# Brown Shrimp Harvests in Upper Laguna Madre/Baffin Bay: A Regression Analysis

## Harvest vs Freshwater Inflows



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# 1. SUMMARY REPORT

## 1.1 Description of the Problem[1]

Bimonthly freshwater inflows into Upper Laguna Madre/Baffin Bay were recorded for the years 1959 to 1993. These variables, and various transformations of them, were used to construct a model for the annual harvest of brown shrimp.

## 1.2 Constructing Models - General Discussion

Stability of coefficient estimates and accuracy of predicted values are primary goals in constructing models for prediction. To this end, the data must be examined from three points of view: individual observations (to detect outliers or influential points); variables, individually and in groups (to select an optimal set of predictors); and the interaction of these two, which produces the overall structure of the data set (to determine whether multicollinearity is present or not). The first two of these were examined by both graphic and quantitative means; the third by quantitative means only.

### 1.2.1 Detecting Influential Points and Outliers

The structures of individual variables were examined via box plots and histograms, as well as by all the usual numerical measures. For each pair of variables, 99 % prediction ellipses and 95% confidence regions were plotted in a further effort to look for unusual points. For example, suppose large values of Variable A are generally associated with large values for Variable B. If an observation consisted of a large value for Variable A but a small value for Variable B, that point would be considered unusual, even though it was well within the range of data for both variables and could not be considered an outlier.

In addition, a number of residual analysis techniques were employed. A large residual indicates a point not well-fit by the model. The deleted residual, however, is somewhat more useful in the search for influential points. The model is fitted without a given observation, and the predicted response and corresponding residual are calculated for that observation. The Studentized deleted residual is scaled to have a Student's $t$ distribution. Histograms and normal P-P plots of the residuals were also examined.

Other quantities, such as the Mahalanobis distance, Cook's distance, the leverage value, standarized values for the *Dffits* (to measure the influence of a given observation on the predicted response) and the *Dfbetas* (to measure the influence of a given observation on the calculated coefficients) were also used to build a general picture of the influence of individual points. Plots were made of the standardized *Dffits* value for each model against the standardized *Dfbeta* values for each predictor in the model. Points which were extreme indicated observations which had strong effects on both predicted values and coefficient estimates.

1 The following discussion, prepared by Jacqueline Kiffe, was taken from Seatrout Harvest in Galveston Bay: A Regression Analysis, by F. Michael Speed, Sr. and Jacqueline Kiffe.

### 1.2.2 Variable Selection

For each regression, residuals were plotted against each of the independent variables to look for nonlinear relationships between the response variable and individual predictors. Partial residual plots were employed to examine the overall relationship between the response and individual predictors. A partial residual is a corollary to the deleted residual. That is, the model is fitted without a given variable and the predicted response and corresponding residual are calculated for each observation. This seeks to answer the question, "What is the relationship of this predictor to the response variable, taking all other variables into account?" Thus, it examines the marginal relationship of a given predictor to the response.

Numerous measures have been developed over the years to assess the adequacy of a given model. We examined a number of these, including $R^2$ and mean squared error (*MSE*), and several others which directly incorporate penalties for having too many predictors in the model, such as adjusted $R^2$, *Cp*, *AIC*, and *SBC*. It is well-established that too many predictors in a model can lead to bad prediction, just as too few can, and these measures are used as part of the attempt to find an optimal model.

### 1.2.3 Multicollinearity

Multicollinearity arises when one or more variables are nearly closely approximated by linear combinations of the remaining variables, resulting in unstable coefficient estimates. The variance inflation factor (*VIF*) was calculated for each coefficient estimate to measure this instability, which is not usually considered profound for *VIF*'s less than 10. No problems were found with this data. Additionally, the condition index (a ratio of eigenvalues of the covariance matrix, with the largest eigenvalue always on top) was calculated. A ratio greater than 30 is considered cause for concern. Again, no evidence of multicollinearity was found.

### 1.2.4 Other Procedures

Several other miscellaneous diagnostics, including the Durbin-Watson test for serial autocorrelation were performed, and no general problems were detected. The Box-Cox procedure, used to find a transformation to normality, was also performed.

## 1.3 How the Final Model Was Chosen

### 1.3.1 Selecting the Data Set Used

First, the variables were explored thoroughly, individually and in pairs, in a first effort to detect outliers. The SAS® programming language allows a number of diagnostics to be calculated for a group of models on a given data set without actually performing a formal regression, thus allowing one to examine a large number of models quite efficiently. The Box-Cox procedure was performed to find if a transformation to normallity was suggested. The log transform was suggested for some variables, and the squared root for others. At this point, there were several data sets for which the diagnostic series was calculated:

1. Untransformed brown shrimp data and untransformed inflow data
2. Log of brown shrimp data and log of inflow data
3. Square root of brown shrimp data and log of inflow data
4. Square root of brown shrimp data and square root of inflow data
5. Various transformation suggested by Box-Cox

### 1.3.2 Selecting the Points to be Omitted

The full regression with all diagnostics was performed for these models, each one contained all variables in its corresponding data set. All diagnostics were generated, and influential points were determined for each model.

***Table 1.1*** *$R^2$ and Adjusted $R^2$ for full data sets.*

| Data Set | $R^2$ | Adj. $R^2$ |
|---|---|---|
| 1 | 0.1549 | -0.0262 |
| 2 | 0.5543 | 0.4588 |
| 3 | 0.3632 | 0.2267 |
| 4 | 0.2553 | 0.0957 |
| 5 | 0.4818 | 0.3707 |

Data sets 2, and 5 presented the highest $R^2$ values. These three models were considered as final candidates. The observations flagged as potentially influential are given in the summary table below, for each model.

***Table 1.2*** *Summary of points in data sets 2 and 5 flagged by Boxplots.*

| Year | Variable |
| --- | --- |
| 1959 | Ln(Sept.-Oct. Infl.), (Sept.-Oct. Infl.)^0.1 |
| 1960 | Ln(July-August Inflows), (July-August Infl.)^0.2 |
| 1961 | Ln(Sept.-Oct. Infl.), (Sept.-Oct. Infl.)^0.1 |
| 1962 | Ln(July-August Inflows), (July-August Infl.)^0.2 |
| 1963 | Ln(May-June Infl.), Ln(July-August Inflows), Ln(Sept.-Oct. Infl.) (May-June Infl.)^0.2, (July-August Infl.)^0.2, (Sept.-Oct. Infl.)^0.1 |
| 1964 | Ln(May-June Infl.), Ln(Sept.-Oct. Infl.), (May-June Infl.)^0.2 (Sept.-Oct. Infl.)^0.1 |
| 1965 | Ln(July-August Inflows), Ln(Sept.-Oct. Infl.), (July-August Infl.)^0.2 (Sept.-Oct. Infl.)^0.1 |
| 1966 | Ln(July-August Inflows), (July-August Infl.)^0.2 |
| 1967 | Ln(May-June Infl.), Ln(Sept.-Oct. Infl.), (May-June Infl.)^0.2 (Sept.-Oct. Infl.)^0.1 |
| 1968 | Ln(Sept.-Oct. Infl.), (Sept.-Oct. Infl.)^0.1 |
| 1969 | Ln(May-June Infl.), (May-June Infl.)^0.2 |
| 1971 | Ln(May-June Infl.), (May-June Infl.)^0.2 |
| 1972 | Ln(Sept.-Oct. Infl.), (Sept.-Oct. Infl.)^0.1 |
| 1974 | Ln(Sept.-Oct. Infl.), (Sept.-Oct. Infl.)^0.1 |
| 1976 | (July-August Infl.)^0.2, |
| 1980 | Ln(July-August Inflows), (July-August Infl.)^0.2 |
| 1981 | (July-August Infl.)^0.2 |

***Table 1.3*** *Summary of points flagged by 99% prediction ellipses.*

| Year | Variable |
|---|---|
| 1961 | (Harvest- Nov.-Dec. Infl.), (Jan.-Feb. Infl.-Nov.-Dec. Infl.) |
| | (March-April Infl.-Nov.-Dec. Infl.), (May-June Infl.- Nov.-Dec. Infl.), |
| | (July-August Infl.- Nov-Dec. Infl.), (Sept.-Oct. Infl.-Nov-Dec. Infl.), |
| 1976 | (Harvest-March-April Infl.), (Harvest-July-August Infl.), |
| | (Jan.-Feb. Infl.-March-April Infl.), (Jan.-Feb. Infl.-July-August Infl.) |
| | (March-April Infl.-May-June Infl.), (March-April Infl.-July-August Infl.), |
| | (March-April Infl.-Sept.-Oct. Infl.), (March-April Infl.-Nov.-Dec. Infl.), |
| | (May-June Infl.- July-August Infl.), (July-August Infl.- Sept.-Oct. Infl.), |
| | (July-August Infl.- Nov-Dec. Infl.) |
| 1992 | (Harvest-Jan.-Feb. Infl.), (Jan.-Feb. Infl.-March-April Infl.), |
| | (Jan.-Feb. Infl.-May-June Infl.), (Jan.-Feb. Infl.-July-August Infl.), |
| | (Jan.-Feb. Infl.-Sept.-Oct. Infl.), (Jan.-Feb. Infl.-Nov.-Dec. Infl.) |

***Table 1.4*** *Outliers of data set 2.*

| Year | BOX | *SRE* | *SDR* | *LEV* | *MAH* | *COO* | *SDF* | *SDB* | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 1959 | 1 | | | | | | | | 1 |
| 1960 | 1 | | | | | | | | 1 |
| 1961 | 1 | | 1 | | | | 1 | 1 | 4 |
| 1962 | 1 | | | | | | | | 1 |
| 1963 | 3 | | | | | | | | 3 |
| 1964 | 2 | | | | | | | | 2 |
| 1965 | 2 | | | | | | | | 2 |
| 1966 | 1 | | | | | | | | 1 |
| 1967 | 2 | | | | | | | | 2 |
| 1968 | 1 | | | | | | | | 1 |
| 1969 | 1 | | | 1 | | | | | 2 |
| 1970 | | | 1 | 1 | | | 1 | 3 | 6 |
| 1971 | 1 | | | | | | | | 1 |
| 1972 | 1 | | | | | | | | 1 |
| 1974 | 1 | | | | | | 1 | | 2 |
| 1975 | | | | | | | 1 | | 1 |
| 1980 | 1 | | | | | | | | 1 |
| 1991 | | | 1 | | | | | | 1 |

***Table 1.5*** *Outliers of data set 5.*

| Year | BOX | *SRE* | *SDR* | *LEV* | *MAH* | *COO* | *SDF* | *SDB* | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 1959 | 1 | | | | | | | | 1 |
| 1960 | 1 | | | | | | | | 1 |
| 1961 | 1 | | | | | | 1 | 1 | 3 |
| 1962 | 1 | | | | | | | | 1 |
| 1963 | 3 | | | | | | | | 3 |
| 1964 | 2 | | | | | | | | 2 |
| 1965 | 2 | | | | | | | | 2 |
| 1966 | 1 | | | | | | | | 1 |
| 1967 | 2 | | | | | | | | 2 |
| 1968 | 1 | | | | | | | | 1 |
| 1969 | 1 | | | | | | | | 1 |
| 1970 | | | 1 | | | | 1 | 2 | 4 |
| 1971 | 1 | | | | | | | | 1 |
| 1972 | 1 | | | | | | | | 1 |
| 1973 | | | | | | | 1 | | 1 |
| 1974 | 1 | | | | | | | | 1 |
| 1975 | | | | 1 | | | | | 1 |
| 1976 | 1 | | | 1 | | | | | 2 |
| 1980 | 1 | | | | | | | | 1 |
| 1981 | 1 | | | | | | | | 1 |
| 1991 | | | 1 | | | | | | 1 |

**1**

***A Key to Abbreviations:***

BOX Box plot
SRE Studentized residual
SDR Studentized deleted residual
LEV Leverage value
MAH Mahalanobis distance
COO Cook's distance
SDF Standardized Dffits value
SDB Standardized Dfbeta value

### 1.3.3 Selecting the Final Candidate Models

After the subset analysis led us to two models, Data Set 2 with 1970 omitted and Data Set 5 with 1970 omitted.

***Table 1.6*** *$R^2$ and Adjusted $R^2$ for data sets number 2 and 5.*

| Data set | Observations omitted | $R^2$ | Adj. $R^2$ |
|---|---|---|---|
| 2 | 1970 | 0.6239 | 0.5567 |
| 5 | 1970 | 0.5498 | 0.4694 |

### 1.3.4 Selecting the Final Models

It appears that Data set 2 with 1970 omitted is the best model. Regression was performed using this model, and the deleted residuals were calculated.

Ln(Brown Shrimp Harvest) = 0.93833 + 0.36428*Ln(Jan.-Feb. Inflows)
-0.22101*Ln( March-Apr. Inflows)
+0.48068*Ln( May-June. Inflows)
+0.99041*Ln( July-Aug. Inflows)
-0.43677*Ln(Sept.-Oct. Inflows)

## 1.4 Best Model: Logged Harvest and Log of Inflows

### 1.4.1 Summary Information

***Table 1.7*** *Descriptive statistics for dependent and independent variables.*

**Descriptive Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Ln(Brown Shrimp Harvest) | 1.2423 | 4.9519 | 34 |
| Ln(January-February Inflows) | -.9126 | 4.3559 | 34 |
| Ln(March-april Inflows) | -.8138 | 4.0979 | 34 |
| Ln(May-June Inflows) | 1.0470 | 3.8927 | 34 |
| Ln(July-August Inflows) | .6730 | 3.3581 | 34 |
| Ln(September-October Inflows) | 1.6330 | 3.5407 | 34 |

***Table 1.8*** *Model summary for the final model.*

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 1 | .790[a] | .624 | .557 | 3.2968 | 1.832 |

a. Predictors: (Constant), Ln(September-October Inflows), Ln(March-april Inflows), Ln(July-August Inflows), Ln(May-June Inflows), Ln(January-February Inflows)

b. Dependent Variable: Ln(Brown Shrimp Harvest)

***Table 1.9*** *Anova for the final model.*

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 504.860 | 5 | 100.972 | 9.290 | .000[a] |
| | Residual | 304.337 | 28 | 10.869 | | |
| | Total | 809.197 | 33 | | | |

a. Predictors: (Constant), Ln(September-October Inflows), Ln(March-april Inflows), Ln(July-August Inflows), Ln(May-June Inflows), Ln(January-February Inflows)

b. Dependent Variable: Ln(Brown Shrimp Harvest)

***Table 1.10*** *Parameter estimates for the final model.*

**Coefficients[a]**

| | Unstandardized Coefficients | | Standardized Coefficients | | | 95% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig. | Lower Bound | Upper Bound |
| (Constant) | .938 | .718 | | 1.306 | .202 | -.533 | 2.410 |
| Ln(January-February Inflows) | .364 | .177 | .320 | 2.059 | .049 | .002 | .727 |
| Ln(March-april Inflows) | -.221 | .169 | -.183 | -1.308 | .202 | -.567 | .125 |
| Ln(May-June Inflows) | .481 | .181 | .378 | 2.661 | .013 | .111 | .851 |
| Ln(July-August Inflows) | .990 | .214 | .672 | 4.636 | .000 | .553 | 1.428 |
| Ln(September-October Inflows) | -.437 | .214 | -.312 | -2.042 | .051 | -.875 | .001 |

a. Dependent Variable: Ln(Brown Shrimp Harvest)

***Table 1.11*** *Residuals statistics for the final model.*

**Residuals Statistics[a]**

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | -7.5718 | 6.8880 | 1.2423 | 3.9114 | 34 |
| Std. Predicted Value | -2.253 | 1.443 | .000 | 1.000 | 34 |
| Standard Error of Predicted Value | .6682 | 2.1173 | 1.2864 | .5209 | 34 |
| Adjusted Predicted Value | -7.8865 | 7.8466 | 1.3827 | 3.9236 | 34 |
| Residual | -10.2513 | 4.5736 | 4.180E-16 | 3.0368 | 34 |
| Std. Residual | -3.109 | 1.387 | .000 | .921 | 34 |
| Stud. Residual | -3.186 | 1.555 | -.018 | 1.016 | 34 |
| Deleted Residual | -10.7639 | 5.7450 | -.1405 | 3.7509 | 34 |
| Stud. Deleted Residual | -3.919 | 1.597 | -.047 | 1.106 | 34 |
| Mahal. Distance | .385 | 12.640 | 4.853 | 4.218 | 34 |
| Cook's Distance | .000 | .502 | .043 | .097 | 34 |
| Centered Leverage Value | .012 | .383 | .147 | .128 | 34 |

a. Dependent Variable: Ln(Brown Shrimp Harvest)

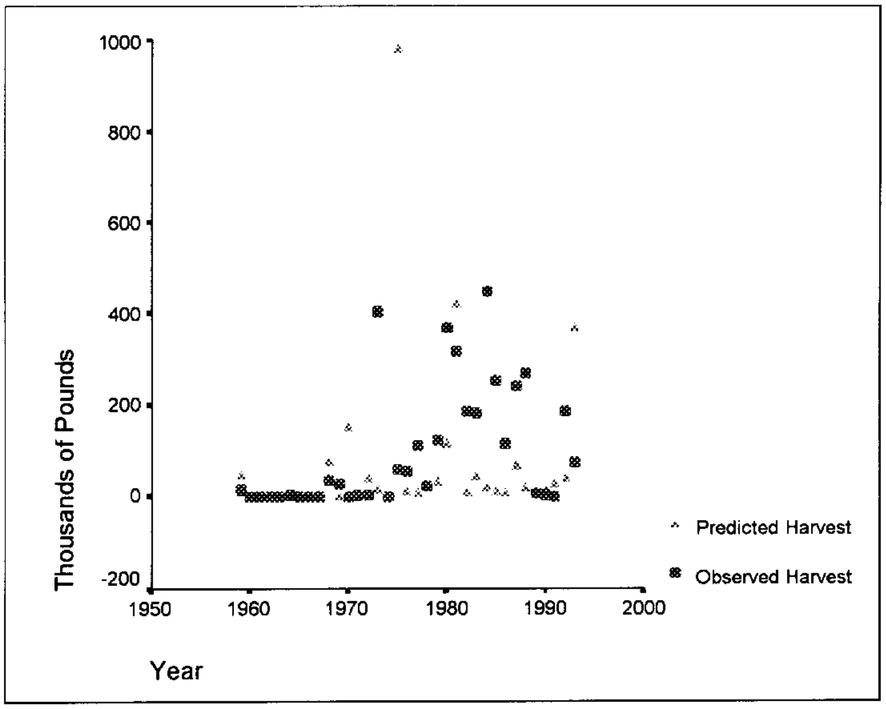


***Figure 1.1*** *Predicted and observed values for the harvest.*

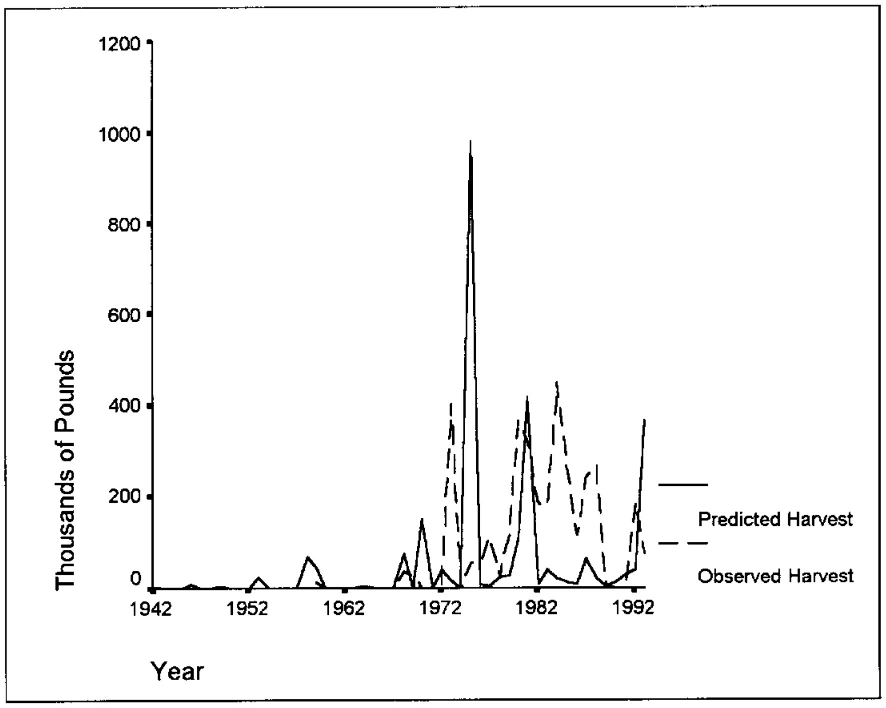


***Figure 1.2*** *Predicted and observed values for the harvest.*

***Table 1.12*** *Prediction Intervals for Brown Shrimp Harvest based on the final model.*

| YEAR | *BRSH* | *PRE_1* | *LICI_1* | *UICI_1* |
|---|---|---|---|---|
| 1959 | 12.65 | 44.88 | .00 | 1028691 |
| 1960 | .00 | .00 | .00 | 26 |
| 1961 | .00 | .35 | .00 | 15228 |
| 1962 | .00 | .00 | .00 | 20 |
| 1963 | .00 | .00 | .00 | 26 |
| 1964 | 2.80 | 2.08 | .00 | 66583 |
| 1965 | .00 | .02 | .00 | 1078 |
| 1966 | .00 | .00 | .00 | 18 |
| 1967 | .22 | 1.39 | .00 | 42524 |
| 1968 | 34.87 | 75.16 | .00 | 2061622 |
| 1969 | 26.57 | .27 | .00 | 6014 |
| 1970 | .00 | 149.89 | .00 | 5425403 |
| 1971 | 1.61 | .38 | .00 | 12966 |
| 1972 | 1.61 | 38.32 | .00 | 522167 |
| 1973 | 402.82 | 16.35 | .00 | 450003 |
| 1974 | .00 | .10 | .00 | 3704 |
| 1975 | 56.78 | 980.40 | .04 | 26180590 |
| 1976 | 55.96 | 9.40 | .00 | 473142 |
| 1977 | 110.50 | 5.20 | .00 | 61144 |
| 1978 | 23.63 | 22.57 | .00 | 248012 |
| 1979 | 120.83 | 29.48 | .00 | 334407 |
| 1980 | 366.31 | 112.88 | .01 | 1428943 |
| 1981 | 316.18 | 418.77 | .03 | 5571802 |
| 1982 | 185.94 | 6.18 | .00 | 73606 |
| 1983 | 180.49 | 40.69 | .00 | 458480 |
| 1984 | 448.41 | 19.09 | .00 | 210004 |
| 1985 | 251.67 | 10.70 | .00 | 124267 |
| 1986 | 115.08 | 7.69 | .00 | 85274 |
| 1987 | 240.69 | 64.70 | .00 | 908836 |
| 1988 | 268.06 | 20.32 | .00 | 221700 |
| 1989 | 5.65 | 4.92 | .00 | 53543 |
| 1990 | 1.15 | 13.41 | .00 | 154032 |
| 1991 | .00 | 28.32 | .00 | 317422 |
| 1992 | 183.67 | 39.09 | .00 | 639477 |
| 1993 | 74.22 | 366.84 | .03 | 5149659 |

*BRSH* Observed brown shrimp harvest
*PRE_1* Predicted brown shrimp harvest
*LICI_1* Lower limit for 99% prediction interval for the brown shrimp harvest.
*UICI_1* Upper limit for 99% prediction interval for the brown shrimp harvest.

## 2. EXPLORING THE DATA

### 2.1 Listing of data

***Table 2.1*** *The brown shrimp data and the inflow data.*

| Year | Brown Sh. | JF_inflow | MA_inflows | MJ_inflow | JA_inflow | SO_inflow | ND_inflow |
|---|---|---|---|---|---|---|---|
| 1959 | 12.65 | 7.00 | .00 | 12.00 | 5.00 | 140.00 | 7.00 |
| 1960 | .00 | .00 | .00 | 5.00 | .00 | 8.00 | .00 |
| 1961 | .00 | 47.00 | 2.00 | .00 | 10.00 | 152.00 | 220.00 |
| 1962 | .00 | .00 | .00 | 4.00 | .00 | 14.00 | .00 |
| 1963 | .00 | .00 | .00 | .00 | .00 | .00 | 1.00 |
| 1964 | 2.80 | .00 | .00 | .00 | 3.00 | .00 | .00 |
| 1965 | .00 | .00 | 2.00 | 37.00 | .00 | .00 | .00 |
| 1966 | .00 | .00 | 14.00 | 100.00 | .00 | 6.00 | .00 |
| 1967 | .22 | .00 | .00 | .00 | 2.00 | .00 | .00 |
| 1968 | 34.87 | 1.00 | .00 | 79.00 | 15.00 | 815.00 | 1.00 |
| 1969 | 26.57 | 1.00 | 1.00 | .00 | 3.00 | 1.00 | .00 |
| 1970 | .00 | .00 | .00 | 39.00 | 28.00 | 1.00 | 1.00 |
| 1971 | 1.61 | .00 | .00 | .00 | 27.00 | 7.00 | .00 |
| 1972 | 1.61 | 61.00 | 15.00 | 62.00 | 12.00 | 418.00 | 2.00 |
| 1973 | 402.82 | .00 | .00 | 105.00 | 3.00 | 3.00 | .00 |
| 1974 | .00 | .00 | 32.00 | 10.00 | 5.00 | 450.00 | .00 |
| 1975 | 56.78 | 2.00 | .00 | 51.00 | 10.00 | 1.00 | .00 |
| 1976 | 55.96 | .00 | 73.00 | 11.00 | 182.00 | 34.00 | .00 |
| 1977 | 110.50 | 8.34 | 3.53 | 9.69 | 2.69 | 70.00 | 30.00 |
| 1978 | 23.63 | 3.81 | 3.19 | 10.62 | 5.37 | 7.07 | 4.39 |
| 1979 | 120.83 | 5.74 | 6.02 | 27.31 | 5.77 | 12.97 | 5.30 |
| 1980 | 366.31 | 3.41 | 1.93 | 5.22 | 100.30 | 72.66 | 2.82 |
| 1981 | 316.18 | 10.52 | 6.87 | 79.01 | 45.83 | 16.38 | 23.86 |
| 1982 | 185.94 | 8.48 | 16.68 | 6.63 | 2.67 | 14.10 | 6.49 |
| 1983 | 180.49 | 5.65 | 3.97 | 7.23 | 10.31 | 6.53 | 3.86 |
| 1984 | 448.41 | 7.37 | 1.46 | 4.98 | 5.28 | 11.14 | 5.09 |
| 1985 | 251.67 | 7.05 | 12.03 | 15.68 | 2.74 | 11.09 | 37.14 |
| 1986 | 115.08 | 4.62 | 1.80 | 10.56 | 3.24 | 40.99 | 7.63 |
| 1987 | 240.69 | 53.53 | 19.17 | 64.87 | 3.54 | 6.58 | 16.32 |
| 1988 | 268.06 | 2.46 | 1.81 | 4.95 | 5.39 | 3.61 | 3.57 |
| 1989 | 5.65 | 2.41 | 2.54 | 1.69 | 3.45 | 8.55 | 2.59 |
| 1990 | 1.15 | 3.82 | 8.35 | 4.01 | 4.76 | 3.73 | 2.23 |
| 1991 | .00 | 4.69 | 4.86 | 9.09 | 7.09 | 6.38 | 2.52 |
| 1992 | 183.67 | 376.09 | 16.57 | 11.06 | 2.81 | 9.63 | 45.15 |
| 1993 | 74.22 | 5.18 | 4.41 | 112.16 | 23.57 | 5.00 | 5.64 |

| | |
|---|---|
| Brown Shrimp | Brown Shrimp harvest (thousands of pounds) |
| JF_inflow | Lagged January-February inflows (thousands of acre-feet) |
| MA_inflow | Lagged March-April inflows (thousands of acre-feet) |
| MJ_inflow | Lagged May-June inflows (thousands of acre-feet) |
| JA_inflow | Lagged July-August inflows (thousands of acre-feet) |
| SO_inflow | Lagged September-October inflows (thousands of acre-feet) |
| ND_inflow | Lagged November-December inflows (thousands of acre-feet) |

***Table .2.3** Percentiles of the brown shrimp data and the inflow data.*

**Percentiles**

| | | Percentiles | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 5 | 10 | 25 | 50 | 75 | 90 | 95 |
| Weighted Average(Definition 1) | Brown Shrimp Harvest | 1.000E-03 | 1.000E-03 | 1.000E-03 | 26.5650 | 183.6700 | 336.2316 | 411.9388 |
| | Ln(Brown Shrimp Harvest) | -6.9078 | -6.9078 | -6.9078 | 3.2796 | 5.2131 | 5.8152 | 6.0199 |
| | Square Root of Bworn Shrimp Harvest | 3.162E-02 | 3.162E-02 | 3.162E-02 | 5.1541 | 13.5525 | 18.3245 | 20.2915 |
| | January-February Inflows | 1.000E-03 | 1.000E-03 | 1.000E-03 | 3.4080 | 7.0530 | 49.6124 | 124.0170 |
| | Ln(January-February Inflows) | -6.9078 | -6.9078 | -6.9078 | 1.2261 | 1.9535 | 3.9022 | 4.4747 |
| | Square Root of January-February Inflows | 3.162E-02 | 3.162E-02 | 3.162E-02 | 1.8461 | 2.6557 | 7.0400 | 10.1268 |
| | March-April Inflows | 1.000E-03 | 1.000E-03 | 1.000E-03 | 2.0000 | 8.3480 | 17.6776 | 40.2000 |
| | Ln(March-april Inflows) | -6.9078 | -6.9078 | -6.9078 | .6931 | 2.1220 | 2.8700 | 3.6307 |
| | Square Root of March-April Inflows | 3.162E-02 | 3.162E-02 | 3.162E-02 | 1.4142 | 2.8893 | 4.2020 | 6.2343 |
| | May-June Inflows | 1.000E-03 | 1.000E-03 | 4.0140 | 10.0000 | 39.0000 | 87.4030 | 106.4318 |
| | Ln(May-June Inflows) | -6.9078 | -6.9078 | 1.3898 | 2.3026 | 3.6636 | 4.4638 | 4.6672 |
| | Square Root of May-June Inflows | 3.162E-02 | 3.162E-02 | 2.0035 | 3.1623 | 6.2450 | 9.3331 | 10.3157 |
| | July-August Inflows | 1.000E-03 | 1.000E-03 | 2.7380 | 5.0000 | 10.3140 | 35.1328 | 116.6432 |
| | Ln(July-August Inflows) | -6.9078 | -6.9078 | 1.0072 | 1.6094 | 2.3335 | 3.5293 | 4.7274 |
| | Square Root of July-August Inflows | 3.162E-02 | 3.162E-02 | 1.6547 | 2.2361 | 3.2115 | 5.8829 | 10.7103 |
| | September-October Inflows | 1.000E-03 | 1.000E-03 | 3.6140 | 8.0000 | 34.0000 | 258.4000 | 523.0000 |
| | Ln(September-October Inflows) | -6.9078 | -6.9078 | 1.2848 | 2.0794 | 3.5264 | 5.4285 | 6.2280 |
| | Square Root of September-October Inflows | 3.162E-02 | 3.162E-02 | 1.9011 | 2.8284 | 5.8310 | 15.5753 | 22.6802 |
| | November-December Inflows | 1.000E-03 | 1.000E-03 | 1.000E-03 | 2.5160 | 6.4900 | 32.8548 | 80.1160 |
| | Ln(November-December Inflows) | -6.9078 | -6.9078 | -6.9078 | .9227 | 1.8703 | 3.4866 | 4.1266 |
| | Square Root of November-December Inflows | 3.162E-02 | 3.162E-02 | 3.162E-02 | 1.5862 | 2.5475 | 5.7239 | 8.3417 |
| Tukey's Hinges | Brown Shrimp Harvest | | | .1115 | 26.5650 | 182.0820 | | |
| | Ln(Brown Shrimp Harvest) | | | -4.2064 | 3.2796 | 5.2044 | | |
| | Square Root of Bworn Shrimp Harvest | | | .2514 | 5.1541 | 13.4936 | | |
| | January-February Inflows | | | 1.000E-03 | 3.4080 | 7.0265 | | |
| | Ln(January-February Inflows) | | | -6.9078 | 1.2261 | 1.9497 | | |
| | Square Root of January-February Inflows | | | 3.162E-02 | 1.8461 | 2.6507 | | |
| | March-April Inflows | | | 1.000E-03 | 2.0000 | 7.6070 | | |
| | Ln(March-april Inflows) | | | -6.9078 | .6931 | 2.0243 | | |
| | Square Root of March-April Inflows | | | 3.162E-02 | 1.4142 | 2.7548 | | |
| | May-June Inflows | | | 4.4835 | 10.0000 | 38.0000 | | |
| | Ln(May-June Inflows) | | | 1.4949 | 2.3026 | 3.6372 | | |
| | Square Root of May-June Inflows | | | 2.1145 | 3.1623 | 6.1639 | | |
| | July-August Inflows | | | 2.7720 | 5.0000 | 10.1570 | | |
| | Ln(July-August Inflows) | | | 1.0195 | 1.6094 | 2.3180 | | |
| | Square Root of July-August Inflows | | | 1.6649 | 2.2361 | 3.1869 | | |
| | September-October Inflows | | | 3.6725 | 8.0000 | 25.1895 | | |
| | Ln(September-October Inflows) | | | 1.3007 | 2.0794 | 3.1612 | | |
| | Square Root of September-October Inflows | | | 1.9163 | 2.8284 | 4.9390 | | |
| | November-December Inflows | | | 1.000E-03 | 2.5160 | 6.0645 | | |
| | Ln(November-December Inflows) | | | -6.9078 | .9227 | 1.8000 | | |
| | Square Root of November-December Inflows | | | 3.162E-02 | 1.5862 | 2.4611 | | |

### 2.2.1 The brown shrimp data

***Table .2.4*** *Descriptives for the brown shrimp data.*

**Descriptives**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| Brown Shrimp Harvest | Mean | | 99.6679 | 22.4249 |
| | 95% Confidence Interval for Mean | Lower Bound | 54.0950 | |
| | | Upper Bound | 145.2408 | |
| | 5% Trimmed Mean | | 86.9159 | |
| | Median | | 26.5650 | |
| | Variance | | 17600.707 | |
| | Std. Deviation | | 132.6677 | |
| | Minimum | | .00 | |
| | Maximum | | 448.41 | |
| | Range | | 448.41 | |
| | Interquartile Range | | 183.6690 | |
| | Skewness | | 1.280 | .398 |
| | Kurtosis | | .562 | .778 |

***Table .2.5*** *Extreme Values for the brown shrimp data.*

**Extreme Values**

| | | | Case Number | Year | Value |
|---|---|---|---|---|---|
| Brown Shrimp Harvest | Highest | 1 | 26 | 1984 | 448.41 |
| | | 2 | 15 | 1973 | 402.82 |
| | | 3 | 22 | 1980 | 366.31 |
| | | 4 | 23 | 1981 | 316.18 |
| | | 5 | 30 | 1988 | 268.06 |
| | Lowest | 1 | 4 | 1962 | .00 |
| | | 2 | 12 | 1970 | .00 |
| | | 3 | 7 | 1965 | .00 |
| | | 4 | 5 | 1963 | .00 |
| | | 5 | 16 | 1974 | .[a] |

a. Only a partial list of cases with the value 0 are shown in the table of lower extremes.

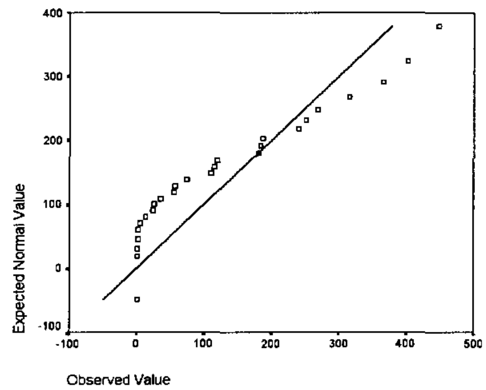


***Figure 2.1*** *Normal Q-Q Plot of Brown Shrimp Harvest.*

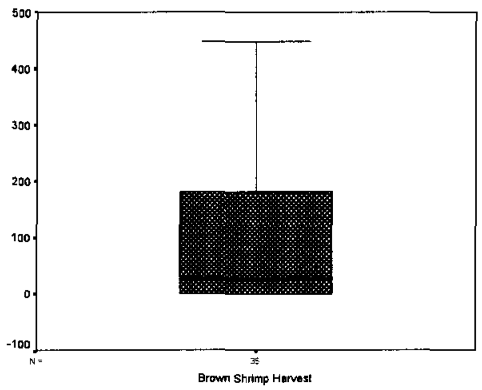


***Figure 2.2*** *BoxPlot of Brown Shrimp Harvest.*

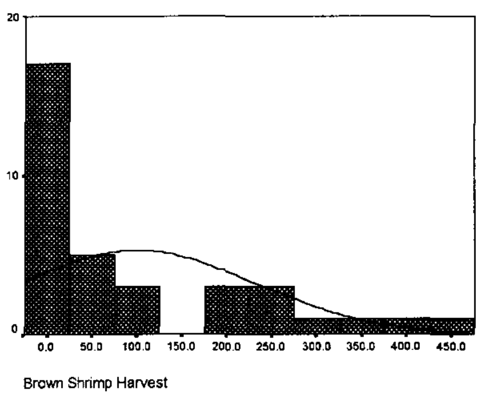


***Figure 2.3*** *Histogram of Brown Shrimp Harvest.*

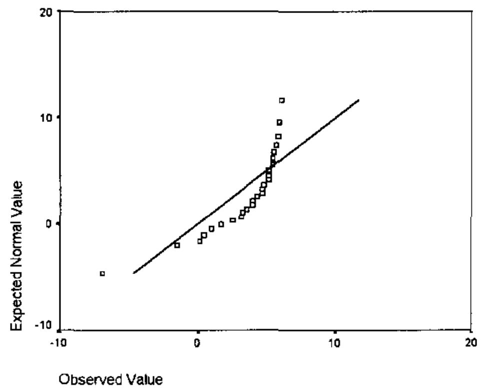


***Figure 2.4*** *Normal Q-Q Plot of Ln(Brown Shrimp Harvest).*

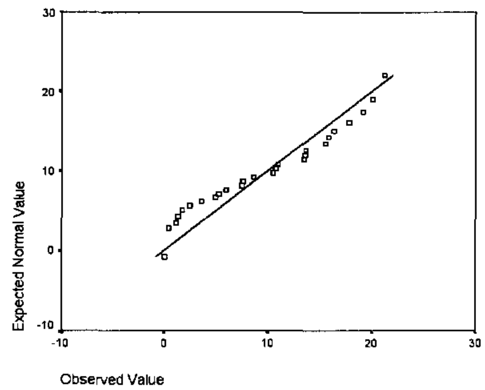


***Figure 2.5*** *Normal Q-Q Plot of Sqrt(Brown Shrimp Harvest).*

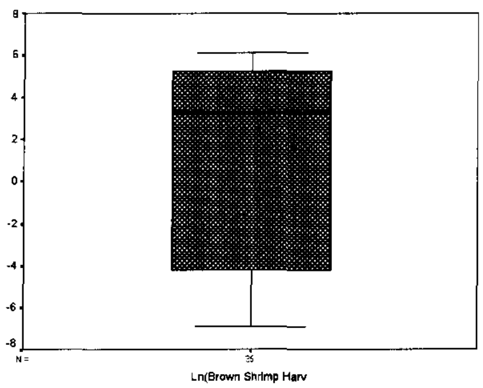


***Figure 2.6*** *BoxPlot of Ln(Brown Shrimp Harvest).*

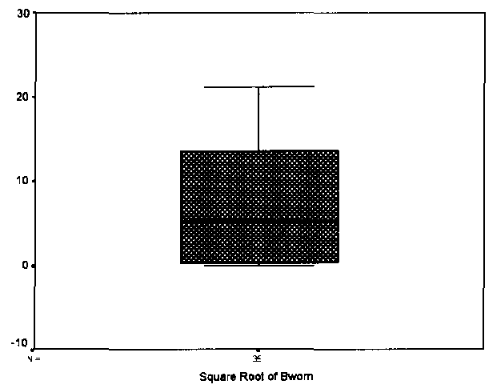


***Figure 2.7*** *BoxPlot of Sqrt(Brown Shrimp Harvest).*

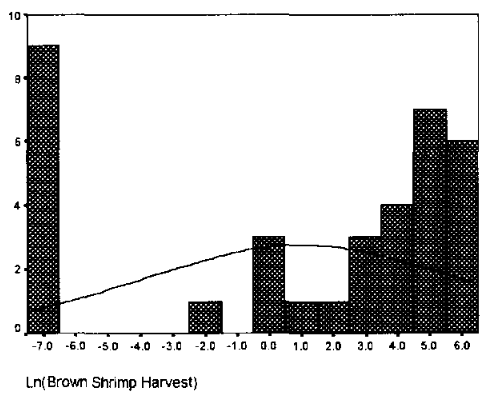


***Figure 2.8*** *Histogram of Ln(Brown Shrimp Harvest).*

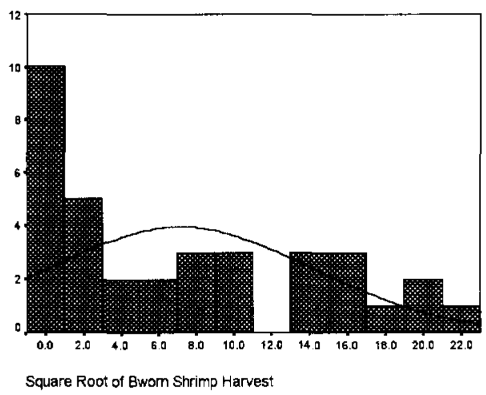


***Figure 2.9*** *Histogram of Sqrt(Brown Shrimp Harvest).*

### 2.2.2 The January-February Inflows data

***Table .2.6*** *Descriptives for the January-February Inflow data.*

**Descriptives**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| January-February Inflows | Mean | | 18.0624 | 10.8239 |
| | 95% Confidence Interval for Mean | Lower Bound | -3.9344 | |
| | | Upper Bound | 40.0591 | |
| | 5% Trimmed Mean | | 6.6777 | |
| | Median | | 3.4080 | |
| | Variance | | 4100.461 | |
| | Std. Deviation | | 64.0348 | |
| | Minimum | | .00 | |
| | Maximum | | 376.09 | |
| | Range | | 376.08 | |
| | Interquartile Range | | 7.0520 | |
| | Skewness | | 5.456 | .398 |
| | Kurtosis | | 31.025 | .778 |

***Table .2.7*** *Extreme Values for the January-February Inflow data.*

**Extreme Values**

| | | | Case Number | Year | Value |
|---|---|---|---|---|---|
| January-February Inflows | Highest | 1 | 34 | 1992 | 376.09 |
| | | 2 | 14 | 1972 | 61.00 |
| | | 3 | 29 | 1987 | 53.53 |
| | | 4 | 3 | 1961 | 47.00 |
| | | 5 | 23 | 1981 | 10.52 |
| | Lowest | 1 | 5 | 1963 | .00 |
| | | 2 | 16 | 1974 | .00 |
| | | 3 | 6 | 1964 | .00 |
| | | 4 | 4 | 1962 | .00 |
| | | 5 | 7 | 1965 | .[a] |

a. Only a partial list of cases with the value 0 are shown in the table of lower extremes.

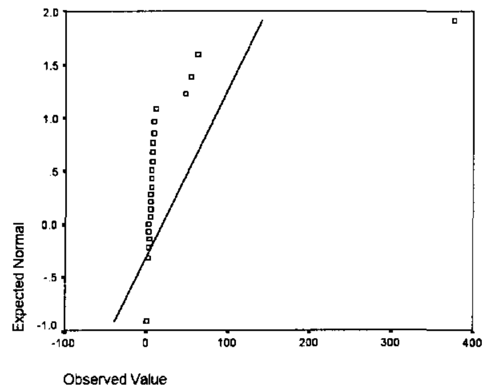


***Figure 2.10*** *Normal Q-Q Plot of January-February Inflows.*

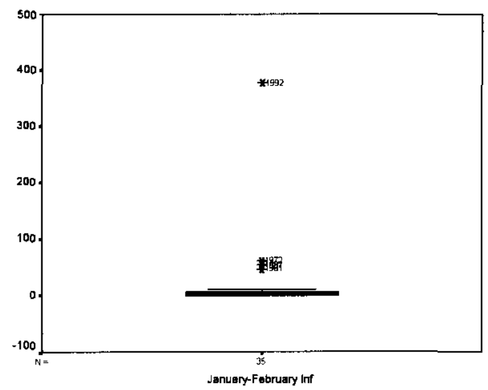


***Figure 2.11*** *BoxPlot of January-February Inflows.*

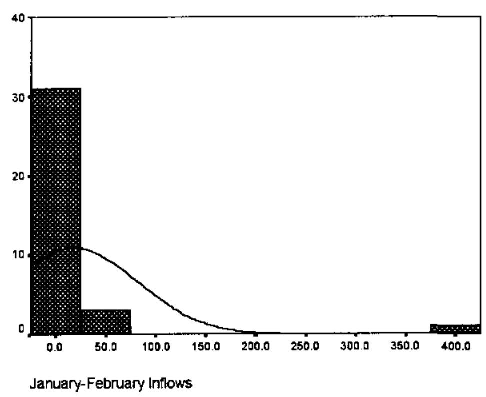


***Figure 2.12*** *Histogram of January-February Inflows.*

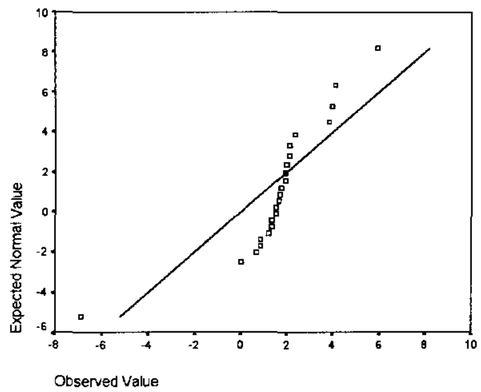


*Figure 2.13* Normal Q-Q Plot of Ln January-February Inflows).

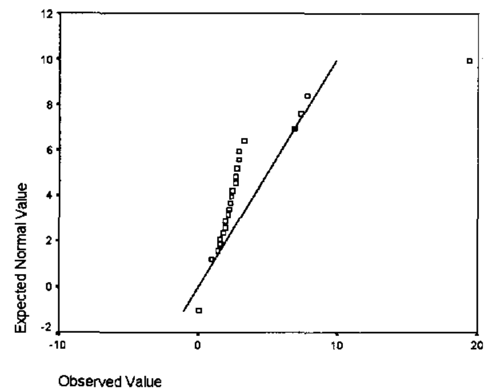


*Figure 2.14* Normal Q-Q Plot of Sqrt( January-February Inflows).

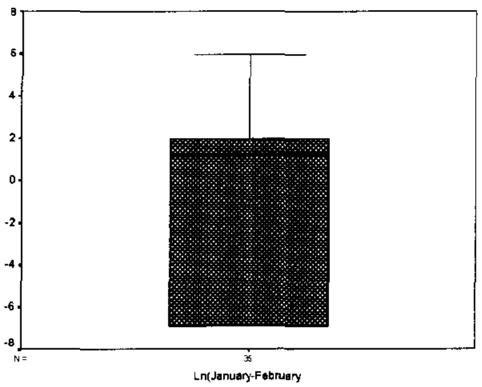


*Figure 2.15* BoxPlot of Ln(January-February Inflows).

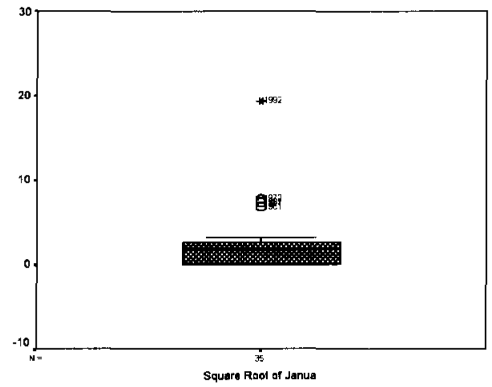


*Figure 2.16* BoxPlot of Square Root of January-February Inflows.

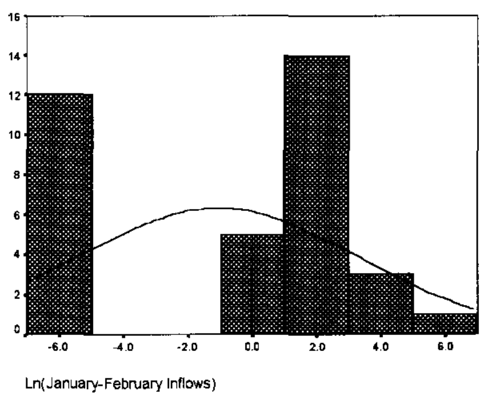


*Figure 2.17* Histogram of Ln(January-February Inflows).

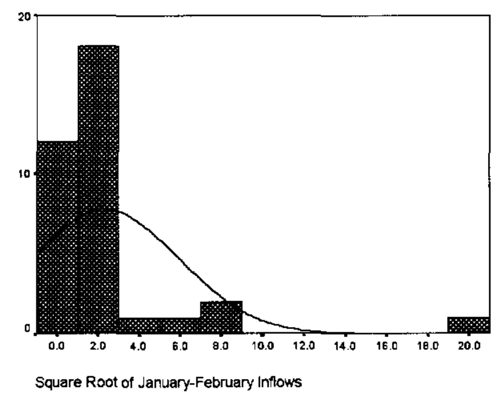


*Figure 2.18* Histogram of Sqrt(January-February Inflows).

### 2.2.3 The March-April Inflows data

***Table .2.8*** *Descriptives for the March-April Inflow data.*

**Descriptives**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| March-April Inflows | Mean | | 7.2627 | 2.2927 |
| | 95% Confidence Interval for Mean | Lower Bound | 2.6034 | |
| | | Upper Bound | 11.9221 | |
| | 5% Trimmed Mean | | 4.9903 | |
| | Median | | 2.0000 | |
| | Variance | | 183.979 | |
| | Std. Deviation | | 13.5639 | |
| | Minimum | | .00 | |
| | Maximum | | 73.00 | |
| | Range | | 73.00 | |
| | Interquartile Range | | 8.3470 | |
| | Skewness | | 3.721 | .398 |
| | Kurtosis | | 16.549 | .778 |

***Table .2.9*** *Extreme Values for the March-April Inflow data.*

**Extreme Values**

| | | | Case Number | Year | Value |
|---|---|---|---|---|---|
| March-April Inflows | Highest | 1 | 18 | 1976 | 73.00 |
| | | 2 | 16 | 1974 | 32.00 |
| | | 3 | 29 | 1987 | 19.17 |
| | | 4 | 24 | 1982 | 16.68 |
| | | 5 | 34 | 1992 | 16.57 |
| | Lowest | 1 | 9 | 1967 | .00 |
| | | 2 | 1 | 1959 | .00 |
| | | 3 | 15 | 1973 | .00 |
| | | 4 | 6 | 1964 | .00 |
| | | 5 | 17 | 1975 | .[a] |

a. Only a partial list of cases with the value 0 are shown in the table of lower extremes.

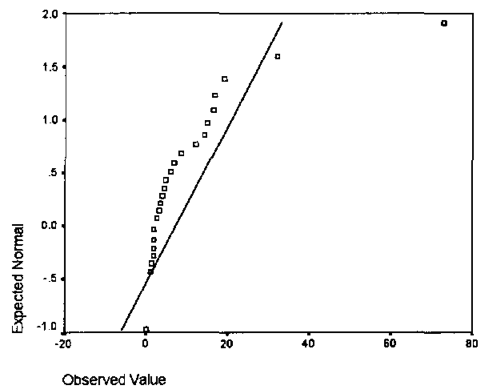


***Figure 2.19*** *Normal Q-Q Plot of March-April Inflows.*

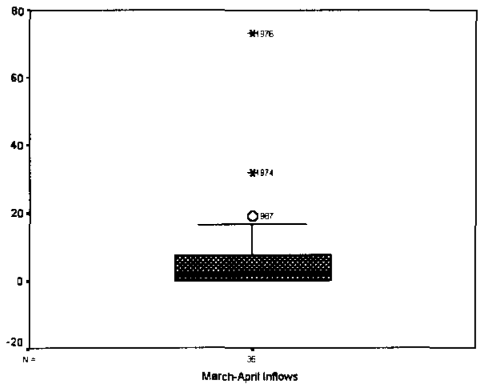


***Figure 2.20*** *BoxPlot of March-April Inflows.*

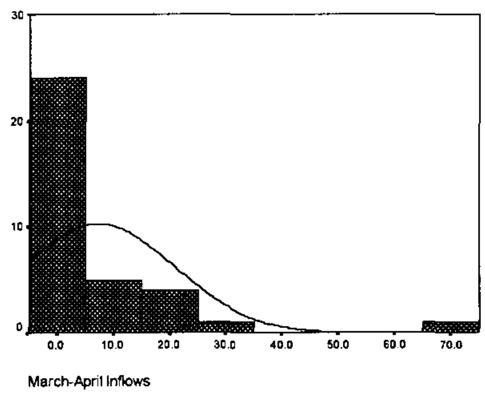


***Figure 2.21*** *Histogram of March-April Inflows.*

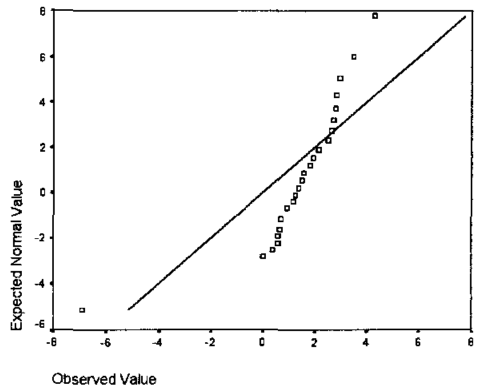


*Figure 2.22* Normal Q-Q Plot of Ln(March-April Inflows).

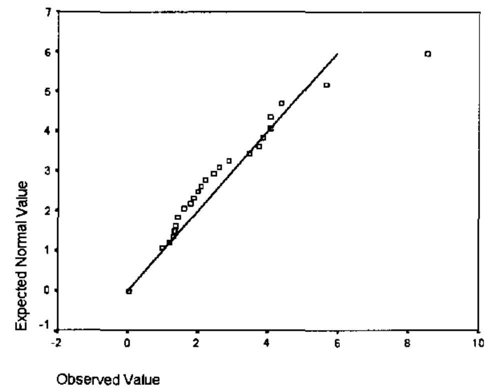


*Figure 2.23* Normal Q-Q Plot of Sqrt(March-April Inflows).

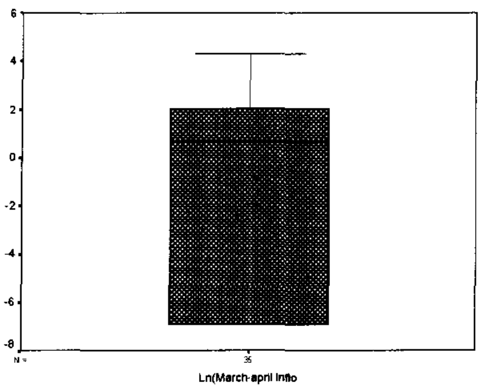


*Figure 2.24* BoxPlot of Ln(March-April) Inflows.

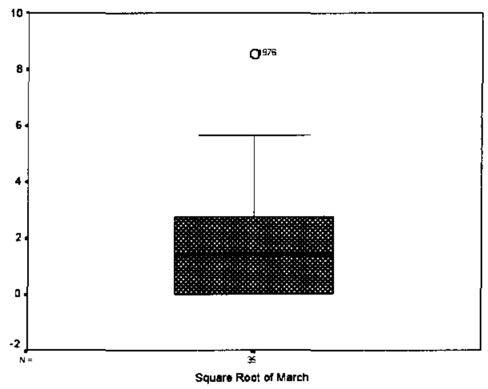


*Figure 2.25* BoxPlot of Square Root of March-April Inflows.

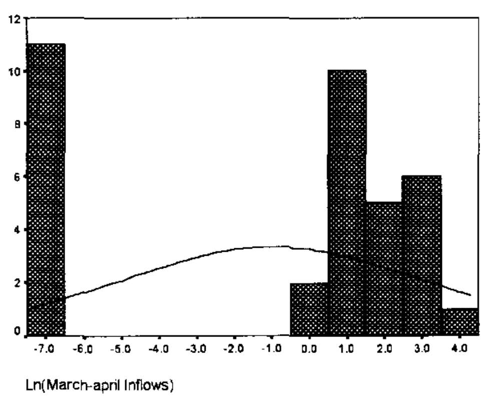


*Figure 2.26* Histogram of Ln(March-April Inflows).

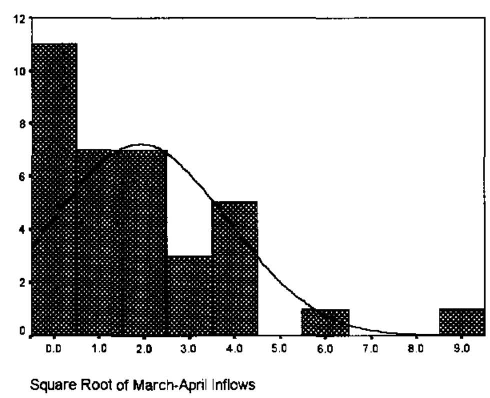


*Figure 2.27* Histogram of Sqrt(March-April Inflows).

### 2.2.4 The May-June Inflows data

***Table .2.10*** *Descriptives for the May-June Inflow data.*

**Descriptives**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| May-June Inflows | Mean | | 25.7075 | 5.6963 |
| | 95% Confidence Interval for Mean | Lower Bound | 14.1313 | |
| | | Upper Bound | 37.2837 | |
| | 5% Trimmed Mean | | 22.5032 | |
| | Median | | 10.0000 | |
| | Variance | | 1135.659 | |
| | Std. Deviation | | 33.6995 | |
| | Minimum | | .00 | |
| | Maximum | | 112.16 | |
| | Range | | 112.16 | |
| | Interquartile Range | | 34.9860 | |
| | Skewness | | 1.444 | .398 |
| | Kurtosis | | .834 | .778 |

***Table .2.11*** *Extreme Values for the May-June Inflow data.*

**Extreme Values**

| | | | Case Number | Year | Value |
|---|---|---|---|---|---|
| May-June Inflows | Highest | 1 | 35 | 1993 | 112.16 |
| | | 2 | 15 | 1973 | 105.00 |
| | | 3 | 8 | 1966 | 100.00 |
| | | 4 | 23 | 1981 | 79.01 |
| | | 5 | 10 | 1968 | 79.00 |
| | Lowest | 1 | 6 | 1964 | .00 |
| | | 2 | 9 | 1967 | .00 |
| | | 3 | 11 | 1969 | .00 |
| | | 4 | 5 | 1963 | .00 |
| | | 5 | 13 | 1971 | .[a] |

a. Only a partial list of cases with the value 0 are shown in the table of lower extremes.

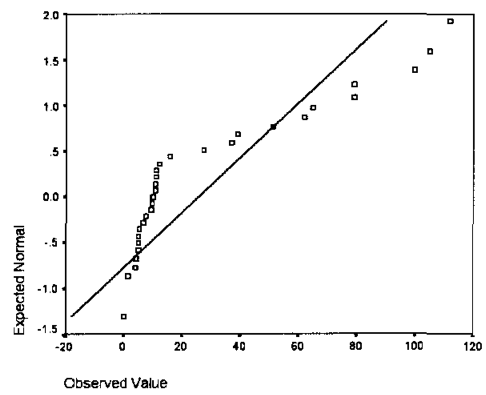


***Figure 2.28*** *Normal Q-Q Plot of May-June Inflows.*

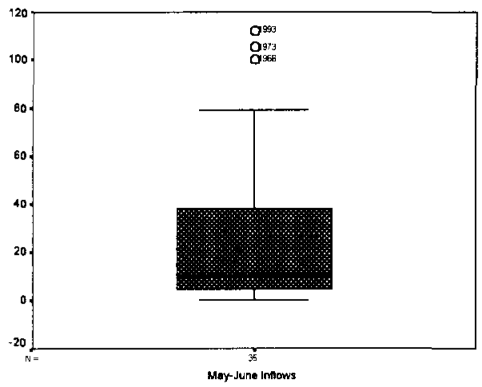


***Figure 2.29*** *BoxPlot of May-June Inflows.*

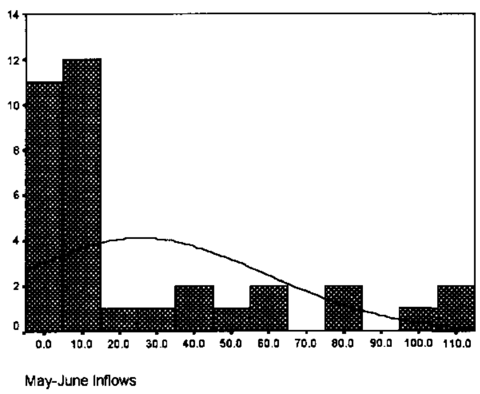


***Figure 2.30*** *Histogram of May-June Inflows.*

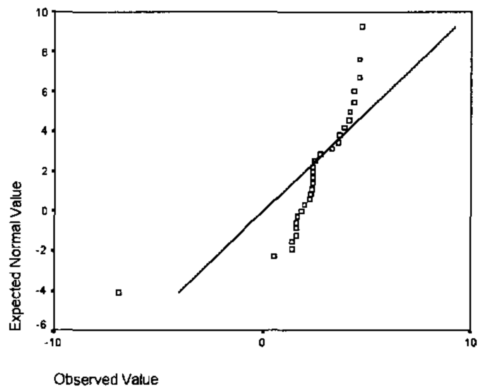


***Figure 2.31*** *Normal Q-Q Plot of Ln(May-Jun Inflows).*

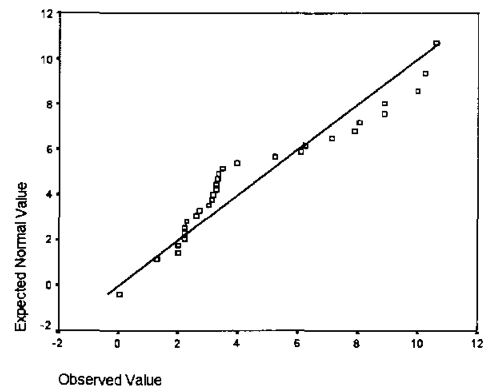


***Figure 2.32*** *Normal Q-Q Plot of Sqrt( May-June Inflows).*

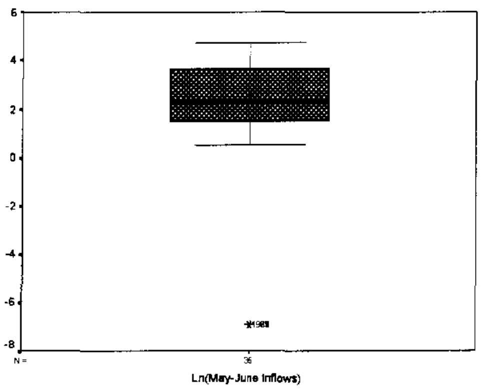


***Figure 2.33*** *BoxPlot of Ln(May-June) Inflows*

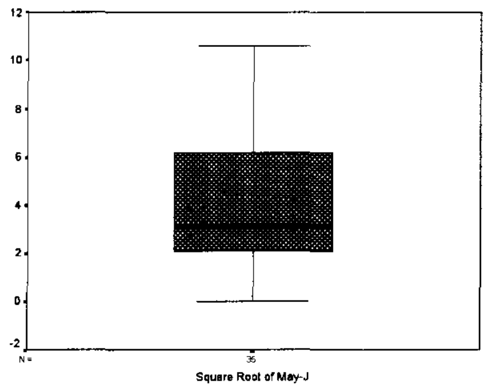


***Figure 2.34*** *BoxPlot of Square Root of May-June Inflows.*

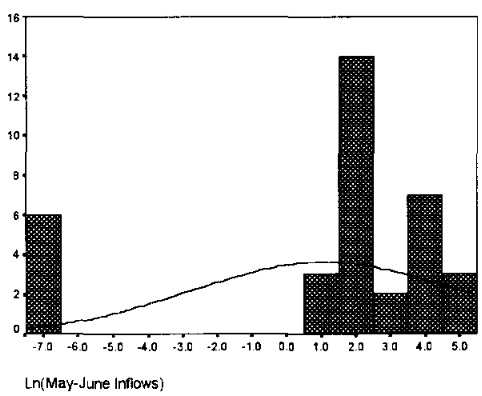


***Figure 2.35*** *Histogram of Ln(May-June Inflows).*

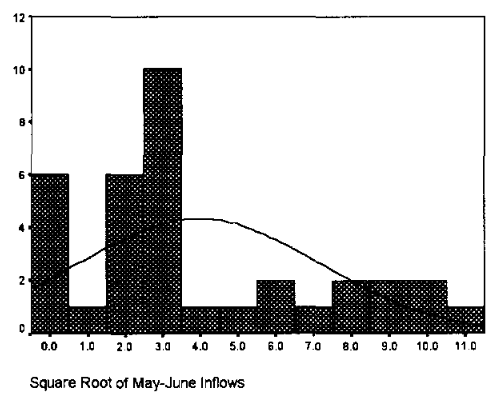


***Figure 2.36*** *Histogram of Sqrt(May-June Inflows).*

### 2.2.5 The July-August Inflows data

***Table .2.12*** *Descriptives for the July-August Inflow data.*

**Descriptives**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| July-August Inflows | Mean | | 15.4233 | 5.8007 |
| | 95% Confidence Interval for Mean | Lower Bound | 3.6348 | |
| | | Upper Bound | 27.2117 | |
| | 5% Trimmed Mean | | 8.9710 | |
| | Median | | 5.0000 | |
| | Variance | | 1177.688 | |
| | Std. Deviation | | 34.3175 | |
| | Minimum | | .00 | |
| | Maximum | | 182.00 | |
| | Range | | 182.00 | |
| | Interquartile Range | | 7.5760 | |
| | Skewness | | 4.027 | .398 |
| | Kurtosis | | 17.550 | .778 |

***Table .2.13*** *Extreme Values for the July-August Inflow data.*

**Extreme Values**

| | | | Case Number | Year | Value |
|---|---|---|---|---|---|
| July-August Inflows | Highest | 1 | 18 | 1976 | 182.00 |
| | | 2 | 22 | 1980 | 100.30 |
| | | 3 | 23 | 1981 | 45.83 |
| | | 4 | 12 | 1970 | 28.00 |
| | | 5 | 13 | 1971 | 27.00 |
| | Lowest | 1 | 4 | 1962 | .00 |
| | | 2 | 2 | 1960 | .00 |
| | | 3 | 7 | 1965 | .00 |
| | | 4 | 8 | 1966 | .00 |
| | | 5 | 5 | 1963 | .00 |

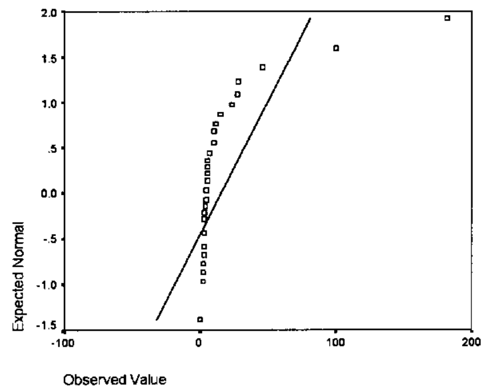


***Figure 2.37*** *Normal Q-Q Plot of July-August Inflows.*

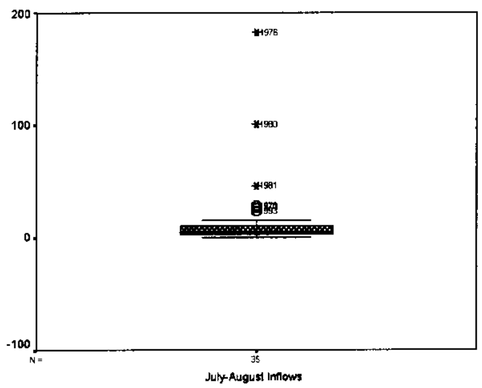


***Figure 2.38*** *BoxPlot of July-August Inflows.*

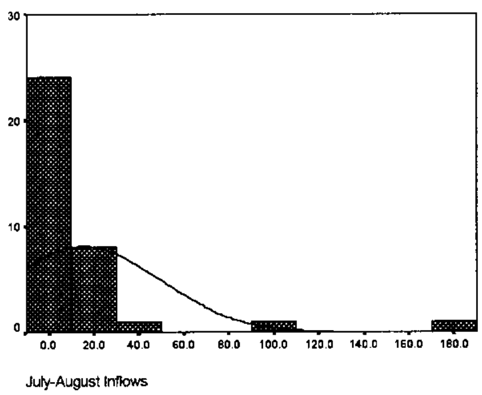


***Figure 2.39*** *Histogram of July-August Inflows.*

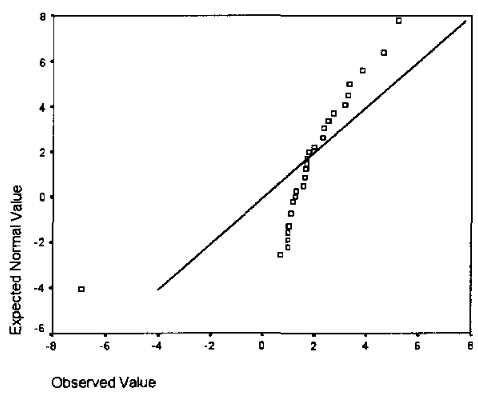


***Figure 2.40*** *Normal Q-Q Plot of Ln(July-August Inflows).*

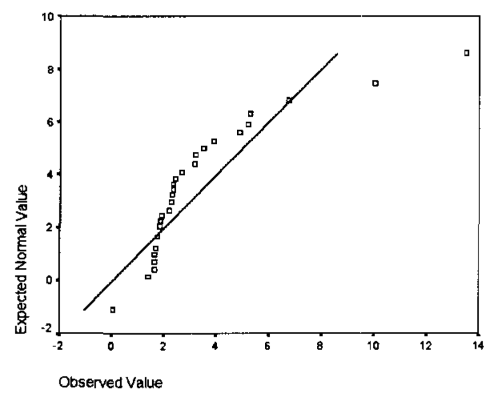


***Figure 2.41*** *Normal Q-Q Plot of Sqrt( July-August Inflows).*

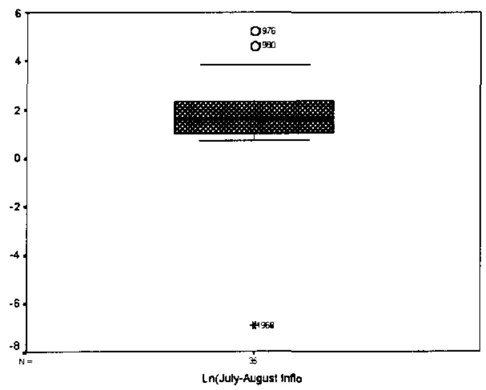


***Figure 2.42*** *BoxPlot of Ln(July-August) Inflows.*

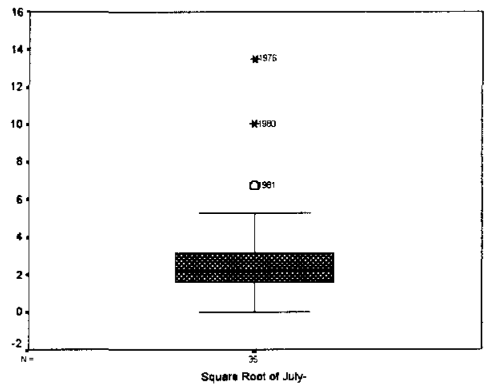


***Figure 2.43*** *BoxPlot of Square Root of July-August Inflows.*

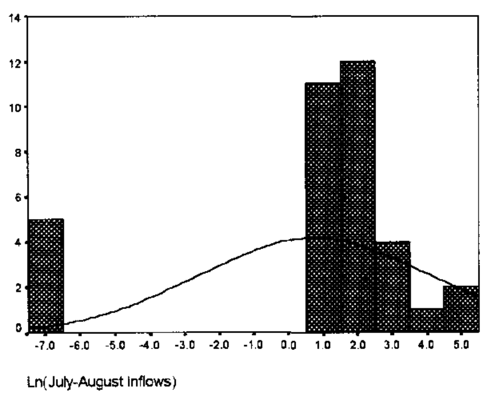


***Figure 2.44*** *Histogram of Ln(July-August Inflows).*

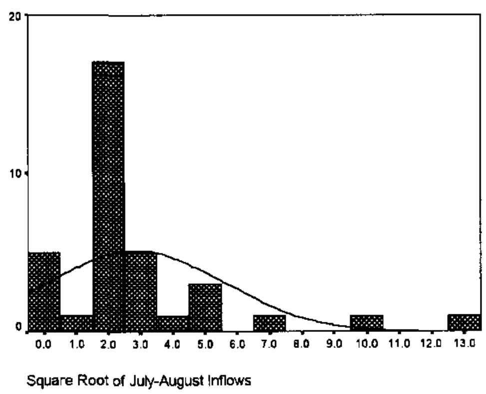


***Figure 2.45*** *Histogram of Sqrt(July-August Inflows).*

### 2.2.6 The September-October Inflows data

***Table .2.14*** *Descriptives for the September-October Inflow data.*

**Descriptives**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| September-October Inflows | Mean | | 67.3261 | 28.1078 |
| | 95% Confidence Interval for Mean | Lower Bound | 10.2042 | |
| | | Upper Bound | 124.4479 | |
| | 5% Trimmed Mean | | 38.2194 | |
| | Median | | 8.0000 | |
| | Variance | | 27651.613 | |
| | Std. Deviation | | 166.2877 | |
| | Minimum | | .00 | |
| | Maximum | | 815.00 | |
| | Range | | 815.00 | |
| | Interquartile Range | | 30.3860 | |
| | Skewness | | 3.474 | .398 |
| | Kurtosis | | 12.758 | .778 |

***Table .2.15*** *Extreme Values for the September-October Inflow data.*

**Extreme Values**

| | | | Case Number | Year | Value |
|---|---|---|---|---|---|
| September-October Inflows | Highest | 1 | 10 | 1968 | 815.00 |
| | | 2 | 16 | 1974 | 450.00 |
| | | 3 | 14 | 1972 | 418.00 |
| | | 4 | 3 | 1961 | 152.00 |
| | | 5 | 1 | 1959 | 140.00 |
| | Lowest | 1 | 9 | 1967 | .00 |
| | | 2 | 7 | 1965 | .00 |
| | | 3 | 5 | 1963 | .00 |
| | | 4 | 6 | 1964 | .00 |
| | | 5 | 11 | 1969 | .[a] |

a. Only a partial list of cases with the value 1 are shown in the table of lower extremes.

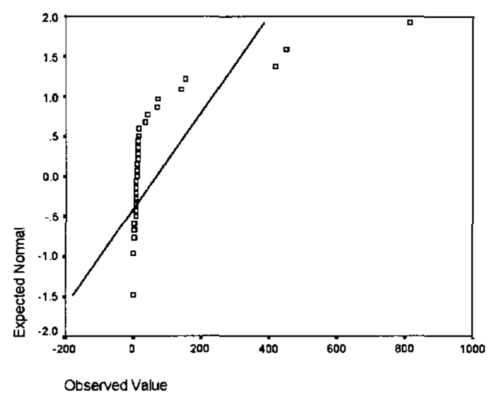


*Figure 2.46* Normal Q-Q Plot of September-October Inflows.

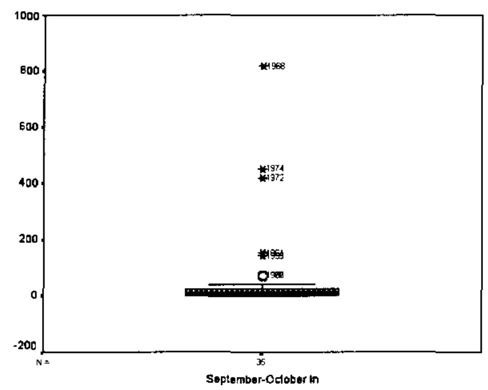


*Figure 2.47* BoxPlot of September-October Inflows.

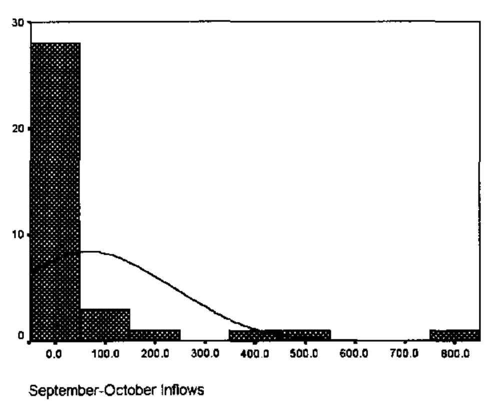


*Figure 2.48* Histogram of September-October Inflows.

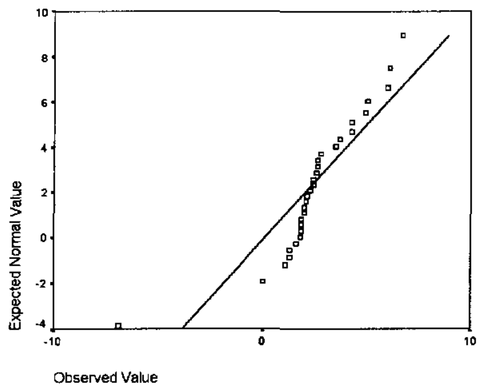


***Figure 2.49*** *Normal Q-Q Plot of Ln(September-October Inflows).*

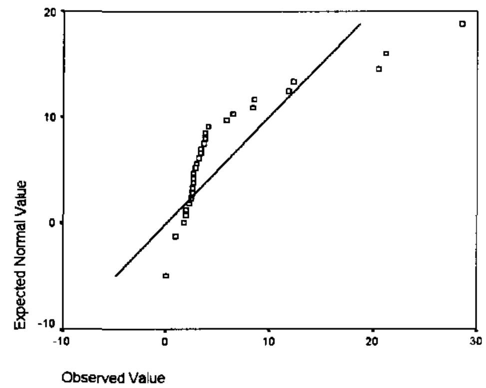


***Figure 2.50*** *Normal Q-Q Plot of Sqrt( September-October Inflows).*

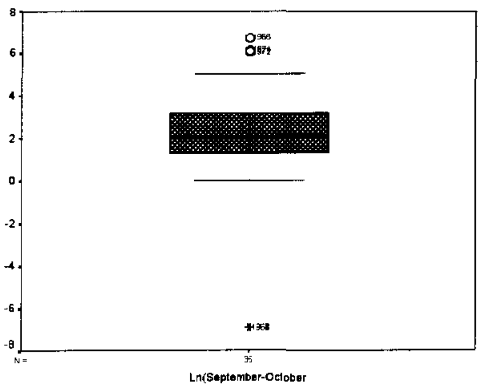


***Figure 2.51*** *BoxPlot of Ln(September-October) Inflows.*

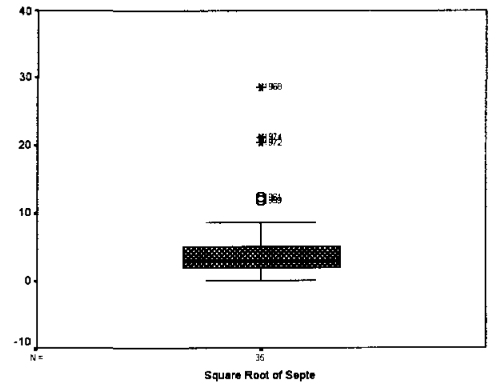


***Figure 2.52*** *BoxPlot of Square Root of September-October Inflows.*

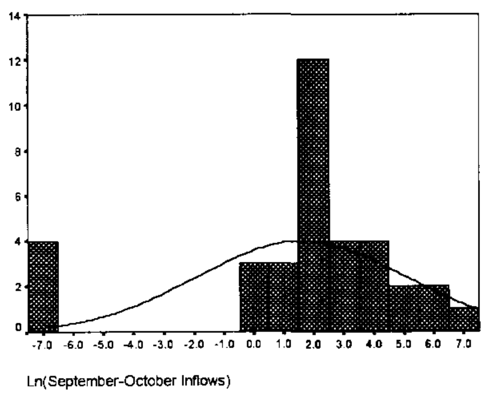


***Figure 2.53*** *Histogram of Ln(September-October Inflows).*

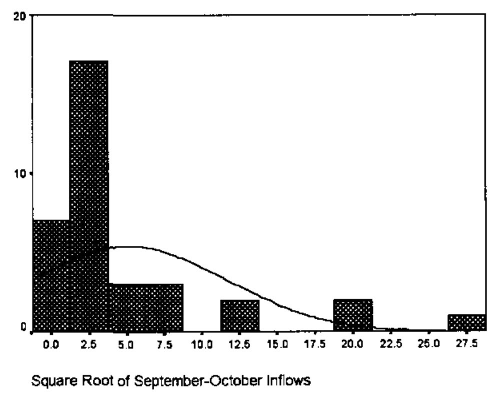


***Figure 2.54*** *Histogram of Sqrt(September-October Inflows).*

### 2.2.7 The November-December Inflows data

***Table .2.16*** *Descriptives for the November-December Inflow data.*

**Descriptives**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| November-December Inflows | Mean | | 12.4743 | 6.3789 |
| | 95% Confidence Interval for Mean | Lower Bound | -.4892 | |
| | | Upper Bound | 25.4378 | |
| | 5% Trimmed Mean | | 5.8013 | |
| | Median | | 2.5160 | |
| | Variance | | 1424.166 | |
| | Std. Deviation | | 37.7381 | |
| | Minimum | | .00 | |
| | Maximum | | 220.00 | |
| | Range | | 220.00 | |
| | Interquartile Range | | 6.4890 | |
| | Skewness | | 5.199 | .398 |
| | Kurtosis | | 28.843 | .778 |

***Table .2.17*** *Extreme Values for the November-December Inflow data.*

**Extreme Values**

| | | | Case Number | Year | Value |
|---|---|---|---|---|---|
| November-December Inflows | Highest | 1 | 3 | 1961 | 220.00 |
| | | 2 | 34 | 1992 | 45.15 |
| | | 3 | 27 | 1985 | 37.14 |
| | | 4 | 19 | 1977 | 30.00 |
| | | 5 | 23 | 1981 | 23.86 |
| | Lowest | 1 | 9 | 1967 | .00 |
| | | 2 | 11 | 1969 | .00 |
| | | 3 | 8 | 1966 | .00 |
| | | 4 | 13 | 1971 | .00 |
| | | 5 | 15 | 1973 | .[a] |

a. Only a partial list of cases with the value 0 are shown in the table of lower extremes.

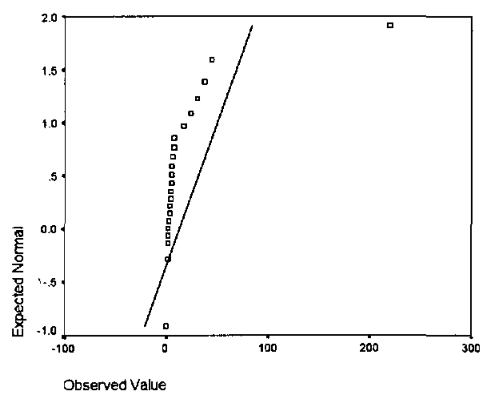


***Figure 2.55*** *Normal Q-Q Plot of November_December Inflows.*

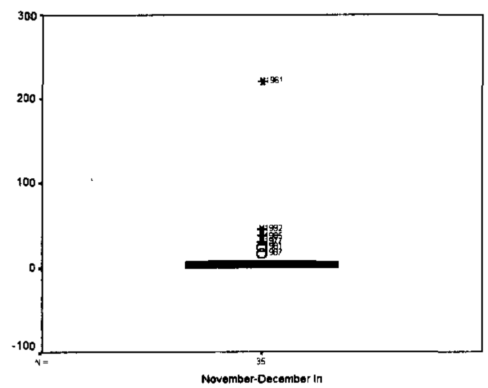


***Figure 2.56*** *BoxPlot of November_December Inflows.*

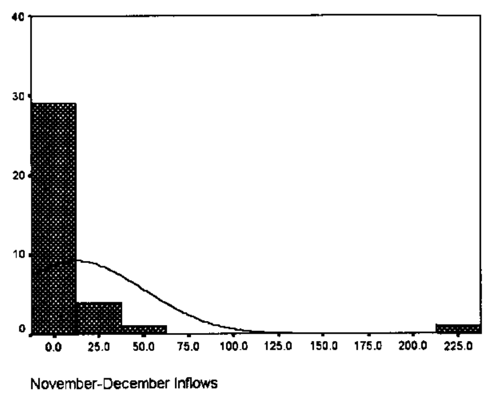


***Figure 2.57*** *Histogram of November_December Inflows.*

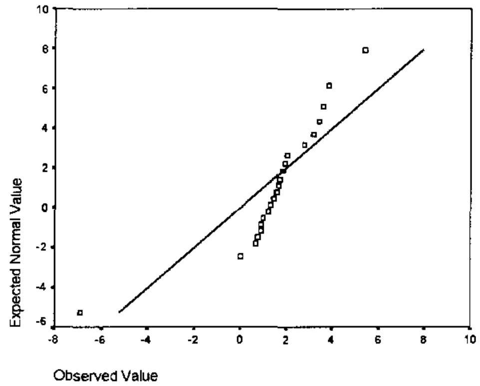


***Figure 2.58*** *Normal Q-Q Plot of Ln(November_December Inflows).*

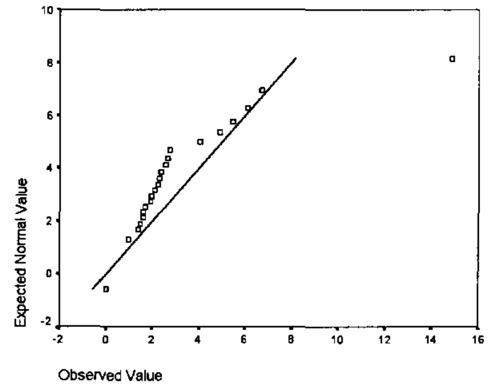


***Figure 2.59*** *Normal Q-Q Plot of Sqrt( November_December Inflows).*

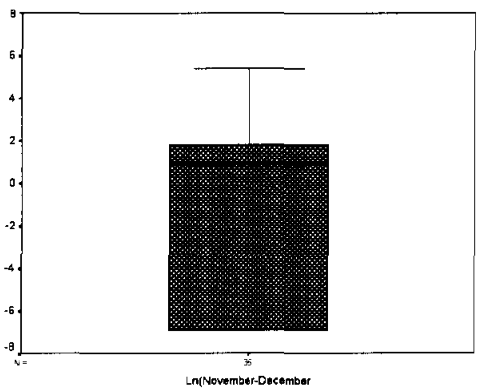


***Figure 2.60*** *BoxPlot of Ln(November _December) Inflows.*

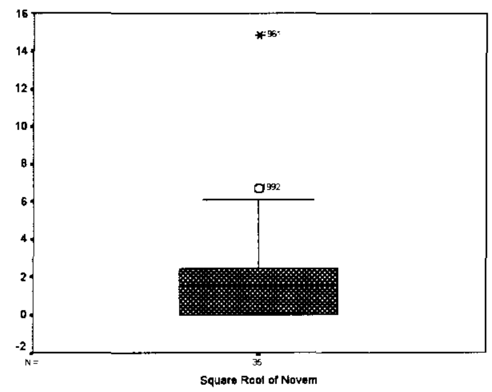


***Figure 2.61*** *BoxPlot of Square Root of November_December Inflows.*

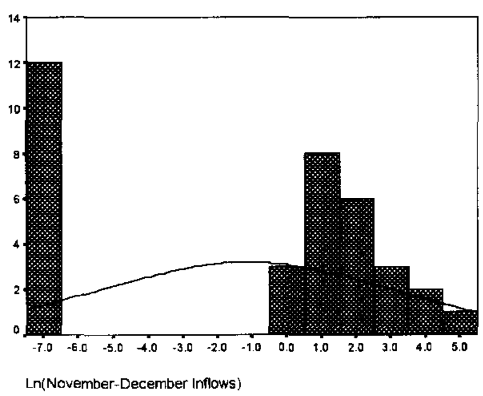


***Figure 2.62*** *Histogram of Ln(November_ December Inflows).*

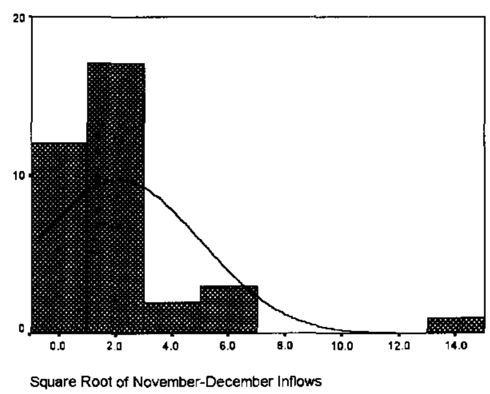


***Figure 2.63*** *Histogram of Sqrt(November_ December Inflows).*

# 3. PREDICTION ELLIPSES AND CONFIDENCE REGIONS

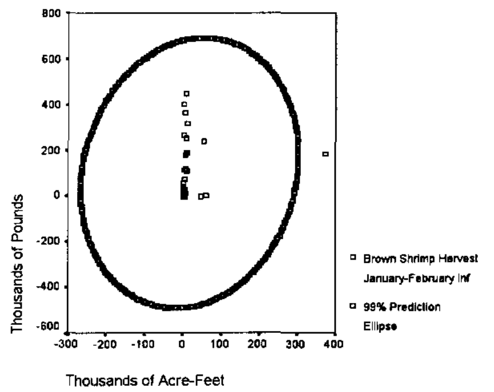


***Figure 3.1*** *Brown Shrimp Harvest vs. January-February Inflows, PE.*

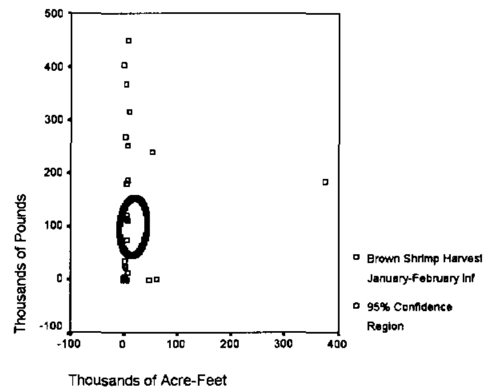


***Figure 3.2*** *Brown Shrimp Harvest vs. January-February Inflows, CR.*

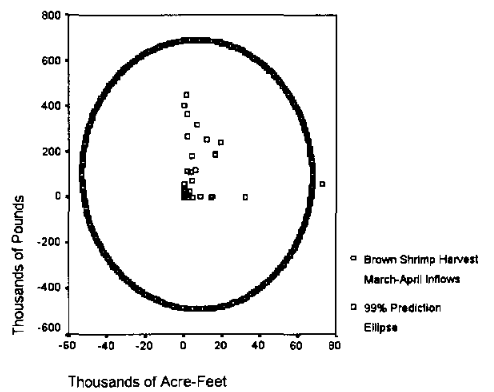


***Figure 3.3*** *Brown Shrimp Harvest vs. March-April Inflows, PE.*

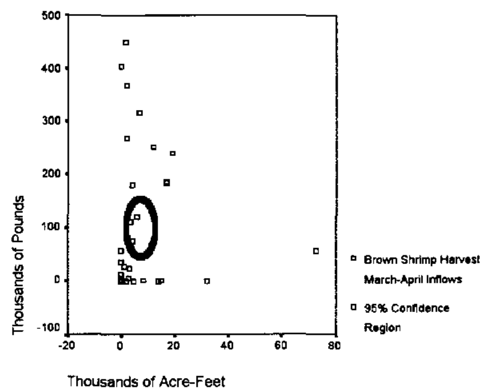


***Figure 3.4*** *Brown Shrimp Harvest vs. March-April Inflows, CR.*

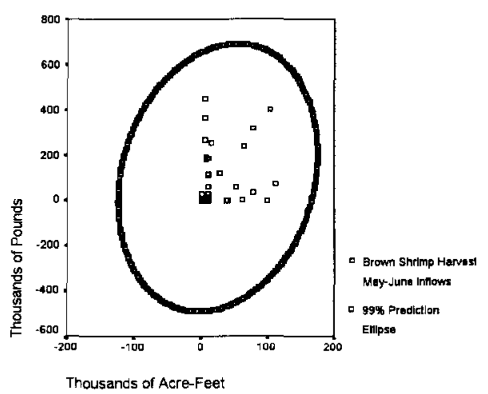


***Figure 3.5*** *Brown Shrimp Harvest vs. May-June Inflows, PE.*

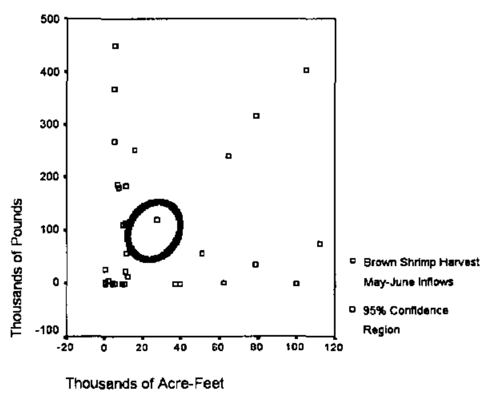


***Figure 3.6*** *Brown Shrimp Harvest vs. May-June Inflows, CR.*

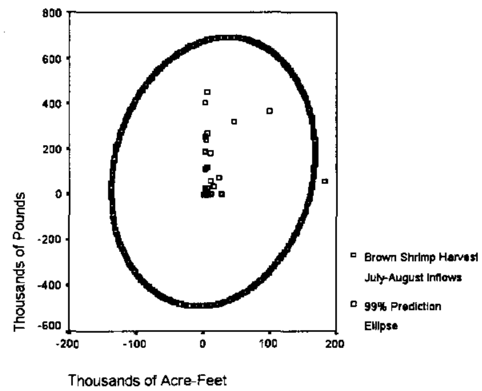


***Figure 3.7*** *Brown Shrimp Harvest vs. July-August Inflows, PE.*

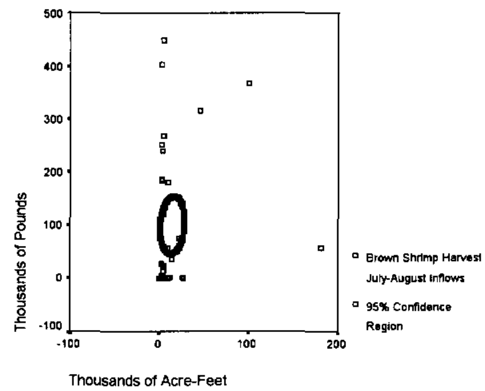


***Figure 3.8*** *Brown Shrimp Harvest vs. July-August Inflows, CR.*

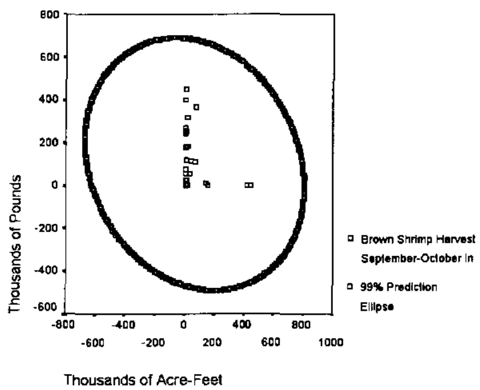


***Figure 3.9*** *Brown Shrimp Harvest vs. September-October Inflows, PE.*

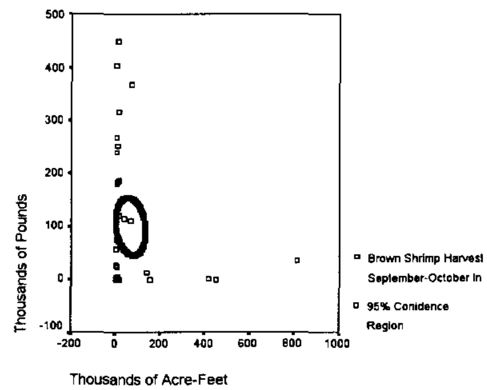


***Figure 3.10*** *Brown Shrimp Harvest vs. September-October Inflows, CR.*

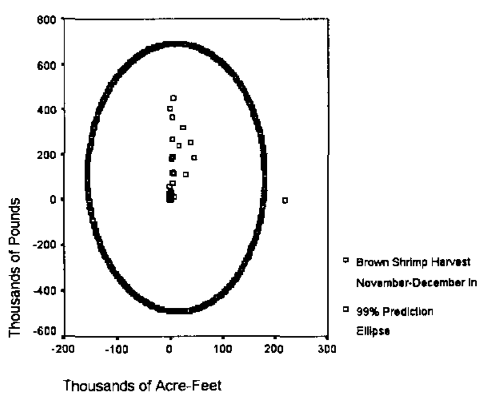


***Figure 3.11*** *Brown Shrimp Harvest vs. November-December Inflows, PE.*

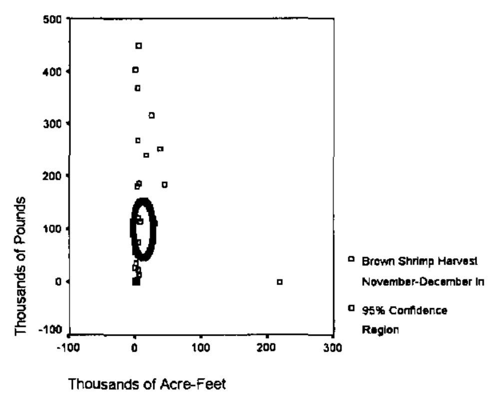


***Figure 3.12*** *Brown Shrimp Harvest vs. November-December Inflows, CR.*

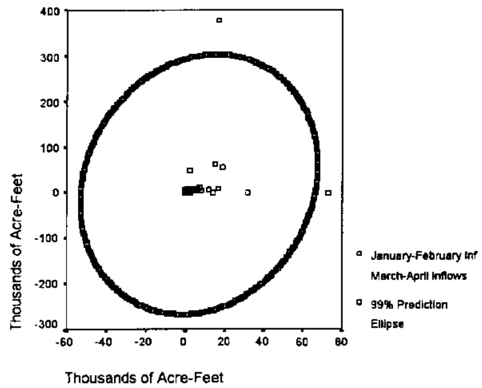


***Figure 3.13*** *January-February Inflows vs. March-April Inflows, PE.*

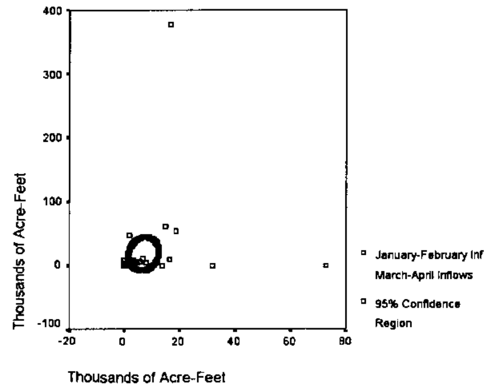


***Figure 3.14*** *January-February Inflows vs. March-April Inflows, CR.*

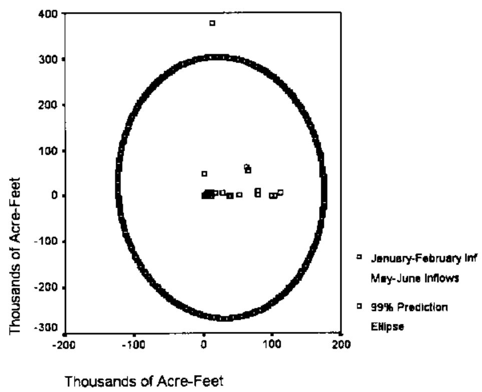


***Figure 3.15*** *January-February Inflows vs. May-June Inflows, PE.*

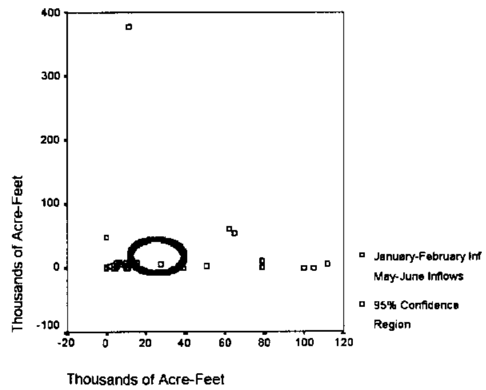


***Figure 3.16*** *January-February Inflows vs. May-June Inflows, CR.*

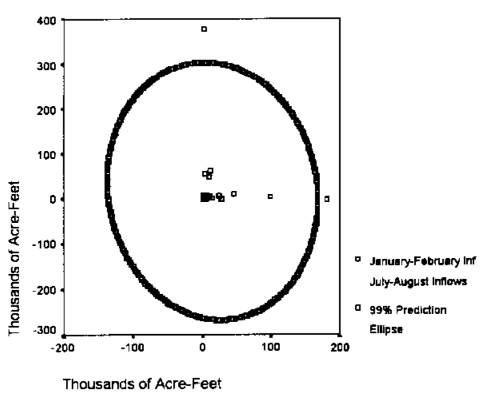


***Figure 3.17*** *January-February Inflows vs. July-August Inflows, PE.*

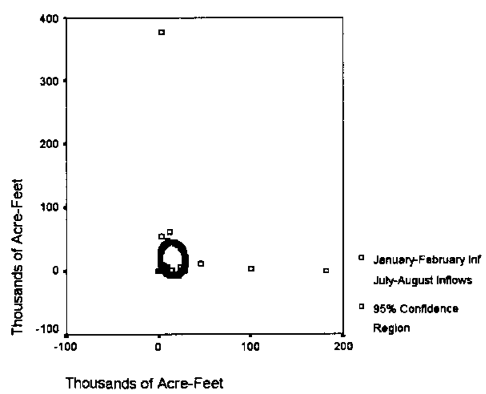


***Figure 3.18*** *January-February Inflows vs. July-August Inflows, CR.*

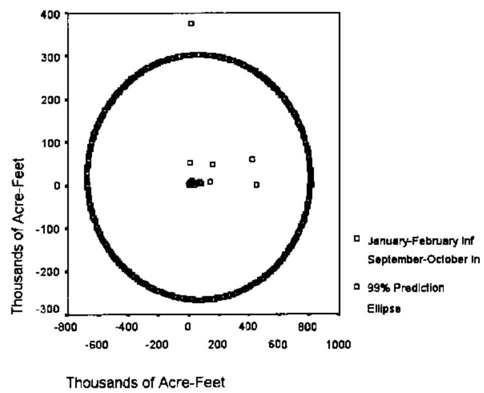


***Figure 3.19*** *January-February Inflows vs. September-October Inflows, PE.*

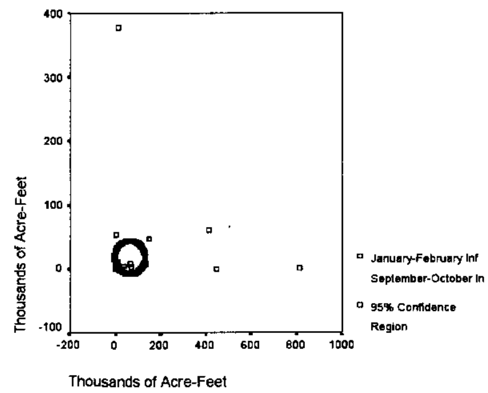


***Figure 3.20*** *January-February Inflows vs. September-October Inflows, CR.*

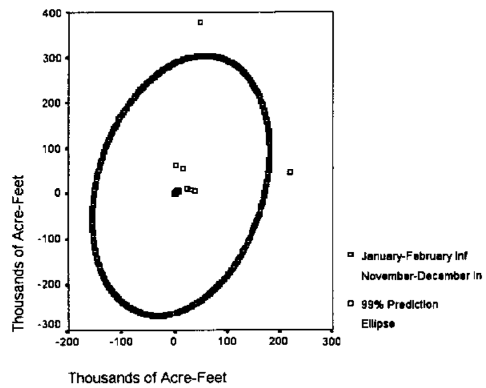


***Figure 3.21*** *January-February Inflows vs. November-December Inflows, PE.*

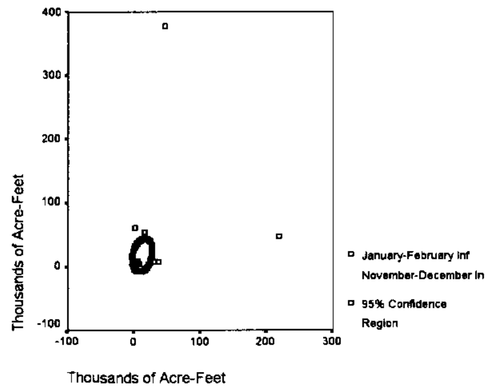


***Figure 3.22*** *January-February Inflows vs. November-December Inflows, CR.*

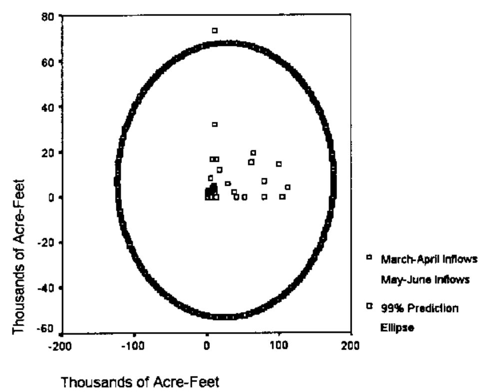


***Figure 3.23*** *March-April Inflows vs. May-June Inflows, PE.*

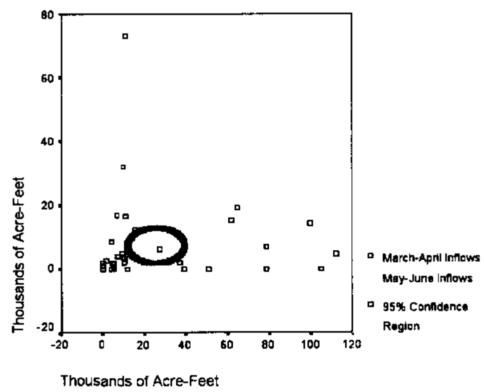


***Figure 3.24*** *March-April Inflows vs. May-June Inflows, CR.*

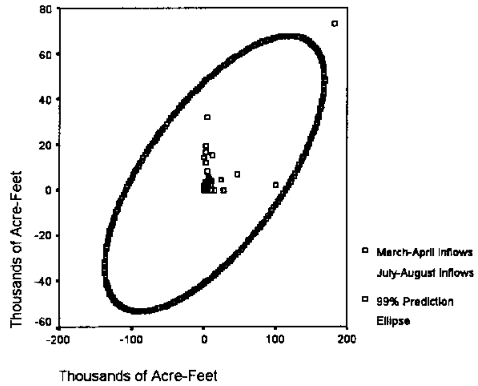


***Figure 3.25*** *March-April Inflows vs. July-August Inflows, PE.*

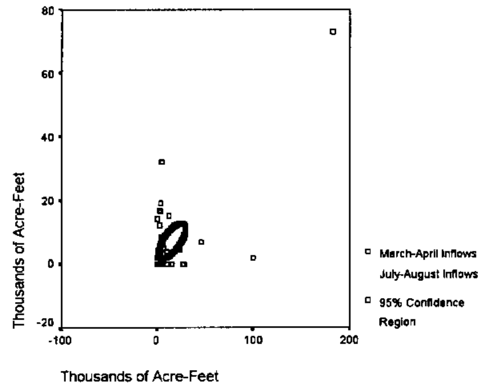


***Figure 3.26*** *March-April Inflows vs. July-August Inflows, CR.*

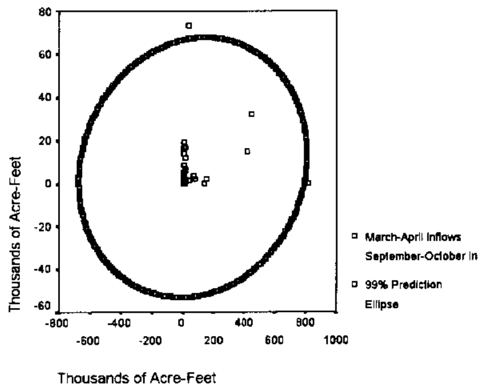


***Figure 3.27*** *March-April Inflows vs. September-October Inflows, PE.*

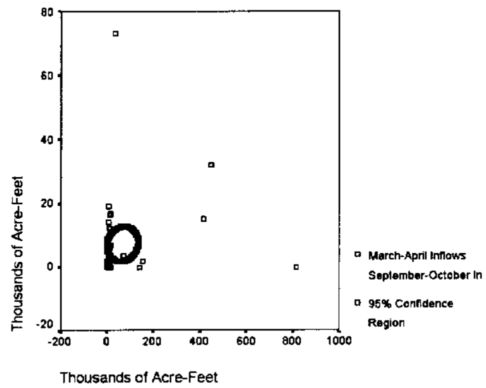


***Figure 3.28*** *March-April Inflows vs. September-October Inflows, CR.*

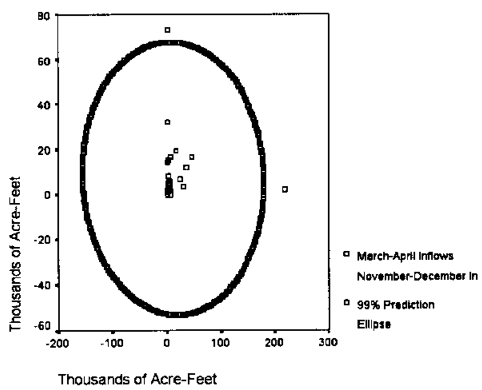


***Figure 3.29*** *March-April Inflows vs. November-December Inflows, PE.*

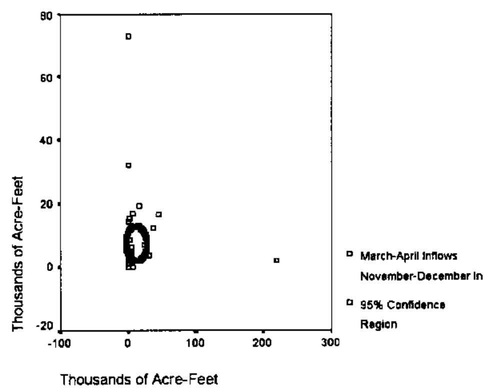


***Figure 3.30*** *March-April Inflows vs. November-December Inflows, CR.*

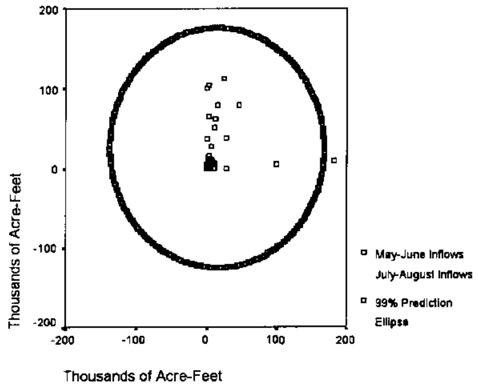


***Figure 3.31*** *May-June Inflows vs. July-August Inflows, PE.*

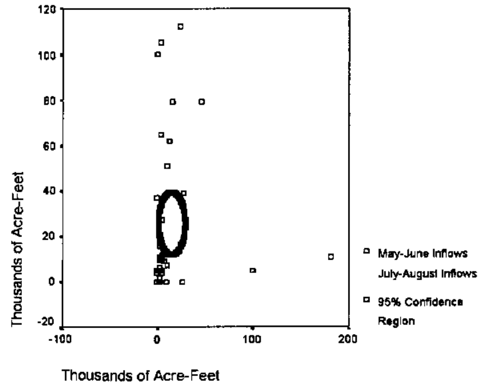


***Figure 3.32*** *May-June Inflows vs. July-August Inflows, CR.*

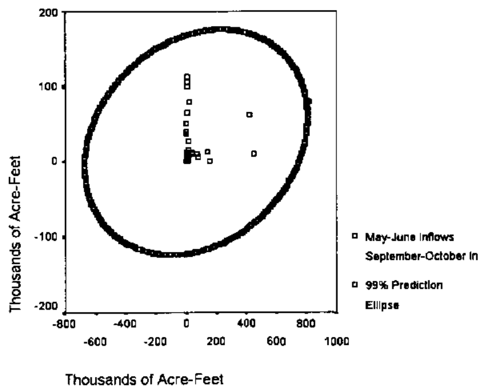


***Figure 3.33*** *May-June Inflows vs. September-October Inflows, PE.*

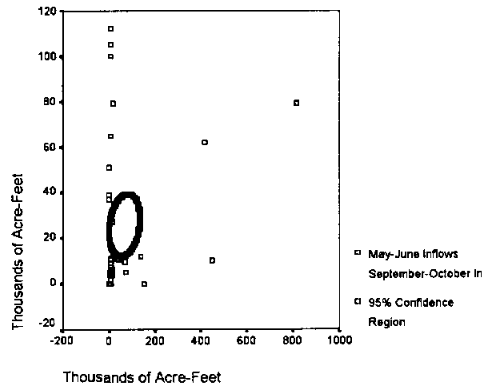


***Figure 3.34*** *May-June Inflows vs. September-October Inflows, CR.*

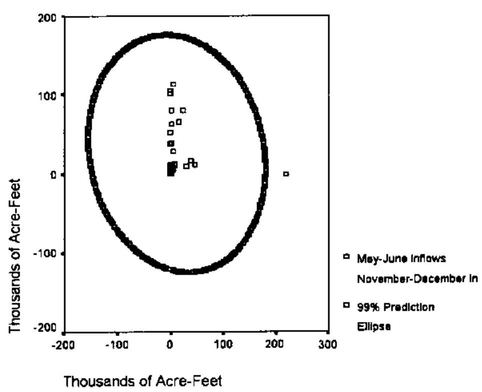


***Figure 3.35*** *May-June Inflows vs. November-December Inflows, PE.*

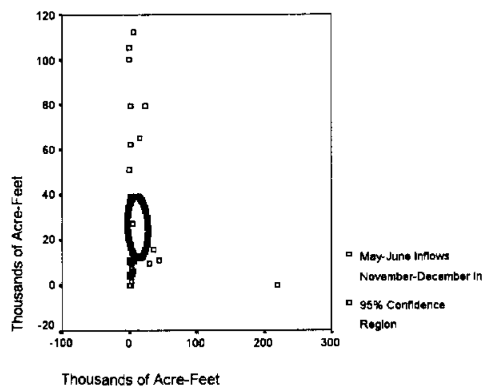


***Figure 3.36*** *May-June Inflows vs. November-December Inflows, CR.*

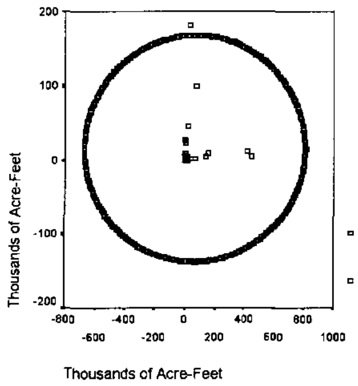


***Figure 3.37*** *July-August Inflows. vs. September-October Inflows, PE.*

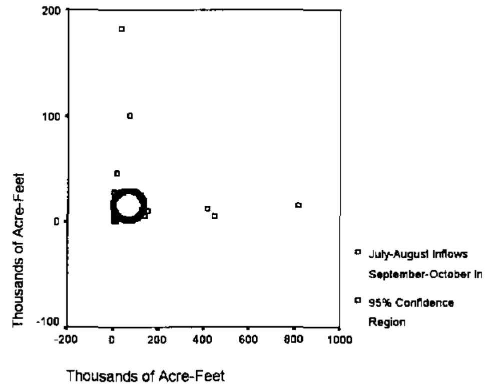


***Figure 3.38*** *July-August Inflows. vs. September-October Inflows, CR.*

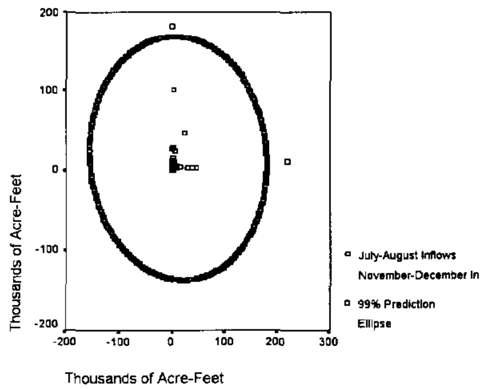


***Figure 3.39*** *July-August Inflows. vs. November-December Inflows, PE.*

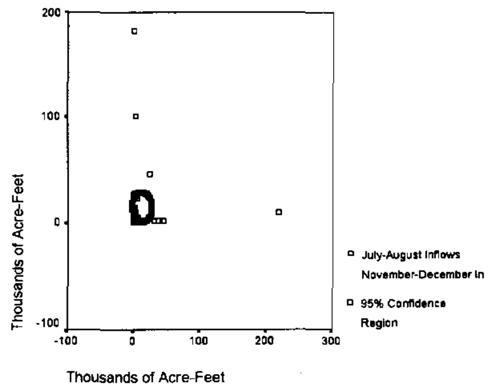


***Figure 3.40*** *July-August Inflows. vs. November-December Inflows, CR.*

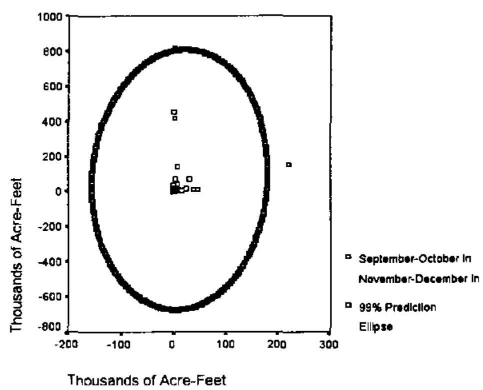


***Figure 3.41*** *September-October Inflows vs. November-December Inflows, PE.*

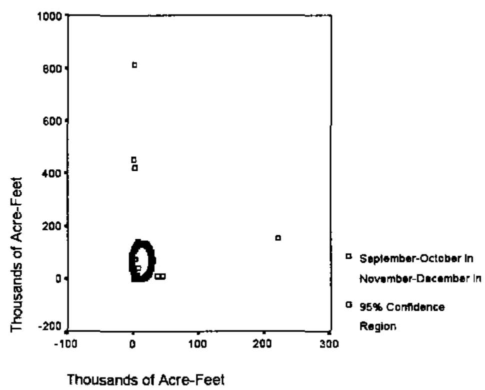


***Figure 3.42*** *September-October Inflows vs. November-December Inflows, CR.*

## 4. Box-Cox Analysis

***Table .4.1*** *Mean Square Error from Box-Cox transformation of the Brown Shrimp data and the inflow data for different lambda.*

| Lam | Brown Shrimp | JF_inflow | MA_inflow | MJ_inflow | JA_inflow | SO_inflow | ND_inflow |
|---|---|---|---|---|---|---|---|
| -2.0 | 2.10E+13 | 86892507 | 1.48E+08 | 3.06E+13 | 2.82E+12 | 3.54E+14 | 48575282 |
| -1.9 | 4.77E+12 | 30038551 | 50136405 | 6.81E+12 | 6.75E+11 | 7.18E+13 | 17121067 |
| -1.8 | 1.09E+12 | 10442029 | 17097077 | 1.52E+12 | 1.63E+11 | 1.46E+13 | 6068140 |
| -1.7 | 2.51E+11 | 3652376 | 5866447 | 3.43E+11 | 3.95E+10 | 3.00E+12 | 2164038 |
| -1.6 | 5.82E+10 | 1286400 | 2026929 | 7.76E+10 | 9.63E+09 | 6.20E+11 | 777112.9 |
| -1.5 | 1.36E+10 | 456641.2 | 705829.6 | 1.77E+10 | 2.37E+09 | 1.29E+11 | 281255.6 |
| -1.4 | 3.20E+09 | 163546.1 | 247985.9 | 4.08E+09 | 5.88E+08 | 2.71E+10 | 102703.1 |
| -1.3 | 7.63E+08 | 59175.5 | 88021.8 | 9.51E+08 | 1.48E+08 | 5.74E+09 | 37888.0 |
| -1.2 | 1.84E+08 | 21666.3 | 31615.0 | 2.24E+08 | 37440560 | 1.23E+09 | 14143.5 |
| -1.1 | 44868111 | 8043.6 | 11513.7 | 53485857 | 9634363 | 2.68E+08 | 5353.4 |
| -1.0 | 11141220 | 3035.7 | 4262.6 | 12987856 | 2520331 | 59365460 | 2059.9 |
| -0.9 | 2821956 | 1168.6 | 1609.5 | 3217276 | 672506.8 | 13398616 | 808.4 |
| -0.8 | 732386.4 | 460.8 | 622.5 | 816661.0 | 183838.6 | 3098350 | 324.9 |
| -0.7 | 195952.9 | 187.2 | 248.0 | 213705.3 | 51782.7 | 738443.6 | 134.5 |
| -0.6 | 54509.3 | 78.9 | 102.6 | 58125.2 | 15145.2 | 182856.3 | 57.8 |
| -0.5 | 15956.9 | 34.9 | 44.4 | 16616.8 | 4646.7 | 47567.0 | 26.0 |
| -0.4 | 5002.9 | 16.4 | 20.4 | 5069.7 | 1515.9 | 13200.9 | 12.4 |
| -0.3 | 1724.1 | 8.3 | 10.1 | 1684.9 | 535.2 | 3996.2 | 6.4 |
| -0.2 | 678.2 | 4.7 | 5.53 | 626.7 | 209.3 | 1364.8 | 3.7 |
| -0.1 | 320.8 | 3.0 | 3.40 | 270.0 | 93.6 | 555.4 | 2.4 |
| 0.0 | 193.5 | 2.2 | 2.41 | 140.5 | 49.9 | 292.3 | 1.8 |
| 0.1 | 154.7 | 2.1 | 2.02 | 91.6 | 33.3 | 215.7 | 1.6 |
| 0.2 | 162.3 | 2.4 | 2.03 | 76.0 | 28.7 | 223.7 | 1.9 |
| 0.3 | 211.8 | 3.8 | 2.44 | 78.0 | 31.6 | 299.5 | 2.7 |
| 0.4 | 322.9 | 7.4 | 3.44 | 93.9 | 41.9 | 471.2 | 4.8 |
| 0.5 | 548.3 | 17.4 | 5.55 | 126.1 | 63.1 | 819.5 | 10.1 |
| 0.6 | 1004.3 | 46.0 | 9.90 | 181.8 | 103.5 | 1525.8 | 23.9 |
| 0.7 | 1944.5 | 131.8 | 19.0 | 275.1 | 180.0 | 2987.2 | 61.6 |
| 0.8 | 3927.7 | 399.2 | 38.9 | 430.9 | 326.4 | 6083.6 | 168.3 |
| 0.9 | 8202.8 | 1259.7 | 83.0 | 692.4 | 611.8 | 12796.2 | 481.3 |
| 1.0 | 17600.7 | 4100.5 | 184.0 | 1135.7 | 1177.7 | 27651.6 | 1424.2 |
| 1.1 | 38620.3 | 13675.8 | 419.9 | 1894.3 | 2317.6 | 61139.6 | 4327.1 |
| 1.2 | 86354.7 | 46505.3 | 982.3 | 3205.2 | 4646.8 | 137873.7 | 13426.7 |
| 1.3 | 196223.8 | 160665.8 | 2344.9 | 5491.2 | 9466.6 | 316268.9 | 42376.8 |
| 1.4 | 452133.6 | 562397.4 | 5694.1 | 9511.5 | 19553.4 | 736389.9 | 135627.8 |
| 1.5 | 1054551 | 1990490 | 14027.8 | 16637.9 | 40876.1 | 1737211 | 439157.7 |
| 1.6 | 2486151 | 7111648 | 34985.3 | 29362.1 | 86357.0 | 4146033 | 1436031 |
| 1.7 | 5917327 | 25616335 | 88175.3 | 52234.9 | 184150.6 | 9997473 | 4735512 |
| 1.8 | 14204424 | 92929434 | 224256.3 | 93607.6 | 395953.8 | 24330319 | 15730548 |
| 1.9 | 34359686 | 3.39E+08 | 574858.6 | 168875.0 | 857684.6 | 59702735 | 52590048 |
| 2.0 | 83691768 | 1.25E+09 | 1483772 | 306538.3 | 1870221 | 1.48E+08 | 1.77E+08 |

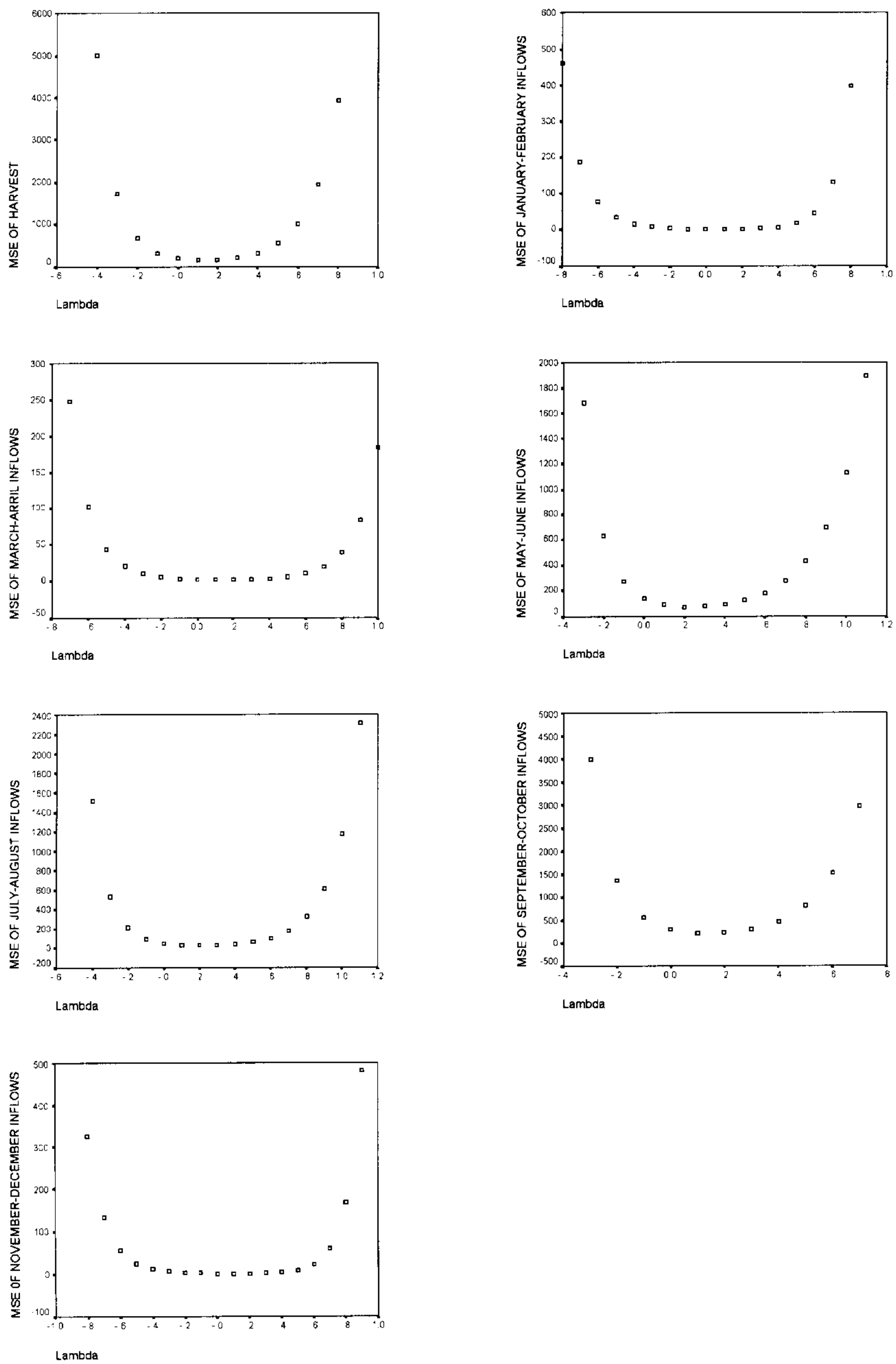


***Figure 4.1*** *Box-Cox Transformation - MSE of Brown Shrimp vs. Lambda and MSE of Inflow data vs. Lambda.*

# 5. MODEL CHOICE DIAGNOSTICS

## 5.1 Untransformed brown shrimp data and untransformed inflow data

***Table 5.1*** *Regression Models for Dependent Variable: BROWN SHRIMP on INFLOWS*

| In | *Rsq* | *Adj Rsq* | *C(p)* | *AIC* | *MSE* | *SBC* | Variables in Model |
|---|---|---|---|---|---|---|---|
| 1 | 0.0341 | 0.0048 | 1.001 | 343.9 | 17516 | 347.0 | QSO_LAG |
| 1 | 0.0337 | 0.0044 | 1.015 | 343.9 | 17523 | 347.0 | QMJ_LAG |
| 1 | 0.0195 | -.0102 | 1.484 | 344.4 | 17780 | 347.6 | QJA_LAG |
| 1 | 0.0146 | -.0153 | 1.648 | 344.6 | 17870 | 347.7 | QJF_LAG |
| 2 | 0.0870 | 0.0300 | 1.248 | 343.9 | 17073 | 348.6 | QMJ_LAG QSO_LAG |
| 2 | 0.0538 | -.0053 | 2.348 | 345.2 | 17695 | 349.9 | QJA_LAG QSO_LAG |
| 2 | 0.0536 | -.0055 | 2.354 | 345.2 | 17698 | 349.9 | QMJ_LAG QJA_LAG |
| 2 | 0.0498 | -.0096 | 2.480 | 345.3 | 17769 | 350.0 | QJF_LAG QMJ_LAG |
| 3 | 0.1073 | 0.0209 | 2.575 | 345.2 | 17232 | 351.4 | QMJ_LAG QJA_LAG QSO_LAG |
| 3 | 0.1032 | 0.0164 | 2.711 | 345.3 | 17312 | 351.5 | QJF_LAG QMJ_LAG QSO_LAG |
| 3 | 0.0877 | -.0006 | 3.224 | 345.9 | 17611 | 352.1 | QMJ_LAG QSO_LAG QND_LAG |
| 3 | 0.0871 | -.0013 | 3.246 | 345.9 | 17623 | 352.2 | QMA_LAG QMJ_LAG QSO_LAG |
| 4 | 0.1267 | 0.0102 | 3.934 | 346.4 | 17421 | 354.2 | QJF_LAG QMJ_LAG QJA_LAG QSO_LAG |
| 4 | 0.1225 | 0.0055 | 4.073 | 346.6 | 17504 | 354.3 | QMA_LAG QMJ_LAG QJA_LAG QSO_LAG |
| 4 | 0.1121 | -.0063 | 4.416 | 347.0 | 17711 | 354.7 | QJF_LAG QMA_LAG QMJ_LAG QJA_LAG |
| 4 | 0.1085 | -.0103 | 4.535 | 347.1 | 17783 | 354.9 | QMJ_LAG QJA_LAG QSO_LAG QND_LAG |
| 5 | 0.1546 | 0.0088 | 5.008 | 347.3 | 17445 | 356.6 | QJF_LAG QMA_LAG QMJ_LAG QJA_LAG QSO_LAG |
| 5 | 0.1267 | -.0239 | 5.933 | 348.4 | 18021 | 357.7 | QJF_LAG QMJ_LAG QJA_LAG QSO_LAG QND_LAG |
| 5 | 0.1236 | -.0275 | 6.036 | 348.5 | 18085 | 357.9 | QMA_LAG QMJ_LAG QJA_LAG QSO_LAG QND_LAG |
| 5 | 0.1134 | -.0395 | 6.373 | 348.9 | 18295 | 358.3 | QJF_LAG QMA_LAG QMJ_LAG QJA_LAG QND_LAG |
| 6 | 0.1549 | -.0262 | 7.000 | 349.2 | 18063 | 360.1 | QJF_LAG QMA_LAG QMJ_LAG QJA_LAG QSO_LAG QND_LAG |

N = 35

## 5.2 Log of brown shrimp data and log of inflow data

***Table 5.2*** *Regression Models for Dependent Variable: Ln(BROWN SHRIMP) on Ln(INFLOWS)*

| In | Rsq | Adj Rsq | C(p) | AIC | MSE | SBC | Variables in Model |
|---|---|---|---|---|---|---|---|
| 1 | 0.3687 | 0.3495 | 8.664 | 100.5 | 16.72 | 103.6 | LN_QJA |
| 1 | 0.3289 | 0.3086 | 11.16 | 102.7 | 17.77 | 105.8 | LN_QJF |
| 1 | 0.1434 | 0.1175 | 22.81 | 111.2 | 22.68 | 114.3 | LN_QND |
| 1 | 0.0688 | 0.0406 | 27.50 | 114.1 | 24.66 | 117.2 | LN_QSO |
| 2 | 0.4739 | 0.4410 | 4.054 | 96.13 | 14.37 | 100.8 | LN_QJF LN_QJA |
| 2 | 0.4106 | 0.3737 | 8.030 | 100.1 | 16.09 | 104.8 | LN_QMJ LN_QJA |
| 2 | 0.3952 | 0.3574 | 8.995 | 101.0 | 16.51 | 105.7 | LN_QJA LN_QND |
| 2 | 0.3814 | 0.3427 | 9.863 | 101.8 | 16.89 | 106.5 | LN_QMA LN_QJA |
| 3 | 0.4979 | 0.4493 | 4.542 | 96.49 | 14.15 | 102.7 | LN_QJF LN_QJA LN_QND |
| 3 | 0.4892 | 0.4397 | 5.094 | 97.10 | 14.40 | 103.3 | LN_QJF LN_QMJ LN_QJA |
| 3 | 0.4871 | 0.4374 | 5.224 | 97.24 | 14.46 | 103.5 | LN_QJF LN_QJA LN_QSO |
| 3 | 0.4762 | 0.4255 | 5.908 | 97.98 | 14.76 | 104.2 | LN_QJF LN_QMA LN_QJA |
| 4 | 0.5242 | 0.4607 | 4.894 | 96.62 | 13.86 | 104.4 | LN_QJF LN_QMJ LN_QJA LN_QSO |
| 4 | 0.5135 | 0.4486 | 5.565 | 97.39 | 14.17 | 105.2 | LN_QJF LN_QMJ LN_QJA LN_QND |
| 4 | 0.5115 | 0.4464 | 5.688 | 97.53 | 14.23 | 105.3 | LN_QJF LN_QJA LN_QSO LN_QND |
| 4 | 0.5001 | 0.4335 | 6.403 | 98.34 | 14.56 | 106.1 | LN_QJF LN_QMA LN_QJA LN_QND |
| 5 | 0.5494 | 0.4717 | 5.309 | 96.71 | 13.58 | 106.0 | LN_QJF LN_QMJ LN_QJA LN_QSO LN_QND |
| 5 | 0.5292 | 0.4481 | 6.576 | 98.24 | 14.18 | 107.6 | LN_QJF LN_QMA LN_QMJ LN_QJA LN_QSO |
| 5 | 0.5199 | 0.4372 | 7.159 | 98.92 | 14.46 | 108.3 | LN_QJF LN_QMA LN_QMJ LN_QJA LN_QND |
| 5 | 0.5124 | 0.4283 | 7.634 | 99.47 | 14.69 | 108.8 | LN_QJF LN_QMA LN_QJA LN_QSO LN_QND |
| 6 | 0.5543 | 0.4588 | 7.000 | 98.32 | 13.91 | 109.2 | LN_QJF LN_QMA LN_QMJ LN_QJA LN_QSO LN_QND |

N = 35

## 5.3 Square root of brown shrimp data and log of inflow data

***Table 5.3*** *Regression Models for Dependent Variable: Sqrt(BROWN SHRIMP) on Ln(INFLOWS)*

| In | Rsq | Adj Rsq | C(p) | AIC | MSE | SBC | Variables in Model |
|---|---|---|---|---|---|---|---|
| 1 | 0.2257 | 0.2022 | 3.044 | 130.9 | 39.85 | 134.0 | LN_QJF |
| 1 | 0.1699 | 0.1447 | 5.497 | 133.4 | 42.72 | 136.5 | LN_QND |
| 1 | 0.1616 | 0.1362 | 5.860 | 133.7 | 43.15 | 136.8 | LN_QJA |
| 1 | 0.1378 | 0.1117 | 6.909 | 134.7 | 44.38 | 137.8 | LN_QMJ |
| 2 | 0.2896 | 0.2452 | 2.233 | 129.9 | 37.70 | 134.6 | LN_QJF LN_QMJ |
| 2 | 0.2777 | 0.2325 | 2.758 | 130.5 | 38.34 | 135.2 | LN_QMJ LN_QJA |
| 2 | 0.2660 | 0.2201 | 3.272 | 131.1 | 38.96 | 135.7 | LN_QJF LN_QJA |
| 2 | 0.2512 | 0.2044 | 3.921 | 131.7 | 39.74 | 136.4 | LN_QMJ LN_QND |
| 3 | 0.3361 | 0.2719 | 2.188 | 129.5 | 36.37 | 135.8 | LN_QJF LN_QMJ LN_QJA |
| 3 | 0.3236 | 0.2582 | 2.739 | 130.2 | 37.06 | 136.4 | LN_QMJ LN_QJA LN_QND |
| 3 | 0.2977 | 0.2297 | 3.878 | 131.5 | 38.48 | 137.7 | LN_QJF LN_QMJ LN_QSO |
| 3 | 0.2907 | 0.2221 | 4.185 | 131.9 | 38.86 | 138.1 | LN_QJF LN_QMJ LN_QND |
| 4 | 0.3615 | 0.2764 | 3.071 | 130.2 | 36.15 | 137.9 | LN_QJF LN_QMJ LN_QJA LN_QSO |
| 4 | 0.3414 | 0.2536 | 3.955 | 131.3 | 37.28 | 139.0 | LN_QMJ LN_QJA LN_QSO LN_QND |
| 4 | 0.3378 | 0.2495 | 4.116 | 131.4 | 37.49 | 139.2 | LN_QJF LN_QMJ LN_QJA LN_QND |
| 4 | 0.3362 | 0.2477 | 4.187 | 131.5 | 37.58 | 139.3 | LN_QJF LN_QMA LN_QMJ LN_QJA |
| 5 | 0.3630 | 0.2531 | 5.008 | 132.1 | 37.31 | 141.4 | LN_QJF LN_QMJ LN_QJA LN_QSO LN_QND |
| 5 | 0.3617 | 0.2517 | 5.063 | 132.2 | 37.38 | 141.5 | LN_QJF LN_QMA LN_QMJ LN_QJA LN_QSO |
| 5 | 0.3441 | 0.2310 | 5.837 | 133.1 | 38.41 | 142.4 | LN_QMA LN_QMJ LN_QJA LN_QSO LN_QND |
| 5 | 0.3378 | 0.2236 | 6.115 | 133.4 | 38.78 | 142.8 | LN_QJF LN_QMA LN_QMJ LN_QJA LN_QND |
| 6 | 0.3632 | 0.2267 | 7.000 | 134.1 | 38.63 | 145.0 | LN_QJF LN_QMA LN_QMJ LN_QJA LN_QSO LN_QND |

N = 35

## 5.4 Square root of of brown shrimp data and square root of inflow data

***Table 5.4*** *Regression Models for Dependent Variable: Sqrt(BROWN SHRIMP) on Sqrt(INFLOWS)*

| In | Rsq | Adj Rsq | C(p) | AIC | MSE | SBC | Variables in Model |
|---|---|---|---|---|---|---|---|
| 1 | 0.0733 | 0.0452 | 3.842 | 137.2 | 47.70 | 140.3 | SQR_QJF |
| 1 | 0.0638 | 0.0354 | 4.200 | 137.6 | 48.18 | 140.7 | SQR_QMJ |
| 1 | 0.0622 | 0.0338 | 4.258 | 137.6 | 48.26 | 140.7 | SQR_QJA |
| 1 | 0.0457 | 0.0168 | 4.880 | 138.2 | 49.12 | 141.3 | SQR_QND |
| 2 | 0.1414 | 0.0877 | 3.283 | 136.5 | 45.57 | 141.2 | SQR_QJF SQR_QJA |
| 2 | 0.1285 | 0.0741 | 3.765 | 137.1 | 46.25 | 141.7 | SQR_QJF SQR_QMJ |
| 2 | 0.1206 | 0.0656 | 4.065 | 137.4 | 46.68 | 142.0 | SQR_QMJ SQR_QND |
| 2 | 0.1146 | 0.0593 | 4.288 | 137.6 | 46.99 | 142.3 | SQR_QMJ SQR_QJA |
| 3 | 0.1852 | 0.1064 | 3.633 | 136.7 | 44.64 | 142.9 | SQR_QJF SQR_QMJ SQR_QJA |
| 3 | 0.1779 | 0.0984 | 3.908 | 137.0 | 45.04 | 143.2 | SQR_QJF SQR_QJA SQR_QSO |
| 3 | 0.1699 | 0.0895 | 4.211 | 137.4 | 45.48 | 143.6 | SQR_QMJ SQR_QJA SQR_QND |
| 3 | 0.1638 | 0.0829 | 4.439 | 137.6 | 45.81 | 143.8 | SQR_QJF SQR_QMJ SQR_QSO |
| 4 | 0.2386 | 0.1371 | 3.626 | 136.3 | 43.10 | 144.1 | SQR_QJF SQR_QMJ SQR_QJA SQR_QSO |
| 4 | 0.2283 | 0.1254 | 4.014 | 136.8 | 43.69 | 144.6 | SQR_QMJ SQR_QJA SQR_QSO SQR_QND |
| 4 | 0.1939 | 0.0864 | 5.308 | 138.3 | 45.64 | 146.1 | SQR_QJF SQR_QMJ SQR_QJA SQR_QND |
| 4 | 0.1888 | 0.0807 | 5.498 | 138.5 | 45.92 | 146.3 | SQR_QJF SQR_QMA SQR_QMJ SQR_QJA |
| 5 | 0.2540 | 0.1253 | 5.050 | 137.6 | 43.69 | 147.0 | SQR_QJF SQR_QMJ SQR_QJA SQR_QSO SQR_QND |
| 5 | 0.2407 | 0.1098 | 5.547 | 138.2 | 44.47 | 147.6 | SQR_QJF SQR_QMA SQR_QMJ SQR_QJA SQR_QSO |
| 5 | 0.2286 | 0.0956 | 6.004 | 138.8 | 45.18 | 148.1 | SQR_QMA SQR_QMJ SQR_QJA SQR_QSO SQR_QND |
| 5 | 0.1968 | 0.0583 | 7.199 | 140.2 | 47.04 | 149.5 | SQR_QJF SQR_QMA SQR_QMJ SQR_QJA SQR_QND |
| 6 | 0.2553 | 0.0957 | 7.000 | 139.6 | 45.17 | 150.4 | SQR_QJF SQR_QMA SQR_QMJ SQR_QJA SQR_QSO SQR_QND |

N = 35

## 5.5 Various transformation suggested by Box-Cox

***Table 5.6*** *Regression Models for Dependent Variable: (BROWN SHRIMP)$^{0.1}$ on variously transformed INFLOWS.*

| In | *Rsq* | *Adj Rsq* | *C(p)* | *AIC* | *MSE* | *SBC* | Variables in Model |
|---|---|---|---|---|---|---|---|
| 1 | 0.2944 | 0.2730 | 7.125 | -57.54 | 0.1828 | -54.43 | QR_QJF |
| 1 | 0.2323 | 0.2091 | 10.48 | -54.59 | 0.1989 | -51.47 | QR_QJA |
| 1 | 0.1566 | 0.1310 | 14.57 | -51.29 | 0.2185 | -48.18 | QR_QND |
| 1 | 0.0768 | 0.0488 | 18.88 | -48.13 | 0.2392 | -45.02 | QR_QMJ |
| 2 | 0.4091 | 0.3721 | 2.929 | -61.74 | 0.1579 | -57.08 | QR_QJF QR_QJA |
| 2 | 0.3237 | 0.2815 | 7.539 | -57.02 | 0.1807 | -52.36 | QR_QJF QR_QMJ |
| 2 | 0.3125 | 0.2696 | 8.146 | -56.45 | 0.1837 | -51.78 | QR_QJA QR_QND |
| 2 | 0.3053 | 0.2619 | 8.535 | -56.08 | 0.1856 | -51.42 | QR_QJF QR_QND |
| 3 | 0.4314 | 0.3764 | 3.721 | -61.09 | 0.1568 | -54.87 | QR_QJF QR_QMJ QR_QJA |
| 3 | 0.4304 | 0.3753 | 3.776 | -61.03 | 0.1571 | -54.81 | QR_QJF QR_QJA QR_QSO |
| 3 | 0.4213 | 0.3653 | 4.270 | -60.47 | 0.1596 | -54.25 | QR_QJF QR_QJA QR_QND |
| 3 | 0.4105 | 0.3535 | 4.851 | -59.83 | 0.1626 | -53.61 | QR_QJF QR_QMA QR_QJA |
| 4 | 0.4706 | 0.4000 | 3.605 | -61.59 | 0.1509 | -53.81 | QR_QJF QR_QMJ QR_QJA QR_QSO |
| 4 | 0.4419 | 0.3675 | 5.155 | -59.74 | 0.1590 | -51.97 | QR_QJF QR_QJA QR_QSO QR_QND |
| 4 | 0.4412 | 0.3666 | 5.195 | -59.70 | 0.1593 | -51.92 | QR_QJF QR_QMJ QR_QJA QR_QND |
| 4 | 0.4364 | 0.3612 | 5.455 | -59.40 | 0.1606 | -51.62 | QR_QJF QR_QMA QR_QMJ QR_QJA |
| 5 | 0.4786 | 0.3887 | 5.174 | -60.12 | 0.1537 | -50.79 | QR_QJF QR_QMJ QR_QJA QR_QSO QR_QND |
| 5 | 0.4738 | 0.3831 | 5.429 | -59.81 | 0.1551 | -50.47 | QR_QJF QR_QMA QR_QMJ QR_QJA QR_QSO |
| 5 | 0.4460 | 0.3505 | 6.934 | -58.00 | 0.1633 | -48.67 | QR_QJF QR_QMA QR_QMJ QR_QJA QR_QND |
| 5 | 0.4424 | 0.3462 | 7.130 | -57.77 | 0.1644 | -48.44 | QR_QJF QR_QMA QR_QJA QR_QSO QR_QND |
| 6 | 0.4818 | 0.3707 | 7.000 | -58.34 | 0.1582 | -47.45 | QR_QJF QR_QMA QR_QMJ QR_QJA QR_QSO QR_QND |

N = 35

Dependent Variable: *(BROWN SHRIMP)*$^{0.1}$

Independent Variables:
*QR_QJF*=(January-February Inflows)$^{0.1}$
*QR_QMA*=(March-April Inflows)$^{0.1}$
*QR_QMJ*=(May-June Inflows)$^{0.2}$
*QR_QMJ*=(July-Agust Inflows)$^{0.2}$
*QR_QND*=(September-October Inflows)$^{0.1}$
*QR_QND*=(November-December Inflows)$^{0.1}$

# 6. REGRESSION FOR THE BEST MODELS

## 6.1 Regression - Log of brown shrimp data on log of inflow data

### 6.1.1 ANOVA and Parameter Estimates

***Table 6.1*** *Model Summary for log of brown shrimp data on log of inflow data.*

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 1 | .745[a] | .554 | .459 | 3.7292 | 1.974 |

a. Predictors: (Constant), Ln(November-December Inflows), Ln(May-June Inflows), Ln(July-August Inflows), Ln(March-april Inflows), Ln(September-October Inflows), Ln(January-February Inflows)

b. Dependent Variable: Ln(Brown Shrimp Harvest)

***Table 6.2*** *ANOVA table of log of brown shrimp data on log of inflow data*

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 484.318 | 6 | 80.720 | 5.804 | .001[a] |
| | Residual | 389.403 | 28 | 13.907 | | |
| | Total | 873.722 | 34 | | | |

a. Predictors: (Constant), Ln(November-December Inflows), Ln(May-June Inflows), Ln(July-August Inflows), Ln(March-april Inflows), Ln(September-October Inflows), Ln(January-February Inflows)

b. Dependent Variable: Ln(Brown Shrimp Harvest)

***Table 6.3*** *Table of coefficients for log of brown shrimp data on log of inflow data.*

**Coefficients[a]**

| | Unstandardized Coefficients | | Standardized Coefficients | | | 95% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig. | Lower Bound | Upper Bound |
| (Constant) | .985 | .814 | | 1.211 | .236 | -.682 | 2.652 |
| Ln(January-February Inflows) | .766 | .290 | .667 | 2.646 | .013 | .173 | 1.360 |
| Ln(March-april Inflows) | -.104 | .187 | -.085 | -.555 | .583 | -.486 | .278 |
| Ln(May-June Inflows) | .317 | .195 | .241 | 1.623 | .116 | -.083 | .717 |
| Ln(July-August Inflows) | .759 | .228 | .500 | 3.330 | .002 | .292 | 1.226 |
| Ln(September-October Inflows) | -.352 | .240 | -.243 | -1.469 | .153 | -.843 | .139 |
| Ln(November-December Inflows) | -.328 | .261 | -.281 | -1.255 | .220 | -.864 | .207 |

a. Dependent Variable: Ln(Brown Shrimp Harvest)

### 6.1.2 Collinearity Diagnostic

***Table 6.4*** *Variance Inflation for log of brown shrimp data on log of inflow data.*

**Coefficients[a]**

| | Collinearity Statistics | |
|---|---|---|
| | Tolerance | VIF |
| Ln(January-February Inflows) | .251 | 3.988 |
| Ln(March-april Inflows) | .677 | 1.477 |
| Ln(May-June Inflows) | .720 | 1.390 |
| Ln(July-August Inflows) | .707 | 1.415 |
| Ln(September-October Inflows) | .581 | 1.721 |
| Ln(November-December Inflows) | .318 | 3.143 |

a. Dependent Variable: Ln(Brown Shrimp Harvest)

***Table 6.5*** *Collinearity Diagnostics(intercept adjusted) for Dependent Variable: Ln(BROWN SHRIMP) on Ln(INFLOWS):*

| Number | *Eigenvalue* | *Condition Index* | Var Prop *LN_QJF* | Var Prop *LN_QMA* | Var Prop *LN_QMJ* | Var Prop *LN_QJA* | Var Prop *LN_QSO* | Var Prop *LN_QND* |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.04975 | 1.00000 | 0.0209 | 0.0344 | 0.0202 | 0.0275 | 0.0330 | 0.0223 |
| 2 | 1.03031 | 1.72047 | 0.0158 | 0.0161 | 0.4035 | 0.1131 | 0.0465 | 0.0264 |
| 3 | 0.78842 | 1.96677 | 0.0151 | 0.1633 | 0.0032 | 0.3824 | 0.1613 | 0.0458 |
| 4 | 0.56864 | 2.31587 | 0.0226 | 0.7272 | 0.0480 | 0.1242 | 0.0116 | 0.1056 |
| 5 | 0.40512 | 2.74372 | 0.0001 | 0.0169 | 0.5244 | 0.3180 | 0.7303 | 0.0025 |
| 6 | 0.15776 | 4.39673 | 0.9255 | 0.0421 | 0.0007 | 0.0347 | 0.0172 | 0.7973 |

### 6.1.3 Residuals Diagnostics

***Table 6.6*** *Residuals Diagnostics for log of brown shrimp data on log of inflow data.*

**Residuals Statistics**[a]

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | -8.5907 | 7.4931 | 1.0094 | 3.7742 | 35 |
| Std. Predicted Value | -2.544 | 1.718 | .000 | 1.000 | 35 |
| Standard Error of Predicted Value | .7658 | 2.5894 | 1.5427 | .6430 | 35 |
| Adjusted Predicted Value | -10.1575 | 10.6275 | 1.2696 | 4.1165 | 35 |
| Residual | -10.1441 | 5.4029 | -5.0753E-17 | 3.3842 | 35 |
| Std. Residual | -2.720 | 1.449 | .000 | .907 | 35 |
| Stud. Residual | -2.787 | 1.625 | -.030 | 1.043 | 35 |
| Deleted Residual | -12.1671 | 6.7949 | -.2601 | 4.5754 | 35 |
| Stud. Deleted Residual | -3.220 | 1.676 | -.058 | 1.113 | 35 |
| Mahal. Distance | .462 | 15.421 | 5.829 | 5.080 | 35 |
| Cook's Distance | .000 | .645 | .059 | .135 | 35 |
| Centered Leverage Value | .014 | .454 | .171 | .149 | 35 |

a. Dependent Variable: Ln(Brown Shrimp Harvest)

***Table 6.7*** *Case Values for Residuals Diagnostics for log of brown shrimp data on log of inflow data.*

| YEAR | *PRE_1* | *RES_1* | *DRE_1* | *ADJ_1* | *ZPR_1* | *ZRE_1* | *SRE_1*[1] | *SDR_1*[2] |
|---|---|---|---|---|---|---|---|---|
| 1959 | 2.8215 | -.2837 | -.3600 | 2.8978 | .4801 | -.0761 | -.0857 | -.0842 |
| 1960 | -6.7902 | -.1176 | -.1641 | -6.7437 | -2.0665 | -.0315 | -.0372 | -.0366 |
| 1961 | -.1183 | -6.7894 | -10.9199 | 4.0121 | -.2988 | -1.8206 | -2.3089 | *-2.5198 |
| 1962 | -7.0581 | .1503 | .2156 | -7.1233 | -2.1375 | .0403 | .0483 | .0474 |
| 1963 | -8.5907 | 1.6829 | 3.2498 | -10.1575 | -2.5436 | .4513 | .6271 | .6202 |
| 1964 | -.2480 | 1.2780 | 1.7880 | -.7580 | -.3332 | .3427 | .4053 | .3992 |
| 1965 | -3.7769 | -3.1308 | -5.3313 | -1.5765 | -1.2682 | -.8395 | -1.0955 | -1.0996 |
| 1966 | -6.7285 | -.1793 | -.2661 | -6.6417 | -2.0502 | -.0481 | -.0586 | -.0575 |
| 1967 | -.5557 | -.9494 | -1.3109 | -.1942 | -.4147 | -.2546 | -.2991 | -.2942 |
| 1968 | 2.7791 | .7724 | 1.0173 | 2.5341 | .4689 | .2071 | .2377 | .2337 |
| 1969 | 1.8969 | 1.3827 | 2.3281 | .9515 | .2351 | .3708 | .4811 | .4744 |
| 1970 | .0962 | -7.0040 | -12.1671 | 5.2593 | -.2419 | -1.8781 | -2.4754 | *-2.7503 |
| 1971 | -1.7002 | 2.1764 | 3.1262 | -2.6500 | -.7179 | .5836 | .6994 | .6929 |
| 1972 | 4.6951 | -4.2189 | -4.7828 | 5.2591 | .9766 | -1.1313 | -1.2045 | -1.2147 |
| 1973 | .5956 | 5.4029 | 6.7949 | -.7964 | -.1096 | 1.4488 | 1.6247 | 1.6764 |
| 1974 | -2.6022 | -4.3055 | -6.4884 | -.4193 | -.9569 | -1.1545 | -1.4173 | -1.4445 |
| 1975 | 7.4931 | -3.4539 | -6.5883 | 10.6275 | 1.7179 | -.9262 | -1.2791 | -1.2945 |
| 1976 | .9801 | 3.0446 | 5.0229 | -.9982 | -.0078 | .8164 | 1.0486 | 1.0506 |
| 1977 | 1.3374 | 3.3676 | 3.6469 | 1.0581 | .0869 | .9030 | .9397 | .9377 |
| 1978 | 2.7414 | .4209 | .4408 | 2.7215 | .4589 | .1129 | .1155 | .1134 |
| 1979 | 3.0655 | 1.7288 | 1.8227 | 2.9716 | .5448 | .4636 | .4760 | .4693 |
| 1980 | 4.0276 | 1.8759 | 2.0240 | 3.8794 | .7997 | .5030 | .5225 | .5156 |
| 1981 | 4.8506 | .9057 | 1.0003 | 4.7560 | 1.0178 | .2429 | .2552 | .2509 |
| 1982 | 2.1313 | 3.0942 | 3.2924 | 1.9331 | .2972 | .8297 | .8559 | .8517 |
| 1983 | 3.4623 | 1.7334 | 1.8224 | 3.3733 | .6499 | .4648 | .4766 | .4699 |
| 1984 | 2.8643 | 3.2414 | 3.3902 | 2.7155 | .4915 | .8692 | .8889 | .8855 |
| 1985 | 1.8272 | 3.7009 | 4.0272 | 1.5009 | .2167 | .9924 | 1.0352 | 1.0366 |
| 1986 | 1.7605 | 2.9851 | 3.1450 | 1.6006 | .1990 | .8004 | .8216 | .8167 |
| 1987 | 4.4307 | 1.0528 | 1.1683 | 4.3152 | .9065 | .2823 | .2974 | .2925 |
| 1988 | 2.5285 | 3.0628 | 3.2055 | 2.3858 | .4025 | .8213 | .8402 | .8357 |
| 1989 | 1.6003 | .1307 | .1364 | 1.5945 | .1565 | .0350 | .0358 | .0352 |
| 1990 | 2.6899 | -2.5475 | -2.6904 | 2.8327 | .4453 | -.6831 | -.7020 | -.6955 |
| 1991 | 3.2363 | -10.1441 | -10.6499 | 3.7421 | .5900 | -2.7201 | -2.7871 | *-3.2197 |
| 1992 | 4.7355 | .4777 | .5498 | 4.6634 | .9872 | .1281 | .1374 | .1350 |
| 1993 | 4.8510 | -.5439 | -.6008 | 4.9079 | 1.0179 | -.1458 | -.1533 | -.1506 |

| | |
|---|---|
| *PRE_1* | Predicted value of harvest |
| *RES_1* | Ordinary residuals: observed harvest minus predicted harvest |
| *DRE_1* | Deleted residuals: resid. obtained when the model is fitted without that obser. |
| *ADJ_1* | Adjusted predicted value: predicted value of harvest when the model is fitted without that observation |
| *ZPR_1* | Z-score of the predicted value of harvest |
| *ZRE_1* | Z-score of the residual |
| *SRE_1* | Studentized residual |
| *SDR_1* | Studentized deleted residuals |

[1]Values greater than 3 are flagged.

[2]This is flagged if it exceeds $t_{n-p-2,\alpha}=t_{27,0.01}=2.473$.

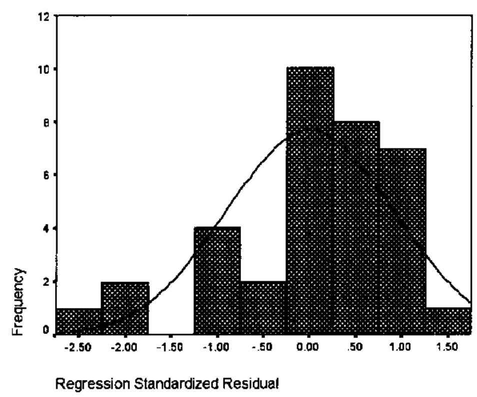


***Figure 6.1*** *Histogram of Standardized Residuals.*

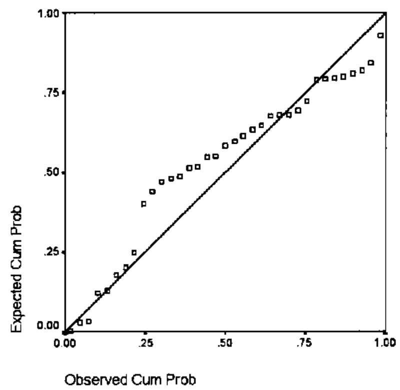


***Figure 6.2*** *Normal P-P Plot of Residuals.*

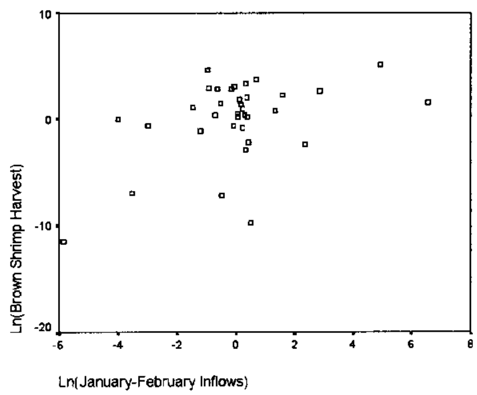


***Figure 6.3*** *Partial Residual Plot for Ln(January-February Inflows).*

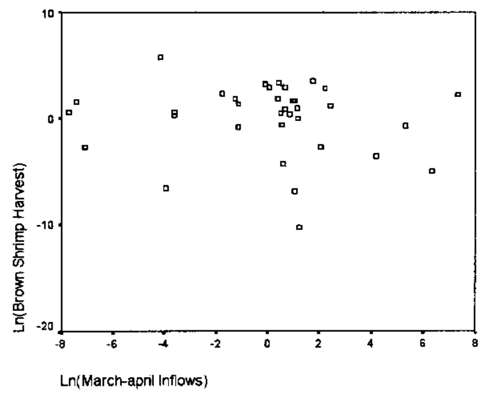


***Figure 6.4*** *Partial Residual Plot for Ln(March-April Inflows).*

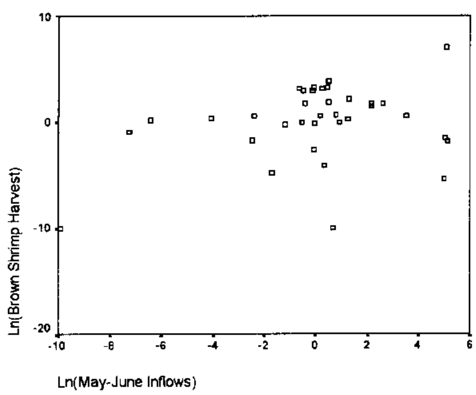


***Figure 6.5*** *Partial Residual Plot for Ln(May-June Inflows).*

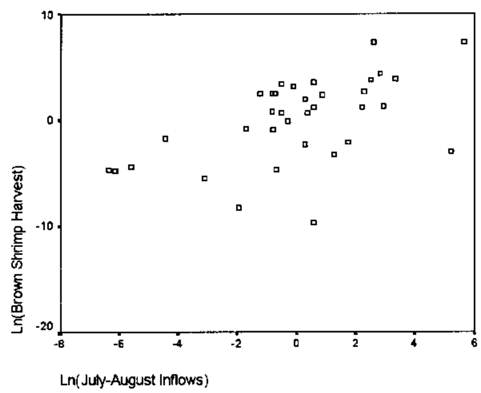


***Figure 6.6*** *Partial Residual Plot for Ln(July-August Inflows).*

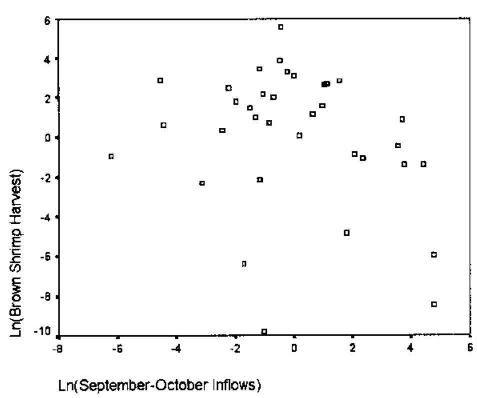


***Figure 6.7*** *Partial Residual Plot for Ln(September-October Inflows).*

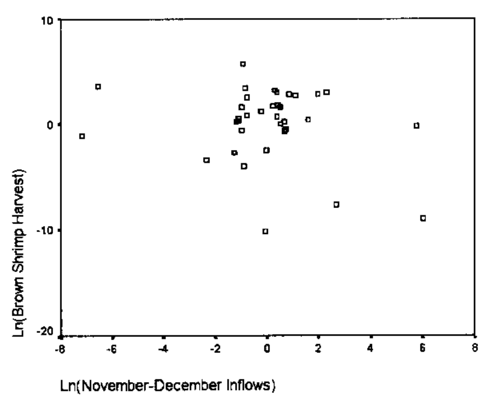


***Figure 6.8*** *Partial Residual Plot for Ln(November-December Inflows).*

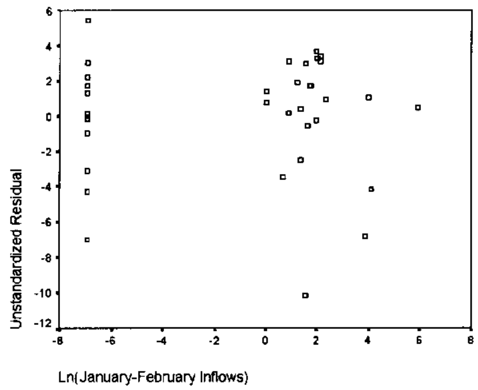


***Figure 6.9*** *Residuals Plot for Ln(January-February Inflows).*

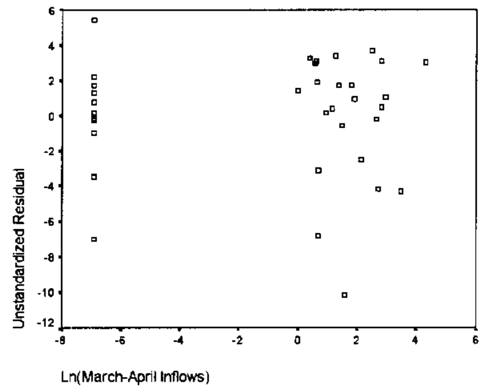


***Figure 6.10*** *Residuals Plot for Ln(March-April Inflows).*

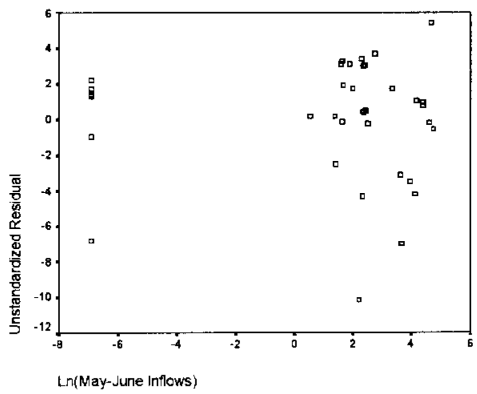


***Figure 6.11*** *Residuals Plot for Ln(May-June Inflows).*

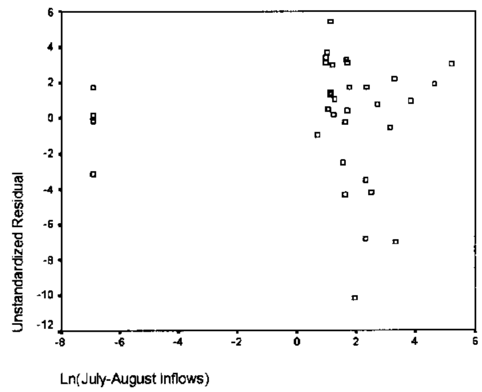


***Figure 6.12*** *Residuals Plot for Ln(July-Augus Inflows).*

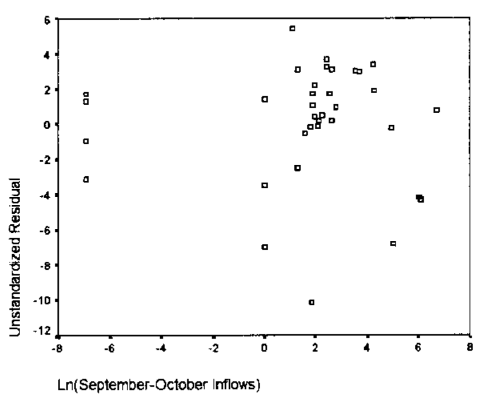


***Figure 6.13*** *Residuals Plot for Ln(September-October Inflows).*

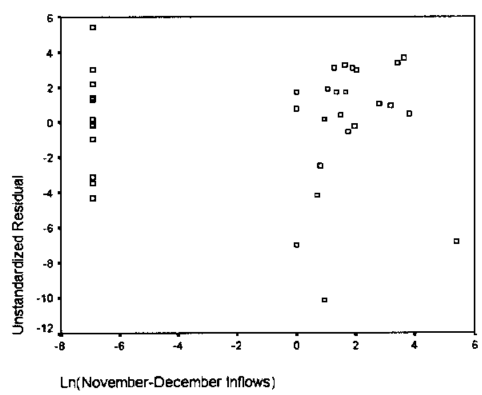


***Figure 6.14*** *Residuals Plot for Ln(November-December Inflows).*

### 6.1.4 Prediction Intervals for Brown Shrimp Harvest

***Table 6.8*** *Prediction Intervals for Brown Shrimp Harvest.*

| YEAR | *LICI_1* | *LN_BRSH* | *UICI_1* |
|---|---|---|---|
| 1959 | -8.523 | 2.538 | 14.166 |
| 1960 | -18.464 | -6.908 | 4.884 |
| 1961 | -12.216 | -6.908 | 11.979 |
| 1962 | -18.819 | -6.908 | 4.703 |
| 1963 | -21.136 | -6.908 | 3.955 |
| 1964 | -11.931 | 1.030 | 11.434 |
| 1965 | -16.025 | -6.908 | 8.471 |
| 1966 | -18.596 | -6.908 | 5.139 |
| 1967 | -12.195 | -1.505 | 11.084 |
| 1968 | -8.699 | 3.551 | 14.258 |
| 1969 | -10.322 | 3.280 | 14.116 |
| 1970 | -12.202 | -6.908 | 12.395 |
| 1971 | -13.467 | .476 | 10.066 |
| 1972 | -6.200 | .476 | 15.591 |
| 1973 | -10.716 | 5.998 | 11.907 |
| 1974 | -14.515 | -6.908 | 9.311 |
| 1975 | -5.025 | 4.039 | 20.012 |
| 1976 | -11.186 | 4.025 | 13.146 |
| 1977 | -9.355 | 4.705 | 12.030 |
| 1978 | -7.794 | 3.162 | 13.277 |
| 1979 | -7.501 | 4.794 | 13.633 |
| 1980 | -6.648 | 5.903 | 14.703 |
| 1981 | -5.930 | 5.756 | 15.632 |
| 1982 | -8.479 | 5.225 | 12.742 |
| 1983 | -7.091 | 5.196 | 14.016 |
| 1984 | -7.664 | 6.106 | 13.393 |
| 1985 | -8.887 | 5.528 | 12.541 |
| 1986 | -8.803 | 4.746 | 12.324 |
| 1987 | -6.372 | 5.484 | 15.233 |
| 1988 | -8.003 | 5.591 | 13.060 |
| 1989 | -8.920 | 1.731 | 12.120 |
| 1990 | -7.885 | 0.142 | 13.265 |
| 1991 | -7.310 | -6.908 | 13.783 |
| 1992 | -6.224 | 5.213 | 15.695 |
| 1993 | -5.931 | 4.307 | 15.633 |

*LICI_1* Lower limit for 99% prediction interval for the natural log of brown shrimp harvest.

*LN_BR SH* Natural log of brown shrimp harvest.

*UICI_1* Upper limit for 99% prediction interval for the natural log of brown shrimp harvest.

### 6.1.5 Outliers and Influential Point Detection

***Table 6.9*** *Mahalanobis distance, Cook's distance, Leverage value and associated p-values*

| YEAR | *MAH_1* | *COOK_1* | *LEV_1*[1] | *MAH_PV*[2] | *COOK_PV*[3] |
|---|---|---|---|---|---|
| 1959 | 6.2347 | .0003 | .1834 | .5126 | .0000 |
| 1960 | 8.6634 | .0001 | .2548 | .2777 | .0000 |
| 1961 | 11.8890 | .4633 | .3497 | .1043 | .1475 |
| 1962 | 9.3177 | .0001 | .2741 | .2306 | .0000 |
| 1963 | 15.4212 | .0523 | .4536 | .0310 | .0003 |
| 1964 | 8.7268 | .0094 | .2567 | .2729 | .0000 |
| 1965 | 13.0619 | .1205 | .3842 | .0706 | .0038 |
| 1966 | 10.1227 | .0002 | .2977 | .1817 | .0000 |
| 1967 | 8.4052 | .0049 | .2472 | .2982 | .0000 |
| 1968 | 7.2141 | .0026 | .2122 | .4069 | .0000 |
| 1969 | 12.8347 | .0226 | *.3775 | .0762 | .0000 |
| 1970 | 13.4564 | .6453 | *.3958 | .0617 | .2850 |
| 1971 | 9.3585 | .0305 | .2752 | .2279 | .0000 |
| 1972 | 3.0377 | .0277 | .0893 | .8815 | .0000 |
| 1973 | 5.9941 | .0972 | .1763 | .5404 | .0019 |
| 1974 | 10.4672 | .1455 | .3079 | .1636 | .0067 |
| 1975 | 15.2042 | .2121 | .4472 | .0335 | .0203 |
| 1976 | 12.4198 | .1021 | .3653 | .0876 | .0022 |
| 1977 | 1.6325 | .0105 | .0480 | .9774 | .0000 |
| 1978 | .5657 | .0001 | .0166 | .9992 | .0000 |
| 1979 | .7802 | .0018 | .0229 | .9976 | .0000 |
| 1980 | 1.5174 | .0031 | .0446 | .9817 | .0000 |
| 1981 | 2.2436 | .0010 | .0660 | .9451 | .0000 |
| 1982 | 1.0751 | .0067 | .0316 | .9935 | .0000 |
| 1983 | .6890 | .0017 | .0203 | .9984 | .0000 |
| 1984 | .5204 | .0052 | .0153 | .9994 | .0000 |
| 1985 | 1.7835 | .0135 | .0525 | .9708 | .0000 |
| 1986 | .7573 | .0052 | .0223 | .9979 | .0000 |
| 1987 | 2.3896 | .0014 | .0703 | .9352 | .0000 |
| 1988 | .5423 | .0047 | .0159 | .9993 | .0000 |
| 1989 | .4622 | .0000 | .0136 | .9996 | .0000 |
| 1990 | .8339 | .0039 | .0245 | .9971 | .0000 |
| 1991 | .6432 | .0553 | .0189 | .9987 | .0003 |
| 1992 | 3.4872 | .0004 | .1026 | .8366 | .0000 |
| 1993 | 2.2476 | .0004 | .0661 | .9449 | .0000 |

*MAH_1* Mahalanobis distance
*COOK_1* Cook's distance
*LEV_1* Leverage value

| | |
|---|---|
| *MAHA_PV* | P-value associated with the Mahalanobis distance |
| *COOK_P* | P-value associated with Cook's distance |

[1]This is flagged if it exceeds $(2p+1)/n$ or 0.5, whichever is smaller.
[2]*MAHA_PV* = 1-F(*MAH_1*), where F is the CDF of a Chi-squared random variable with $p+1$ degrees of freedom. Small values indicate a problem.
[3]*COOK_PV* = F(*COOK_1*), where F is the CDF of an F-ratio random variable with $p+1$ numerator degrees of freedom and $n-p-1$ denominator degrees of freedom. A value greater than 0.5 indicates a problem. A value less than 0.2 indicates no problem. Values in between are inconclusive.

***Table 6.10*** *Standardized dffits value and Standardized dfbeta values*

| YEAR | *SDFFITS* | *SDFBET_0* | *SDFBET_1* | *SDFBET_2* |
|---|---|---|---|---|
| 1959 | -.0437 | -.0027 | -.0098 | .0366 |
| 1960 | -.0230 | -.0017 | -.0013 | .0078 |
| 1961 | *-1.9654 | -.7028 | .1268 | -.1671 |
| 1962 | .0312 | .0016 | .0014 | -.0103 |
| 1963 | .5984 | .3126 | -.2000 | -.0541 |
| 1964 | .2522 | .1061 | .0051 | -.0272 |
| 1965 | -.9219 | -.4446 | -.0359 | -.3002 |
| 1966 | -.0400 | -.0081 | .0066 | -.0186 |
| 1967 | -.1816 | -.0794 | -.0058 | .0200 |
| 1968 | .1316 | -.0213 | .0048 | -.0995 |
| 1969 | .3923 | .1378 | .2348 | .0743 |
| 1970 | *-2.3613 | .0569 | *1.6518 | .7146 |
| 1971 | .4578 | -.0089 | -.0963 | -.0735 |
| 1972 | -.4441 | -.1250 | -.2376 | -.0380 |
| 1973 | .8510 | -.1169 | -.1428 | -.3923 |
| 1974 | *-1.0286 | .1105 | .4875 | -.5631 |
| 1975 | *-1.2332 | -.1015 | -.9095 | .6327 |
| 1976 | .8469 | -.0515 | -.4189 | .4962 |
| 1977 | .2700 | .1437 | -.0501 | .0219 |
| 1978 | .0247 | .0197 | .0004 | .0049 |
| 1979 | .1094 | .0767 | .0046 | .0255 |
| 1980 | .1449 | .0405 | -.0229 | .0103 |
| 1981 | .0811 | .0362 | -.0148 | .0091 |
| 1982 | .2155 | .1716 | .0230 | .0969 |
| 1983 | .1065 | .0835 | .0141 | .0237 |
| 1984 | .1897 | .1514 | .0480 | -.0043 |
| 1985 | .3078 | .2137 | -.0782 | .0958 |
| 1986 | .1890 | .1126 | -.0118 | .0023 |
| 1987 | .0969 | .0683 | .0380 | .0176 |
| 1988 | .1804 | .1530 | -.0043 | .0284 |
| 1989 | .0074 | .0063 | .0001 | .0021 |
| 1990 | -.1647 | -.1430 | -.0249 | -.0735 |
| 1991 | -.7189 | -.5727 | -.1326 | -.2009 |
| 1992 | .0524 | .0378 | .0323 | .0038 |
| 1993 | -.0487 | -.0234 | .0012 | -.0044 |

*SDFFITS* Standardized *dffits* value
*SDFBET_0* Standardized *dfbeta* for the intercept term
*SDFBET_1* Standardized *dfbeta* for log of January-February inflows
*SDFBET_2* Standardized *dfbeta* for log of March-April inflows

*Items are flagged if |*sdffits*| or |*sdfbeta*| exceed 1.0 for a small data set or $2\sqrt{(p+1)/n}$ for a large data set. The cutoff used here is 1.

***Table 6.11*** *Standardized dfbeta values*

| YEAR | *SDFBET_3* | *SDFBET_4* | *SDFBET_5* | *SDFBET_6* |
|---|---|---|---|---|
| 1959 | -.0046 | .0046 | -.0144 | -.0048 |
| 1960 | .0001 | .0163 | -.0105 | .0033 |
| 1961 | *1.6567 | .3813 | -.9781 | -.5975 |
| 1962 | -.0016 | -.0221 | .0161 | -.0043 |
| 1963 | -.1852 | -.2351 | -.1241 | .3480 |
| 1964 | -.0595 | .0960 | -.1385 | -.0318 |
| 1965 | -.3792 | .2731 | .5742 | .1283 |
| 1966 | -.0046 | .0240 | -.0093 | .0057 |
| 1967 | .0450 | -.0617 | .0989 | .0235 |
| 1968 | .0304 | .0093 | .0610 | .0078 |
| 1969 | -.2341 | -.0318 | .0262 | -.2835 |
| 1970 | -.9498 | *-1.1559 | .3979 | *-1.5276 |
| 1971 | -.2809 | .1434 | .1970 | -.0455 |
| 1972 | -.0229 | .0538 | -.1487 | .2114 |
| 1973 | .5016 | .2965 | -.0538 | -.1242 |
| 1974 | .1583 | -.1356 | -.5441 | .1107 |
| 1975 | -.4824 | -.1875 | .3634 | .8984 |
| 1976 | .0183 | .4657 | .0983 | -.0802 |
| 1977 | -.0340 | -.0729 | .0970 | .1350 |
| 1978 | .0047 | .0025 | -.0063 | .0055 |
| 1979 | .0329 | .0078 | -.0209 | .0179 |
| 1980 | -.0119 | .0815 | .0331 | .0164 |
| 1981 | .0360 | .0369 | -.0250 | .0292 |
| 1982 | -.0235 | -.0454 | -.0013 | .0246 |
| 1983 | .0132 | .0252 | -.0328 | .0081 |
| 1984 | -.0031 | -.0059 | -.0128 | .0191 |
| 1985 | .0291 | -.0338 | -.0333 | .1734 |
| 1986 | -.0052 | -.0373 | .0569 | .0640 |
| 1987 | .0350 | -.0099 | -.0394 | -.0046 |
| 1988 | .0211 | .0303 | -.0629 | .0498 |
| 1989 | -.0022 | -.0006 | .0004 | .0013 |
| 1990 | .0026 | -.0118 | .0538 | .0005 |
| 1991 | -.1134 | -.1139 | .2195 | .0106 |
| 1992 | .0013 | -.0150 | -.0123 | -.0080 |
| 1993 | -.0293 | -.0213 | .0250 | -.0076 |

*SDFBET_3* Standardized *dfbeta* for log of May-June inflows
*SDFBET_4* Standardized *dfbeta* for log of July-August inflows
*SDFBET_5* Standardized *dfbeta* for log of September-October inflows
*SDFBET_6* Standardized *dfbeta* for log of November-December inflows

*Items are flagged if |*sdffits*| or |*sdfbeta*| exceed 1.0 for a small data set or $2\sqrt{(p + 1) / n}$ for a large data set. The cutoff used here is 1.

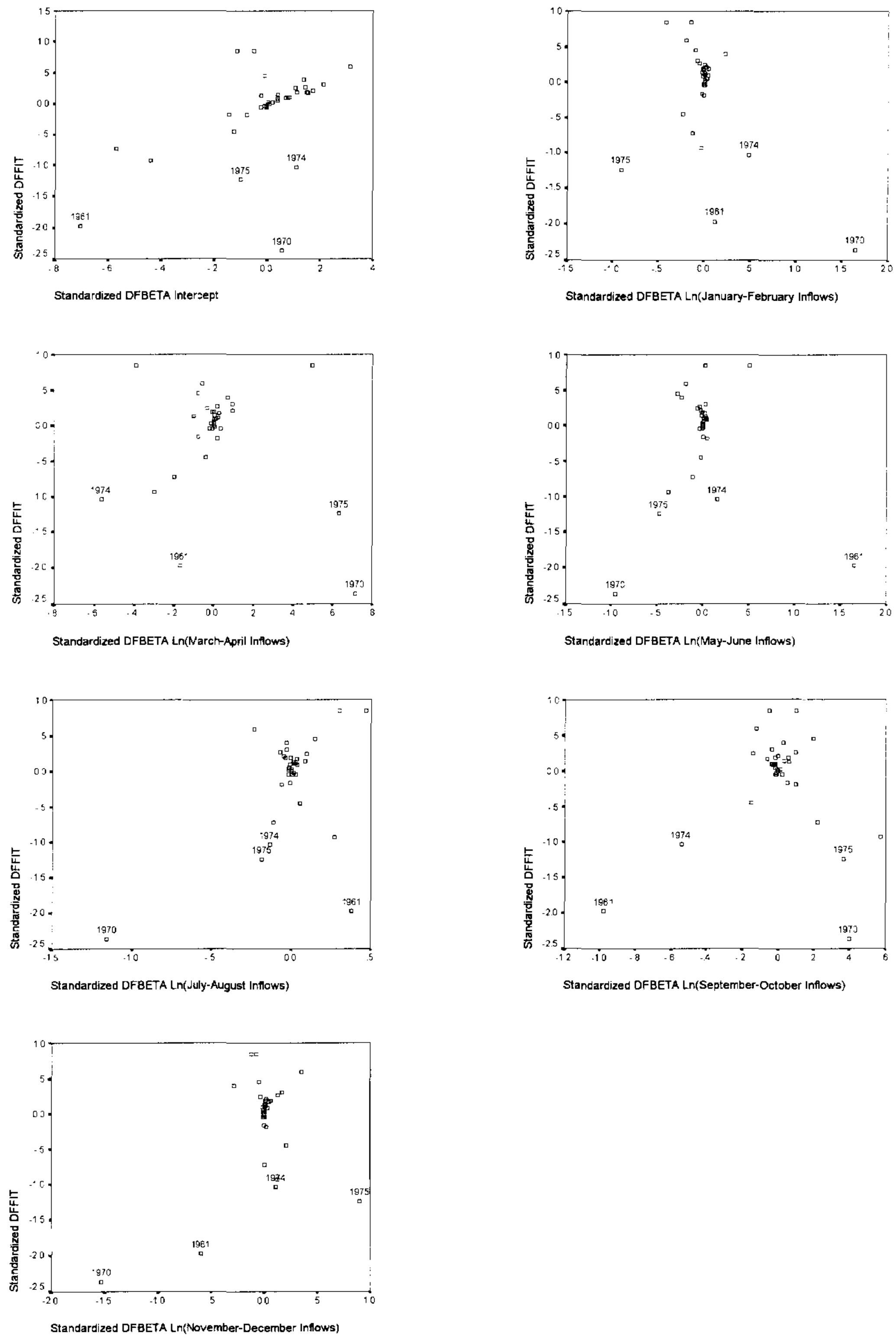


***Figure 6.15*** *Standardized DFFITS vs. Standardized DFBETA Intercept and vs. Standardized DFBETA of log of inflow variables.*

## 6.2 Regression - Various transformation

### 6.2.1 ANOVA and Parameter Estimates

***Table 6.12*** *Model Summary for various transformation.*

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 1 | .694[a] | .482 | .371 | .3978 | 1.773 |

a. Predictors: (Constant), (November-December Inflows)^0.1, (May-June Inflows)^0.2, (July-August Inflows)^0.2, (March-April Infows)^0.1, (September-October Inflows)^0.1, (January-February Inflows)^0.1

b. Dependent Variable: (Brown Harvest)^0.1

***Table 6.13*** *ANOVA table of various transformations.*

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 4.119 | 6 | .687 | 4.339 | .003[a] |
| | Residual | 4.431 | 28 | .158 | | |
| | Total | 8.550 | 34 | | | |

a. Predictors: (Constant), (November-December Inflows)^0.1, (May-June Inflows)^0.2, (July-August Inflows)^0.2, (March-April Infows)^0.1, (September-October Inflows)^0.1, (January-February Inflows)^0.1

b. Dependent Variable: (Brown Harvest)^0.1

***Table 6.14*** *Table of coefficients for various transformations.*

**Coefficients[a]**

| | Unstandardized Coefficients | | Standardized Coefficients | | | 95% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig. | Lower Bound | Upper Bound |
| (Constant) | .397 | .292 | | 1.358 | .185 | -.202 | .995 |
| (January-February Inflows)^0.1 | .855 | .350 | .648 | 2.441 | .021 | .138 | 1.573 |
| (March-April Infows)^0.1 | -9.812E-02 | .235 | -.068 | -.417 | .680 | -.580 | .384 |
| (May-June Inflows)^0.2 | .153 | .105 | .217 | 1.459 | .156 | -.062 | .367 |
| (July-August Inflows)^0.2 | .355 | .128 | .417 | 2.772 | .010 | .093 | .617 |
| (September-October Inflows)^0.1 | -.330 | .237 | -.232 | -1.391 | .175 | -.816 | .156 |
| (November-December Inflows)^0.1 | -.222 | .338 | -.163 | -.655 | .518 | -.914 | .471 |

a. Dependent Variable: (Brown Harvest)^0.1

## 6.2.2 Collinearity Diagnostic

***Table 6.15*** *Collinearity Diagnostic for various transformations.*

**Coefficients[a]**

| | Collinearity Statistics | |
|---|---|---|
| | Tolerance | VIF |
| (January-February Inflows)^0.1 | .263 | 3.807 |
| (March-April Infows)^0.1 | .704 | 1.421 |
| (May-June Inflows)^0.2 | .840 | 1.190 |
| (July-August Inflows)^0.2 | .819 | 1.221 |
| (September-October Inflows)^0.1 | .666 | 1.501 |
| (November-December Inflows)^0.1 | .300 | 3.337 |

a. Dependent Variable: (Brown Harvest)^0.1

***Table 6.16*** *Collinearity Diagnostics(intercept adjusted) for various transformations.*

| Number | *Eigenvalue* | *Condition Index* | Var Prop *QR_QJF* | Var Prop *QR_QMA* | Var Prop *QR_QMJ* | Var Prop *QR_QJA* | Var Prop *QR_QSO* | Var Prop *QR_QND* |
|---|---|---|---|---|---|---|---|---|
| 1 | 1.69444 | 1.00000 | 0.0005 | 0.1427 | 0.0015 | 0.1418 | 0.0077 | 0.0035 |
| 2 | 1.32162 | 1.13230 | 0.2432 | 0.0048 | 0.1293 | 0.0000 | 0.0202 | 0.2713 |
| 3 | 1.19703 | 1.18977 | 0.0678 | 0.0001 | 0.2486 | 0.0107 | 0.3764 | 0.0540 |
| 4 | 0.82907 | 1.42961 | 0.3499 | 0.0028 | 0.2541 | 0.0049 | 0.2926 | 0.1717 |
| 5 | 0.68250 | 1.57566 | 0.1606 | 0.0050 | 0.3650 | 0.0317 | 0.2628 | 0.4755 |
| 6 | 0.27533 | 2.48076 | 0.1780 | 0.8446 | 0.0015 | 0.8109 | 0.0403 | 0.0239 |

### 6.2.3 Residuals Diagnostics

***Table 6.17*** *Residuals Diagnostics for various transformations.*

**Residuals Statistics[a]**

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | .5170 | 1.7599 | 1.2322 | .3481 | 35 |
| Std. Predicted Value | -2.055 | 1.516 | .000 | 1.000 | 35 |
| Standard Error of Predicted Value | 8.089E-02 | .2805 | .1678 | 6.008E-02 | 35 |
| Adjusted Predicted Value | .5259 | 1.8758 | 1.2559 | .3643 | 35 |
| Residual | -.9019 | .6948 | -9.5162E-17 | .3610 | 35 |
| Std. Residual | -2.267 | 1.747 | .000 | .907 | 35 |
| Stud. Residual | -2.324 | 1.967 | -.026 | 1.017 | 35 |
| Deleted Residual | -1.1658 | .8811 | -2.3741E-02 | .4599 | 35 |
| Stud. Deleted Residual | -2.540 | 2.081 | -.042 | 1.068 | 35 |
| Mahal. Distance | .435 | 15.932 | 5.829 | 4.340 | 35 |
| Cook's Distance | .000 | .455 | .042 | .097 | 35 |
| Centered Leverage Value | .013 | .469 | .171 | .128 | 35 |

a. Dependent Variable: (Brown Harvest)^0.1

***Table 6.18*** *Case Values for Residuals Diagnostics for various transformations.*

| YEAR | *PRE_1* | *RES_1* | *DRE_1* | *ADJ_1* | *ZPR_1* | *ZRE_1* | *SRE_1*[1] | *SDR_1*[2] |
|---|---|---|---|---|---|---|---|---|
| 1959 | 1.3178 | -.0289 | -.0364 | 1.3253 | .2460 | -.0727 | -.0816 | -.0801 |
| 1960 | .5592 | -.0580 | -.0736 | .5748 | -1.9336 | -.1457 | -.1642 | -.1613 |
| 1961 | 1.2245 | -.7233 | -1.0840 | 1.5852 | -.0220 | -1.8184 | -2.2260 | -2.4095 |
| 1962 | .5266 | -.0254 | -.0331 | .5343 | -2.0272 | -.0638 | -.0729 | -.0715 |
| 1963 | .5170 | -.0158 | -.0248 | .5259 | -2.0547 | -.0398 | -.0498 | -.0489 |
| 1964 | .9806 | .1278 | .1651 | .9434 | -.7227 | .3214 | .3652 | .3595 |
| 1965 | .8478 | -.3466 | -.5006 | 1.0018 | -1.1042 | -.8714 | -1.0472 | -1.0491 |
| 1966 | .6651 | -.1639 | -.2456 | .7468 | -1.6291 | -.4121 | -.5045 | -.4977 |
| 1967 | .9462 | -.0859 | -.1099 | .9702 | -.8216 | -.2160 | -.2443 | -.2402 |
| 1968 | 1.3129 | .1135 | .1674 | 1.2590 | .2318 | .2854 | .3466 | .3411 |
| 1969 | 1.1937 | .1944 | .2882 | 1.0999 | -.1105 | .4887 | .5951 | .5881 |
| 1970 | 1.2342 | -.7331 | -1.1658 | 1.6669 | .0059 | -1.8428 | -2.3239 | *-2.5401 |
| 1971 | .9892 | .0595 | .0798 | .9690 | -.6979 | .1496 | .1732 | .1702 |
| 1972 | 1.6501 | -.6013 | -.7630 | 1.8118 | 1.2006 | -1.5116 | -1.7028 | -1.7661 |
| 1973 | 1.1270 | .6948 | .8811 | .9408 | -.3021 | 1.7468 | 1.9669 | 2.0806 |
| 1974 | .7000 | -.1988 | -.3279 | .8291 | -1.5289 | -.4998 | -.6419 | -.6350 |
| 1975 | 1.7216 | -.2239 | -.3781 | 1.8758 | 1.4062 | -.5629 | -.7315 | -.7253 |
| 1976 | 1.3465 | .1490 | .2963 | 1.1992 | .3286 | .3745 | .5282 | .5213 |
| 1977 | 1.2004 | .4004 | .4474 | 1.1534 | -.0913 | 1.0065 | 1.0640 | 1.0667 |
| 1978 | 1.3485 | .0234 | .0245 | 1.3475 | .3342 | .0589 | .0602 | .0591 |
| 1979 | 1.4101 | .2051 | .2162 | 1.3990 | .5111 | .5156 | .5294 | .5225 |
| 1980 | 1.6118 | .1928 | .2271 | 1.5775 | 1.0906 | .4848 | .5261 | .5192 |
| 1981 | 1.7487 | .0295 | .0353 | 1.7430 | 1.4840 | .0743 | .0812 | .0797 |
| 1982 | 1.2843 | .4021 | .4340 | 1.2523 | .1496 | 1.0107 | 1.0501 | 1.0521 |
| 1983 | 1.4427 | .2386 | .2507 | 1.4306 | .6049 | .5998 | .6148 | .6079 |
| 1984 | 1.3646 | .4769 | .4993 | 1.3422 | .3804 | 1.1989 | 1.2267 | 1.2383 |
| 1985 | 1.2724 | .4657 | .5285 | 1.2096 | .1156 | 1.1708 | 1.2472 | 1.2603 |
| 1986 | 1.2337 | .3736 | .3960 | 1.2113 | .0044 | .9392 | .9670 | .9658 |
| 1987 | 1.6564 | .0740 | .0862 | 1.6442 | 1.2187 | .1861 | .2008 | .1973 |
| 1988 | 1.3095 | .4396 | .4597 | 1.2895 | .2222 | 1.1051 | 1.1301 | 1.1359 |
| 1989 | 1.1950 | -.0061 | -.0064 | 1.1954 | -.1067 | -.0152 | -.0157 | -.0154 |
| 1990 | 1.3239 | -.3096 | -.3295 | 1.3439 | .2636 | -.7783 | -.8030 | -.7978 |
| 1991 | 1.4031 | -.9019 | -.9446 | 1.4457 | .4909 | -2.2672 | -2.3203 | *-2.5352 |
| 1992 | 1.7599 | -.0757 | -.0983 | 1.7826 | 1.5162 | -.1903 | -.2169 | -.2131 |
| 1993 | 1.7010 | -.1627 | -.1919 | 1.7302 | 1.3471 | -.4090 | -.4442 | -.4377 |

| | |
|---|---|
| *PRE_1* | Predicted value of harvest |
| *RES_1* | Ordinary residuals: observed harvest minus predicted harvest |
| *DRE_1* | Deleted residuals: residuals obtained when the model is fitted without that observation |
| *ADJ_1* | Adjusted predicted value: predicted value of harvest when the model is fitted without that observation |
| *ZPR_1* | Z-score of the predicted value of harvest |
| *ZRE_1* | Z-score of the residual |
| *SRE_1* | Studentized residual |
| *SDR_1* | Studentized deleted residuals |

[1]Values greater than 3 are flagged.
[2]This is flagged if it exceeds $t_{n-p-2,\alpha}=t_{27,0.01}=2.473$.

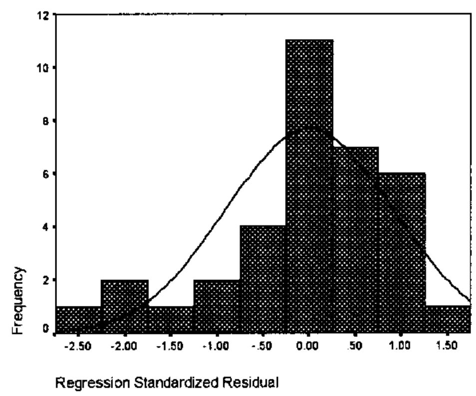


***Figure 6.16*** *Histogram of Standardized Residuals.*

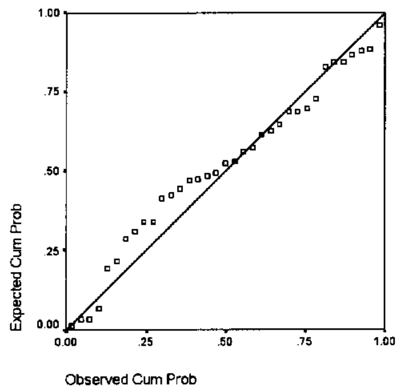


***Figure 6.17*** *Normal P-P Plot of Residuals.*

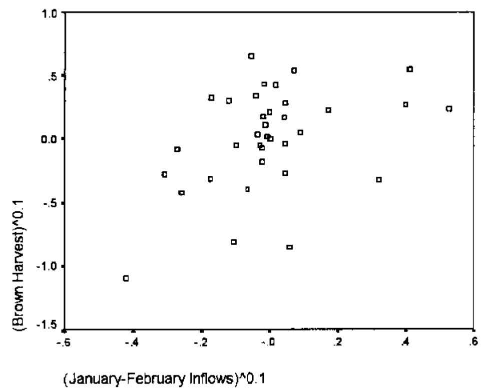


***Figure 6.18*** *Partial Residual Plot for (January-February)^(0.1).*

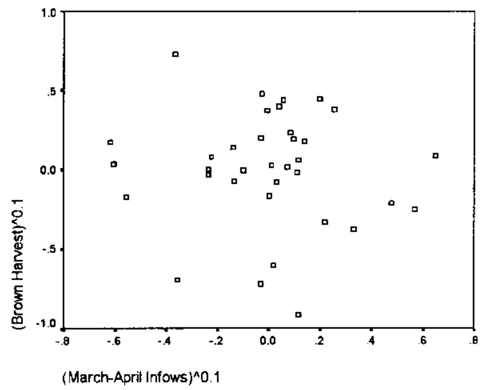


***Figure 6.19*** *Partial Residual Plot for (March-April Inflows)^(0.1).*

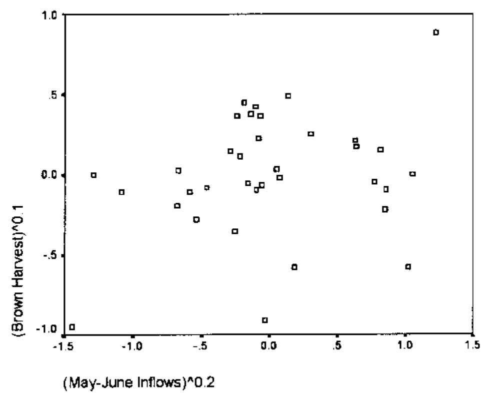


***Figure 6.20*** *Partial Residual Plot for (May-June Inflows)^(0.2).*

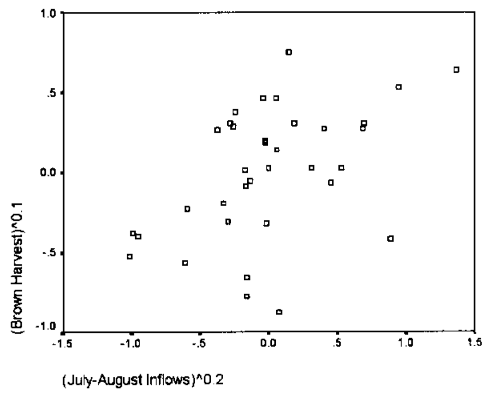


***Figure 6.21*** *Partial Residual Plot for (July-August Inflows)^(0.2).*

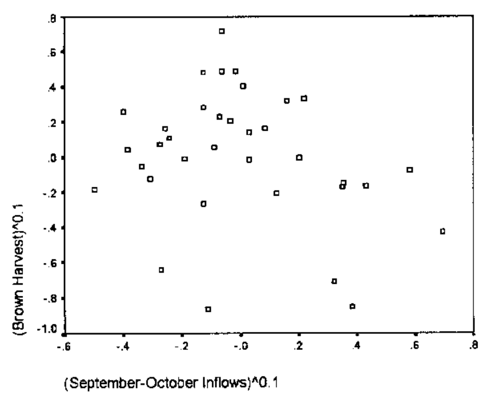


***Figure 6.22*** *Partial Residual Plot for (September-October)^(0.1).*

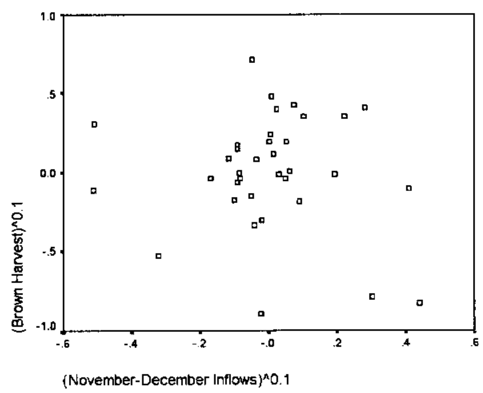


***Figure 6.23*** *Partial Residual Plot for (November-December Inflows)^(0.1).*

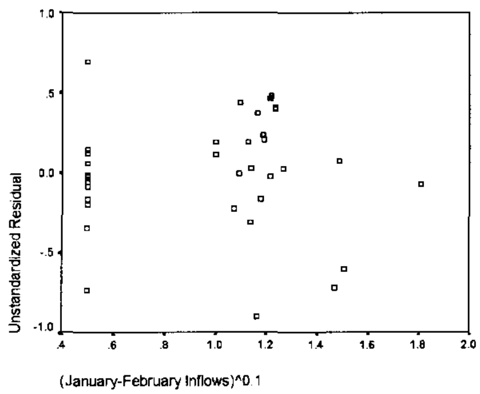


***Figure 6.24*** *Residuals Plot for (January-February)^(0.1).*

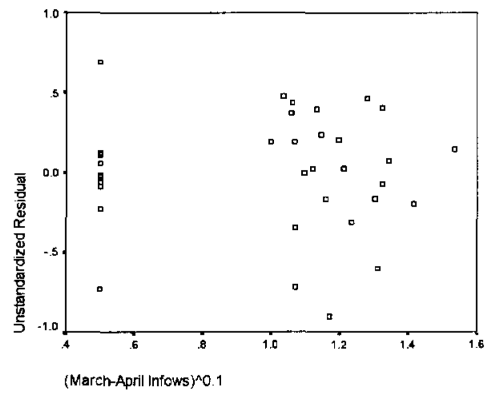


***Figure 6.25*** *Residuals Plot for (March-April Inflows)^(0.1).*

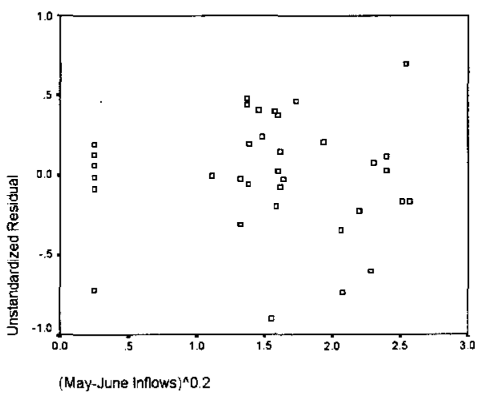


***Figure 6.26*** *Residuals Plot for Sqrt(May-June Inflows)^(0.2).*

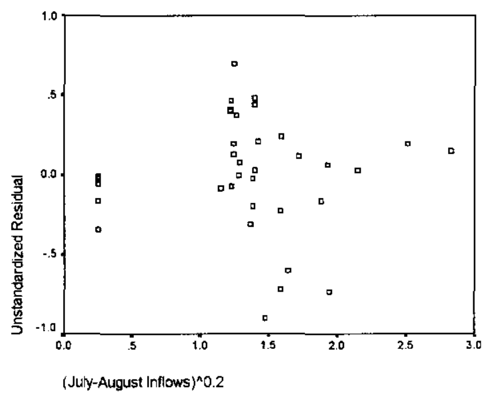


***Figure 6.27*** *Residuals Plot for (July-August Inflows)^(0.2).*

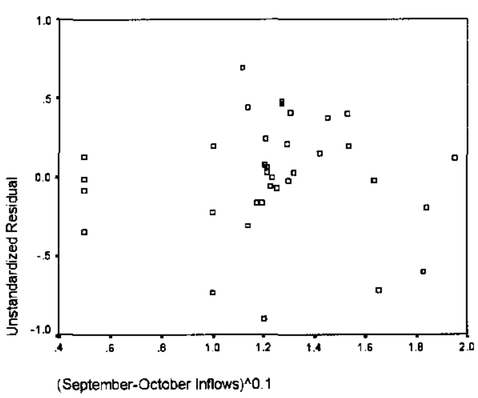


***Figure 6.28*** *Residuals Plot for (September-October Inflows)^(0.1).*

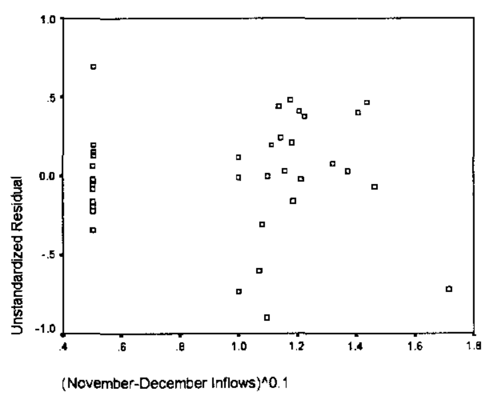


***Figure 6.29*** *Residuals Plot for(November-December Inflows)^(0.1).*

### 6.2.4 Prediction Intervals for Brown Shrimp Harvest

***Table 6.19*** *Prediction Intervals for Brown Shrimp Harvest.*

| YEAR | *LICI_1* | *TR_BRSH* | *UICI_1* |
|---|---|---|---|
| 1959 | .111 | 1.289 | 2.525 |
| 1960 | -.651 | .501 | 1.769 |
| 1961 | -.044 | .501 | 2.493 |
| 1962 | -.694 | .501 | 1.747 |
| 1963 | -.765 | .501 | 1.799 |
| 1964 | -.236 | 1.108 | 2.198 |
| 1965 | -.409 | .501 | 2.105 |
| 1966 | -.604 | .501 | 1.934 |
| 1967 | -.267 | .860 | 2.159 |
| 1968 | .049 | 1.426 | 2.577 |
| 1969 | -.072 | 1.388 | 2.459 |
| 1970 | -.053 | .501 | 2.521 |
| 1971 | -.242 | 1.049 | 2.220 |
| 1972 | .440 | 1.049 | 2.860 |
| 1973 | -.083 | 1.822 | 2.337 |
| 1974 | -.598 | .501 | 1.998 |
| 1975 | .417 | 1.498 | 3.026 |
| 1976 | .002 | 1.496 | 2.691 |
| 1977 | .045 | 1.601 | 2.356 |
| 1978 | .227 | 1.372 | 2.470 |
| 1979 | .283 | 1.615 | 2.537 |
| 1980 | .433 | 1.805 | 2.791 |
| 1981 | .563 | 1.778 | 2.934 |
| 1982 | .145 | 1.686 | 2.423 |
| 1983 | .317 | 1.681 | 2.568 |
| 1984 | .241 | 1.841 | 2.488 |
| 1985 | .110 | 1.738 | 2.435 |
| 1986 | .104 | 1.607 | 2.364 |
| 1987 | .482 | 1.730 | 2.830 |
| 1988 | .187 | 1.749 | 2.432 |
| 1989 | .068 | 1.189 | 2.322 |
| 1990 | .192 | 1.014 | 2.456 |
| 1991 | .279 | .501 | 2.527 |
| 1992 | .541 | 1.684 | 2.979 |
| 1993 | .521 | 1.538 | 2.881 |

*LICI_1* Lower limit for 99% prediction interval for (Brown Shrimp Harvest)^(0.1).
*TR_BHSH* (Brown Shrimp Harvest)^(0.1)
*UICI_1* Upper limit for 99% prediction interval for (Brown Shrimp Harvest)^(0.1)

### 6.2.5 Outliers and Influential Point Detection

***Table 6.20*** *Mahalanobis distance, Cook's distance, Leverage value and associated p-values*

| YEAR | *MAH_1* | *COOK_1* | *LEV_1*[1] | *MAH_PV*[2] | *COOK_PV*[3] |
|---|---|---|---|---|---|
| 1959 | 6.0406 | .0002 | .1777 | .5350 | .0000 |
| 1960 | 6.2415 | .0010 | .1836 | .5119 | .0000 |
| 1961 | 10.3419 | .3530 | .3042 | .1700 | .0785 |
| 1962 | 6.9431 | .0002 | .2042 | .4348 | .0000 |
| 1963 | 11.2770 | .0002 | .3317 | .1270 | .0000 |
| 1964 | 6.6989 | .0056 | .1970 | .4609 | .0000 |
| 1965 | 9.4850 | .0696 | .2790 | .2197 | .0006 |
| 1966 | 10.3365 | .0181 | .3040 | .1703 | .0000 |
| 1967 | 6.4538 | .0024 | .1898 | .4879 | .0000 |
| 1968 | 9.9756 | .0081 | .2934 | .1900 | .0000 |
| 1969 | 10.0940 | .0244 | .2969 | .1833 | .0000 |
| 1970 | 11.6488 | .4554 | .3426 | .1127 | .1420 |
| 1971 | 7.6582 | .0015 | .2252 | .3637 | .0000 |
| 1972 | 6.2357 | .1114 | .1834 | .5125 | .0029 |
| 1973 | 6.2148 | .1481 | .1828 | .5149 | .0071 |
| 1974 | 12.4152 | .0382 | .3652 | .0877 | .0001 |
| 1975 | 12.8931 | .0526 | *.3792 | .0748 | .0003 |
| 1976 | 15.9324 | .0394 | *.4686 | .0257 | .0001 |
| 1977 | 2.6040 | .0190 | .0766 | .9191 | .0000 |
| 1978 | .4346 | .0000 | .0128 | .9997 | .0000 |
| 1979 | .7774 | .0022 | .0229 | .9977 | .0000 |
| 1980 | 4.1605 | .0070 | .1224 | .7611 | .0000 |
| 1981 | 4.5670 | .0002 | .1343 | .7126 | .0000 |
| 1982 | 1.5321 | .0125 | .0451 | .9812 | .0000 |
| 1983 | .6703 | .0027 | .0197 | .9986 | .0000 |
| 1984 | .5506 | .0101 | .0162 | .9992 | .0000 |
| 1985 | 3.0674 | .0300 | .0902 | .8787 | .0000 |
| 1986 | .9509 | .0080 | .0280 | .9956 | .0000 |
| 1987 | 3.8176 | .0009 | .1123 | .8005 | .0000 |
| 1988 | .5122 | .0083 | .0151 | .9994 | .0000 |
| 1989 | .7590 | .0000 | .0223 | .9978 | .0000 |
| 1990 | 1.0861 | .0059 | .0319 | .9933 | .0000 |
| 1991 | .5649 | .0364 | .0166 | .9992 | .0001 |
| 1992 | 6.8611 | .0020 | .2018 | .4435 | .0000 |
| 1993 | 4.1983 | .0051 | .1235 | .7567 | .0000 |

*MAH_1* Mahalanobis distance
*COOK_1* Cook's distance
*LEV_1* Leverage value

| | |
|---|---|
| *MAHA_PV* | P-value associated with the Mahalanobis distance |
| *COOK_PV* | P-value associated with Cook's distance |

[1]This is flagged if it exceeds $(2p+1)/n$ or 0.5, whichever is smaller.
[2]*MAHA_PV* = 1-F(*MAH_1*), where F is the CDF of a Chi-squared random variable with $p+1$ degrees of freedom. Small values indicate a problem.
[3]*COOK_PV* = F(*COOK_1*), where F is the CDF of an F-ratio random variable with $p+1$ numerator degrees of freedom and $n-p-1$ denominator degrees of freedom. A value greater than 0.5 indicates a problem. A value less than 0.2 indicates no problem. Values in between are inconclusive.

***Table 6.21*** *Standardized dffits value and Standardized dfbeta values*

| YEAR | *SDFFITS* | *SDFBET_0* | *SDFBET_1* | *SDFBET_2* |
|---|---|---|---|---|
| 1959 | -.0409 | .0012 | -.0072 | .0321 |
| 1960 | -.0837 | -.0412 | .0036 | .0250 |
| 1961 | *-1.7015 | .3425 | .2757 | .0522 |
| 1962 | -.0394 | -.0174 | .0020 | .0112 |
| 1963 | -.0367 | -.0229 | .0166 | .0035 |
| 1964 | .1940 | .1649 | .0159 | -.0337 |
| 1965 | -.6992 | -.3516 | .0712 | -.2488 |
| 1966 | -.3513 | -.0303 | .0937 | -.1734 |
| 1967 | -.1269 | -.1112 | -.0110 | .0217 |
| 1968 | .2350 | -.0528 | -.0046 | -.1517 |
| 1969 | .4085 | .1742 | .2607 | .0592 |
| 1970 | *-1.9516 | -.2113 | *1.1947 | .6702 |
| 1971 | .0993 | .0375 | -.0061 | -.0256 |
| 1972 | -.9160 | .3730 | -.5617 | -.0261 |
| 1973 | *1.0771 | .3303 | -.1105 | -.5027 |
| 1974 | -.5118 | .1179 | .1862 | -.2757 |
| 1975 | -.6018 | -.2024 | -.4373 | .3102 |
| 1976 | .5183 | -.1076 | -.1763 | .2835 |
| 1977 | .3657 | -.1206 | -.1220 | .0275 |
| 1978 | .0123 | -.0004 | -.0003 | .0027 |
| 1979 | .1217 | -.0289 | -.0001 | .0317 |
| 1980 | .2189 | -.0679 | -.0098 | -.0098 |
| 1981 | .0352 | -.0135 | -.0076 | .0007 |
| 1982 | .2966 | -.0463 | .0188 | .1662 |
| 1983 | .1369 | -.0041 | .0254 | .0315 |
| 1984 | .2681 | .0112 | .0812 | -.0173 |
| 1985 | .4627 | -.1117 | -.2017 | .1600 |
| 1986 | .2364 | -.0543 | -.0356 | -.0023 |
| 1987 | .0799 | -.0142 | .0322 | .0148 |
| 1988 | .2426 | .0398 | -.0154 | .0388 |
| 1989 | -.0036 | -.0005 | .0000 | -.0011 |
| 1990 | -.2025 | -.0189 | -.0329 | -.1069 |
| 1991 | -.5515 | .0003 | -.1323 | -.1799 |
| 1992 | -.1166 | .0085 | -.0853 | -.0046 |
| 1993 | -.1854 | .0376 | .0092 | -.0010 |

| | |
|---|---|
| *SDFFITS* | Standardized *dffits* value |
| *SDFBET_0* | Standardized *dfbeta* for the intercept term |
| *SDFBET_1* | Standardized *dfbeta* for (January-February Inflows)^(0.1) |
| *SDFBET_2* | Standardized *dfbeta* for (March-April Inflows)^(0.1) |

*Items are flagged if |*sdffits*| or |*sdfbeta*| exceed 1.0 for a small data set or $2\sqrt{(p + 1) / n}$ for a large data set. The cutoff used here is 1.

***Table 6.22*** *Standardized dfbeta values*

| YEAR | *SDFBET_3* | *SDFBET_4* | *SDFBET_5* | *SDFBET_6* |
|---|---|---|---|---|
| 1959 | -.0019 | .0048 | -.0191 | -.0038 |
| 1960 | .0026 | .0557 | -.0382 | .0125 |
| 1961 | *1.1237 | .1463 | -.6749 | -.7592 |
| 1962 | .0034 | .0261 | -.0210 | .0059 |
| 1963 | .0094 | .0117 | .0100 | -.0213 |
| 1964 | -.0726 | .0535 | -.0977 | -.0316 |
| 1965 | -.2823 | .2485 | .3744 | .0422 |
| 1966 | -.1247 | .1995 | -.0461 | .0260 |
| 1967 | .0486 | -.0271 | .0624 | .0210 |
| 1968 | .0690 | .0085 | .1440 | .0060 |
| 1969 | -.2428 | -.0059 | -.0147 | -.3107 |
| 1970 | -.8656 | -.9161 | .5182 | *-1.2004 |
| 1971 | -.0562 | .0443 | .0237 | -.0195 |
| 1972 | -.0975 | .0977 | -.3829 | .5435 |
| 1973 | .7567 | .1112 | -.0890 | -.0943 |
| 1974 | .1154 | .0781 | -.3384 | .0698 |
| 1975 | -.2134 | -.1364 | .1724 | .4112 |
| 1976 | -.0420 | .3239 | .0132 | -.0562 |
| 1977 | -.0398 | -.1352 | .1491 | .2135 |
| 1978 | .0008 | .0001 | -.0032 | .0032 |
| 1979 | .0432 | -.0045 | -.0231 | .0242 |
| 1980 | -.0430 | .1713 | .0289 | .0017 |
| 1981 | .0188 | .0192 | -.0127 | .0144 |
| 1982 | -.0700 | -.0983 | .0063 | .0235 |
| 1983 | -.0122 | .0379 | -.0465 | .0039 |
| 1984 | -.0619 | -.0163 | -.0113 | .0102 |
| 1985 | .0493 | -.1038 | -.0509 | .3220 |
| 1986 | -.0165 | -.0818 | .0962 | .0875 |
| 1987 | .0358 | -.0116 | -.0328 | -.0060 |
| 1988 | -.0299 | .0218 | -.0864 | .0740 |
| 1989 | .0019 | .0007 | -.0003 | -.0004 |
| 1990 | .0551 | .0038 | .0621 | .0134 |
| 1991 | .0190 | -.0656 | .1730 | .0456 |
| 1992 | .0061 | .0257 | .0277 | .0352 |
| 1993 | -.1322 | -.0813 | .0955 | -.0366 |

*SDFBET_3* Standardized *dfbeta* for (May-June Inflows)^(0.2)

*SDFBET_4* Standardized *dfbeta* for (July-August Inflows)^(0.2)

*SDFBET_5* Standardized *dfbeta* for (September-October Inflows)^(0.1)

*SDFBET_6* Standardized *dfbeta* for (November-December Inflows)^(0.1)

*Items are flagged if |*sdffits*| or |*sdfbeta*| exceed 1.0 for a small data set or $2\sqrt{(p + 1) / n}$ for a large data set. The cutoff used here is 1.

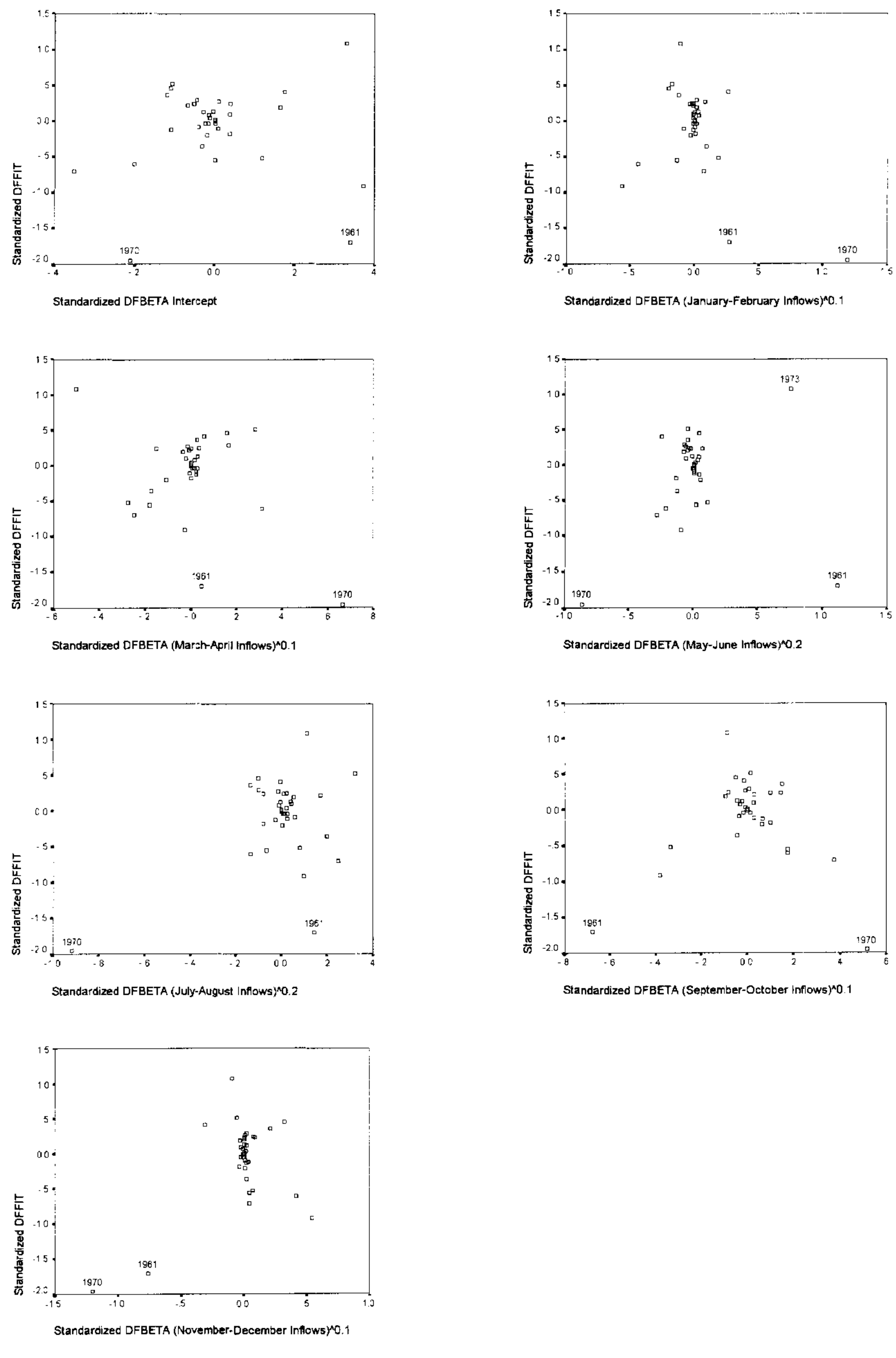


***Figure 6.30*** *Standardized DFFITS vs. Standardized DFBETA Intercept and vs. Standardized DFBETA of various transforms of inflow variables.*

# 7. EXAMINING SUBSETS OF THE DATA

## 7.1 Log of brown shrimp data and log of inflow data: 1970 Omitted

***Table 7.1*** *Regression Models for Dependent Variable: Ln(BROWN SHRIMP) on Ln(INFLOWS): 1970 Omitted*

| In | *Rsq* | *Adj Rsq* | *C(p)* | *AIC* | *MSE* | *SBC* | Variables in Model |
|---|---|---|---|---|---|---|---|
| 1 | 0.4557 | 0.4387 | 9.093 | 91.09 | 13.76 | 94.14 | LN_QJA |
| 1 | 0.2977 | 0.2758 | 20.44 | 99.75 | 17.76 | 102.8 | LN_QJF |
| 1 | 0.1659 | 0.1399 | 29.91 | 105.6 | 21.09 | 108.7 | LN_QND |
| 1 | 0.0876 | 0.0591 | 35.53 | 108.7 | 23.07 | 111.7 | LN_QMJ |
| 2 | 0.5198 | 0.4889 | 6.488 | 88.83 | 12.53 | 93.40 | LN_QMJ LN_QJA |
| 2 | 0.5065 | 0.4747 | 7.443 | 89.75 | 12.88 | 94.33 | LN_QJF LN_QJA |
| 2 | 0.4840 | 0.4507 | 9.063 | 91.27 | 13.47 | 95.85 | LN_QJA LN_QND |
| 2 | 0.4578 | 0.4228 | 10.94 | 92.96 | 14.15 | 97.54 | LN_QJA LN_QSO |
| 3 | 0.5610 | 0.5171 | 5.529 | 87.78 | 11.84 | 93.88 | LN_QMJ LN_QJA LN_QSO |
| 3 | 0.5431 | 0.4974 | 6.816 | 89.14 | 12.32 | 95.24 | LN_QJF LN_QMJ LN_QJA |
| 3 | 0.5334 | 0.4867 | 7.514 | 89.85 | 12.59 | 95.96 | LN_QMJ LN_QJA LN_QND |
| 3 | 0.5290 | 0.4819 | 7.830 | 90.17 | 12.70 | 96.28 | LN_QMA LN_QMJ LN_QJA |
| 4 | 0.6009 | 0.5459 | 4.664 | 86.54 | 11.14 | 94.17 | LN_QJF LN_QMJ LN_QJA LN_QSO |
| 4 | 0.5873 | 0.5304 | 5.643 | 87.68 | 11.52 | 95.31 | LN_QMJ LN_QJA LN_QSO LN_QND |
| 4 | 0.5679 | 0.5083 | 7.038 | 89.24 | 12.06 | 96.87 | LN_QJF LN_QMA LN_QMJ LN_QJA |
| 4 | 0.5670 | 0.5072 | 7.104 | 89.31 | 12.08 | 96.95 | LN_QMA LN_QMJ LN_QJA LN_QSO |
| 5 | 0.6239 | 0.5567 | 5.013 | 86.52 | 10.87 | 95.68 | LN_QJF LN_QMA LN_QMJ LN_QJA LN_QSO |
| 5 | 0.6071 | 0.5370 | 6.220 | 88.01 | 11.35 | 97.16 | LN_QMA LN_QMJ LN_QJA LN_QSO LN_QND |
| 5 | 0.6010 | 0.5297 | 6.661 | 88.53 | 11.53 | 97.69 | LN_QJF LN_QMJ LN_QJA LN_QSO LN_QND |
| 5 | 0.5679 | 0.4907 | 9.038 | 91.24 | 12.49 | 100.4 | LN_QJF LN_QMA LN_QMJ LN_QJA LN_QND |
| 6 | 0.6241 | 0.5406 | 7.000 | 88.50 | 11.27 | 99.19 | LN_QJF LN_QMA LN_QMJ LN_QJA LN_QSO LN_QND |

N=34

***Table 7.2*** *Analysis of Variance for Dependent Variable: Ln(BROWN SHRIMP) on Ln(INFLOWS): 1970 Omitted*

| Source | *DF* | *Sum of Squares* | *Mean Square* | *F* Value | Prob>*F* |
|---|---|---|---|---|---|
| Model | 6 | 505.01146 | 84.16858 | 7.471 | 0.0001 |
| Error | 27 | 304.18519 | 11.26612 | | |
| C Total | 33 | 809.19665 | | | |

| | | | |
|---|---|---|---|
| Root MSE | 3.35650 | R-square | 0.6241 |
| Dep Mean | 1.24226 | Adj R-sq | 0.5406 |
| C.V. | 270.19336 | | |

***Table 7.3*** *Parameter Estimates for Dependent Variable: Ln(BROWN SHRIMP) on Ln(INFLOWS): 1970 Omitted*

| Variable | *DF* | *Parameter Estimate* | *Standard Error* | *T* for H0: *Parameter*=0 | Prob > \|*T*\| | *Variance Inflation* |
|---|---|---|---|---|---|---|
| INTERCEP | 1 | 0.943561 | 0.73263885 | 1.288 | 0.2087 | 0.00000000 |
| LN_QJF | 1 | 0.335834 | 0.30409377 | 1.104 | 0.2792 | 5.13942325 |
| LN_QMA | 1 | -0.223589 | 0.17346819 | -1.289 | 0.2084 | 1.48014232 |
| LN_QMJ | 1 | 0.483899 | 0.18595442 | 2.602 | 0.0149 | 1.53484821 |
| LN_QJA | 1 | 0.995828 | 0.22243709 | 4.477 | 0.0001 | 1.63430190 |
| LN_QSO | 1 | -0.438191 | 0.21805686 | -2.010 | 0.0546 | 1.74600959 |
| LN_QND | 1 | 0.031259 | 0.26920405 | 0.116 | 0.9084 | 4.10333434 |

***Table 7.4*** *Collinearity Diagnostics(intercept adjusted) for Dependent Variable: Ln(BROWN SHRIMP) on Ln(INFLOWS): 1970 Omitted*

| Number | *Eigenvalue* | *Condition Index* | Var Prop *LN_QJF* | Var Prop *LN_QMA* | Var Prop *LN_QMJ* | Var Prop *LN_QJA* | Var Prop *LN_QSO* | Var Prop *LN_QND* |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.11612 | 1.00000 | 0.0158 | 0.0334 | 0.0185 | 0.0244 | 0.0308 | 0.0166 |
| 2 | 1.04751 | 1.72476 | 0.0122 | 0.0211 | 0.3533 | 0.1022 | 0.0418 | 0.0191 |
| 3 | 0.77165 | 2.00955 | 0.0106 | 0.1203 | 0.0002 | 0.3043 | 0.2010 | 0.0523 |
| 4 | 0.57969 | 2.31851 | 0.0219 | 0.7230 | 0.0235 | 0.1208 | 0.0479 | 0.0549 |
| 5 | 0.36920 | 2.90520 | 0.0112 | 0.1015 | 0.5520 | 0.2842 | 0.6773 | 0.0016 |
| 6 | 0.11584 | 5.18665 | 0.9283 | 0.0007 | 0.0524 | 0.1641 | 0.0012 | 0.8554 |

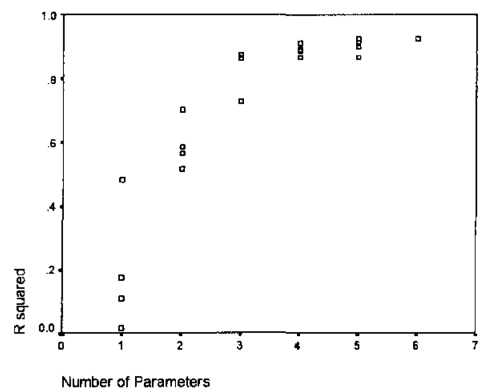


***Figure 7.1*** *The $R^2$ criteria vs. Number of parameters.*

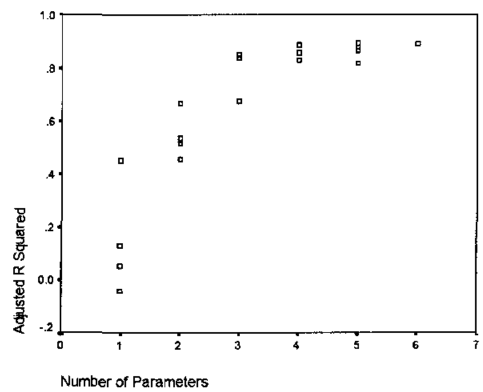


***Figure 7.2*** *The Adjusted $R^2$ criteria vs. Number of parameters.*

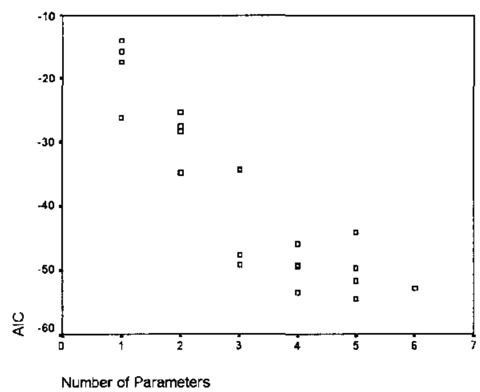


***Figure 7.3*** *The AIC criteria vs. Number of parameters..*

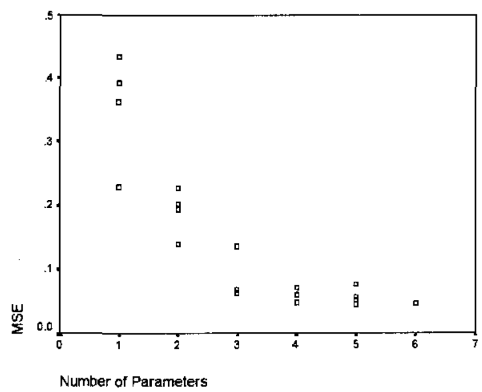


***Figure 7.4*** *MSE vs. Number of parameters.*

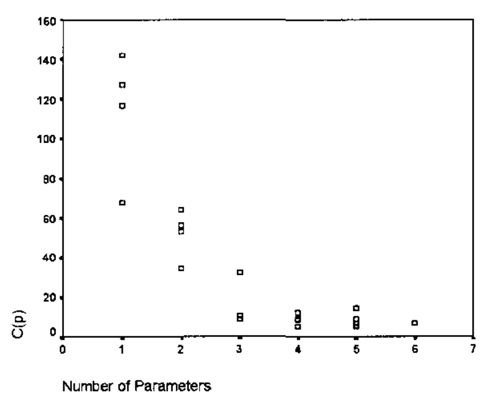


***Figure 7.5*** *The C(p) criteria vs. Number of parameters.*

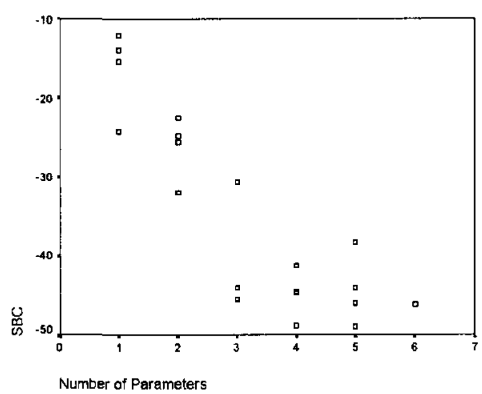


***Figure 7.6*** *The SBC criteria vs. Number of parameters.*

## 7.2 Various Transformation of data: 1970 Omitted

***Table** 7.7 Regression Models for Dependent Variable: Various Transformations 1970 Omitted*

| In | Rsq | Adj Rsq | C(p) | AIC | MSE | SBC | Variables in Model |
|---|---|---|---|---|---|---|---|
| 1 | 0.3054 | 0.2837 | 11.95 | -57.59 | 0.1736 | -54.54 | QR_QJA |
| 1 | 0.2663 | 0.2434 | 14.31 | -55.73 | 0.1834 | -52.67 | QR_QJF |
| 1 | 0.1708 | 0.1449 | 20.08 | -51.57 | 0.2073 | -48.51 | QR_QND |
| 1 | 0.1055 | 0.0775 | 24.03 | -48.99 | 0.2236 | -45.94 | QR_QMJ |
| 2 | 0.4263 | 0.3892 | 6.654 | -62.09 | 0.1481 | -57.51 | QR_QJF QR_QJA |
| 2 | 0.3851 | 0.3455 | 9.138 | -59.73 | 0.1587 | -55.15 | QR_QJA QR_QND |
| 2 | 0.3792 | 0.3391 | 9.497 | -59.41 | 0.1602 | -54.83 | QR_QMJ QR_QJA |
| 2 | 0.3095 | 0.2650 | 13.70 | -55.79 | 0.1782 | -51.21 | QR_QMA QR_QJA |
| 3 | 0.4664 | 0.4130 | 6.232 | -62.55 | 0.1423 | -56.44 | QR_QJF QR_QMJ QR_QJA |
| 3 | 0.4583 | 0.4041 | 6.718 | -62.04 | 0.1444 | -55.94 | QR_QJF QR_QJA QR_QSO |
| 3 | 0.4446 | 0.3890 | 7.548 | -61.19 | 0.1481 | -55.08 | QR_QMJ QR_QJA QR_QND |
| 3 | 0.4339 | 0.3773 | 8.194 | -60.54 | 0.1510 | -54.44 | QR_QJF QR_QMA QR_QJA |
| 4 | 0.5317 | 0.4671 | 4.286 | -64.99 | 0.1292 | -57.36 | QR_QJF QR_QMJ QR_QJA QR_QSO |
| 4 | 0.5087 | 0.4409 | 5.674 | -63.36 | 0.1355 | -55.73 | QR_QMJ QR_QJA QR_QSO QR_QND |
| 4 | 0.4864 | 0.4155 | 7.024 | -61.85 | 0.1417 | -54.22 | QR_QJF QR_QMA QR_QMJ QR_QJA |
| 4 | 0.4664 | 0.3928 | 8.229 | -60.55 | 0.1472 | -52.92 | QR_QJF QR_QMJ QR_QJA QR_QND |
| 5 | 0.5498 | 0.4694 | 5.192 | -64.33 | 0.1286 | -55.17 | QR_QJF QR_QMA QR_QMJ QR_QJA QR_QSO |
| 5 | 0.5334 | 0.4500 | 6.185 | -63.11 | 0.1333 | -53.95 | QR_QJF QR_QMJ QR_QJA QR_QSO QR_QND |
| 5 | 0.5235 | 0.4385 | 6.778 | -62.40 | 0.1361 | -53.25 | QR_QMA QR_QMJ QR_QJA QR_QSO QR_QND |
| 5 | 0.4869 | 0.3953 | 8.989 | -59.89 | 0.1466 | -50.73 | QR_QJF QR_QMA QR_QMJ QR_QJA QR_QND |
| 6 | 0.5530 | 0.4536 | 7.000 | -62.57 | 0.1324 | -51.89 | QR_QJF QR_QMA QR_QMJ QR_QJA QR_QSO QR_QND |

*N* = 34

***Table 7.8*** *Analysis of Variance for Dependent Variable: Various Transformations: 1970 Omitted*

| Source | DF | Sum of Squares | Mean Square | F Value | Prob>F |
|---|---|---|---|---|---|
| Model | 6 | 4.42358 | 0.73726 | 5.567 | 0.0007 |
| Error | 27 | 3.57596 | 0.13244 | | |
| C Total | 33 | 7.99953 | | | |

| | | | |
|---|---|---|---|
| Root MSE | 0.36393 | R-square | 0.5530 |
| Dep Mean | 1.25368 | Adj R-sq | 0.4536 |
| C.V. | 29.02877 | | |

***Table 7.9*** *Parameter Estimates for Dependent Variable: Various Transformations: 1970 Omitted*

| Variable | DF | Parameter Estimate | Standard Error | T for H0: Parameter=0 | Prob > \|T\| | Variance Inflation |
|---|---|---|---|---|---|---|
| INTERCEP | 1 | 0.453390 | 0.26825944 | 1.690 | 0.1025 | 0.00000000 |
| QR_QJF | 1 | 0.472323 | 0.35421966 | 1.333 | 0.1935 | 4.42691346 |
| QR_QMA | 1 | -0.242493 | 0.22278055 | -1.088 | 0.2860 | 1.43285606 |
| QR_QMJ | 1 | 0.235773 | 0.10122383 | 2.329 | 0.0276 | 1.30447152 |
| QR_QJA | 1 | 0.462368 | 0.12454497 | 3.712 | 0.0009 | 1.33745521 |
| QR_QSO | 1 | -0.442445 | 0.22152087 | -1.997 | 0.0560 | 1.54235971 |
| QR_QND | 1 | 0.149874 | 0.34222040 | 0.438 | 0.6649 | 4.08101177 |

***Table 7.10*** *Collinearity Diagnostics(intercept adjusted) for Dependent Variable: Various Transformations: 1970 Omitted*

| Prop Number | Eigenvalue | Condition Index | Var Prop QR_QJF | Var Prop QR_QMA | Var Prop QR_QMJ | Var Prop QR_QJA | Var Prop QR_QSO | Var Prop QR_QND |
|---|---|---|---|---|---|---|---|---|
| 1 | 2.86831 | 1.00000 | 0.0204 | 0.0407 | 0.0189 | 0.0286 | 0.0379 | 0.0192 |
| 2 | 1.03362 | 1.66583 | 0.0270 | 0.0061 | 0.3822 | 0.0078 | 0.0728 | 0.0534 |
| 3 | 0.88279 | 1.80253 | 0.0070 | 0.0322 | 0.1621 | 0.5328 | 0.0563 | 0.0109 |
| 4 | 0.64668 | 2.10605 | 0.0083 | 0.6824 | 0.0147 | 0.0619 | 0.2404 | 0.0145 |
| 5 | 0.44145 | 2.54902 | 0.0276 | 0.2384 | 0.3528 | 0.3192 | 0.5848 | 0.0031 |
| 6 | 0.12715 | 4.74952 | 0.9097 | 0.0002 | 0.0692 | 0.0497 | 0.0078 | 0.8989 |

***Table 7.11*** *Parameter Estimates of Models for Dependent Variable Various Transformations 1970 Omitted*

| OBS | _RMSE_ | INTERCEP | QR_QJF | QR_QMA | QR_QMJ | QR_QJA | QR_QSO | QR_QND |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.41670 | 0.63444 | . | . | . | 0.46254 | . | . |
| 2 | 0.42826 | 0.58345 | 0.67525 | . | . | . | . | . |
| 3 | 0.45529 | 0.72840 | . | . | . | . | . | 0.54412 |
| 4 | 0.47288 | 0.91513 | . | . | 0.22372 | . | . | . |
| 5 | 0.38478 | 0.29607 | 0.48420 | . | . | 0.35630 | . | . |
| 6 | 0.39833 | 0.34641 | . | . | . | 0.40057 | . | 0.38430 |
| 7 | 0.40025 | 0.38010 | . | . | 0.18801 | 0.44000 | . | . |
| 8 | 0.42211 | 0.56075 | . | 0.09728 | . | 0.44555 | . | . |
| 9 | 0.37722 | 0.14769 | 0.42150 | . | 0.14207 | 0.35303 | . | . |
| 10 | 0.38006 | 0.49615 | 0.56979 | . | . | 0.41193 | -0.28992 | . |
| 11 | 0.38485 | 0.14269 | . | . | 0.16965 | 0.38579 | . | 0.34989 |
| 12 | 0.38854 | 0.36766 | 0.53934 | -0.14539 | . | 0.36958 | . | . |
| 13 | 0.35942 | 0.38560 | 0.52360 | . | 0.20260 | 0.43536 | -0.43633 | . |
| 14 | 0.36813 | 0.36391 | . | . | 0.23560 | 0.47246 | -0.43570 | 0.45682 |
| 15 | 0.37641 | 0.24061 | 0.50241 | -0.24327 | 0.16780 | 0.37466 | . | . |
| 16 | 0.38365 | 0.14401 | 0.40408 | . | 0.14294 | 0.35359 | . | 0.01958 |
| 17 | 0.35864 | 0.47064 | 0.59915 | -0.23154 | 0.22623 | 0.45477 | -0.43011 | . |
| 18 | 0.36513 | 0.37026 | 0.42959 | . | 0.20867 | 0.44017 | -0.44544 | 0.10805 |
| 19 | 0.36895 | 0.43521 | . | -0.20957 | 0.26133 | 0.49442 | -0.43227 | 0.52295 |
| 20 | 0.38286 | 0.23059 | 0.44796 | -0.24802 | 0.17111 | 0.37689 | . | 0.06296 |
| 21 | 0.36393 | 0.45339 | 0.47232 | -0.24249 | 0.23577 | 0.46237 | -0.44245 | 0.14987 |

***Table 7.12*** *Criteria Statistics of Models for Dependent Variable: Various Transformations. 1970 Omitted*

| OBS | _MSE_ | _RSQ_ | _ADJRSQ_ | _CP_ | _AIC_ | _SBC_ |
|---|---|---|---|---|---|---|
| 1 | 0.17364 | 0.30541 | 0.28370 | 11.9532 | -57.5879 | -54.5352 |
| 2 | 0.18340 | 0.26635 | 0.24342 | 14.3126 | -55.7277 | -52.6749 |
| 3 | 0.20729 | 0.17081 | 0.14490 | 20.0831 | -51.5655 | -48.5128 |
| 4 | 0.22361 | 0.10550 | 0.07755 | 24.0278 | -48.9879 | -45.9351 |
| 5 | 0.14806 | 0.42625 | 0.38923 | 6.6544 | -62.0863 | -57.5072 |
| 6 | 0.15867 | 0.38513 | 0.34546 | 9.1381 | -59.7330 | -55.1539 |
| 7 | 0.16020 | 0.37919 | 0.33914 | 9.4970 | -59.4059 | -54.8268 |
| 8 | 0.17818 | 0.30952 | 0.26497 | 13.7049 | -55.7898 | -51.2107 |
| 9 | 0.14230 | 0.46635 | 0.41299 | 6.2322 | -62.5500 | -56.4445 |
| 10 | 0.14444 | 0.45831 | 0.40414 | 6.7180 | -62.0414 | -55.9359 |
| 11 | 0.14811 | 0.44457 | 0.38902 | 7.5480 | -61.1895 | -55.0841 |
| 12 | 0.15096 | 0.43387 | 0.37725 | 8.1944 | -60.5407 | -54.4353 |
| 13 | 0.12918 | 0.53169 | 0.46710 | 4.2858 | -64.9906 | -57.3588 |
| 14 | 0.13552 | 0.50871 | 0.44094 | 5.6739 | -63.3617 | -55.7299 |
| 15 | 0.14168 | 0.48636 | 0.41552 | 7.0236 | -61.8493 | -54.2175 |
| 16 | 0.14719 | 0.46641 | 0.39281 | 8.2288 | -60.5535 | -52.9217 |
| 17 | 0.12862 | 0.54980 | 0.46941 | 5.1918 | -64.3317 | -55.1735 |
| 18 | 0.13332 | 0.53336 | 0.45004 | 6.1848 | -63.1122 | -53.9540 |
| 19 | 0.13612 | 0.52354 | 0.43846 | 6.7780 | -62.4040 | -53.2459 |
| 20 | 0.14658 | 0.48693 | 0.39531 | 8.9892 | -59.8871 | -50.7289 |
| 21 | 0.13244 | 0.55298 | 0.45364 | 7.0000 | -62.5724 | -51.8878 |

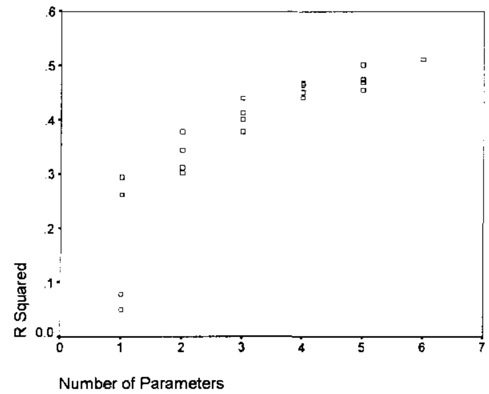


***Figure** 7.7 The $R^2$ criteria vs. Number of parameters.*

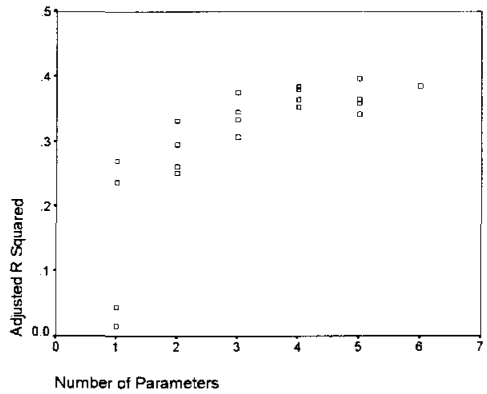


***Figure 7.8** The Adjusted $R^2$ criteria vs. Number of parameters.*

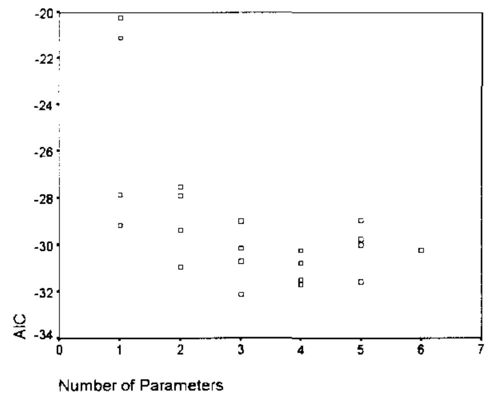


***Figure** 7.9 The AIC criteria vs. Number of parameters..*

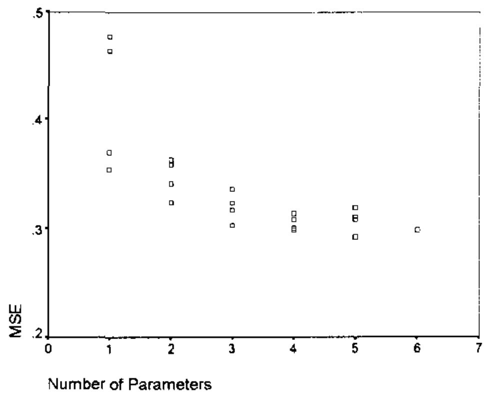


***Figure 7.10** MSE vs. Number of parameters.*

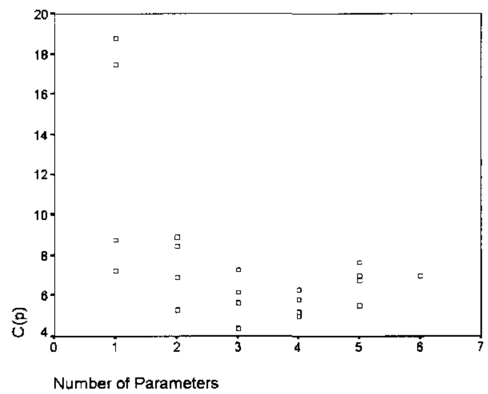


***Figure** 7.11 The C(p) criteria vs. Number of parameters.*

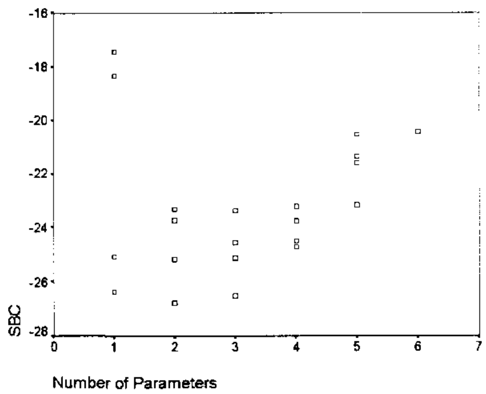


***Figure** 7.12 The SBC criteria vs. Number of parameters.*