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# LOGISTIC REGRESSION MODEL FOR PREDICTION OF BANKRUPTCY

*ISMAIL B*
*PROFESSOR*
*DEPARTMENT OF STATISTICS*
*MANGALORE UNIVERSITY*
*MANGALAGANGOTHRI*

*ASHWINI KUMARI*
*LECTURER*
*DEPARTMENT OF STATISTICS*
*M. G. M. COLLEGE*
*UDUPI*

**ABSTRACT**

*One of the most significant threats of a national economy is the bankruptcy of its banks. Estimation of bankruptcy provides invaluable information on which governments, investors and shareholders can base their financial decisions in order to prevent possible losses. In this paper model was developed using stepwise logistic regression with financial ratios to make bankruptcy predictions. Descriptive statistics, correlations and independent T-test are used for testing to see the characteristics of each variable on both failed and non-failed banks. Samples were developed by using financial ratios from 16 nationalised banks in India. The result from empirical study reveals that the financial ratios related to one year prior model are better than two year prior model for the purpose of prediction . The result of statistical test has pointed out that owners fund as percentage of total source, long term debt/equity and quick ratio are the significant in predicting bankruptcy. The Nagelkerke $R^2$ indicated 84.4% of the variation in the outcome variable. The predictability accuracy of the model with owners fund as percentage of total source is 87.5 % which is under 95%confidence level.*

**KEYWORDS**
Financial Ratios, Logistic Regression.

## I INTRODUCTION

The use of the logistic regression model has exploded during the past decade. From its original acceptance in epidemiologic research, the methods is now commonly used in many fields like biomedical research, business and finance, criminology, ecology, engineering, health policy, wildlife biology.

Logistic regression can be used to predict a dependent variable on the basis of continuous and/or categorical independents and to determine the percent of variance in the dependent variable explained by the independents.

Unlike OLS regression, however, logistic regression does not assume linearity of relationship between the independent variables and the dependent, does not require normally distributed variables, does not assume homoscedasticity, and in general has less stringent requirements.

The predictive success of the logistic regression can be assessed by looking at the classification table, showing correct and incorrect classifications of the dichotomous, ordinal or polytomous dependent. Goodness-of-fit tests such as the likelihood ratio test are available as indicators of model appropriateness, as is the Wald statistic to test the significance of individual independent variables.

Since Altman's Z model, some studies have been carried out on failure classification. Altman and Narayan conducted a survey called "An International Survey of Business Failure Classification Models"(1997). Meyer and Pifer (1970) in their paper, Prediction of Bank Failures, matched failed and non-failed banks and analyzed them with both Multivariate Discriminant analysis and Multivariate Regression analysis, and then compared the classification results. The Logistic Regression approach was first proposed for bank failure prediction by Martin (1997) and for the prediction of business failure by Ohlson.

Tam and Kiang (1992) made a Neural Network application in the case of bank failure prediction and compared the results with some other methods such as Discriminant Analysis and Logistic Regression.

In this work, Logistic Regression was used to find models and make predictions in order to determine the Banks in India which were financially in bad condition.

## II LOGISTIC REGRESSION MODEL

Regression method for data analysis is concerned with describing the relationship between a response variable and one or more explanatory variables. The general regression model is of the form

$$Y = m(x) + \varepsilon \qquad (1)$$

The logistic regression model is standard method of analysis when the outcome variable is discrete, taking on two or more possible values.

We use the quantity

$$\Pi(x) = E(Y/x) \qquad (2)$$

In linear regression we assume that mean value be represented by

$$E(Y/X=x) = \beta_0 + \beta_1 x \qquad (3)$$

In case of Logistic regression , the conditional mean of the respected variable Y gives X=x being dichotomous is expressed by the quantity

$$E(Y/X=x) = \pi(x) \qquad (4)$$

where

$$\pi(x) = \frac{e^{\beta_0+\beta_1 x}}{1+e^{\beta_0+\beta_1 x}}$$

A transformation of $\pi(x)$ that is central to our study of logistic regression is the logit transformation .This transformation is defined, in terms of $\pi(x)$ as

$$g(x) = \ln\left[\frac{\pi(x)}{1-\pi(x)}\right] \qquad (5)$$

$$= \beta_0 + \beta_1 x .$$

The importance of this transformation is that g(x) has many of the desirable properties of a linear regression model. The logit g(x) is linear in its parameters , may be continuous and may range from -∞ to +∞, depending on the range of x.

In case of a dichotomous outcome variable, we may express the value of the outcome variable given x as $y = \pi(x) + \varepsilon$ .

If y=1 then $\varepsilon = 1-\pi(x)$ with probability $\pi(x)$, and if y=0 then $\varepsilon = -\pi(x)$ with probability $1-\pi(x)$. Thus $\varepsilon$ has a distribution with mean zero and variance equal to $\pi(x)[1-\pi(x)]$. That is conditional distribution of the outcome variable follows a binomial distribution with probability given by the conditional mean $\pi(x)$.

### A. FITTING THE LOGISTIC REGRESSION MODEL

Suppose we have a sample of n independent observations of the pair $(x_i, y_i)$, i =1,2………………n, where $y_i$ denotes the value of a dichotomous outcome variable and $x_i$ is the value of the independent variable for the $i^{th}$ subject. Assume that the outcome variable has been coded as zero or one, representing the absence or the presence of the characteristic, respectively.

If Y is coded as 0 or 1 then the expression for $\Pi(x)$ given in the equation (3) provides the conditional probability that Y is equal to 1 given x. this will be denoted as $P(Y=1|x)$. It follows that the quantity $1-\Pi(x)$ gives the conditional probability that Y is equal to zero given x, $P(Y=0|x)$. Thus for those pairs $(x_i, y_i)$, where $y_i = 1$, the contribution of likelihood function is $\Pi(x_i)$ and for those pairs where $y_i = 0$, contribution of likelihood function is $1-\Pi(x_i)$, where the quantity $\Pi(x_i)$ denotes the value of $\Pi(x)$ computed at $x_i$.

Then the likelihood function for the pairs $(x_i, y_i)$ is given by

$$\Pi(x_i)^{y_i}\left[1-\Pi(x_i)\right]^{1-y_i} \quad (6)$$

Since observations are assumed to be independent, the likelihood function is obtained as product of the terms given in the expression (5) as follows:

$$l(B) = \prod_{i=1}^{n} \Pi(x_i)^{y_i}\left[1-\Pi(x_i)\right]^{1-y_i} \quad (7)$$

The function is

$$l(\beta) = \ln[l(\beta)]$$

$$= \sum_{i=1}^{n}\{y_i \ln[\Pi(x_i)] + (1-y_i)\ln[1-\Pi(x_i)]\} \quad (8)$$

To find the value of $\beta$ that maximizes $L(\beta)$ we differentiate $L(\beta)$ with respect to $\beta 0$ and $\beta 1$ and set the resulting expressions equals to zero. These equations, known as likelihood equations, are:

$$\sum\left[y_i - \Pi(x_i)\right] = 0 \quad (9)$$

$$\sum x_i\left[y_i - \Pi(x_i)\right] = 0 \quad (10)$$

In linear regressions, the likelihood equations obtained by differentiating the sum of squared deviations function with respect to $\beta$ are linear in the unknown parameters and thus are easily solved.

For logistic regression the expressions in equation (9) and( 10) are nonlinear in $\beta 0$ and $\beta 1$ and thus require special methods for their solution . These methods are iterative in nature and have been programmed into available logistic regression software.
As, such it represents the fitted or predicted value for the logistic regression model. An interesting consequence of equation (9) is that

$$\sum_{i=1}^{n} y_i = \sum_{i=1}^{n}\hat{\Pi}(x_i) \quad (11)$$

ie the sum of the observed values of y is equal to the sum of the predicted (expected) value. This property is useful in fitting the model.

The Statistic G follows a Chi -square distribution with 1 d.f , under the hypothesis that $\beta_1 = 0$ is given by

$$G = 2\left\{\sum_{i=1}^{n}\left[y_i \ln(\hat{\pi}_i) + (1-y_i)\ln(1-\hat{\pi}_i)\right] - \left[n_1 \ln(n_1) + n_0 \ln(n_0) - n\ln(n)\right]\right\} \quad (12)$$

An important object to testing for significance of the model is calculation and interpretation of confidence intervals for parameters of interest. As is the case in linear regression we can obtain these for the slope, intercept and the “line”.

The confidence interval estimators for the slope and intercept are based on their respective Wald tests. The $100(1-\alpha)\%$ confidence interval for the slope coefficient are

$$\hat{\beta}_1 \pm z_{1-\alpha/2}S\hat{E}(\hat{\beta}_1) \quad (13)$$

and for the intercept they are

$$\hat{\beta}_0 \pm z_{1-\alpha/2} S\hat{E}(\hat{\beta}_0) \quad (14)$$

where $z_{1-\alpha/2}$ is the upper $100(1-\alpha/2)\%$ point from the standard normal distribution and $S\hat{E}(.)$ denotes a model-based estimator of the standard error of the respective parameter.

The logit is the linear part of the logistic regression model and, is most like the fitted line in a linear regression model. The estimator of the logit is

$$\hat{g}(x) = \hat{\beta}_0 + \hat{\beta}_1 x \quad (15)$$

the estimator of the variance of the estimator of the logit requires obtaining the variance of a sum, and it is given by

$$\hat{V}ar[\hat{g}(x)] = \hat{V}ar(\hat{\beta}_0) + x^2 \hat{V}ar(\hat{\beta}_1) + 2x\hat{C}ov(\hat{\beta}_0, \hat{\beta}_1) \quad (16)$$

In general the variance of a sum is equal to the sum of the variance of each term and twice the covariance of each possible pair of terms formed from the components of sum. And a $100(1-\alpha)\%$ Wald-based confidence interval for the logit are

$$\hat{g}(x) \pm z_{1-\alpha/2} S\hat{E}[\hat{g}(x)] \quad (17)$$

where $S\hat{E}[\hat{g}(x)]$ is the positive square root of the variance estimator in (16).

## III DATA PRESENTATION AND ANALYSIS

In this paper the ratio's related to the year 2008 is considered as independent variable and corresponding to 2009 is considered as a dependent variable.

For the year 2008, the variables C5, C18, C20, C21, C22, C23, C24, C31, C32, C34 and C37 have the p value less than 0.05. So these variables are considered as significant variable. Similarly for the year 2009 the significant variables are C5, C18, C20, C21, C22, C23, C24, C31, C32, C33, C34.

The logistic regression model involves developing econometric models to identify the factors which are responsible for forecasting the bankruptcy.

In the first step of analysis we computed the p value which is used to identify the significant factors. Then stepwise logistic regression was carried out to identify the factors which are jointly responsible for the successive level of the bank. Stepwise logistic regression was carried out using forward inclusion and backward elimination methods. Likelihood ratio test, wald test and score (conditional) test are also used for selecting best regressors. The regressor included in the logistic regression model is C19.

The logit of the binary regression model for 1 independent variable is

$$g(x) = \beta_0 + \beta_1 x$$

The conditional probability that the outcome is successive bank is denoted by

$$P(Y = 1/x) = \pi(x)$$

where

$$\pi(x) = \frac{e^{g(x)}}{1 + e^{g(x)}}$$

In the analysis based on logistic regression, the predictor variable is the ratio C19=Total debt/equity(x) for the year 2008 and the endogeneous variable isC20= Owners fund as % of total source (Y) for the year 2009.

The fitted model is

$\hat{y} = 19.947 + (-0.906)C_{19}$

This model is used in order to rank and classify the the banks according to their performances. The model was tested with the data set compiled from 2009 and this way exact prediction was made.

The model was transformed using logistic form. Probabilities were calculated using transform model. Banks were ranked by probabilities and they are classified using 0.5 cut-off point. Those under 0.5 were classified as failed and above 0.5 as successful. The result can be seen in Table 2

In binary logistic regression the maximum likelihood estimate of $\beta 0$ and $\beta 1$ are $\hat{\beta}_0$ =19.947, $\hat{\beta}_1$ =(-0.906) .

The estimated logit is given by the equation

$\hat{g}$ (x) =19.947 + $(-0.906)C_{19}$

and the fitted value are given by the equation

$$\pi(x) = \frac{\exp(g(x))}{1 + \exp(g(x))}$$

-2log likelihood is 0.000

**CONCLUSION**

The classification rule applied to the ratios for the year 2009 gives 4 banks at failure level. The prediction using logistic regression model for the year 2010 gives 5 banks at failure level which includes the four banks classified under classification rule. That is Canara Bank (B5), Corporation Bank (B7), Karnataka Bank (B9), Union Bank of India (B14), Vijaya Bank (B16). And it was seen that even if cut-off point had been chosen as 0.8 or higher in order to classify a bank as successful, we get the same list of failed banks.

Since the model was constructed using 2008 predictors and 2009 dependent variables(one year priori model),it made a prediction for the year 2010.

In summary, the validation of the result of this study indicates that a logistic regression model provides reasonably good results in financial distress and it has a good predictive power of bankruptcy failures.

## IV. TWO YEAR PRIORI MODEL

### A. CHOICE OF DEPENDENT AND INDEPENDENT VARIABLE :

In this section the ratio's related to the year 2006 is considered as independent variable and corresponding to 2008 is considered as a dependent variable.

For the year 2006, the variables C5, C19, C20, C21, C22, C23, C30, C31, C32, C34 and C37 have the p value less than 0.05. So these variables are considered as significant variable. Similarly for the year 2008, the significant variables are C5, C18, C20, C21, C22, C23, C24, C31, C32, C34 and C37.

Now from the significant ratios corresponding to the year 2008, one particular ratio is chosen as dependent variable. For this each of these variable is regressed on the significant ratios corresponding to the year 2006. In each case we used forward inclusion using likelihood ratio test, Wald test, and score test, to choose the best subset among the regressors. This procedure gives C20 (for the year 2008) as the dependent variable in which one ratio namely C13 as significant.

In the first step of analysis we computed the p value which is used to identify the significant factors. Then stepwise logistic regression was carried out to identify the factors which are jointly responsible for the successive level of the bank. Stepwise logistic regression was carried out using forward inclusion and backward elimination methods . Likelihood ratio test, Wald test and score(conditional) test are also used for selecting best regressors. The regressor included in the logistic regression model is C13.

The logit of the binary regression model for 1 independent variable is

$$g(x) = \beta_0 + \beta_1 x$$

The conditional probability that the outcome is successive bank is denoted by

$$P(Y = 1/x) = \pi(x)$$

where

$$\pi(x) = \frac{e^{g(x)}}{1 + e^{g(x)}}$$

In the analysis based on logistic regression, the predictor variable is the ratio C13=Net Profit Margin (x) for the year 2006 and the endogeneous variable is C20= Owners fund as % of total source (Y) for the year 2008.

The fitted model is

$\hat{y} = -70.893 + (10.205)C_{13}$

This model is used in order to rank and classify the banks according to their performances. The model was tested with the data set compiled from 2008.

The model was transformed using logistic form. Probabilities were calculated using transform model. Banks were ranked by probabilities and they are classified using 0.5 cut-off point. Those under 0.5 were classified as failed and above 0.5 as successful. The result can be seen in Table 4.

In binary logistic regression the maximum likelihood estimate of $\beta 0$ and $\beta 1$ are $\hat{\beta}_0$ = (- 70.893) and $\hat{\beta}_1$ =(10.205) .

The estimated logit is given by the equation

$\hat{g}$ (x) =$-70.893 + (10.205)C_{13}$

and the fitted value are given by the equation

$$\pi(x) = \frac{\exp(g(x))}{1 + \exp(g(x))}$$

-2log likelihood is 0.000

**B. CONCLUSION :**

The classification rule applied to the ratios for the year 2008 gives 5 banks at failure level. The prediction using logistic regression model for the year 2010 gives 2 banks at failure level which excludes 3 banks classified under classification rule.

For the year 2008 , the banks which are at failure level are Canara Bank (B5), Karnataka Bank (B14), Union Bank (B14), Vijaya Bank (B16). And for the year 2010, the banks which are at failure level are Canara Bank (B5) and Karnataka Bank (B9).

Since the model was constructed using 2006 predictors and 2008 dependent variables (Two years priori model), it made a prediction for the year 2010.

## V. COMPARISON OF ONE YEAR PRIORI MODEL AND 2 YEARS PRIORI MODEL

For both the one year priori model and 2year priori model the dependent variable is C20= owners fund as %of source and independent variable is C19 and C13 respctively.

Two year priori model gives only two banks at failure level that is B5 and B9. But one year priori model gives 5 banks at failure level including those two banks. That is B5, B7, B14, B16.

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## VI. APPENDIX

TABLES:

- Financial Ratios
- Banks are ranked using the 1 year priori model
- Banks and their codes( 1 year priori model)
- Banks are ranked using the 2 years priori model
- Banks and their codes (2 year priori model)
- Out put: Logistic Regression tables for Binary logistic regression model.

**TABLE 1: FINANCIAL RATIOS**

| | |
|---|---|
| | Per share ratios |
| C1 | Adjusted EPS (Rs) |
| C2 | Adjusted cash EPS (Rs) |
| C3 | Reported EPS (Rs) |
| C4 | Reported cash EPS (Rs) |
| C5 | Dividend per share |
| C6 | Operating profit per share (Rs) |
| C7 | Book value (excl rev res) per share (Rs) |
| C8 | Book value (incl rev res) per share (Rs.) |
| C9 | Net operating income per share (Rs) |
| C10 | Free reserves per share (Rs) |
| | |
| | Profitability ratios |
| C11 | Operating margin (%) |
| C12 | Gross profit margin (%) |
| C13 | Net profit margin (%) |
| C14 | Adjusted cash margin (%) |
| C15 | Adjusted return on net worth (%) |
| C16 | Reported return on net worth (%) |
| C17 | Return on long term funds (%) |
| | |
| | Leverage ratios |
| C18 | Long term debt / Equity |
| C19 | Total debt/equity |
| C20 | Owners fund as % of total source |
| C21 | Fixed assets turnover ratio |
| | |
| | Liquidity ratios |
| C22 | Current ratio |
| C23 | Current ratio (inc. st loans) |
| C24 | Quick ratio |
| C25 | Inventory turnover ratio |
| | |
| | Payout ratios |
| C26 | Dividend payout ratio (net profit) |
| C27 | Dividend payout ratio (cash profit) |
| C28 | Earning retention ratio |
| C29 | Cash earnings retention ratio |
| | |
| | Coverage ratios |
| C30 | Adjusted cash flow time total debt |
| C31 | Financial charges coverage ratio |
| C32 | Fin. charges cov.ratio (post tax) |
| | |
| | Component ratios |
| C33 | Material cost component (% earnings) |
| C34 | Selling cost Component |
| C35 | Exports as percent of total sales |
| C36 | Import comp. in raw mat. consumed |
| C37 | Long term assets / total Assets |
| C38 | Bonus component in equity capital (%) |

**TABLE 2: BANKS ARE RANKED USING THE MODEL (SEE COUNTED XB VALUES AND THEIR PROBABILITIES)**

| Banks Used in Analysis | XB | Prob(Y=1) | Predicted |
|---|---|---|---|
| **Allahabad Bank** | 7.1031 | 0.99917812 | 1 |
| **Andra Bank** | 5.68974 | 0.99663092 | 1 |
| **Bank of Baroda** | 6.99438 | 0.99908382 | 1 |
| **Bank of India** | 4.068 | 0.9831763 | 1 |
| **Canara Bank** | -1.9569 | 0.12380293 | 0 |
| **Central Bank of India** | 2.64558 | 0.93373804 | 1 |
| **Corporation Bank** | -12.9648 | 2.3413E-06 | 0 |
| **Dena Bank** | 7.59234 | 0.99949595 | 1 |
| **Karnataka Bank** | -0.16302 | 0.45933502 | 0 |
| **Oriental Bank of Commerce** | 7.35678 | 0.99936216 | 1 |
| **Punjab National Bank** | 7.35678 | 0.99936216 | 1 |
| **Syndicate Bank** | 7.25712 | 0.99929536 | 1 |
| **Uco Bank** | 5.48136 | 0.9958536 | 1 |
| **Union Bank Of India** | -9.66696 | 6.3338E-05 | 0 |
| **United Bank Of India** | 2.73618 | 0.93912809 | 1 |
| **Vijaya Bank** | -1.15056 | 0.24038681 | 0 |

**TABLE 3: BANKS AND THEIR CODES (1 YEAR PRIORI MODEL)**

| | Banks Used in Analysis | 2009 | 2010 |
|---|---|---|---|
| B1 | Allahabad Bank | 1 | 1 |
| B2 | Andra Bank | 1 | 1 |
| B3 | Bank of Baroda | 1 | 1 |
| B4 | Bank of India | 1 | 1 |
| B5 | Canara Bank | 0 | 0 |
| B6 | Central Bank of India | 1 | 1 |
| B7 | Corporation Bank | 0 | 0 |
| B8 | Dena Bank | 1 | 1 |
| B9 | Karnataka Bank | 0 | 0 |
| B10 | Oriental Bank of Commerce | 1 | 1 |
| B11 | Punjab National Bank | 1 | 1 |
| B12 | Syndicate Bank | 1 | 1 |
| B13 | Uco Bank | 1 | 1 |
| B14 | Union Bank Of India | 0 | 0 |
| B15 | United Bank Of India | 1 | 1 |
| B16 | Vijaya Bank | 1 | 0 |
| The banks are sorted alfabetically. 0=Failed, 1=Successful | | | |

**TABLE 4: BANKS ARE RANKED USING THE 2 YEARS PRIORI MODEL**

| Banks Used in Analysis | XB | Prob(Y=1) | Predicted |
|---|---|---|---|
| Allahabad Bank | 79.3246 | 1 | 1 |
| Andra Bank | 99.63255 | 1 | 1 |
| Bank of Baroda | 26.15655 | 1 | 1 |
| Bank of India | 22.07455 | 1 | 1 |
| Canara Bank | -50.483 | 1.19E-22 | 0 |
| Central Bank of India | 39.7292 | 1 | 1 |
| Corporation Bank | 21.9725 | 1 | 1 |
| Dena Bank | 107.4904 | 1 | 1 |
| Karnataka Bank | -133.756 | 8.14E-59 | 0 |
| Oriental Bank of Commerce | 44.8317 | 1 | 1 |
| Punjab National Bank | 44.8317 | 1 | 1 |
| Syndicate Bank | 136.0644 | 1 | 1 |
| Uco Bank | 96.8772 | 1 | 1 |
| Union Bank Of India | 6.8691 | 0.998962 | 1 |
| United Bank Of India | 126.5738 | 1 | 1 |
| Vijaya Bank | 17.38025 | 1 | 1 |

**TABLE 5: BANKS AND THEIR CODES (2 YEARS PRIORI MODEL) (2 YEARS PRIORI MODEL)**

| | Banks Used in Analysis (2 years priori model) | 2008 | 2010 |
|---|---|---|---|
| B1 | Allahabad Bank | 1 | 1 |
| B2 | Andra Bank | 1 | 1 |
| B3 | Bank of Baroda | 1 | 1 |
| B4 | Bank of India | 1 | 1 |
| B5 | Canara Bank | 0 | 0 |
| B6 | Central Bank of India | 1 | 1 |
| B7 | Corporation Bank | 0 | 1 |
| B8 | Dena Bank | 1 | 1 |
| B9 | Karnataka Bank | 0 | 0 |
| B10 | Oriental Bank of Commerce | 1 | 1 |
| B11 | Punjab National Bank | 1 | 1 |
| B12 | Syndicate Bank | 1 | 1 |
| B13 | Uco Bank | 1 | 1 |
| B14 | Union Bank Of India | 0 | 1 |
| B15 | United Bank Of India | 1 | 1 |
| B16 | Vijaya Bank | 0 | 1 |
| The banks are sorted alphabetically. 0= Failed, 1= Successful | | | |

**OUTPUT LOGISTIC REGRESSION TABLES FOR BINARY LOGISTIC REGRESSION MODEL**

**DEPENDENT VARIABLE ENCODING**

| Original Value | Internal Value |
|---|---|
| 0 | 0 |
| 1 | 1 |

**FORWARD STEPWISE (CONDITIONAL):**

**OMNIBUS TESTS OF MODEL COEFFICIENTS**

| | Chi-Square | Df | Sig. |
|---|---|---|---|
| Step1 Step | 13.487 | 1 | .000 |
| Block | 13.487 | 1 | .000 |
| Model | 13.487 | 1 | .000 |

**MODEL SUMMARY**

| Step | -2 Log likelihood | Cox & Snell R Square | Nagelkerke R Square |
|---|---|---|---|
| 1 | 4.507[a] | .570 | .844 |

**HOSMER AND LEMSHOW TEST**

| Step | Chi-square | df | Sig. |
|---|---|---|---|
| 1 | 1.452 | 6 | .963 |

**CLASSIFICATION TABLE**

| Observed | | | Predicted | | |
|---|---|---|---|---|---|
| | | | Y20 | | Percentage correct |
| | | | 0 | 1 | |
| Step1 | Y20 | 0 | 3 | 1 | 75.0 |
| | | 1 | 1 | 11 | 91.7 |
| Overall Percentage | | | | | 87.5 |

**VARIABLES IN THE EQUATION**

| | B | S.E | Wald(Z) | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|
| Step 1[a] C19 | -.906 | .678 | 1.785 | 1 | .181 | .404 |
| Constant | 19.947 | 14.931 | 1.785 | 1 | .182 | 4.600E8 |

**LOGISTIC REGRESSION (2 YEAR PRIORI MODEL)**

**OMNIBUS TESTS OF MODEL COEFFICIENTS:**

| | | Chi-Square | Df | Sig. |
|---|---|---|---|---|
| Step1 | Step | 19.875 | 1 | .000 |
| | Block | 19.875 | 1 | .000 |
| | Model | 19.875 | 1 | .000 |

**FORWARD STEPWISE (WALD)**

| Observed | | | Predicted | | |
|---|---|---|---|---|---|
| | | | Y20 | | Percentage correct |
| | | | 0 | 1 | |
| Step1 | Y20 | 0 | 5 | 0 | 100.0 |
| | | 1 | 0 | 11 | 100.0 |
| Overall Percentage | | | | | 100.0 |

**VARIABLES IN THE EQUATION**

| | B | S.E | Wald(Z) | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|
| Step 1[a] C13 | 10.205 | 2.413E3 | .000 | 1 | .997 | 2.705E4 |
| Constant | -70.893 | 1.779E4 | .000 | 1 | .997 | .0000 |

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