48714.09 | 135851.2 | 282234.2 | 93878.64 | 64318.62 |
| SR1HK | 93.15504 | 142.37812 | 16.41748 | 45.66442 | 2.84254313 | 482.3884 | 51.67216 | 147.4661 | 34.40765 | 9.709297 |
| SR1FA | 48.36355 | 60.543964 | 31.59542 | 60.12905 | 66.6631545 | 21.49168 | 56.74573 | 62.88159 | 43.15093 | 78.52983 |
| SR1KL | 424.891 | 589.38088 | 136.2932 | 1047.54 | 432.104657 | 356.0431 | 283.656 | 968.2777 | 579.7762 | 680.3727 |
| SR1CV | 681.1849 | 683.37682 | 247.5978 | 1376.596 | 2333.09675 | 51.05275 | 266.2027 | 974.665 | 1622.483 | 3631.035 |
| SWLSWOR1HK | 50.15249 | 119.42897 | 1.825435 | 2.338321 | 0.96504882 | 1516.282 | 51.15798 | 100.1232 | 6.089057 | 2.424488 |
| SWLSWOR1FA | 79.68157 | 180.87876 | 2.544444 | 1.145467 | 0.94417362 | 161.0905 | 111.2408 | 89.68149 | 7.128991 | 3.373859 |
| SWLSWOR1KL | 492.5029 | 154.32657 | 11.72647 | 32.40126 | 8.39745653 | 58.77404 | 95.52379 | 211.205 | 116.6533 | 82.83764 |
| SWLSWOR1CV | 2.009344 | 84.040467 | 24.45012 | 46.62055 | 24.5313757 | 18.16277 | 78.96951 | 38.9898 | 19.47203 | 4.327658 |
| SWLSW2R1HK | 145.795 | 438.23977 | 5.283273 | 26.93472 | 2.59434816 | 2313.567 | 13.26177 | 198.6712 | 35.39516 | 14.37941 |
| SWLSW2R1FA | 134.0714 | 93.82228 | 38.72202 | 214.6154 | 113.004202 | 50.82032 | 1.465721 | 81.29096 | 92.4254 | 104.2014 |
| SWLSW2R1KL | 241.3266 | 958.69281 | 38.0861 | 521.9785 | 156.244216 | 47.88119 | 4.618333 | 407.6982 | 328.2343 | 593.9847 |
| SWLSW2R1CV | 100.7465 | 204.369 | 113.1543 | 1072.693 | 1751.25545 | 9.288356 | 2.959314 | 103.995 | 373.8179 | 1055.767 |

Table A. 45: MSE result when the magnitude of outlier is 1, $\rho$ = 0.99 and $\sigma^2$=100.

| | | $\sigma^2$= 100 | $\delta^2$ = 1 | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.99 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 60505 | 7198.9921 | 1044.528 | 1894.802 | 771.095055 | 7598.63 | 7702.419 | 6658.426 | 2810.557 | 1501.548 |
| SR1HK | 1348.309 | 461.86911 | 42.95441 | 66.55707 | 21.4924104 | 657.8781 | 13.26177 | 360.269 | 162.3918 | 109.0255 |
| SR1FA | 42.79704 | 30.778991 | 13.1989 | 19.44088 | 13.582168 | 12.78026 | 1.465721 | 14.46827 | 9.17628 | 14.78817 |
| SR1KL | 556.5819 | 159.17419 | 48.69835 | 115.1261 | 62.0359421 | 149.6671 | 4.618333 | 205.2244 | 177.7627 | 186.1716 |
| SR1CV | 396.0781 | 21.660696 | 78.29143 | 91.27973 | 165.317154 | 54.32445 | 2.959314 | 153.3504 | 231.1263 | 250.7178 |
| SWLSWOR1HK | 527595.3 | 27475.583 | 784.5354 | 338.6696 | 374.171269 | 75608.9 | 10739.99 | 16126.68 | 3087.08 | 1841.622 |
| SWLSWOR1FA | 442.6678 | 1880.0448 | 71.02996 | 81.28872 | 70.7062768 | 666.6164 | 339.6985 | 390.006 | 210.532 | 130.7796 |
| SWLSWOR1KL | 62.50424 | 197.59612 | 91.85254 | 105.738 | 179.507731 | 70.15079 | 55.91728 | 140.4074 | 254.4687 | 299.6879 |
| SWLSWOR1CV | 11.39273 | 58.83509 | 114.5569 | 3.901961 | 36.1547882 | 29.18307 | 4.747707 | 52.98129 | 133.0862 | 212.8628 |
| SWLSW2R1HK | 92461.7 | 7992.839 | 498.074 | 1936.23 | 432.893207 | 6378.675 | 1.18177 | 2579.725 | 1312.795 | 1238.262 |
| SWLSW2R1FA | 573.014 | 257.57999 | 65.64663 | 293.39 | 253.747578 | 97.53185 | 1.040027 | 58.59876 | 57.50459 | 134.7004 |
| SWLSW2R1KL | 497.6182 | 121.68478 | 68.03424 | 310.4193 | 294.522328 | 71.11791 | 1.357277 | 98.75879 | 137.9389 | 327.5414 |
| SWLSW2R1CV | 50.25702 | 21.996411 | 63.04117 | 263.678 | 564.666986 | 14.00472 | 0.956682 | 38.70245 | 131.1265 | 408.7938 |

Table A. 46: MSE result when the magnitude of outlier is 5, $\rho$ = 0.99 and $\sigma^2$=100.

| | | $\sigma^2$ = 100 | $\delta^2$ = 1 | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.99 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 220007.7 | 73029.734 | 12499.36 | 37068.47 | 9086.28934 | 49582.99 | 40904.99 | 71092.37 | 36542.03 | 22905.19 |
| SR1HK | 824.7254 | 287.86701 | 60.81263 | 178.4093 | 35.3804655 | 801.2065 | 1784.746 | 426.0741 | 155.2175 | 126.3358 |
| SR1FA | 33.66125 | 50.318101 | 30.96339 | 56.20418 | 52.4304079 | 21.58759 | 32.64714 | 42.86901 | 33.89152 | 61.32737 |
| SR1KL | 637.7376 | 418.32468 | 227.7356 | 730.8064 | 467.492314 | 472.9546 | 942.2416 | 799.256 | 700.7971 | 939.0375 |
| SR1CV | 1268.663 | 335.91728 | 252.4465 | 1398.403 | 1082.53907 | 60.09886 | 463.6549 | 690.0098 | 1185.437 | 2074.021 |
| SWLSWOR1HK | 72305.55 | 28867.484 | 1347.807 | 447.4579 | 216.861405 | 63681.82 | 20730.45 | 17936.34 | 2955.556 | 1518.204 |
| SWLSWOR1FA | 1348.799 | 4156.2459 | 112.6948 | 197.7995 | 169.045069 | 1741.569 | 1299.385 | 1209.867 | 579.2967 | 373.0256 |
| SWLSWOR1KL | 951.6011 | 994.94199 | 401.2801 | 468.5435 | 449.1028 | 417.123 | 825.0874 | 1123.253 | 1625.097 | 1393.432 |
| SWLSWOR1CV | 1.961331 | 331.09298 | 204.9479 | 19.97205 | 1158.42448 | 20.13071 | 136.537 | 76.92164 | 355.6294 | 731.3786 |
| SWLSW2R1HK | 14299.33 | 3620.329 | 411.8529 | 1455.109 | 568.79159 | 5649.617 | 6.965937 | 1945.719 | 945.6225 | 1438.886 |
| SWLSW2R1FA | 339.9849 | 220.83909 | 141.3675 | 938.271 | 886.096396 | 102.4266 | 3.236044 | 140.5705 | 210.6395 | 605.5776 |
| SWLSW2R1KL | 591.6024 | 231.89288 | 283.1643 | 1962.051 | 1909.35418 | 70.59105 | 17.4904 | 533.9462 | 935.5083 | 2638.096 |
| SWLSW2R1CV | 4.565488 | 29.082945 | 200.0139 | 814.0359 | 2120.81391 | 20.06632 | 0.910908 | 72.355 | 395.3366 | 2301.318 |

Table A. 47: MSE result when the magnitude of outlier is 1, $\rho$ = 0.99 and $\sigma^2$=100.

| | | $\sigma^2$ = 100 | $\delta^2$ = 2 | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.99 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 172336.6 | 218741.53 | 4242.087 | 25150.33 | 5011.94582 | 28149.79 | 84947.62 | 94550.78 | 24165.36 | 14593.74 |
| SR1HK | 470.2594 | 751.15897 | 47.50235 | 153.135 | 23.9609564 | 1783.421 | 314.2175 | 498.3265 | 148.2957 | 57.45379 |
| SR1FA | 63.1723 | 143.45435 | 22.64929 | 58.68919 | 37.0752194 | 26.9262 | 100.2111 | 72.4486 | 29.15507 | 43.91493 |
| SR1KL | 497.3289 | 1475.7868 | 104.9358 | 650.9362 | 243.017644 | 494.4681 | 433.0896 | 814.835 | 456.5624 | 476.1985 |
| SR1CV | 137.4032 | 231.96195 | 149.6245 | 478.7332 | 509.018905 | 78.03972 | 199.608 | 252.2819 | 629.945 | 1123.109 |
| SWLSWOR1HK | 1393.646 | 16758.596 | 7.290343 | 24.42032 | 2.13872798 | 76579.72 | 17276.64 | 1897.272 | 146.9472 | 29.48846 |
| SWLSWOR1FA | 195.6635 | 530.59433 | 4.951248 | 2.63386 | 1.10218344 | 467.5413 | 146.2743 | 169.5054 | 15.17897 | 6.863375 |
| SWLSWOR1KL | 104.2519 | 783.07619 | 13.89462 | 57.64919 | 12.8660205 | 45.81535 | 56.20922 | 201.8987 | 210.29 | 142.2225 |
| SWLSWOR1CV | 37.1562 | 31.053324 | 21.23818 | 83.15298 | 1.45162203 | 15.47272 | 6.33476 | 39.53452 | 15.39891 | 4.204906 |
| SWLSW2R1HK | 902.4065 | 37091.325 | 78.83216 | 693.7237 | 14.82996 | 40850.83 | 83.56392 | 4632.253 | 1204.426 | 366.6573 |
| SWLSW2R1FA | 441.3653 | 781.37462 | 101.6863 | 572.4118 | 276.430336 | 363.3508 | 1.600977 | 181.5895 | 190.041 | 220.9747 |
| SWLSW2R1KL | 666.8833 | 1339.1467 | 61.86997 | 836.1784 | 275.346571 | 190.2771 | 40.62979 | 416.202 | 438.3125 | 767.3722 |
| SWLSW2R1CV | 70.84821 | 837.15616 | 90.566 | 962.2791 | 985.213449 | 39.03291 | 6.657362 | 80.80906 | 314.4916 | 917.984 |

Table A. 48: MSE result when the magnitude of outlier is 5, $\rho$ = 0.99 and $\sigma^2$=100.

| | | $\sigma^2$ = 100 | $\delta^2$ = 2 | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.99 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 989187.2 | 1828907.6 | 59289.9 | 362444.6 | 117667.956 | 193791 | 560380.2 | 1103511 | 370911.1 | 252382.2 |
| SR1HK | 2742.033 | 673.23757 | 60.94123 | 174.0809 | 7.09745225 | 1914.115 | 212.1242 | 610.4262 | 140.792 | 35.52668 |
| SR1FA | 98.39934 | 118.36966 | 43.24139 | 72.94706 | 83.7956807 | 37.32913 | 97.23139 | 101.0499 | 62.03307 | 104.6876 |
| SR1KL | 7267.227 | 6198.7208 | 575.8652 | 4062.206 | 1595.68143 | 1410.079 | 1168.611 | 3883.586 | 2332.496 | 2683.527 |
| SR1CV | 174.1381 | 952.86958 | 312.3895 | 2973.628 | 5272.92742 | 85.64916 | 396.8905 | 1742.798 | 3018.351 | 7308.991 |
| SWLSWOR1HK | 6221.216 | 3285.6313 | 9.054814 | 18.75233 | 1.00076571 | 23185.22 | 767.3428 | 1578.475 | 78.77779 | 24.34394 |
| SWLSWOR1FA | 676.1037 | 1439.5012 | 7.514146 | 4.233443 | 1.46299083 | 872.9335 | 799.0864 | 486.6847 | 31.95779 | 13.77648 |
| SWLSWOR1KL | 565.1273 | 4509.1063 | 40.81123 | 153.3691 | 30.1290527 | 341.7481 | 652.713 | 1145.26 | 598.4072 | 497.9613 |
| SWLSWOR1CV | 1.945807 | 173.80356 | 77.83362 | 198.0869 | 230.091835 | 38.1932 | 223.8665 | 57.34762 | 59.31043 | 11.17671 |
| SWLSW2R1HK | 5787.423 | 5459.4351 | 75.5526 | 463.263 | 16.5680091 | 38318.26 | 138.2471 | 2776.205 | 493.9332 | 240.4462 |
| SWLSW2R1FA | 504.1158 | 952.62557 | 256.0786 | 1054.782 | 567.043655 | 354.3178 | 5.121588 | 483.3048 | 512.9828 | 558.3965 |
| SWLSW2R1KL | 2892.991 | 4766.013 | 262.6763 | 3079.435 | 743.841644 | 185.7392 | 27.24661 | 2725.889 | 2258.218 | 4396.202 |
| SWLSW2R1CV | 3.742972 | 768.53617 | 451.3994 | 3914.794 | 6680.86955 | 38.67174 | 6.628222 | 300.0534 | 1145.998 | 4054.576 |

Table A. 49: MSE result when the magnitude of outlier is 1, $\rho$ = 0.999 and $\sigma^2$ = 1.

| | | $\sigma^2$=1 | $\delta^2$ = 1 | $k$ = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.999 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 8303.227605 | 1279.85914 | 157.214673 | 308.414773 | 100.615548 | 871.581593 | 662.6010995 | 1089.68668 | 410.3011419 | 233.6186 |
| SR1HK | 67.02242964 | 13.83231242 | 4.91395859 | 5.93495642 | 3.85095276 | 70.9152395 | 33.36967108 | 37.3944496 | 15.07533445 | 11.65315 |
| SR1FA | 4.95991712 | 5.122119853 | 4.12108766 | 5.90151905 | 3.85597355 | 3.51232048 | 3.28013912 | 3.09682466 | 2.264708492 | 3.046268 |
| SR1KL | 4.625299055 | 4.976197159 | 3.79797449 | 5.81736559 | 3.93210205 | 2.13999407 | 2.189171677 | 2.68459783 | 2.992788429 | 5.096361 |
| SR1CV | 26.37744837 | 8.542374481 | 8.06369743 | 17.3502542 | 20.0217054 | 5.10998267 | 21.07965301 | 10.498914 | 22.16693409 | 34.0453 |
| SWLSWOR1HK | 381.0868944 | 36.84126825 | 1.82189281 | 2.06684467 | 1.3440002 | 88.8332154 | 40.62589796 | 17.7402123 | 5.117259135 | 1.668269 |
| SWLSWOR1FA | 4.903536498 | 7.104949332 | 1.74306824 | 1.81104489 | 1.37580005 | 5.29904767 | 2.760650596 | 2.56595607 | 1.06803006 | 1.61088 |
| SWLSWOR1KL | 5.700177143 | 6.548789118 | 2.52970731 | 2.63399382 | 1.77409808 | 2.28764226 | 1.881132729 | 2.33485964 | 2.534004684 | 2.454848 |
| SWLSWOR1CV | 1.677779154 | 7.423982831 | 2.98745046 | 4.82251793 | 1.98193062 | 3.44761807 | 1.116065697 | 2.80840911 | 5.633062345 | 2.695498 |
| SWLSW2R1HK | 27.62148538 | 18.37345577 | 1.54788414 | 2.04275503 | 1.56502934 | 6.93346748 | 0.900000839 | 4.43068334 | 3.514301557 | 2.951526 |
| SWLSW2R1FA | 1.874490105 | 1.900756077 | 1.06772039 | 1.70013312 | 1.41095933 | 1.34738815 | 0.900353696 | 1.31986253 | 1.3220349 | 1.444615 |
| SWLSW2R1KL | 2.257565734 | 2.895116813 | 1.25335625 | 2.44891196 | 2.11633571 | 1.793602 | 0.901493865 | 2.18413538 | 2.732132906 | 3.878413 |
| SWLSW2R1CV | 3.079734802 | 1.758236101 | 1.77486567 | 6.27758025 | 7.49547229 | 1.13386849 | 0.900839758 | 1.6302893 | 3.479559147 | 6.959524 |

Table A. 50: MSE result when the magnitude of outlier is 5, $\rho$ = 0.999 and $\sigma^2$ = 1.

| | | $\sigma^2$=1 | $\delta^2$ = 1 | k= 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.999 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 45837.98392 | 25006.73251 | 2019.94671 | 8526.90287 | 1825.74835 | 8671.72907 | 5322.120891 | 16914.1977 | 6836.91717 | 4384.652 |
| SR1HK | 9.62114064 | 17.02257146 | 7.50368576 | 14.1274313 | 5.84218823 | 65.4389436 | 21.20565343 | 21.9277954 | 8.085016643 | 9.363517 |
| SR1FA | 17.54000509 | 16.25502732 | 11.4039262 | 26.9088246 | 15.6719907 | 4.80777057 | 10.53296197 | 10.7212406 | 8.329604383 | 15.71157 |
| SR1KL | 12.93985005 | 18.67735113 | 10.5947943 | 27.5896688 | 14.9292568 | 5.98773301 | 12.30719405 | 14.5101829 | 11.33160929 | 20.32737 |
| SR1CV | 58.19422787 | 37.94965095 | 39.8002893 | 154.127946 | 145.062537 | 15.190172 | 5.847386129 | 119.919875 | 196.8453894 | 331.0134 |
| SWLSWOR1HK | 20.47986919 | 17.59530236 | 2.00944693 | 0.96395565 | 1.12636256 | 56.8920929 | 12.45677292 | 11.8525234 | 2.598532787 | 1.696907 |
| SWLSWOR1FA | 5.715202441 | 21.19400322 | 1.90645171 | 3.21222832 | 1.51084291 | 7.16702922 | 7.407393209 | 4.40624916 | 2.796803465 | 2.364721 |
| SWLSWOR1KL | 17.81330399 | 20.66211732 | 4.59391946 | 4.00202075 | 2.85405167 | 4.69180282 | 11.56645445 | 7.48352668 | 6.980281819 | 6.741315 |
| SWLSWOR1CV | 1.984705545 | 14.37964121 | 5.91118609 | 9.13902543 | 4.6817654 | 2.3696521 | 0.99464943 | 6.91673277 | 14.19958669 | 4.419815 |
| SWLSW2R1HK | 3.450488545 | 10.61287004 | 1.37922463 | 2.9975191 | 1.68519482 | 7.40634827 | 0.499999997 | 3.12343939 | 1.844843491 | 2.129556 |
| SWLSW2R1FA | 2.381948785 | 2.408239607 | 1.38249877 | 5.87615186 | 3.76407162 | 1.31693799 | 0.499999997 | 1.45951456 | 1.659608718 | 2.60127 |
| SWLSW2R1KL | 4.339872601 | 3.199139382 | 1.90152453 | 6.07467505 | 4.94652516 | 1.70511711 | 0.499999997 | 4.15683354 | 5.369051448 | 8.551382 |
| SWLSW2R1CV | 2.874089847 | 1.993571508 | 1.59651444 | 26.7282953 | 23.8377576 | 1.14622733 | 0.499999997 | 2.65992488 | 10.34194189 | 33.79279 |

Table A. 51: MSE result when the magnitude of outlier is 1, $\rho = 0.999$ and $\sigma^2$=1.

| | | $\sigma^2$=1 | $\delta^2 = 2$ | $k = 1$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.999$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 53873.17783 | 27052.5961 | 513.859681 | 2949.65561 | 718.570458 | 2705.79761 | 5917.331393 | 11621.9634 | 2497.307741 | 1624.01 |
| SR1HK | 31.82423621 | 34.01037529 | 4.410745 | 8.44325114 | 3.69345899 | 158.65162 | 208.1258904 | 32.023757 | 10.66894051 | 5.466084 |
| SR1FA | 13.97367662 | 20.15821095 | 5.48574885 | 13.1425927 | 7.35472338 | 4.25060456 | 12.01858905 | 8.51689516 | 3.768670119 | 6.597979 |
| SR1KL | 16.83224844 | 22.7165738 | 4.83636207 | 13.1394276 | 6.70096299 | 3.49340188 | 13.15186032 | 10.7278958 | 5.573497067 | 8.475514 |
| SR1CV | 5.231284964 | 8.032742652 | 12.0828071 | 27.5786394 | 52.7299512 | 7.44667546 | 14.41920775 | 14.5087113 | 53.76735509 | 99.14911 |
| SWLSWOR1HK | 2.716288254 | 23.35380571 | 1.10528295 | 1.11105186 | 0.96435926 | 19.9942881 | 75.542681 | 3.10384541 | 1.466512977 | 1.000003 |
| SWLSWOR1FA | 2.774780055 | 4.599112833 | 1.0987712 | 1.1142165 | 0.97605494 | 6.57348174 | 5.674830196 | 1.77525736 | 1.196111047 | 1.029556 |
| SWLSWOR1KL | 4.078116911 | 5.754176587 | 1.36892203 | 1.28138946 | 0.92268186 | 2.70120533 | 14.75425446 | 2.88230829 | 2.546391364 | 1.093053 |
| SWLSWOR1CV | 2.012608781 | 2.762747159 | 1.1390787 | 1.34132927 | 0.931889 | 3.1283553 | 1.001741585 | 2.0851169 | 2.346638573 | 1.033701 |
| SWLSW2R1HK | 2.490282714 | 12.51572411 | 1.0467852 | 3.29661228 | 0.96242637 | 30.4881263 | 0 | 7.25097745 | 2.03103646 | 1.361404 |
| SWLSW2R1FA | 2.653519521 | 1.884661187 | 1.04579746 | 2.07344284 | 1.30812426 | 1.75012481 | 0 | 1.70184995 | 1.450657212 | 1.38524 |
| SWLSW2R1KL | 2.817969238 | 3.570373619 | 1.11605408 | 2.93209116 | 1.54897298 | 2.59913562 | 0 | 3.49973298 | 2.572109352 | 3.438802 |
| SWLSW2R1CV | 3.412783285 | 2.358974893 | 2.04398726 | 10.4389205 | 10.6180652 | 1.25653032 | 0 | 2.44001284 | 6.355768634 | 14.99595 |

Table A. 52: MSE result when the magnitude of outlier is 5, $\rho = 0.999$ and $\sigma^2$=1.

| | | $\sigma^2$=1 | $\delta^2 = 2$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.999$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 99006.91644 | 175988.0007 | 7025.08113 | 48178.6965 | 12842.4006 | 22035.6179 | 43182.30545 | 148769.476 | 39694.52072 | 29519.22 |
| SR1HK | 10.6748813 | 29.36702587 | 6.45114582 | 19.8359886 | 4.29265876 | 146.880855 | 77.79145642 | 37.765157 | 10.14624872 | 8.54765 |
| SR1FA | 30.82783492 | 38.22114393 | 21.0395574 | 81.8665128 | 66.4572194 | 7.46625881 | 14.94349573 | 50.003124 | 31.96255615 | 63.22968 |
| SR1KL | 17.13724413 | 53.81745565 | 16.5265218 | 100.39208 | 55.757169 | 12.3803515 | 14.9308431 | 78.188002 | 37.13067797 | 64.22985 |
| SR1CV | 19.17617623 | 2.75600593 | 35.2318053 | 604.985013 | 578.091492 | 18.2060452 | 158.7149856 | 229.550098 | 431.5434891 | 1178.069 |
| SWLSWOR1HK | 4.463945104 | 8.327672576 | 1.07885524 | 1.07335944 | 0.98809035 | 21.4146047 | 10.34685978 | 3.04381486 | 1.181536921 | 1.003675 |
| SWLSWOR1FA | 3.496560896 | 9.43149401 | 1.10123387 | 1.13820227 | 0.98743886 | 9.08630251 | 6.496631545 | 4.38817855 | 1.462863854 | 1.133005 |
| SWLSWOR1KL | 6.718342884 | 11.38971383 | 1.75110883 | 2.13362349 | 1.23732242 | 5.80892826 | 7.332407537 | 11.8783645 | 4.958115072 | 1.933666 |
| SWLSWOR1CV | 3.635758754 | 6.77822762 | 1.65989429 | 2.92255553 | 1.72340433 | 5.11394744 | 1.020454667 | 3.44146082 | 5.445445005 | 1.162393 |
| SWLSW2R1HK | 32.3475342 | 7.362578306 | 0.99412357 | 1.5333994 | 1.01695189 | 31.3938313 | 3.062297544 | 5.4451714 | 1.639431334 | 1.412279 |
| SWLSW2R1FA | 7.795851693 | 4.541387019 | 1.75528042 | 11.3554066 | 6.35263946 | 1.94829074 | 0.914679059 | 3.56984519 | 3.610889095 | 4.422124 |
| SWLSW2R1KL | 10.185514 | 11.0300815 | 1.61836861 | 11.2837286 | 6.12886878 | 2.38694724 | 0.913720358 | 10.6695556 | 6.881883745 | 9.796513 |
| SWLSW2R1CV | 2.690809277 | 1.52957216 | 9.93515878 | 26.3423162 | 54.9808677 | 1.23830958 | 0.908896095 | 6.03703917 | 20.47518772 | 67.81595 |

Table A. 53: MSE result when the magnitude of outlier is 1, $\rho = 0.999$ and $\sigma^2 = 25$.

| | | $\sigma^2 = 25$ | $\delta^2 = 1$ | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.999$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 160747.7169 | 20014.67962 | 2329.01757 | 6883.6825 | 1941.52413 | 18270.9765 | 10645.02123 | 18008.1341 | 7189.440066 | 3802.521 |
| SR1HK | 2142.531427 | 310.7560099 | 137.666606 | 44.8249681 | 41.2569989 | 1604.75357 | 898.4531995 | 841.407518 | 382.1678865 | 262.1219 |
| SR1FA | 28.39139718 | 20.25014382 | 12.5071229 | 19.7175449 | 13.4340604 | 8.75161967 | 30.4090605 | 10.0288206 | 6.67417781 | 10.31145 |
| SR1KL | 53.89125966 | 25.94692957 | 16.176047 | 34.7716563 | 28.893971 | 14.5681899 | 37.97558932 | 31.8793066 | 43.32809385 | 72.97212 |
| SR1CV | 2.646391994 | 16.03943924 | 41.0623579 | 115.541235 | 84.2690703 | 22.4683736 | 38.48572246 | 56.0166496 | 137.3725422 | 198.4463 |
| SWLSWOR1HK | 534519.5101 | 17481.39897 | 134.52089 | 222.216412 | 106.53691 | 15364.8414 | 20991.4513 | 10804.7811 | 2531.467174 | 260.5999 |
| SWLSWOR1FA | 121.3405364 | 460.5539159 | 35.9860276 | 67.2742747 | 30.9311864 | 148.109638 | 458.8768815 | 110.808132 | 60.15570781 | 29.12641 |
| SWLSWOR1KL | 12.61585739 | 131.7811528 | 61.0699515 | 68.7208147 | 61.1186311 | 22.6994812 | 108.2744738 | 39.1011564 | 46.53599963 | 54.32119 |
| SWLSWOR1CV | 1.983736607 | 20.36074044 | 52.7852206 | 58.1795816 | 12.9906694 | 14.4215653 | 0.989011076 | 17.3116973 | 49.83980478 | 18.87511 |
| SWLSW2R1HK | 48194.58185 | 11263.13251 | 2029.56738 | 317.778114 | 162.312568 | 3095.30108 | 0 | 1728.9018 | 943.5551108 | 873.1759 |
| SWLSW2R1FA | 54.71631516 | 43.22745761 | 13.4523806 | 55.8593676 | 52.4455872 | 18.3648715 | 0 | 12.5340947 | 13.09171604 | 25.81607 |
| SWLSW2R1KL | 42.24910972 | 33.57768782 | 10.6938914 | 49.5140636 | 68.1818052 | 10.6827188 | 0 | 17.1018414 | 24.04576284 | 52.38784 |
| SWLSW2R1CV | 51.13590657 | 18.26836505 | 5.1158839 | 7.70143916 | 81.1292102 | 1.85467715 | 0 | 5.78056997 | 22.34205978 | 59.12086 |

Table A. 54: MSE result when the magnitude of outlier is 5, $\rho = 0.999$ and $\sigma^2 = 25$.

| | | $\sigma^2 = 25$ | $\delta^2 = 1$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.999$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 231738.2161 | 89228.38707 | 19081.3523 | 54264.6563 | 25887.1027 | 124194.421 | 92009.81025 | 196639.151 | 93433.52883 | 58283.33 |
| SR1HK | 1608.995971 | 111.2009718 | 61.1285444 | 132.581603 | 88.8433557 | 1777.25842 | 1735.041835 | 632.172315 | 229.752039 | 182.4684 |
| SR1FA | 53.68245625 | 44.47282167 | 52.0594609 | 95.0285483 | 118.271654 | 21.9706298 | 35.48829423 | 66.6611028 | 62.13117328 | 104.293 |
| SR1KL | 92.34958442 | 83.6355526 | 83.3497182 | 213.305755 | 229.934854 | 76.3819992 | 119.8331726 | 236.918525 | 214.5202231 | 312.9502 |
| SR1CV | 160.8456129 | 8.343358315 | 18.5975885 | 498.61548 | 47.9668116 | 49.9668299 | 460.0653989 | 357.613673 | 776.8291243 | 1769.223 |
| SWLSWOR1HK | 5778.458587 | 8247.804317 | 387.748371 | 306.170972 | 99.1790336 | 17850.3267 | 18616.30006 | 11407.9801 | 1670.891658 | 420.3933 |
| SWLSWOR1FA | 739.9217131 | 1809.130317 | 40.5243496 | 153.978415 | 39.7023183 | 346.523484 | 362.8642883 | 403.783855 | 386.094775 | 99.07511 |
| SWLSWOR1KL | 225.1637919 | 668.1743031 | 230.015112 | 178.829395 | 176.986619 | 117.34288 | 181.5251789 | 285.461 | 386.3898577 | 267.4424 |
| SWLSWOR1CV | 1.046785256 | 182.3381854 | 333.274669 | 109.167884 | 1.49363958 | 7.04764332 | 1.10099421 | 33.5753095 | 150.3322556 | 34.64196 |
| SWLSW2R1HK | 730.406408 | 184.6164209 | 250.340217 | 455.677713 | 310.643785 | 2909.49024 | 1.471459402 | 1363.5131 | 564.395944 | 622.8482 |
| SWLSW2R1FA | 53.57469508 | 126.9958714 | 41.5022826 | 341.305892 | 471.231009 | 18.9765445 | 0.895541306 | 44.8938798 | 87.12621003 | 260.633 |
| SWLSW2R1KL | 50.79169375 | 118.1376528 | 51.856263 | 494.019672 | 628.254805 | 10.5202152 | 3.972156839 | 109.683394 | 205.0273738 | 517.1389 |
| SWLSW2R1CV | 14.73997709 | 2.09882595 | 18.3904695 | 118.121401 | 265.877101 | 1.82307938 | 0.900157783 | 10.5604932 | 67.22111903 | 363.5338 |

Table A. 55: MSE result when the magnitude of outlier is 1, $\rho = 0.999$ and $\sigma^2$=25.

| | | $\sigma^2 = 25$ | $\delta^2 = 2$ | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.999$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 466643.7477 | 440102.3707 | 11716.5143 | 62008.2617 | 19448.758 | 63766.6683 | 152193.3287 | 263012.352 | 57346.58485 | 35883.19 |
| SR1HK | 1303.374179 | 722.4422324 | 51.818983 | 128.384178 | 151.846304 | 3967.55656 | 4125.059421 | 757.283916 | 230.4731155 | 103.1999 |
| SR1FA | 83.09972592 | 192.9888019 | 27.2828168 | 101.612326 | 129.288915 | 21.8956419 | 142.9654284 | 81.8422762 | 35.39549499 | 57.02102 |
| SR1KL | 172.2727871 | 408.2165562 | 37.4227179 | 218.157366 | 222.655119 | 50.705543 | 223.5250538 | 244.543433 | 127.5212538 | 162.7987 |
| SR1CV | 56.08242204 | 116.4425474 | 39.7653114 | 105.54221 | 985.905531 | 28.6851017 | 178.2740176 | 54.0489977 | 325.0083661 | 676.8606 |
| SWLSWOR1HK | 162.3184401 | 2740.411954 | 1.91304603 | 8.36555446 | 1.74298843 | 6633.64387 | 275.7317741 | 943.060335 | 153.9365227 | 1.485838 |
| SWLSWOR1FA | 60.98419389 | 463.1021314 | 1.80423924 | 2.84135388 | 0.90737041 | 184.782822 | 204.2954119 | 69.4780964 | 11.29920449 | 1.743661 |
| SWLSWOR1KL | 46.13941175 | 487.8835317 | 4.25510301 | 20.6813453 | 4.10689751 | 12.3818113 | 188.2102695 | 124.367979 | 56.20321369 | 8.516298 |
| SWLSWOR1CV | 3.780282197 | 44.07259355 | 3.18670692 | 15.9757289 | 1.7460694 | 7.01806783 | 1.000478486 | 10.0190036 | 16.01515422 | 5.96653 |
| SWLSW2R1HK | 1561.812317 | 3615.681068 | 88.3593153 | 1003.86026 | 4.30020285 | 16704.1508 | 0 | 2305.84886 | 580.0695857 | 198.044 |
| SWLSW2R1FA | 57.43281286 | 140.6001892 | 33.8228811 | 236.995333 | 108.806397 | 55.6765074 | 0 | 60.4726019 | 58.83378188 | 81.4228 |
| SWLSW2R1KL | 40.51049152 | 281.9408165 | 16.448847 | 200.833311 | 66.2535213 | 24.1126007 | 0 | 94.0700608 | 84.52715007 | 157.7973 |
| SWLSW2R1CV | 51.38947092 | 14.86362496 | 18.432336 | 157.181576 | 207.532126 | 4.8062927 | 0 | 13.8214278 | 53.9783063 | 175.7075 |

Table A. 56: MSE result when the magnitude of outlier is 5, $\rho = 0.999$ and $\sigma^2$=25.

| | | $\sigma^2 = 25$ | $\delta^2 = 2$ | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho = 0.999$ | | | $p = 3$ | | | | | $p = 6$ | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 1799463.49 | 5340750.897 | 143687.587 | 832850.464 | 330589.417 | 462546.748 | 1374729.61 | 3063898.63 | 863866.5567 | 620612.4 |
| SR1HK | 249.7601229 | 1201.022292 | 84.7732567 | 387.692653 | 319.158878 | 3939.69632 | 198.7545468 | 964.682634 | 261.1954519 | 180.1061 |
| SR1FA | 173.898455 | 379.5108564 | 118.895274 | 298.150898 | 572.507335 | 52.2501842 | 157.2237188 | 268.7963 | 199.7649348 | 364.2503 |
| SR1KL | 428.8498843 | 2517.101008 | 262.462808 | 1666.71337 | 2073.19073 | 249.850204 | 396.1169398 | 1809.27358 | 920.6891913 | 1384.531 |
| SR1CV | 185.7475374 | 444.931608 | 162.880198 | 994.293629 | 9529.99436 | 67.9232767 | 136.2806869 | 584.16105 | 1190.002095 | 4786.504 |
| SWLSWOR1HK | 515.4454176 | 4711.513503 | 1.86914933 | 13.2890596 | 1.39717753 | 11608.672 | 7755.482933 | 1248.65253 | 77.94345668 | 2.079238 |
| SWLSWOR1FA | 259.348688 | 1824.012322 | 2.25283194 | 4.83240567 | 0.92855598 | 339.287566 | 577.6311552 | 277.835934 | 54.67440295 | 4.837883 |
| SWLSWOR1KL | 263.8607265 | 3375.095056 | 10.8853506 | 114.035147 | 11.3387946 | 81.0726328 | 466.7513124 | 868.084169 | 228.8454037 | 64.00722 |
| SWLSWOR1CV | 2.60468214 | 75.06070628 | 90.0175673 | 23.8801564 | 2.517444 | 12.0200962 | 0.941901772 | 13.1666448 | 62.55836802 | 21.35854 |
| SWLSW2R1HK | 2932.609949 | 4303.712434 | 15.5303692 | 659.045283 | 7.70614637 | 13852.2708 | 1335.201209 | 2428.8116 | 350.505586 | 281.7322 |
| SWLSW2R1FA | 1546.058885 | 532.3057398 | 138.949969 | 1159.36876 | 710.172695 | 56.1050869 | 2.243531438 | 328.79174 | 416.3585593 | 561.8319 |
| SWLSW2R1KL | 792.4977368 | 3091.020141 | 67.0072361 | 1579.08074 | 961.03094 | 24.1327817 | 8.873349126 | 850.652254 | 780.6556817 | 1520.488 |
| SWLSW2R1CV | 314.4191621 | 59.08911126 | 106.044017 | 1081.4593 | 192.510956 | 4.87616862 | 0.998287018 | 94.8589148 | 328.6765322 | 1021.331 |

Table A. 57: MSE result when the magnitude of outlier is 1, $\rho = 0.999$ and $\sigma^2$=100.

| | | $\sigma^2$= 100 | $\delta^2$ = 1 | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.999 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 212074.488 | 126990.7678 | 10971.8904 | 19013.5467 | 7533.30192 | 72612.884 | 42720.49929 | 69796.184 | 27996.90035 | 14663.9 |
| SR1HK | 20576.0561 | 116.0605229 | 317.678019 | 199.683192 | 78.5046408 | 6557.3067 | 3679.870165 | 3415.48482 | 1599.461843 | 1039.001 |
| SR1FA | 32.23126058 | 57.21906801 | 23.24665 | 41.3536303 | 28.6720534 | 20.988631 | 90.38579224 | 27.5882952 | 18.67090992 | 27.08914 |
| SR1KL | 80.32613859 | 102.0642241 | 44.8366792 | 117.716384 | 77.1337155 | 54.5598417 | 130.2833102 | 124.350719 | 172.4485526 | 280.381 |
| SR1CV | 10.85888852 | 1.059226571 | 38.0301734 | 179.981977 | 141.255576 | 36.5668504 | 114.3758142 | 103.779435 | 300.6972415 | 510.214 |
| SWLSWOR1HK | 1251858.995 | 5090.869705 | 1147.50556 | 3960.82666 | 1258.33803 | 246727.169 | 74904.01558 | 165707.698 | 39508.38083 | 3949.735 |
| SWLSWOR1FA | 1314.552392 | 1870.033354 | 124.649179 | 343.862803 | 138.070614 | 1015.84869 | 2682.007124 | 760.634538 | 571.3103401 | 175.8555 |
| SWLSWOR1KL | 51.82236028 | 106.8498943 | 94.3325389 | 188.311261 | 247.566924 | 62.186084 | 332.9919379 | 141.459846 | 285.7665709 | 237.4732 |
| SWLSWOR1CV | 150.5362519 | 2.728680238 | 141.902947 | 48.0664308 | 75.8750168 | 51.7403645 | 0.992114762 | 46.5045559 | 167.3665521 | 41.65355 |
| SWLSW2R1HK | 156360.1934 | 3854.462006 | 3131.99777 | 7243.02432 | 2157.87612 | 40608.0375 | 0 | 21177.4179 | 14399.10169 | 12568.9 |
| SWLSW2R1FA | 706.0278511 | 1659.911876 | 108.573584 | 632.30921 | 438.359325 | 104.975373 | 0 | 84.8596344 | 107.557598 | 245.9653 |
| SWLSW2R1KL | 133.643985 | 495.4147637 | 62.6966721 | 252.336969 | 342.871898 | 32.4164112 | 0 | 65.8706479 | 110.8624582 | 288.2765 |
| SWLSW2R1CV | 371.0987262 | 1.005676228 | 54.9967795 | 6.2769129 | 209.998659 | 7.26990856 | 0 | 19.6728642 | 43.0243911 | 169.7484 |

Table A. 58: MSE result when the magnitude of outlier is 5, $\rho = 0.999$ and $\sigma^2$=100.

| | | $\sigma^2$ = 100 | $\delta^2$ = 1 | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.999 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 2336325.163 | 749526.4253 | 78800.4686 | 316086.903 | 143406.83 | 482862.831 | 274187.4594 | 707916.764 | 354511.8405 | 219454.1 |
| SR1HK | 2779.021049 | 521.09274 | 322.641952 | 647.354875 | 791.642605 | 7108.92285 | 2741.477308 | 2668.177 | 948.9669946 | 722.8078 |
| SR1FA | 135.5192174 | 118.8500996 | 114.044415 | 235.218771 | 395.836755 | 53.1564714 | 124.8818241 | 152.112627 | 138.7845566 | 231.3865 |
| SR1KL | 487.7093748 | 407.3993278 | 361.011965 | 1055.71886 | 1319.33138 | 295.4675 | 835.3097797 | 931.047534 | 850.6378099 | 1203.051 |
| SR1CV | 2147.737785 | 202.642908 | 34.2501041 | 2261.96077 | 7310.60856 | 78.3162185 | 11.48990248 | 627.347309 | 1105.732241 | 3263.87 |
| SWLSWOR1HK | 739259.6824 | 101007.041 | 2581.71066 | 754.526095 | 4084.62125 | 284963.164 | 154573.1822 | 194917.21 | 27149.58415 | 6563.868 |
| SWLSWOR1FA | 3196.674516 | 13874.86148 | 283.749245 | 1417.02868 | 578.667988 | 2984.28833 | 2240.315019 | 3614.42271 | 3363.456035 | 691.767 |
| SWLSWOR1KL | 642.5029557 | 1509.418391 | 1018.13569 | 872.825801 | 2649.12911 | 383.082628 | 538.482595 | 1306.94397 | 2597.575398 | 1546.403 |
| SWLSWOR1CV | 1.995296636 | 308.9914803 | 3111.7968 | 328.346621 | 3.30910277 | 27.3159162 | 0.995470957 | 151.77931 | 757.3914405 | 136.8035 |
| SWLSW2R1HK | 107001.9612 | 52956.98507 | 8578.25807 | 14399.2193 | 4081.88244 | 49484.2334 | 0.499999997 | 18514.2909 | 9820.306827 | 10372.64 |
| SWLSW2R1FA | 302.2980425 | 853.8718328 | 652.992123 | 5628.48572 | 6482.78082 | 119.318837 | 0.499999997 | 403.611745 | 773.7829202 | 2363.837 |
| SWLSW2R1KL | 1696.356703 | 592.2596837 | 492.814186 | 5412.66218 | 5423.60468 | 34.2528794 | 0.499999997 | 699.849433 | 1527.400681 | 4786.718 |
| SWLSW2R1CV | 320.0524944 | 3.242712815 | 54.0013703 | 155.677636 | 424.383722 | 5.35733104 | 0.499999997 | 40.2948023 | 293.7306521 | 1760.25 |

Table A. 59: MSE result when the magnitude of outlier is 1, $\rho = 0.999$ and $\sigma^2$=100.

| | | $\sigma^2$ = 100 | $\delta^2$ = 2 | k = 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.999 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 4808707.878 | 1464284.112 | 44330.198 | 244665.487 | 75907.8524 | 255321.298 | 611310.8111 | 1040348.5 | 227856.3844 | 141762.3 |
| SR1HK | 3270.207654 | 869.1573917 | 281.292836 | 493.201198 | 578.347036 | 15962.4541 | 16069.89406 | 2990.19705 | 980.2320654 | 405.487 |
| SR1FA | 404.9883262 | 310.4939377 | 64.1955244 | 221.598607 | 323.089341 | 58.106811 | 426.5490282 | 203.61241 | 88.33805397 | 138.4067 |
| SR1KL | 1442.15623 | 874.6100184 | 141.5763 | 833.927717 | 844.071443 | 200.147877 | 855.5407449 | 981.166766 | 516.061232 | 641.2558 |
| SR1CV | 148.5252029 | 222.4021106 | 70.3483915 | 242.96541 | 1897.3922 | 46.5267196 | 587.1495725 | 139.894967 | 445.6981651 | 1488.914 |
| SWLSWOR1HK | 3634.824924 | 43489.80214 | 7.27772141 | 97.8950294 | 9.70669964 | 99542.1643 | 4443.465312 | 14556.3291 | 2346.798106 | 8.79189 |
| SWLSWOR1FA | 481.3988962 | 1525.364719 | 3.57807711 | 9.66666462 | 0.70019871 | 1028.16906 | 1225.830601 | 465.542424 | 88.5740774 | 4.764867 |
| SWLSWOR1KL | 324.8185083 | 500.278855 | 13.7164653 | 141.535215 | 25.9145823 | 59.3503143 | 1001.290774 | 578.487941 | 263.498302 | 53.40502 |
| SWLSWOR1CV | 2.003453553 | 132.7298462 | 54.1969586 | 50.5700291 | 3.44907541 | 8.72773092 | 1.000347899 | 23.4924766 | 51.05585678 | 31.98582 |
| SWLSW2R1HK | 2280.232594 | 3438.349023 | 576.597262 | 14556.9344 | 51.9921692 | 293466.303 | 0 | 46018.7684 | 6603.606264 | 3322.01 |
| SWLSW2R1FA | 603.5392962 | 572.7614624 | 262.377086 | 2102.87143 | 1126.83738 | 358.58594 | 0 | 529.283597 | 584.6127427 | 813.5222 |
| SWLSW2R1KL | 830.0758673 | 1088.033765 | 101.046389 | 1407.56206 | 565.279175 | 103.461846 | 0 | 626.535627 | 663.2589678 | 1413.727 |
| SWLSW2R1CV | 574.8523432 | 20.7079176 | 49.4858203 | 843.610438 | 1068.60283 | 28.568548 | 0 | 64.649477 | 244.383356 | 694.2742 |

Table A. 60: MSE result when the magnitude of outlier is 5, $\rho$ = 0.999 and $\sigma^2$=100.

| | | $\sigma^2$ = 100 | $\delta^2$ = 2 | k = 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho$ = 0.999 | | | $p$ = 3 | | | | | $p$ = 6 | | |
| Estimators | 15 | 20 | 30 | 50 | 100 | 15 | 20 | 30 | 50 | 100 |
| OLS | 6925706.804 | 12776854.6 | 563839.631 | 3969425.95 | 1271661.05 | 1855946.73 | 5682793.713 | 11982219.1 | 3417956.791 | 2438704 |
| SR1HK | 1007.830582 | 2141.937312 | 319.678542 | 1691.59746 | 1227.59932 | 15711.7286 | 784.4675809 | 3881.52894 | 1079.394374 | 714.9908 |
| SR1FA | 305.4103395 | 369.8036168 | 207.800558 | 455.953675 | 945.854881 | 116.848938 | 339.9283759 | 482.911435 | 343.8204426 | 605.7535 |
| SR1KL | 1658.418107 | 3565.813114 | 946.107008 | 7845.93866 | 8078.12923 | 999.363364 | 1625.779218 | 7197.97691 | 3713.77306 | 5468.129 |
| SR1CV | 506.2228159 | 11.07143894 | 263.901543 | 3505.61252 | 21587.757 | 107.863055 | 148.4657236 | 1203.76746 | 1783.453874 | 7454.201 |
| SWLSWOR1HK | 7799.948273 | 59773.47129 | 10.0365292 | 194.476932 | 1.57525831 | 177928.411 | 127857.7121 | 19866.4947 | 1219.220819 | 17.71863 |
| SWLSWOR1FA | 1749.803629 | 8315.146792 | 5.0924433 | 23.452527 | 0.70934328 | 1764.77086 | 4371.658643 | 1837.95804 | 375.1761149 | 19.39843 |
| SWLSWOR1KL | 1253.995903 | 5076.829316 | 47.2323346 | 533.721281 | 55.665168 | 405.564229 | 2118.924777 | 4798.15141 | 1499.805735 | 388.1135 |
| SWLSWOR1CV | 1.39429505 | 285.7615597 | 590.912937 | 170.562373 | 1527.7239 | 13.4521871 | 0.928970652 | 75.7164312 | 256.1929645 | 42.93602 |
| SWLSW2R1HK | 47213.51434 | 82645.21237 | 292.735678 | 5394.76459 | 97.847548 | 238574.557 | 32217.33112 | 41416.8442 | 5702.672288 | 4582.661 |
| SWLSW2R1FA | 12096.48617 | 2512.951811 | 1135.47235 | 6539.31569 | 4659.62644 | 366.470617 | 11.61217332 | 2382.46776 | 2998.837789 | 3879.266 |
| SWLSW2R1KL | 2912.231605 | 16243.23977 | 482.789699 | 9586.22877 | 6309.87789 | 123.644274 | 81.74138561 | 6732.44178 | 6315.153991 | 14427.79 |
| SWLSW2R1CV | 1202.840548 | 45.54131562 | 314.835585 | 3628.03467 | 338.776175 | 28.9640788 | 1.826927664 | 329.206713 | 1441.084985 | 5005.833 |