FINANCIAL RATIOS AS PREDICTORS OF BANK FAILURE IN KANSAS

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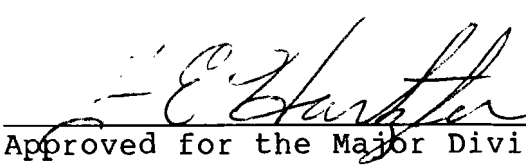
Through 1985 and into 1986, Kansas communities suffered failure of their banking institutions in record numbers. The number of bank failures in Kansas, Nebraska, and Oklahoma were equal in 1985 and led the nation.

The Federal Deposit Insurance Corporation (FDIC) was involved in each of the failures of banks serving Kansas communities. In each instance of failure, the FDIC cited financial difficulties as the cause for intervention by the FDIC. Therefore financial ratios were the focus of the study.

It was found that loans as a percentage of deposits combined with equity as a percentage of assets were associated with bank failure. These two ratios were observed in a total of 55 out of 60 cases of bank failures. These numbers are based upon three annual statements of conditions preceding failure. One year prior to failure, these ratios were associated with failed banks in 19 of 20 cases.

This thesis is an analysis of the causes for these failures and factors predicting them.



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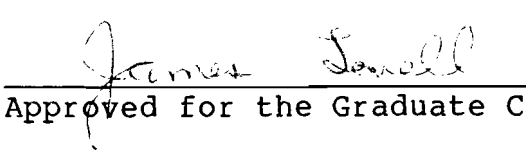

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CHAPTER I

DEFINITION OF PROBLEM

Since 1982 the number of bank failures has increased at an alarming rate. In 1985 a total of 120 banks failed throughout the United States (1:61). Of this total, the agricultural and petroleum producing States of Kansas, Nebraska, and Oklahoma emerged as the nation's leaders in bank failures with 13 each (1:26). The 13 failures in Kansas involved in excess of $240 million of deposits (1:62-67). An additional eight Kansas banks failed during the first seven months of 1986.

Purpose of Study

Few, if any, of these failures of Kansas banks were anticipated by depositors. The quantitative tools with which to predict bank failures have not been the subject of extensive prior research and no recent studies have been devoted entirely to the failure of small banks. This study was therefore begun to identify factors which could predict potential bank failures among small Kansas banks. It was anticipated that identification of these factors could serve the banking public and bank management by providing a heightened awareness of the causes for bank failure and prompting management practices to avert such failures.

Criteria for Study

During the initial consideration of the problem, questions arose involving isolation of factors which would distinguish potential failing banks from potential succeeding banks. Inasmuch as each of the banks which failed in Kansas was identified by the Federal Deposit Insurance Corporation (FDIC) as failing due to financial difficulties (1:61), it was determined that inquiry directed at the financial statements of the affected banks would be the most appropriate measure by which to isolate factors which led to the failure of these banks.

A number of factors were considered as possibly distinguishing failure from probable success. Most of these factors were rejected as violating one or more of the following criteria: (1) ease of accessibility by the banking public, (2) duplicating other relevant factors, and (3) involving factors not generally accepted as measures of a bank's financial condition. Two financial ratios were selected as satisfying these criteria--(1) loans as a percentage of deposits and (2) equity as a percentage of assets. Financial data necessary for calculation of these two percentages were readily available from statements of condition filed of public record annually or from consolidated statements generally available at each bank's business locations. The ratio, loans as a percentage of deposits, was selected as a measure the liquidity of banks. The ratio, equity as a

percentage of assets, was included to assess banks' capital adequacy--their ability to withstand operating losses (capital adaquacy). Both ratios are generally accepted measures of a bank's financial condition as indicated by discussion of these ratios in much of the literature (1, 3, 11, 12, 13, 14, 15, 16, 22).

Hypothesis

Having selected two financial ratios considered appropriate to address the problem, the basic hypothesis of the study was formulated:

1. The mean value of each of these ratios is not statistically equal for the failed and the succeeding banks.

2. These ratios predict a trend toward bank failure when statistically analyzed.

Importance of Study

The potential importance of the study was to provide a method to evaluate of a bank's financial condition, thus allowing the banking industry and the banking public a means to monitor the soundness of a given bank. The banking industry would be provided advance warning of impending failure and to prompt corrective management practices to avoid failure.

Considering that most (13 out of 21) of the Kansas banks which failed during the period January 1, 1985, through July 31, 1986, served communities of two thousand

or fewer population, the scope of the study was seen as being limited to establishing a predictive model for small banks. A review of the related literature was to confirm that only limited attention had been given to small banks and no study directed toward establishing a quantitative predictor model had been conducted involving small banks exclusively.

Definition of Terms

The term "failure", "failed", and "bank failure" as used herein is defined as intervention by the FDIC into the operations of a given bank because of financial difficulties being experienced by said bank. "Failed sample" indicates those banks selected for study which required intervention by the FDIC during the period June 1, 1985 through July 31, 1986. Similarly "succeeding banks" and "successful banks" are those banks which were not classified as a failure as of July 31, 1986.

"LOANS" is defined as total loans less allowance for possible loan losses; "ASSETS" is defined as total assets; "DEPOSITS" is defined as total deposits; "EQUITY" is defined as total equity capital. Each of these definitions with terms appearing on the reports submitted annually to the Kansas Banking Department (20). In Tables 1 and 2, column 7 indicates the amount in column 3 divided by the amount in column 5. Column 8 indicates the amount in column 6 divided by the amount in column 4.

CHAPTER II

REVIEW OF LITERATURE

Some recent studies published concerning bank failures have focused on the manner in which bank failures were handled especially by the insurer, generally the FDIC (3, 4). The literature tended to address the issue of bank failures in a remedial fashion--what was done once the banking institution has failed. While these studies have value because they emphasized the positive and negative aspects of procedures followed in the event of a bank's failing, they provided little insight into predicting, and thereby avoiding, bank failure. In addition, such studies suggest factors which may be quantifiable for inclusion in a quantitative-predictive model.

Risk is inherent in the banking industry as in all business enterprises. It was the conclusion of several writers that the nature and degree of risk accounted for the large number of bank failures during the past five years (5, 6, 7).

Cates (5) identified seven types of risk as important factors in predicting bank failures. He observed, "We have singled that (non-consumer lending) out as a factor that correlates closely with failure, usually

two or three years in advance of failure" (5:18). Of the seven risks considered, Cates cited the risks associated with asset quality, control, and liquidity to be leading contributors to bank failure--"never capital deficiencies." (5:20).

While Cates (5) isolated factors which he considered important precursors of bank failure, these factors were not included in a quantitative-predictive model. Rather, it appeared that these factors were to be analyzed quite subjectively by interested parties. The study also assumed nearly unlimited access to a bank's financial records and operations in order to assess factors such as asset quality, sources of funds, non-consumer lending, and internal control measures.

Huertas and Stauber (6) observed that deposit insurance may account for some of the very failures against which the insurance is issued. Inasmuch as relatively large depositors (up to $100,000 deposits under current FDIC coverage) are insured against loss in the event of the failure of the bank, there exists little incentive for these uninsured depositors to monitor the risks taken by the fincncial institution in question and thus avoid banks which expose depositors to loss in the event of the bank's failure (6:4). This type of regulation imposed by the depositors is commonly known as "market discipline." With the depositors protected against loss, bank management is more at liberty to invest

deposit liabilities in higher risk loans and securities which, owing to the level of risk, offer a much higher potential return. This form of risk may be identified as the risk associated with asset quality discussed by Cates (5:16).

The Huertas and Strauber (6) study defined small banks as those having $100 million or less in deposits and pointed out that of the 12,000 plus banks of this size in the United States only 3 percent of the deposits in these small banks was uninsured (6:6). Compared with this amount of 3 percent nationally, the uninsured deposits in Kansas banks failing or otherwise requiring intervention by the FDIC during 1986 was only about one-fourth of 1 percent (2). Each of the banks included in this thesis met the criteriia for small banks (6).

In a 1984 article, Benston (7) associated failure of banks with the presence of deposit insurance. Banks already financially stressed may seek funds from brokers, which exact high rates of interest in exchange for these funds. To justify the costs of these funds, the bank must in turn seek out high yield/high risk investments. Each of the owners of a beneficial interest in these brokered funds is protected to the $100,000 FDIC limit and may have slight, if any, concern about the manner in which the funds are invested. After all their deposit is insured provided their beneficial interest does not exceed $100,000. Here again, one may relate the problem posed by

brokered deposits and deposit insurance with asset quality and liquidity risks discussed by Cates (5).

Market discipline has been addressed in the writings of a number of observers of the banking the industry's turbulence during the recent past (3, 5, 6, 8, 9, 10). The concept of market discipline is, as one author observed, ". . . the complex process whereby banks fund banks, corporate and public depositors fund banks, securities firms are exposed overnight to bank risk and so forth." (5:19). If suppliers of funds perceived too high of a risk at a given bank, they would withdraw funds, withhold deposits, or require higher interest in return for their placing funds with high risk banking institutions (6:6).

Benston (9) related the absence of market discipline to deposit insurance. He contended, "Deposit insurance allows those who hold a majority of banks' liabilities (depositors) to ignore the institution's financial condition." (9:5).

The proposal for greater financial disclosure on which Benston (9) based his paper was considered a principle element of effective market discipline. Disclosure of sufficient financial information in some detail is certainly a beginning point from which meaningful evaluation of banks' financial conditions may proceed. However, as Gilbert cautioned, it is important that the possible advantages of greater disclosure of

financial conditions, as it may contribute to market discipline, be weighed against the potential adverse impact on the subject bank if less than fully satisfactory information was disclosed (10:76). A financially troubled bank may have succeeded but for disclosure of facts perceived as adverse by depositors.

Responding to inquiry from the editors of Issues in Bank Regulation, the FDIC cited a growing need for market discipline as deregulation of the banking industry progressed (3:6). The FDIC further responded that ". . . discipline could also be encouraged through the suppliers of capital, . . . specifically subordindated debt holders." (9:6).

The encouraging of subordinated debt holders to impose market discipline on banks introduced a new dimension to the concept. If, by raising the equity capital requirement, the FDIC could cause banks to seek additional funds through subordinated debt, efficiently operated banks could raise the additional funds at rates not greatly in excess of those paid on certificates of deposit. The banks posing higher risks could raise the additional equity capital represented by subordinated debt only through payment of a premium for the funds (9:5).

Gilbert (10) questioned the effectiveness of market discipline to prevent excessive risk-taking by banks. He argued that even if disclosure of the financial condition of banks was expanded, the need for regulatory

agencies remained (10:76). If allowed to run its natural course, market discipline could lead to failure of the affected banks and the accompanying loss to uninsured depositors. This issue was addressed in a dual-standard manner by David Cates in an interview published in Barron's (8). Mr. Cates' position was that the harsh reality of market discipline was appropriate when affecting small banks but some banks are "too big to fail" and should be afforded unlimited protection from the FDIC, such protection extending even to creditors and uninsured depositors. If a banking institution was considered too large for the FDIC to allow its failure, such banks would attract a concentration of deposits at the expense of the small banks which can fail without intervention (4:24-25). Given this senerio, "the effects on other depository institutions" about which the regulatory agencies became concerned when Continental Illinois National Bank faced a financial crisis in May 1984 (4:24) are the very result of this double standard. Any bank reaching the threshold of being "too big to fail" would certainly have no incentive to monitor trends toward failure such as risk exposure and critical financial ratios--they would be just "too big to fail" with the FDIC ever ready to lend assistance.

Some of the factors discussed in the literature reviewed to this point may be appropriate as variables in a quantitative model to predict bank failure. Factors such as brokered deposits (7), growth in non-consumer

lending (5), and asset quality (5) could be quantified, but to date, the literature addresses these variables only as subjective considerations.

Notwithstanding the conclusions of Cates (5) that capital deficiency has not been a prior indicator of bank failure, capital adequacy has been a matter of concern addressed in much of the recent literature (1, 3, 11, 12, 13, 14, 15, 16). The FDIC has continued to consider the adequacy of a bank's capital to be a contributor to a bank's financial soundness. The continuing nature of the concern by the FDIC for capital adequacy is indicated by administrative action initiated during 1985 seeking to raise the primary capital (essentially capital as a percentage of assets) requirement from 6 percent to 9 percent (1:18).

Putnam (13) reported in 1983, ". . . the balance sheet can be evaluated using three key classes of variables: asset quality, liquidity and, capital adequacy." (13:10). The study cited the relationship of asset quality to the typical highly-leveraged position of banking institutions. Being highly leveraged, large losses suffered on loans and securities transactions can lead to the institution's demise (13:11-12). Liquidity problems, Putnam contended, usually accompany failure (13:12) and should therefore be monitored closely. Capital adequacy was presented as a virtual cornerstone of bank operations and capital must be a sufficiently large

percentage of assets to allow the banking institution to withstand sustained losses (13:12).

Putnam (13) discussed asset quality in terms which closely related asset quality to capital adequacy (13:11-12). If large losses on loans and securities surfaced as a cause of failure, capital must be adequate to withstand losses (13:12). It would appear that Putnam's discussion of capital adequacy and asset quality involved virtually the same factor. One could expect that, given this analogy, entering either an asset quality or a capital adequacy measurement into a discriminant function would add little to the discriminatory power of the multivariate discriminant function.

In a 1983 study Bovenzi, Marino, and McFadden (12) reported a quantitative model for predicting bank failure. The study was prompted by the FDIC's exploring the possibility of risk-related deposit insurance premiums (12:14). The data were not analyzed by discriminant analysis to establish the probability of failure of banks (12:19-22). The model failed to produce results superior to other similar attempts to construct a predictive model. The model's ability to detect bank failures ranged from 35 percent three years prior to failure to 67 percent one year prior to failure (12:22).

The Bovenzi, Marino, and McFadden study (12) did point out a consideration not specifically addressed in the other literature. Both Type I and Type II errors both

occurred in predictive models. Among considerations for developing a predictive model should be to minimize Type I errors in classification (12:14). A Type I error results in a failed (or failing) bank being classified as succeeding.

The concern over capital adequacy continued to be associated with bank failure. Citing "under capitalization and high risk lending" (14:67) as contributing factors in the failures of United American Banks (Tennessee) and Penn Square Bank (Oklahoma), Dince concluded that the level of loan participations and the rising level of reserves for bad debts should have served as a warning to banking regulatory authorities of financial distress to indicating corrective administrative measures.

It is to be noted that much of the information upon which Dince (14) based his findings was gained through hearings conducted by the House Subcommittee on Governmental Operations (14:68, 70). This information included items such as the rating given Penn Square Bank by banking examiners (14:69) and administrative orders issued to United American Banks regarding questionable banking practices (14:70). Such information is not normally available as a matter of public information and could not be obtained for a sufficient number of banks to serve as a basis for the statistical analysis. The Kansas Banking Department does not publicly disclose information

of this nature either prior to or following a bank's failure.

Today Continental Illinois National Bank and Trust Company (Continental) is a viable financial institution. However, in May 1984, Continental was facing liquidity problems and possible failure which could have produced a ripple effect throughout a considerable segment of the economy (22:3). In response to the situation, the FDIC provided an infusion of funds, in the amount of $1.5 billion, in the form of a subordinated loan to Continental (3:3-4). The subordinated loan was considered by the FDIC to be an interim measure pending a permanent program to assist Continental (3:4). Being subordinated to other liabilities of Continental, the loan may be viewed as an input of funds to establish capital adequacy.

In seeking a permanent program to stabilize the financial condition at Continental, the FDIC, in addition purchasing $3.5 billion of Continental's loans, proposed to acquire an additional $1 billion in preferred and convertible preferred stock (15:6-7). The interim loan in the amount of $1.5 billion was to be repaid upon implementation of the permanent assistance program (15:8). Thus it appeared that through FDIC assistance in rebuilding Continental's capital adequacy, a major bank failure was averted.

Not unlike Cates study (5), Noonan and Fetner (16) identified a listing of risks which includes asset quality

and liquidity (16:51). However, Noonan and Fetner related the potential losses from each type of risk to the need for capital adequacy (16:52). Since operating loss is certainly an element of insolvency and failure of a bank, capital may be viewed as the cushion which permits a bank to withstand temporary financial reversals.

In a 1985 article, Rose and Kolari (11) reported tracking the failures of 94 banks from across the United States during the period 1964-1977 (11:48). Each failing bank was analyzed during the eight years prior to its failure using 23 financial indicators introduced by the FDIC by its Integrated Monitoring System (IMS). These financial indicators included equity as a percentage of assets (equity/assets) and loans as a percentage of deposits (loans/deposits) as measures of capital adequacy and liquidity respectively (11:45-46).

The study (11) tested each of the variables separately for significance through application of a statistical t-test. Equity/assets tested significant at the 5 percent level during the sixth and fifth year prior to failure and at the 1 percent level one year prior to failure (11:51). Equity/assets equaled 8.5 percent for the succeeding banks and 6.6 percent for failed banks one year prior to closure (11:48). However, when entered as a variable into a discriminant function, the ratio, equity/assets, did not prove a powerful contributor in discriminating between failed and comparable succeeding

banking institutions (11:55).

Rose and Kolari (11) also considered loans as a percentage of deposits (loans/deposits) in their analysis of the data (11:45-46). A t-test indicated significance at the 5 percent level (or better) during the six years prior to failure (11:52). Loans/deposits averaged 57.6 percent for succeeding banks and 71.3 percent for failed banks one year prior to failure and was the greatest contributor to the discriminant function predicting failed banks verses succeeding banks. The ratio also proved to be a major contributor during the second and third years prior to failure (11:55).

The project (11) included equity/assets and loans/deposits in various combinations with 21 other financial indicators. The study concluded that the financial ratios and indicators tracked by IMS were significant as individual factors but, when entered into multivariate analysis, provided little in the way of predictive ability. This observation was not intended however to preclude the possibility that an appropriate combination of the IMS factors would yield enhanced predictive strength (11:56).

It may be concluded from the previous review of publications relating to bank failures that many of the factors which are discussed as contributing to failure of banks related to highly subjective criteria and generally involved large banks as defined by Huertas and Strauber

(6:6).

The major quantitative study involving discriminant analysis (11) appears to include banks from accross the nation in all size catagories. In addition the Rose and Kolari study focused on the 94 bank failures occurring during the period 1964-1977 (14:48) and failed to address the period 1982-1985 during which period bank failures reached record numbers--a period during which deregulation of the banking industry was first exerting its impact.

CHAPTER III

METHODOLOGY

The ratios selected for this study, loans as a percentage of deposits and equity as a percentage of assets, were tested statistically by multivariate discriminant analysis (MDA). This technique appears to be appropriate when one wishes to compare the means of two or more groups for significant differences. While a number of statistical tests compare means, MDA allows introduction of two or more variables for simultaneous comparison. One text (17) explains, "Discriminant analysis involves deriving the linear combination of the two (or more) independent variables that will discriminate best between the a priori defined groups. This is achieved by the statistical decision rule of maximizing the between-group variance relative to the within-group variance; this relationship is expressed as the ratio of between-group to within-group variance." As applied to this thesis, MDA was selected to study the separation of failed and succeeding banks based upon financial ratios.

The population of this study was confined to banks chartered by the State of Kansas which served Kansas communities of not more than 2000 persons. Subjects were drawn from this population based on their status as a bank that failed during the period June 1, 1985 through July

31, 1986 to be compared with a sample of banks which had not failed during the same period (20). Ten banks were selected from each group.

The ten failed banks, comprising the sample, were selected randomly from 13 banks in the failed catagory. The random selection was accomplished by assigning a number to each of the 13 banks and drawing from these 13 numbers one of the numbers assigned. After drawing one of the 13 numbers, the number drawn was placed back into the group of 13 and another number was withdrawn. In the event a previously drawn number was selected the number was replaced into the group of 13. This procedure was continued until a sample of ten banks was obtained.

Ten succeeding banks, comprising the sample, were systematically selected for comparison from those banks which had not failed as of July 31, 1986. These ten banks were selected from a directory of Kansas banks (19). The directory contained 230 pages of bank listings. The bank selected was the first bank meeting the selection criteria of state chartered and community population on or following page one and each succeeding twenty-third page following page one.

The financial data from which the ratios were computed and the computed percentages appear in Tables 1 and 2. This financial data, available at a nominal cost, were obtained from records available to the public in the offices of the Kansas Banking Department. Information,

from which the selected ratios were computed, is also generally available from individual banks at their business locations. The Kansas Banking Department maintains records of this nature for a period of five years following filing. The data were entered into a computer spreadsheet for processing and analysis. The computer printout for each of the years studied appears as Appendix 1.

In formulating the hypothesis, it was determined that MDA was the most appropriate statistical test by which to measure the contributation made by selected financial ratios to discrimination between failed banks and succeeding banks. Two variables were to be considered in predicting the future of a given bank thus requiring a statistical technique allowing multivariates.

The data concerning the failed banks relative to the succeeding banks were entered into a MDA formula. The analysis closely followed the hypothetical example presented by Weston and Brigham (18:186-195). Whether MDA utilizes a matrix structure (17) or linear equations (18), the end result remains essentially the same--isolation of factors which discriminate between two or more groups and thereby predict their classification in one of the a priori groups, in this study, failed bank or succeeding bank.

Weston and Brigham (18) presented formulae appropriate for two variables in a discriminant function.

The solution for two simultaneous equations resulted in an algebraic expression defining Z as a function of X(1) and X(2), the two independent variables entered into the equation.

The problem addressed by this study similarly involved two independent variables, loans as a percentage of deposits and equity as a percentage of assets. The resultant formula, in the form of Z= aX(1) + bX(2), indicated a Z score for each bank during each year under consideration. Computations performed involving the relevant data are contained in Table 3.

Discriminant formulae were derived for each of the three years preceeding failure of the banks comprising the failed sample. Since four of the failed banks did not file annual statements of condition for the final fiscal year of operation (20), data for these four banks included the annual statements for the years 1982, 1983, and 1984. Except for these four instances involving a failed bank, the period considered by this study encompassed the three annual statements of condition beginning with the June 30, 1983 statement. The results of the MDA analysis are shown in Table 4.

In the cases of the four banks which did not file a annual statement of condition covering the period July 1, 1984 through June 30, 1985 (20), the data analyzed were based on three annual statements of condition, the final one of which was filed not more than 13 months prior to

failure. The data from these four banks could (given the sample size limitation) distort the formulae derived toward Type I error (12). This distortion may occur because the last annual report filed by these four banks was for the period ended June 30, 1984, whereas the remaining banks filed an annual report for the period ended June 30, 1985. If failure of a given bank became increasingly predictable as its failure became imminent, one may anticipate the older data to introduce some misclassification of failing banks as succeeding. It may be argued that the data for the banks serving Dexter, Edna, Eskridge, and Madison could be regarded as data for the second year prededing failure rather than for the first year prior to their failing.

The 20 banks comprising the test group were examined by considering the selected financial ratios individually. This procedure was simply arranging the calculated ratios for each bank in ascending order and observing the range of where the scores for the two groups appeared in the same region. These rankings appear in Table 6.

The predictive strength of model was further tested by applying the formulae derived to financial ratios calculated for banks which failed during 1986, but which were not included in the test group. Using the same financial ratios as were used in deriving the discriminant formulae, a Z score was calculated for each of the banks. Data used in testing these banks were taken from summary

statements of condition for each bank as published in the 1985-1986 Kansas Bank Directory (19) and summarized the June 30, 1985 annual statements of condition.

The formula applied to test the banks failing in 1986 was determined by the date of closure. Banks which closed prior to June 30, 1986 were tested by the Z formula applicable to the annual statement of condition filed one year prior to closing. Those banks closing after June 30, 1986 were tested using the formula applicable to the second annual statement of condition preceding failure. Z scores for these banks appears in Table 7.

Limiting the study was the size of the sample selected for initial analysis and the number of variables included. Knowledge of the dates on which the failed banks were placed on the "problem" list by bank examiners would also assist in the determination of factors relavent as early predictors of failure.

CHAPTER IV

FINDINGS

The results of testing the data through discriminant analysis suggest the validity of the hypothesis on which the study was based. Table 4 lists Z scores for each of the 20 banks comprising the sample. The lower Z scores generally favored the successful banks.

During the period covered by the third annual statement of condition preceding failure, only one bank which ultimately failed scored in the range of scores computed for successful banks. Three banks which ultimately failed scored in the range covered by the ten succeeding banks during the second reporting period prior to failure, and only one failed bank scored in the succeeding range of scores during the period covered by the final annual statement of condition filed.

Table 4 indicates the scores calculated for each bank included in the two groups. A threshold score may be arbitrarily established above which a bank is classified as a potential failure. If one sets the threshold score at 400 for the 1982/1983 period, all of the scores for failed banks would appear above this threshold score, thus eliminating Type I errors in classification. Similarly, a threshold score of 400 for the 1983/1984 period would

result in only one Type I error in classification. During the 1984/1985 period, no Type I errors in classification appear if the threshold score is set at 750.

Assigning threshold scores eliminates (or minimizes) Type I errors but the number of Type II errors in classification increases. Compromising the number of Type II errors in classification to eliminate (or reduce) Type I errors appeared preferable and, it (minimization of Type I errors) is a position supported by prior research (12).

Conceding the fact that establishing threshold scores increases the number of Type II errors in classification, one may argue that those banks which in fact succeed following their classification as a potential failure represent marginal members of the succeeding group. As such, the operations of these banks may be the subject of closer monitoring by depositors and the bank's management.

A comparison of Z score rankings for the three annual statements of condition next preceding failure (in the instances of succeeding banks, the 1983, 1984, and 1985 annual statements of condition) appears in Table 5. Here too only one bank which ultimately failed is classified as a succeeding bank based on composite Z scores (Type I error). Lower composite scores generally indicate succeeding banks.

Entering the appropriate data into the formulae

contained in Table 3 and completing the calculations resulted in a formula for each of the years studied. The formulae derived for the succeeding banks was based upon data contained in the 1983, 1984, and 1985 annual statements of condition. The data for the failed banks were taken from annual statements for similar periods with the exception of the banks serving the communities of Dexter, Edna, Eskridge, and Madison.

The annual statements for these four banks were not filed for the period ended June 30, 1985 because of their closure on or near the date of required filing. These four banks closed during the period June 13, 1985 through July 18, 1985. The data included for these four banks were from annual statements filed in 1982, 1983, and 1984, being the last three statements filed prior to closing.

Since the data included for the banks serving the communities of Dexter, Edna, Eskridge, and Madison were approximately one year older than the data for the remaining six banks in the failed bank group, some distortion of Z scores might be anticipated. Assuming that loans as a percentage of deposits increased and/or equity as a percentage of assets decreased during the approximately 12 months of operation prior to the closing of these four banks, the formulae would result in even greater discrimination between the failed group and the succeeding group. When one considers the case of Farmers and Merchants State Bank of Dexter, Kansas (Dexter), this

assumption becomes increasingly credible.

The Z scores for Dexter ranked number eight and number two based on data from the third and second annual statements of condition filed preceding failure. The last annual statement of condition placed Dexter at number twelve. Only the final statement of condition placed Dexter in the failed range of Z scores. Closure did not, however, occur until June 20, 1985 (1:62) or nearly a year after the last filing of a statement of condition. Given the previous Z scores calculated for Dexter, one must conclude that a marked deterioration in financial condition occurred between June 30, 1984 and the date of closure. It may be argued that the final statement of condition filed for Dexter could be better analyzed using a formula applicable to the second year prededing failure.

The predictive strength of model was further tested by applying the formulae derived to financial ratios calculated for banks which failed during 1986 which were not included in the test sample. As indicated by Table 6, the Z scores for each of these banks fell within the range of Z scores calculated for the failed banks in the original test group.

When the Z scores of these banks are considered relative to the suggested threshold scores, their classification as a potential failure becomes even more plausible. Even without reference to threshold scores, any bank scoring in the range of potential failure

warrants attention.

Finally, when the variables were considered individually as a means of discriminating between the failed group and the succeeding group, it was found that loans as a percentage of deposits offered somewhat greater discrimination than equity as a percentage of assets. Table 6 indicates that loans/deposits produced two Type I errors compared with four Type I errors which appeared when equity/assets was considered individually.

Referring to the original hypothesis, it was found that the means of the two financial ratios are not statistically the same for the failed successful bank groups. Secondly, the selected ratios, loans as a percentage of deposits and equity as a percentage of assets, are factors which predict a trend toward bank failure when entered as variables in a formula derived through discriminant analysis.

CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

This thesis focused on the use of financial ratios to predict failures among banking institutions. The statistical test considered appropriate to investigate the problem was one those which determined the similarity of the mean values of two or more variables. Secondly, the study sought to establish the strength of the selected financial ratios as predictors of bank failure.

The literature appearing since deregulation of the banking industry began in 1980 disclosed little in the way of quantitative studies devoted to predicting failures, especially among small banks serving small communities. Since Kansas ranked among the nation's leaders in bank failures and most of these failures involved small banks which served small communities, it was determined that a study devoted to the causes for these failures and the predictability of failure was appropriate.

It was considered necessary that the data, upon which a study of this nature could be based, be readily available to the banking public as well as the banking industry. Therefore two financial ratios were selected as potential predictors of a bank's degree of success. Loans as a percentage of deposits and equity as a percentage of

assets were selected as indicators of the soundness of banks and both could be determined from readily available public records.

When entered into a formula derived through discriminate analysis, these variables proved useful in classifying a given bank as a potential failure as long as three years (or longer) prior to failure. The range of scores computed for the two groups (failed and succeeded) indicated reasonably high between-group discrimination was obtained through use of the two selected ratios in a discriminant formula.

When a score was arbitrarily determined above which a bank was classified as a potential failure, Type I errors in classification were eliminated for the first and third annual reporting periods. While this arbitrary determination was effective in eliminating Type I errors, the number of Type II errors was made greater but, for purposes of this research, the compromise in favor of an increased number of Type II errors was considered preferable.

Conclusions

From the study, it may be concluded that failure of a banking institution is not an event which occurs suddenly and without prior warning. Properly analyzed, financial ratios afford some insight into the future of a given bank. Although, as with virtually any predictive model, the insight afforded is imperfect, the information made available through a simple formula can serve as a warning

to both bank depositors and bank management.

Implications for futher studies include expanding the number of banks considered covering an expanded geographic area. Inclusion of banks of all sizes would further test the predictive strength of the model presented by this paper.

The selection of banks for the succeeding group in this study was made solely on the basis of their status as having not failed at the time of selection. Perhaps future studies could compare failed banks with highly successful banks (as determined by measurable factors) to develop discriminant formulae which may enhance the predictive strength of the model presented herein.

It is not the purpose of a study of this nature to predict failure and then revel at the accuracy of the predictive model when a bank failure occurs. Rather a quantitative predictor model as developed by this study is intended to contribute to greater understanding of how bank failures develop and determine management practices to avoid failure.

Recommendations

Based upon the findings of this study, it is anticipated that further studies, including additional variables, a larger sample, and studying expanded geographic areas could be the subject of future research. The initial expansion of this thesis is seen as including all banks which have failed in Kansas during a defined

period compared to banks which continue to operate.

Table 1

Three Years' Data and Calculated Financial Ratios
(successful banks: $ X 1000)

1 BANK CITY	2 YEAR	3 LOANS	4 ASSETS	5 DEPOSITS	6 EQUITY	7 3/5 %	8 6/4 %
ALDEN STATE	1983	2503	3508	2897	608	86.4	17.3
ALDEN, KS	1984	2377	4040	3419	618	69.5	15.3
	1985	2606	4689	3933	691	66.3	14.7
BUSHTON STATE	1983	4402	9533	8497	900	51.8	9.4
BUSHTON, KS	1984	4929	9873	8818	909	55.9	9.2
	1985	4660	8611	7437	997	62.7	11.6
PEOPLES EXCHANGE	1983	1695	4537	4121	354	41.1	7.8
ELMDALE, KS	1984	2418	4777	4348	386	55.6	8.1
	1985	2832	4539	4170	328	67.9	7.2
FARMERS STATE	1983	7403	13572	11843	1465	62.5	10.8
HARDTNER, KS	1984	8236	14858	12892	1654	63.9	11.1
	1985	9797	16263	14171	1802	69.1	11.1

Table 1 (continued)

KANOPOLIS STATE	1983	4562	8995	8159	819	55.9	9.1
KANOPOLIS, KS	1984	5610	10740	9055	888	62.0	8.3
	1985	6011	12552	11301	1029	53.2	8.2
STATE BANK OF LEBO	1983	5409	12389	10005	2128	54.1	17.2
LEBO, KS	1984	5695	11971	9612	2177	59.2	18.2
	1985	6133	13004	10570	2196	58.0	16.9
LINN STATE	1983	5099	9645	8541	967	59.7	10.0
LINN, KS	1984	6813	10678	9444	1000	72.1	9.4
	1985	7057	11831	10646	1009	66.3	8.5
FARMERS STATE	1983	4609	7739	6529	824	70.6	10.6
OFFERLE, KS	1984	5788	8768	7696	840	75.2	9.6
	1985	6041	9723	8655	893	69.8	9.2
RAYMOND STATE	1983	1880	3528	3090	438	60.8	12.4
RAYMOND, KS	1984	2240	4015	3545	464	63.2	11.6
	1985	2447	4205	3591	559	68.1	13.3

Table 1 (continued)

TIMKEN STATE	1983	4154	6339	5394	945	77.0	14.9
TIMKEN, KS	1984	4272	6847	5620	1118	76.0	16.3
	1985	3236	5684	5010	557	64.6	9.8

Table 2

Three Years' Data and Calculated Financial Ratios
(failed banks: $ X 1000)

1 BANK CITY	2 YEAR	3 LOANS	4 ASSETS	5 DEPOSITS	6 EQUITY	7 3/5 %	8 6/4 %
FARMERS STATE BANK	1982	3178	5781	4987	633	63.7	10.9
DEXTER, KS	1983	2780	5735	5176	447	53.7	7.8
	1984	3562	5571	5046	435	70.6	7.8
FIRST STATE BANK	1982	5776	8437	7601	717	76.0	8.5
EDNA, KS	1983	6820	10011	8365	669	81.5	6.7
	1984	7003	10528	9875	548	70.9	5.2
ESKRIDGE STATE	1982	5447	8674	7925	749	68.7	8.6
ESKRIDGE, KS	1983	6797	8939	7933	951	85.7	10.6
	1984	8025	9644	8550	1017	93.8	10.5
FARMERS & MERCHANTS	1983	21677	29262	25346	2223	85.5	7.6
LaCROSSE, KS	1984	24148	31453	28007	2658	86.2	8.5
	1985	26063	34617	31174	2553	83.6	7.4

Table 2 (continued)

MADISON BANK	1982	4284	6639	5889	511	72.7	7.7
MADISON, KS	1983	5035	7582	6766	562	74.4	7.4
	1984	5621	8432	7734	535	72.7	6.3
CITIZENS STATE	1983	10524	11782	10062	1536	104.6	13.0
McCRACKEN, KS	1984	9494	10945	9597	1055	98.9	9.6
	1985	9717	11413	10552	697	92.1	6.1
CITIZENS STATE	1983	17230	24736	21439	2719	80.4	11.0
ST. FRANCIS, KS	1984	19245	28027	24171	2665	79.6	9.5
	1985	17968	25332	23085	1530	77.8	6.0
SEDAN STATE	1983	18536	28493	25566	2265	72.5	7.9
SEDAN,KS	1984	19100	30161	27372	2354	69.8	7.8
	1985	17892	28153	26586	1252	67.3	4.4
TALMAGE STATE	1983	6206	8800	7674	860	80.9	9.8
TALMAGE, KS	1984	8089	10290	9207	886	87.9	8.6
	1985	8842	10846	9960	628	88.8	5.8

Table 2 (continued)

WHITE CLOUD	1983	2793	5095	4505	294	62.0	5.8
WHITE CLOUD, KS	1984	3213	5906	5313	470	60.5	8.0
	1985	3764	6098	5567	459	67.6	7.5

Table 3

Calculations for Multivariate
Discriminant Analysis

The following calculations utilize the methodology presented by Weston and Brigham (18:185-195):

Between-group variances, S(11) and S(22) are determined for each variable:

$$S(11)=\sum\left[X(11j)-\bar{X}(11)\right]^2+\sum\left[X(12j)-\bar{X}(12)\right]^2=$$

column f, line 14, appendix 1 plus column f, line 28, appendix 1.

$$S(22)=\sum\left[X(21j)-\bar{X}(21)\right]^2+\sum\left[X(22j)-\bar{X}(22)\right]^2=$$

column K, line 14, appendix 1 plus coluumn K, line 28, appendix 1.

Within-group variances, S(12) and S(21) are determined:

$$S(12)=S(21)=\sum\left[X(11j)-X(11)\right]\left[X(21j)-X(21)\right]+\left[X(12j)-X(12)\right]\left[X(22J-X(22)\right]=$$

column L, line 14, appendix 1 plus column L, line 28, appendix 1.

$D(1)= X(11) - X(12)$ and $D(2)= X(21) - X(22)$.

$V(1)S(11) + V(2)S(12)= D(1)$

$V(1)S(21) + V(2)S(22)= D(2)$

Where X(11j) is the value of X for the first variable in the first group for bank j (j= 1 to 10) and X(12j) is the value of X for the first variable in the second group for bank j, etc.

Table 3 (continued)

Solving the simultaneous equations for D(1) and D(2) yields a Z score formula, $Z = V(1)X(1) = V(2)X(2)$, where X(1) is the value for the first variable for each bank and X(2) is the value for the second variable for each bank.

Table 4

Z Scores
Succeeding (SUC.) and Failed (FAIL) Banks

1982/1983		1983/1984		1984/1985	
SUC.	FAIL	SUC.	FAIL	SUC.	FAIL
168		274		367	
245			358	537	
318		360		547	
343		371		581	
366		391		612	
385		398		658	
396		404		687	
	406		414	719	
452		423		750	
483		441			765
494		495		778	
	502		495		800
	508	519			847
	562		539		872
	569		557		877
	573		595		954
	584		609		999
	605		626		1060
	701		639		1118
	775		720		1157

Table 5

Ranking by Z Scores

Community Served	Year			Composite Score
	1982/ 1983	1983/ 1984	1984/ 1985	
Lebo	1	1	1	3
Elmdale	2	4	11	17
Bushton	3	3	4	10
Raymond	4	5	4	14
Kanopolis	5	9	2	16
Linn	6	11	8	25
Hardtner	7	7	7	21
Dexter *	8	2	12	22
Timken	9	10	6	25
Offerle	10	13	9	32
Alden	11	6	3	20
White Cloud *	12	8	10	30
Eskridge *	13	16	18	47
Sedan *	14	12	13	39
Madison *	15	14	14	43
St. Francis *	16	15	16	47
Edna *	17	17	15	49
Talmage *	18	19	19	56
LaCrosse *	19	18	17	54
McCracken *	20	20	20	60

* denotes banks which failed during the period July 1, 1984 through July 31, 1985

Table 6

Discrimination by Individual Variables
(1984/1985 annual statements)

Equity/Assets		Loans/Deposits	
Suc.	Fail	Suc.	Fail
169		532	
147		580	
133		627	
116		646	
111		663	
	105	663	
98			673
92			676
85		679	
82		681	
	78	691	
	75	698	
	74		706
72			709
	63		727
	61		778
	60		836
	58		888
	52		921
	44		938

Table 7

Z Scores of Banks Failing in 1986
(not included in test group)

Community Served	Z Score	Date of Closing
White City	1101	January 9
Nortonville	765	May 1
Chanute	815	June 19
Kiowa	529	July 17
McCune	420	July 24
Easton	529	August 7
Yates Center	445	August 14
Westphalia	503	August 15
Minneapolis	505	August 21
LaCrosse *	652	September 25
Hoxie	582	November 13
Hays	578	December 4

* Home State Bank (Farmers and Merchants State Bank of Rush County, LaCrosse, included in test group)

References

1. U.S., Federal Deposit Insurance Corporation, 1985 Annual Report, (by Juliette E. Amberson). Washington: FDIC, 1986.

2. Palmer, Judy K. Correspondence to author. 3 July 1987.

3. "The Continental Illinois Assistance Program: The View of FDIC." Issues in Bank Regulation, 7, no. 4 (1984): 3-5.

4. U.S., Federal Reserve Bank of St. Louis. Recent Changes in Handling Bank Failures and Their Effects on the Banking Industry, (by R. A. Gilbert). St. Louis: Federal Reserve Bank, 1985.

5. Cates, David C. "Bank Risk and Predicting Bank Failures." Issues in Bank Regulation, 9, no. 2 (1985): 16-20.

6. Huertas, Thomas F. and Stauber, Rachel L. S. "Deposit Insurance: Overhaul or Tune-up?" Issues in Bank Regulation, 9, no. 3 (1986): 3-24.

7. Benston, George J. "Brokered Deposits and Deposit Insurance Reform." Issues in Bank Regulation, 7, no. 4 (1984): 17-24.

8. "All Debits, No Credits." Barron's, 30 July 1984: 6-18.

9. Benston, George J. "Financial Disclosure and Bank Failure." Economic Review (Federal Reserve Bank of Atlanta), 69, no. 3 (1984): 5-12.

10. Gilbert, Gary G. "Disclosure and Market Discipline: Issues and Evidence." Economic Review (Federal Reserve Bank of Atlanta), 68, no. 11 (1983): 70-76.

11. Rose, Peter S. and Kolari, James W. "Early WarningSystems as a Monitoring Device for Bank Condition." Quarterly Journal of Business and Economics, 24, no.1 (1985): 43-60.

12. Bovenzi, John F., Marino, James A., and McFadden, Frank E. "Commercial Bank Failure Prediction Models." Economic Review (Federal Reserve Bank of Atlanta), 68,

no. 11 (1983): 14-26.

13. Putnam, Barron H. "Early Warning Systems and Financial Analysis in Bank Monitoring: Concepts of Financial Monitoring." Economic Review (Federal Reserve Bank of Atlanta), 68, no. 11 (1983): 6-13.

14. Dince, Robert R. "Domestic Failures and Bank Examination." Issues in Bank Regulation, 8, no. 1 (1984): 67-71.

15. "A Permanent Assistnace Program for Continental Illinois Bank and Trust Company." Issues in Bank Regulation, 7, no. 4 (1984): 6-10.

16. Noonan, John H. and Fetner, Susan K. "Capital and Capital Standards." Economic Review (Federal Reserve Bank of Atlanta), 68, no. 11 (1983): 50-53.

17. Hair, Joseph F., Anderson, Rolph E., and Tatham, Ronald L. Multivariate Data Analysis. New York: Macmillan, 1987.

18. Weston, J. F., and Brigham, Eugene F. Managerial Finance. 7th ed. Hinsdale: Dryden Press, 1981.

19. "1985-1986 Kansas Bank Directory", Bank News. Kansas City: 1986.

20. Kansas Banking Department, Correspondence to author. 8 Sept. 1986.

Bibliography

"All Debits, No Credits." Barron's, 30 July 1984: 6-18.

Benston, George J. "Brokered Deposits and Deposit Insurance Reform." Issues in Bank Regulation, 7, no. 4 (1984): 17-24.

---, "Financial Disclosure and Bank Failure." Economic Review (Federal Reserve Bank of Atlanta), 69, no. 3 (1984): 5-12.

Bovenzi, John F., James A. Marino, and Frank E. McFadden. "Commercial Bank Failure Prediction Models." Economic Review (Federal Reserve Bank of Atlanta), 68, no. 11 (1983): 14-26.

Cates, David C. "Bank Risk and Predicting Bank Failures." Issues in Bank Regulation, 9, no. 2 (1985): 16-20.

"The Continental Illinois Assistance Program: The View of FDIC." Issues in Bank Regulation, 7, no. 4 (1984): 3-5.

Dince, Robert R. "Domestic Failures and Bank Examination." Issues in Bank Regulation, 8, no. 1 (1984): 67-71.

Gilbert, Gary G. "Disclosure and Market Discipline: Issues and Evidence." Economic Review (Federal Reserve Bank of Atlanta), 68, no. 11 (1983): 70-76.

Hair, Joseph F., Rolph E. Anderson, and Ronald L. Tatham. Multivariate Data Analysis. New York: Macmillan, 1987.

Huertas, Thomas F. and Rachel L. S. Stauber. "Deposit Insurance: Overhaul or Tune-up?" Issues in Bank Regulation, 9, no. 3 (1986): 3-24.

1985-1986 Kansas Bank Directory, Kansas City: Bank News, 1986.

Noonan, John H. and Susan K. Fetner. "Capital and Capital Standards." Economic Review (Federal Reserve Bank of Atlanta), 68, no. 11 (1983): 50-53.

"A Permanent Assistnace Program for Continental Illinois Bank and Trust Company." Issues in Bank Regulation,

7, no. 4 (1984): 6-10.

Putnam, Barron H. "Early Warning Systems and Financial Analysis in Bank Monitoring: Concepts of Financial Monitoring." Economic Review (Federal Reserve Bank of Atlanta), 68, no. 11 (1983): 6-13.

Rose, Peter S. and James W. Kolari. "Early Warning Systems as a Monitoring Device for Bank Condition." Quarterly Journal of Business and Economics, 24, no.1 (1985): 43-60.

U.S., Federal Deposit Insurance Corporation, 1985 Annual Report, (by Juliette E. Amberson). Washington: FDIC, 1986.

U.S., Federal Reserve Bank of St. Louis. Recent Changes in Handling Bank Failures and Their Effects on the Banking Industry, (by R. A. Gilbert). St. Louis: Federal Reserve Bank, 1985.

Weston, J. F., and Eugene F. Brigham. Managerial Finance. 7th ed. Hinsdale: Dryden Press, 1981.

Appendix 1

Computer Printout

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2	FAILED	L/D	AVG L/D	DIFF L/D		COL. D^2	E/A	COL. G AVG		DIFF E/A	COL. J^2	COL D*J
3	DEXTER	63.7		-13		169	10.9			1.82	3.3124	-23.66
4	EDNA	76		-0.7		0.49	8.5			-0.58	0.3364	0.406
5	ESKRIDGE	68.7		-8		64	8.6			-0.48	0.2304	3.84
6	LACROSSE	85.5		8.8		77.44	7.6			-1.48	2.1904	-13.024
7	MADISON	72.7		-4		16	7.7			-1.38	1.9044	5.52
8	MCCRACKEN	104.6		27.9		778.41	13			3.92	15.3664	109.368
9	ST FRANCI	80.4		3.7		13.69	11			1.92	3.6864	7.104
10	SEDAN	72.5		-4.2		17.64	7.9			-1.18	1.3924	4.956
11	TALMADGE	80.9		4.2		17.64	9.8			0.72	0.5184	3.024
12	WHITE CLO	62	76.7	-14.7		216.09	5.8	9.08		-3.28	10.7584	48.216
13												
14		SUMATIONS OF COLUMNS:				1370.4					39.696	145.75
15												
16	SUCCESSFUL											
17	ALDEN	86.4		24.41		595.8481	17.3			5.35	28.6225	130.5935
18	BUSHTON	51.8		-10.19		103.8361	9.4			-2.55	6.5025	25.9845
19	ELMDALE	41.1		-20.89		436.3921	7.8			-4.15	17.2225	86.6935
20	HARDTNER	62.5		0.51		0.2601	10.8			-1.15	1.3225	-0.5865
21	KANOPLIS	55.9		-6.09		37.0881	9.1			-2.85	8.1225	17.3565
22	LEBO	54.1		-7.89		62.2521	17.2			5.25	27.56249	-41.4225
23	LINN	59.7		-2.29		5.2441	10			-2.29	5.2441	5.2441
24	OFFERLE	70.6		8.61		74.1321	10.6			8.61	74.1321	74.1321
25	RAYMOND	60.8		-1.19		1.4161	12.4			-1.19	1.4161	1.4161
26	TIMKEN	77	61.93	15.01		225.3001	14.9	11.95		15.01	225.3001	225.3001
27												
28		SUMATIONS OF COLUMNS:				1541.769				20.04	395.4473	524.7114
29												
30												
32		S11=	2912.169									
33		S12=	670.4614									
34		S21=	670.4614									
35		S22=	435.1433									
36		D1=	14.71									
37		D2=	-2.87									

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2	FAILED	L/D	AVG L/D	DIFF L/D		COL. D^2	E/A	COL.G AVG		DIFF E/A	COL. J^2	COL D*J
3	DEXTER	53.7		-24.12		581.7744	7.8			-0.65	0.4225	15.678
4	EDNA	81.5		3.68		13.5424	6.7			-1.75	3.062499	-6.44
5	ESKRIDGE	85.7		7.88		62.0944	10.6			2.15	4.6225	16.942
6	LACROSSE	86.2		8.38		70.2244	8.5			0.05	0.0025	0.419000
7	MADISON	74.4		-3.42		11.6964	7.4			-1.05	1.1025	3.591
8	MCCRACKEN	98.9		21.08		444.3664	9.6			1.15	1.3225	24.242
9	ST FRANCI	79.6		1.78		3.168399	9.5			1.05	1.1025	1.869
10	SEDAN	69.8		-8.02		64.3204	7.8			-0.65	0.4225	5.213
11	TALMADGE	87.9		10.08		101.6064	8.6			0.15	0.0225	1.512
12	WHITE CLO	60.5	77.82	-17.32		299.9824	8	8.45		-0.45	0.2025	7.794
13												
14		SUMATIONS OF COLUMNS:				1652.776					12.28499	70.82
15												
16	SUCCESSFUL											
17	ALDEN	69.5		4.24		17.9776	15.3			3.59	12.8881	15.2216
18	BUSHTON	55.9		-9.36		87.6096	9.2			-2.51	6.3001	23.4936
19	ELMDALE	55.6		-9.66		93.3156	8.1			-3.61	13.0321	34.8726
20	HARDTNER	63.9		-1.36		1.8496	11.1			-0.61	0.3721	0.8296
21	KANOPLIS	62		-3.26		10.6276	8.3			-3.41	11.6281	11.1166
22	LEBO	59.2		-6.06		36.7236	18.2			6.49	42.1201	-39.3294
23	LINN	72.1		6.84		46.7856	9.4			10.11	102.2121	69.1524
24	OFFERLE	75.2		9.94		98.8036	9.6			13.21	174.5041	131.3074
25	RAYMOND	63.2		-2.06		4.243600	11.6			1.21	1.4641	-2.4926
26	TIMKEN	76	65.26	10.74		115.3476	16.3	11.71		14.01	196.2801	150.4674
27												
28		SUMATIONS OF COLUMNS:				513.284				38.48	560.801	394.6398
29												
30												
32		S11=	2166.06									
33		S12=	465.4592									
34		S21=	465.4592									
35		S22=	573.0859									
36		D1=	12.56									
37		D2=	-3.26									

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2	FAILED	L/D	AVG L/D	DIFF L/D		COL. D^2	E/A	COL.G AVG		DIFF E/A	COL. J^2	COL D*J
3	DEXTER	70.6		-7.92		62.7264	7.8			1.1	1.21	-8.712
4	EDNA	70.9		-7.62		58.0644	5.2			-1.5	2.25	11.43
5	ESKRIDGE	93.8		15.28		233.4784	10.5			3.8	14.44	58.064
6	LACROSSE	83.6		5.08		25.8064	7.4			0.7	0.49	3.556
7	MADISON	72.7		-5.82		33.8724	6.3			-0.4	0.16	2.328
8	MCCRACKEN	92.1		13.58		184.4164	6.1			-0.6	0.36	-8.148
9	ST FRANCI	77.8		-0.72		0.5184	6			-0.7	0.49	0.504
10	SEDAN	67.3		-11.22		125.8884	4.4			-2.3	5.29	25.806
11	TALMADGE	88.8		10.28		105.6784	5.8			-0.9	0.81	-9.252
12	WHITE CLO	67.6	78.52	-10.92		119.2464	7.5	6.7		0.8	0.64	-8.736
13												
14		SUMATIONS OF COLUMNS:				949.696					26.14	66.84
15												
16	SUCCESSFUL											
17	ALDEN	66.3		1.7		2.89	14.7			3.65	13.3225	6.205
18	BUSHTON	62.7		-1.9		3.61	11.6			0.55	0.3025	-1.045
19	ELMDALE	67.9		3.3		10.89	7.2			-3.85	14.8225	-12.705
20	HARDTNER	69.1		4.5		20.25	11.1			0.049999	0.002499	0.224999
21	KANOPLIS	53.2		-11.4		129.96	8.2			-2.85	8.1225	32.49
22	LEBO	58		-6.6		43.56	16.9			5.85	34.2225	-38.61
23	LINN	66.3		1.7		2.89	8.5			4.31	18.5761	7.327
24	OFFERLE	69.8		5.2		27.04	9.2			7.81	60.9961	40.612
25	RAYMOND	68.1		3.5		12.25	13.3			6.11	37.3321	21.385
26	TIMKEN	64.6	64.6	0		0	9.8	11.05		2.61	6.8121	0
27												
28		SUMATIONS OF COLUMNS:				253.34				24.24	194.5114	55.884
29												
30												
32		S11=	1203.036									
33		S12=	122.724									
34		S21=	122.724									
35		S22=	220.6514									
36		D1=	13.92									
37		D2=	-4.35									