Supply Response Analysis of Pakistani Wheat Growers

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Abstract

Alternative specifications of model of supply response of Pakistani wheat growers and their economic implications are considered in terms of the existences and nature of production lags, and the choice between expected wheat and gross returns as the preferred explanatory of producer's response to changing economic condition. Data were collected from 1961-2008 by using time series analysis and data were analysis by using SPSS-16.5 version. The analyses indicate that there are lags which are due primarily to the difficulties and cost of rapid adjustment rather than to the time required to revise expectations. The statistical results were similar for the alternative specification of gross margins and wheat as the economic decision available. However, the wheat elasticities derived using the gross margins specification were about a third of those using the wheat specification. The paper used data by using the time series analysis of Wheat response analysis. A longitudinal in depth study is needed for the decision analysis. The gross margin specification yielded additional information in the form of yield and input cost elasticities.The clarified concept of Wheat response analysis presented. Also, the systematized the factors is introduced and tested empirically.

Keywords: Supply, Response, Wheat, Growers, Rural area

Agriculture is the largest sector of Pakistan's economy. The agriculture sector contributes around 21.9 percent in GDP, and engaged half of the total employed labor force. It is largest source of foreign exchange earnings and meets raw material needs' of country's major industries such as textile and sugar production. (Economic Survey of Pakistan (2007-08). The growth in the agriculture sector increased from 4.6 percent to 7.8 percent in the current year. This increase attributes to 9 percent expansion in major crops, 4.9 in minor crops, 5.6 percent in livestock, and 8.3 in fisheries sector. A feature of improved growth in the agriculture sector is record production of wheat and wheat and recovery in cotton (Economic Survey of Pakistan 2007-08). Improved growth in a

agriculture sector is attributed to the government's agricultural policy reforms such as waiving of interest on loans, introduction of Khushali bank, support wheat policy and introduction of micro credit facility. The growth is also attributed to timely measures to get cotton out of deep-seated crisis (e*t al S.M.Nasir*) Wheat is the second principal food and commercial crop and occupies about 10% of the total cropped area. The total cropped under the wheat during the year 2007-08 171 thousand hectares, and production was 1966(Economic survey of Pakistan).

The actual prices and their lag prices may be expressed either in enumerative currency (*Rao and Shrama et al, 1999*) Thailand, India, Chad are the main competitors of Pakistan (*Shaikh et al*) The government of Pakistan is taking effective measures to increase the yield, production and quality of export wheat. Research efforts are continuing on developing high yielding varieties of wheat. Emphases are also being laid on agronomic research as well as on improved extension services, fertilizer use, direct seedling etc. The flow of input and credits is also being substantially increased. The research was investigated with the objectives to determine the factors that affect the supply of wheat in Pakistan, and to estimate the short run wheat elasticities of wheat in Pakistan.

1.1 Theoretical model and Dynamic Supply Analysis

An agriculture supply function describes how the quantity of the product offered for sale varies as its wheat varies to relative to other product wheat (Cochrane 1995). Cochrane distinguishes between supply function response. The supply function describes the quantity, which would be supplied at different wheat's with all other things constant, while the supply response relationship describes what will happen to the quantity supplied when all other things are not held constant. Nerlove (1958) provided much of the theoretical frame work in the supply response studies, and (*Rao J.M et al 1999*) of the response analysis of agricultural commodities.

Let the supply equation be

$$Q_t = a_o + a_1 P^* t + a_2 Z_t \ldots\ldots\ldots \quad (1)$$

Where Q_t = Quantity produced in time t

P = Actual price of wheat

P^* = Expected price wheat

P_{t-1}= Lagged Price of Wheat

Z_t = Supply shifters

D_t = Dummy variable

The expected wheat is not observable and is explained as expected 'normal' wheat, ie, the level about which the future wheat is expected to fluctuate. This can be expected as:

$$P^* - P^*_{t-1} - \beta(P_{t-1} - P^*_{t-1}), \qquad 0 \leq \beta \leq 1 \ldots\ldots\ldots\ldots\ldots \quad (2)$$

Assume $\beta=1$= $P^*=P_{t-1}$

We can get the following equation by getting the value of P^* from equation (2) and substituting in into equation (1) and rearranging it,

$$Q_t = b_o + b_1 P + b_2 P_{t-1} + b_3 Q_t + b_4 Z_{t-1} + b_5 Z_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

The equation (3) can be estimated economically.

To estimate elasticities the formula used was $\partial Q/\partial P$. P/Q the first term for short and long run will be

Short run $\partial Q_t/\partial P_{t-1}$ and Long run: $b_1/_1-b_2$

1.2 Analytical Model and Method of Estimation

The main interest of this study is the response of total planned output to a number of variables, because the planned output is an unobserved variable so time series data on planned output are not available. Hence a proxy of actual output has to be used in analyzing the response of planned output of wheat to variation in its wheat. The second analysis in this paper is done by taking the acreage under wheat a dependent variable. Area is concerned to be a reasonably good proxy for production so long as it is a major input. The main objective of supply response studies is to analyze the movements in the intended acreage to wheat changes. The actual acreage may not reflect the intended acreage due to certain constraints (Lim, 1975). Necessary time series data over the years 1975-2005 were collected from the secondary sources.

2. Variables included in Econometric Model

2.1 Production of Wheat (QR_t)

Depended variable was total production of wheat in Pakistan. The time series data of wheat production were

collected from different sources.

2.2 Acreage under Wheat (AW_t)

Acreage under wheat in Pakistan was taken as a dependent variable in the acreage response model. Time series data were collected from government publications.

2.3 Lagged wheat of Wheat (PW_{t-1})

The data on wheat of wheat were collected from 1975-2005. The lagged value of wheat of wheat has direct relationship with production and acreage under wheat t. Therefore, the coefficient of this variable should have a positive sign.

2.4 Lagged production of Wheat (PW_{t-1})

This variable is expected to have a significant impact on production of wheat in year t. This variable was expected to have a positive sign.

2.5 Lagged acreage under of Wheat (AW_{t-1})

The lagged acreage under wheat also has a positive impact on the acreage under wheat in year t. The variable has a positive sign.

2.6 Lagged production of Cotton (PC_{t-1})

The lagged wheat of cotton has an inverse relationship with production and acreage under wheat because the cotton is competitive crop. Therefore the coefficient of this variable was expected to have a negative sign.

2.7 Dummy Variable (D_t)

Due to war with India, a dummy variable for the year 1975-2005was added to adjust the disruption to agriculture production. The coefficient of this variable was expected to have a negative sign for production and acreage under wheat.

2.8 Mathematical form of the Model

The following models were chosen among the various mathematical forms on the basis of economic, statistical and econometric criteria.

A. Production Response

$$\mathbf{QRt = f (PW_{t-1}, QW_{t-1}, PW_{t-1}, D_t, e_t)}$$

B. Acreage Response

$$\mathbf{AW_t = f (PW_{t-1}, AW_{t-1}, PC_{t-1}, D_t, e_t)}$$ **where,**

AW_t is the total wheat production (000tonnes) in year t.

AW_t is the total acreage under wheat (000 hec) in year t

PW_{t-1} is the wholesale wheat of Wheat (Rs/mounds) in year $_{t-1}$

QW_{t-1} is the total wheat production (000 tones) in year $_{t-1}$

AW_{t-1} is the total acreage under Wheat (000 hec.) in year $_{t-1}$

PC_{t-1} is the wholesale wheat of Cotton (Rs/mounds) in year $_{t-1}$

D_t is the dummy variable for war 1966.

e_t is the random disturbance term.

Results and Discussion

The time series for the present study was from 1961 to 2005 and secondary data will be collected for the analyses. The results were obtained by using SHAZAM and its presented in Table1, and 2.

(A) Production Response

$$\text{Ln } QW_t = 2.56 + 0.192 \text{ Ln } PW_{t-1} + \text{LnQW}_{t-1} - 0.019 \text{ Ln } PC_{t-1} - 0.258 LND_t$$

3. Interpretation of results

The examination of the co-efficient of determination for production response equation indicated that 96% variation in the production of wheat in Pakistan was explained by the explanatory variable included in the model.

(a) Lagged production of Wheat (PW_{t-1})

The Coefficient of lagged wheat of wheat had a positive sign with a value of 0.192. The coefficient is significant at 5% confidence level which indicated that with one unit increase in the wheat of the wheat in the last year, the production increased by 0.192 units. The sign and magnitude of co-efficient was according to expectations.

(b) Lagged production of Wheat (QW_{t-1})

The co-efficient of this variable had a positive sign with a value of 0.653 and was significant at 0.1 confidence level, which showed that lagged production of wheat had a significant influence on the production of the wheat. The size and sign of c0-efficient was according to the expectations based on theory.

(c) Lagged wheat of Cotton (PC_{t-1})

The lagged wheat of cotton hah a negative sign with a value of 0.019 and non significant. The sign of co-efficient indicated that lagged wheat of cotton and wheat production had an inverse relationship, as both are competitive crops. The co-efficient is non-significant because cotton is mainly grown on marginal land and has little influence on production of wheat.

(d) War Dummy (D_t)

The dummy variable represented the war India in 1965. The co-efficient was negative, as was expected with a value of 0.258 and a significant at 5 percent confidence level. The negative influence of war on production might be due to non-availability of inputs at crucial stages in the production.

(B) Acreage Response

$$\text{Ln } AW_t = 6.8 + 0.096 \text{ Ln } PW_{t-1} + 0.158 \text{ Ln } PC_{t-1} - 0.0936 \text{Ln} D_t$$

3.1 Interpretation of results

The examination of the co-efficient of determination was 0.9564, which indicated that 95% percent variation in the acreage under wheat in Pakistan was being explained by the independent variable included in the model

(a) Lagged price of Wheat (PW_{t-1})

The Coefficient of lagged wheat of wheat had a positive sign with a value of 0.0965. The coefficient is significant at 5% confidence level which indicated that lagged wheat of wheat had significant influence on acreage under wheat.

(b) Lagged production of Wheat (AW_{t-1})

The lagged acreage under Wheat had a positive sign, according to expectations, with a value of 0.158 and was non-significant. This indicated that scope of horizontal expansion in Pakistan was limited.

(c) Lagged production of Cotton (PC_{t-1})

The co-efficient of this variable had a positive sign with a value of 0.059 and was non significant. The unexpected sign of co-efficient showed that wheat of cotton had no influence on the acreage of the wheat as the cotton are sown on marginal lands.

(d) War Dummy (D_t)

The dummy variable represented the war India in 1965-71, The co-efficient was negative, as was expected with a value of 0.094 and a significant at 5 percent confidence level. This indicated that war had a negative impact on the acreage under wheat, which might be due to destruction of irrigation and other infrastructure and non-availability of inputs and other services.

4. Elasticities

The estimated short-run and long run elasticities for production and acreage response under wheat are summarized in Table.3

The own wheat elasticity for production shows that with the increase in the wheat of Wheat by 1 percent during the period of analysis, the quantity of wheat production increased by 0.184 percent in the short run and 0.44percent in the long run. In case of acreage response, with the increase in the wheat of wheat by 1 percent during the period of analysis, the acreage under wheat increased by 0.080 percent in the short run and 0.110 percent in the long run.

5. Conclusion

The “best” model was a long linear form, many variables were not including in the model due to non-availability of data, and important variables are included. The results of the analysis indicate that wheat growers are response to changes in the wheat of wheat in the case of production and acreage under wheat response. The lagged wheat

of cotton has no significant impact on the production of wheat and acreage under wheat. This may attributed to the reason that cotton is grown on marginal lands and usually in the western areas of Pakistan. The cultivation of cotton is also risky due to the attack of pests. The dummy variable for the war period had a negative impact both on production and acreage under wheat in the years 1961-2005. The co-efficient of lagged acreage was non significant, which indicated that horizontal expansion in area is limited in Pakistan, any increase in production will come through vertical expansion in future. This is a policy implication for government policy makers and researchers with regards to elasticities. The own wheat elasticity of wheat is 0.192 and 0.553 for short-run and long run production response and were acceptable on economic and statistical criteria.

References

Askari, H, and Cummings, J. (1977). Estimating agricultural supply response in the Nerlove model, a survey. *American journal of Agricultural Economics Review*, 18, page.257, 292.

Bond M.E. (1983). Agricultural response to prices in sub-Saharan Africa, monetary fund staff page. 30.

Cocharne, W.W. (1995). Conceptualizing the supply relation in Agriculture. *Journal of Economics*, Vol, 37(5) 1161-75.

Economic Survey of Pakistan. (2005). Ministry of finance, Government of Pakistan.

Jaforullah, M. (1993). Asymmetric supply response: evidence from Bangladesh. *Journal of Agricultural Economics*, 44, 490,495

Lim, S.L. (1999). *The supply response of primary producers*. Penerbit University Malaysia.

Maitha, J.K. (1970). Productivity response to price, a case study of Kenyan coffee. *African Economic Review*, 2, 31-37.

Nerlvo, M. (1958). *The dynamics of supply response estimation of Farmers response to wheat.* Jhon Hopkins press, Baltimore.

Ogbu, O.M., & Gwetibou, M. (1990). Agricultural supply response in sub-Saharan a critical review of the literature. *Afr. Dev. Rev*, 2, 83-99.

R.Piggot, Supply response of wheat, UNE, armidale NSW 2351. Australia.

Rao J.M. (1989). Agricultural supply response: a survey Agric. *Eco*. 3, 1-22.

S.M. Nasir 5th Edition Economics of Pakistan, Salma publishers, Lahore.

Shaikh Mubarak Ali, Economy of Pakistan Rehber publishers, Urdu Bazaar.

Sherma, K.L. (1992). Aggregate farm supply response, in Kenya. *East American Economic Review*.

Table 1. Structural co-efficient, their significance and value of R2 for wheat production response in Pakistan (1961-2007-08)

Variable	**Co-efficient**	**Standard Error**	**t-Ratio**	
Constant	2.75	0.867	2.948	***
PR_{t-1}	0.192	0.077	2.468	**
QR_{t-1}	0.653	0.1236	5.282	***
PC_{t-1}	- 0.019	0.083	0.23	
D_t	- 0.258	0.103	2.489	**
R^2	0.9674			
R^2 (Adjusted)	0.9629			

Notes: *** = Significant at 1 percent level of Significance.

** = Significant at 5 percent level of Significance.

Table 2. Structural co-efficient, their significance and value of R2 for wheat production response in Pakistan (1961-2007-08)

Variable	**Co-efficient**	**Standard Error**	**t-Ratio**	
Constant	6.8	1.043	6.518	***
PR_{t-1}	0.0965	0.0389	2.478	**
AR_{t-1}	0.158	0.128	1.235	
PC_{t-1}	0.0599	0.035	1.67	
D_t	- 0.094	0.0486	1.924	**
R^2	0.9604			
R^2 (Adjusted)	0.9564			

Notes: *** = Significant at 1 percent level of Significance.

** = Significant at 5 percent level of Significance.

Table 3. Own Wheat Elasticities for Production and Acreage under wheat in Pakistan. (1961-2007-08)

	Production Response	**Acreage Response**
Short Run	**0.184**	**0.080**
Long Run	**0.44**	**0.110**

Appendix:

Years	Acreage under Wheat(000)	Production under Wheat(000)	Price of Wheat Rs/Mons.	Price of Cotton/mons
1961	6639	3814	15.62	16.46
1962	4923	4027	14.49	16.88
63	5022	4170	13.78	16.85
64	5019	4162	15.25	15.27
65	5317	4591	16.65	33.34
66	5155	3916	15.18	14.84
67	5344	4335	2290	19.32
68	5983	6418	2026	23.22
69	6160	6618	17.37	24.50
70	6229	7294	17.53	32.42
71	5977	6476	18.27	22.51
72	5797	6890	20.77	24.19
73	5971	7442	21.36	33.33
74	6113	7629	27.54	39.34
75	5812	7673	40.71	49.5
76	6111	8691	39.65	46.36
77	6390	9144	42.37	48.59
78	6360	8367	46.31	79.64
79	6687	9950	51.45	68.12
80	6924	10587	51.88	74.62
81	6984	11475	58.00	100.00
82	7223	11304	68.05	139.75
83	7398	12414	71.08	121.23
84	7343	10882	74.66	93.06
85	7259	11703	81.80	100.10
86	7403	13923	86.76	106.08
87	7706	12016	85.89	82.38
88	7308	12675	86.10	105.36
89	7730	14419	94.43	174.52
90	7845	14316	104.52	134.83
91	7911	14565	119.03	107.51
92	7878	15684	139.99	133.26
93	8300	16157	147.53	178.74

94	8034	15213	160.00	257.37
95	8152	16699	188.71	344.62
96	8194	16374	190	400
97	8219	16853	200	423
98	8280	17417	225	450
99	8231	17734	250	700
2000	8349	19210	270	760
2001	8291	19320	280	800
2002	8234	19443	300	440
2003	8243	1955	310	500
2004	8543	1988	390	550
2005	8767	1966	415	500
2006	8786	1888	514	650
2007-08	8876	1988	523	1100

Years	**Production**			
	under	**Acreage**	**Price**	**Years**
1961	3814	6639	15.62	1
1962	4027	4923	14.49	2
63	4170	5022	13.78	3
64	4162	5019	15.25	4
65	4591	5317	16.65	5
66	3916	5155	15.18	6
67	4335	5344	2290	7
68	6418	5983	2026	8
69	6618	6160	17.37	9
70	7294	6229	17.53	10
71	6476	5977	18.27	11
72	6890	5797	20.77	12
73	7442	5971	21.36	13
74	7629	6113	27.54	14
75	7673	5812	40.71	15
76	8691	6111	39.65	16
77	9144	6390	42.37	17
78	8367	6360	46.31	18
79	9950	6687	51.45	19
80	10587	6924	51.88	20
81	11475	6984	58	21
82	11304	7223	68.05	22
83	12414	7398	71.08	23
84	10882	7343	74.66	24
85	11703	7259	81.8	25
86	13923	7403	86.76	26
87	12016	7706	85.89	27
88	12675	7308	86.1	28
89	14419	7730	94.43	29
90	14316	7845	104.52	30
91	14565	7911	119.03	31

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92	15684	7878	139.99	32
93	16157	8300	147.53	33
94	15213	8034	160	34
95	16699	8152	188.71	35
96	16374	8194	190	36
97	16853	8219	200	37
98	17417	8280	225	38
99	17734	8231	250	39
2000	19210	8349	270	40
2001	19320	8291	280	41
2002	19443	8234	300	42
2003	1955	8243	310	43
2004	1988	8543	390	44
2005	1966	876	415	45
2006	2011	8787	514	46
2007-08	2088	8765	613	47

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.767893
R Square	0.58966
Adjusted R Square	0.559636
Standard Error	3477.025
Observations	45

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	7.12E+08	2.37E+08	19.63908	4.76E-08
Residual	41	4.96E+08	12089705		
Total	44	1.21E+09			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-5768.27	2665.794	-2.16381	0.036358	-11151.9	-384.585	-11151.9	-384.585
X Variable 1	1.954231	0.439955	4.441889	6.61E-05	1.065724	2.842739	1.065724	2.842739
X Variable 2	-0.71805	1.198775	-0.59899	0.552478	-3.13902	1.702927	-3.13902	1.702927
X Variable 3	127.9544	47.78352	2.677793	0.010612	31.45359	224.4551	31.45359	224.4551

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*Standard Residuals*
1	7322.614	-3508.61	-1.04535
2	4097.919	-70.9192	-0.02113
3	4419.852	-249.852	-0.07444
4	4540.888	-378.888	-0.11289
5	5250.198	-659.198	-0.1964
6	5062.623	-1146.62	-0.34162
7	3926.496	408.5037	0.121709
8	5492.769	925.2307	0.275662
9	7408.916	-790.916	-0.23564
10	7671.597	-377.597	-0.1125
11	7306.554	-830.554	-0.24745
12	7080.952	-190.952	-0.05689
13	7548.519	-106.519	-0.03174
14	7949.536	-320.536	-0.0955
15	7479.81	193.1898	0.057559
16	8192.841	498.1591	0.148421
17	8864.073	279.9273	0.083401
18	8930.571	-563.571	-0.16791
19	9693.868	256.1318	0.076312
20	10284.67	302.3333	0.090077
21	10525.48	949.5196	0.282898
22	11113.28	190.7203	0.056823
23	11581.05	832.9511	0.248168
24	11598.95	-716.95	-0.21361
25	11557.62	145.3781	0.043314
26	11963.42	1959.576	0.583833
27	12684.14	-668.135	-0.19906
28	12034.15	640.8453	0.190932
29	12980.81	1438.187	0.428491
30	13326.26	989.7408	0.294882
31	13572.77	992.226	0.295622
32	13621.19	2062.812	0.614591
33	14568.41	1588.586	0.473301
34	14167.59	1045.411	0.311468
35	14505.53	2193.472	0.65352
36	14714.63	1659.367	0.494389
37	14884.26	1968.737	0.586562
38	15113.47	2303.526	0.686309
39	15127.72	2606.28	0.776511
40	15471.91	3738.087	1.11372
41	15479.34	3840.659	1.14428
42	15481.54	3961.457	1.18027
43	15619.91	-13664.9	-4.0713
44	16276.69	-14288.7	-4.25715
45	1403.596	562.4036	0.167562

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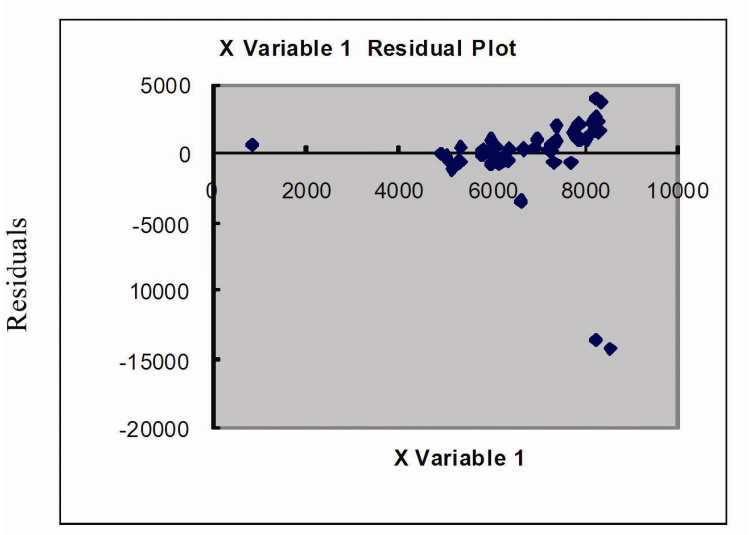
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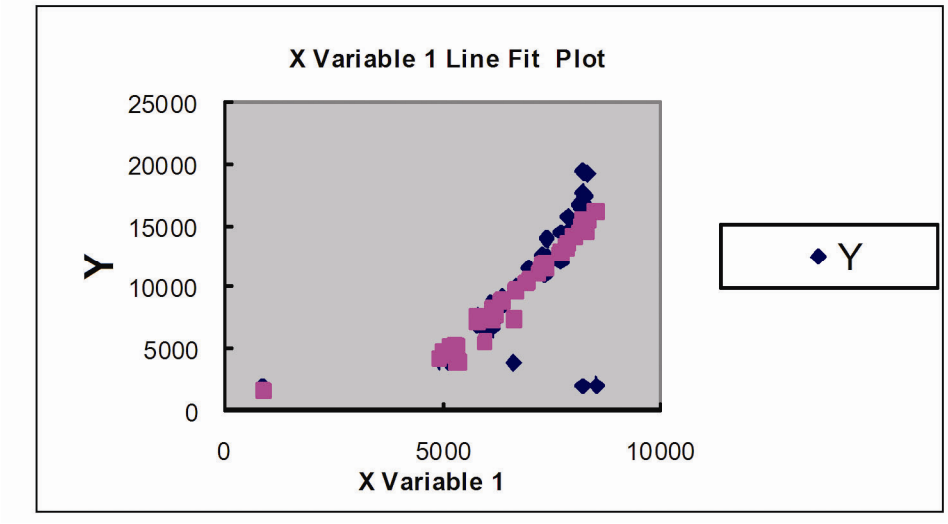
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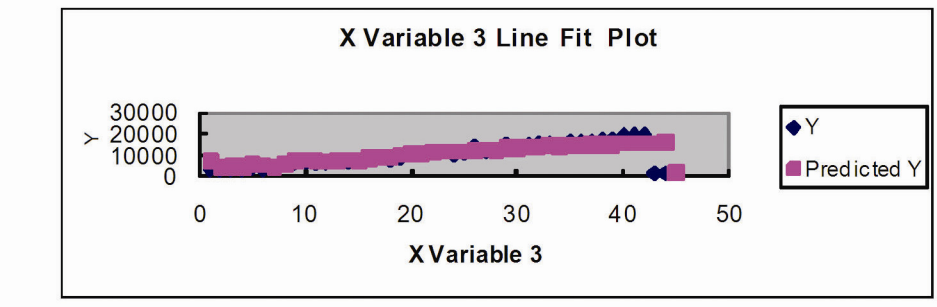
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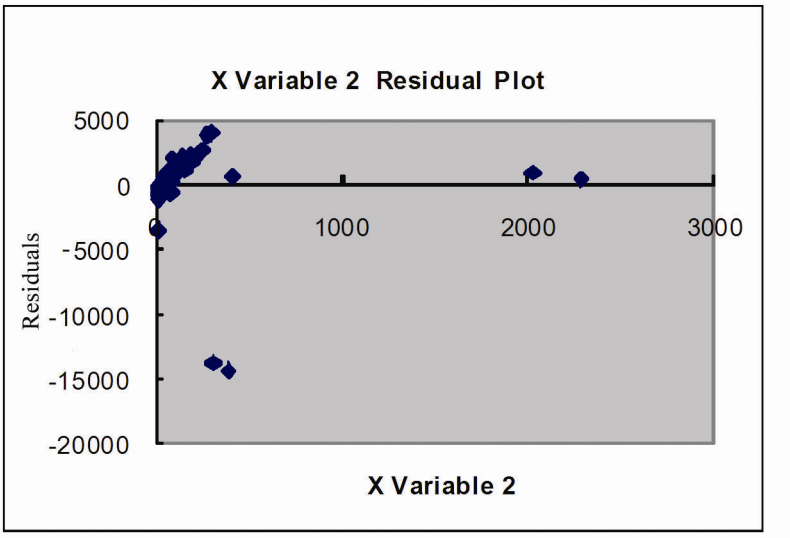
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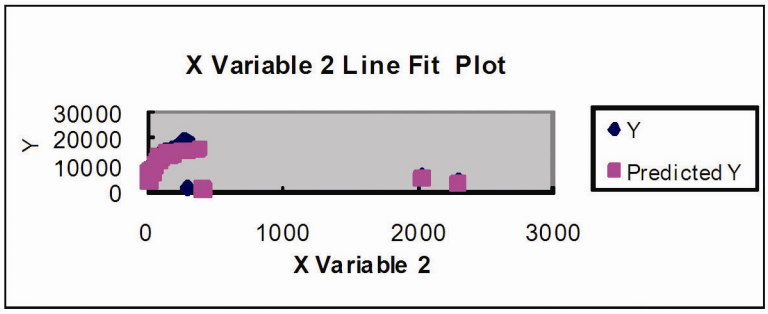
2000
3000
X Variable 2


X Variable 2 Line Fit Plot
30000
20000
10000
0
Y
0
1000
2000
3000
X Variable 2
Y
Predicted Y