Project 1
Team 1
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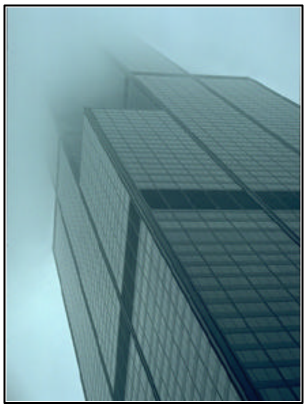

Primary Goals of Acadia Bank Loan Officers

As Acadia Bank loan officers, it is our primary goal to develop the best possible solution for our borrowers' workout problems. As a large-scale bank, Acadia recognizes the importance of successfully resolving loan workouts, in addition to maintaining rapport with the lenders. We take extreme pride in our ability to assess every aspect of a loan workout. From mathematical calculations to applicable reasoning, we gather information necessary to produce the best possible solution to every loan workout.

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Background Loan Information for William Levitz

One of our borrowers, William Levitz, has recently been failing to make his expected interest payments. Our responsibility is to make a decision on whether to foreclose or work out Mr. Levitz's loan. To arrive at our decision, we must closely examine his long-run visibility. We've taken the time and consideration to determine whether he has missed his recent payments due to temporary illiquidity, or because there is a permanent problem. Given only the information that he has 13 years of experience, a graduate degree, and the economy is booming, we have to arrive upon a conclusion. We may either recommend to foreclose on the loan and liquidate all of Mr. Levitz's assets, or to work out and develop a new schedule of payments. We, the loan officers, know that if we choose to foreclose Mr. Levitz's loan, Acadia Bank will only recover a foreclosure value of **$xxxx** on the **$xxxx** loan. However, if we workout the loan and it succeeds, Acadia will regain the entire $xxxx loan. Conversely, if the loan workout fails, we will lose over 80% of the loan value, and end up with a meager **$xxxx**.

Acadia Bank

William Levitz

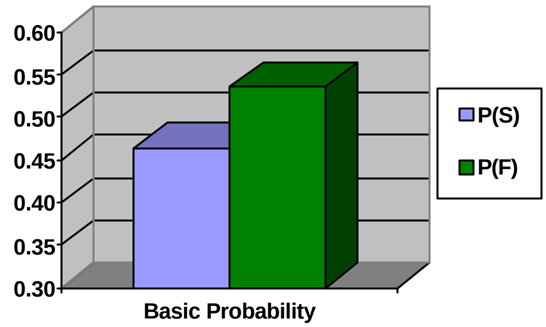
Full Loan Value: $	Years of Experience: xx
Foreclosure Value: $	Education Level: Graduate Degree
Default Value: $	Economic State: Boom

Our journey as loan officers first begins with assumptions. We currently possess a huge database of loan workout records from Acadia Bank. We, as a team, have made the assumption that the loan records from each of the three former banks made loans to a very similar population of borrowers as Acadia Bank. These records will be extremely useful to us throughout our loan workout process.

Basic Probability

The primary calculations needed for our analysis begin with finding the probability of *S*, the event that a workout will succeed, and the probability of *F*, the event that a workout will fail. By applying the theories of Basic Probability to the bank records, we arrive at the figures shown to the right:

$$P(S) \approx .464$$
$$P(F) \approx .536$$



In terms applicable to our situation, these figures simply mean that over a huge number of trials that test the result of a loan workout, approximately **46.4%** will be successful and approximately **53.6%** will fail. We are able to use this basic information to calculate an **Expected Value** for a workout, taking into consideration only the monetary values of our loan, such as the full value and the default value. At this point we are completely disregarding any other given information about Mr. Levitz's loan.

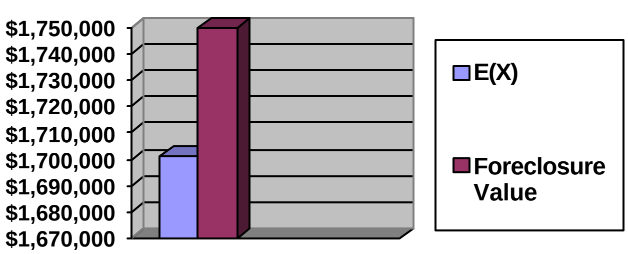
Expected Value Considering Basic Probability

Here we let *X* be the random variable giving the amount of dollars that Acadia Bank receives from our future loan work out attempt. The Expected Value of *X* <u>only</u> takes into account the estimated probabilities of success and failure, along with the loan value information for Mr. Levitz's loan.
The equation and subsequent calculations for the Expected Value of *X* are shown to the right:

$$E(X) = \text{Full Loan Value} \times P(S) + \text{Default Value} \times P(F)$$

$$E(X) =$$

We find that the expected value of our loan, using only the loan value information, is approximately $xxx. We then compare it to our foreclosure value, which is $1,750,000. At this point, since the foreclosure value is $xxxx more, it would be more reasonable to foreclose and attempt to gain back at least $xxxx of our 2.4 million dollar loan.



> ***"It is our primary goal to develop the best possible solution for our borrowers' workout problems."***

Utilizing the Database

Although we have obtained an expected value from the basic probabilities of success and failure, this value does not take into consideration any outside conditions that pertain to the loan. Therefore, the expected value of $xx is not accurate enough to base our decision on. We must go one step further and apply the conditions of the loan, such as experience, education and economic state. By doing this we will gain a better understanding of Mr.Levitz's chances of a successful workout.

Using the bank records of the newly merged Acadia Bank, we calculated the number of instances in which a success occurred and contained borrower information that matched Mr. Levitz's specific information. In order to properly explain our calculations, we must first introduce our chosen variables and formulas of mathematics.

Y = Number of Years of Experience

T = Education Level

C = State of Economy

BR BANK				
Number Successful	Number Successful With Y	Number Failed	Number Failed With Y	Number With Y

CAJUN BANK				
Number Successful	Number Successful With T	Number Failed	Number Failed With T	Number With T

DUPONT BANK				
Number Successful	Number Successful With C	Number Failed	Number Failed With C	Number With C

From these calculations, we, as loan officers, had to take into consideration the real-world meaning of our newly computed numbers and discuss how they apply to our specific loan situation. Before speculating about the new information, we found that it would be much more helpful to transform our numbers into easily applicable probabilities.

Because we are most interested in the successful past workouts that match our information, we decided to set up calculations for the probability of success given each of our different criteria. For example, if we wanted to know the probability of a workout being successful given that it involved a borrower with xx years of experience, we would solve for $P(S|Y)$.

Conditional Probability

Since the project description states that each of the three former banks made loans to very similar populations of borrowers, we assume that:

$$P(S|Y) = P(S_{BR}|Y_{BR}) = \frac{P(S_{BR} \cap Y_{BR})}{P(Y_{BR})}$$

Let the initials *BR*, *CJ*, and *DP* stand for the BR, Cajun, and DuPont Banks, respectively. Attaching one of these as a subscript on an event indicates that the event occurred at the given bank. For example, S_{BR} is the event that a borrower's attempted work out at the BR Bank will be successful, and T_{CJ} is the event that a borrower with an attempted work out at the Cajun Bank has a Bachelor's Degree.

By adding the number of successes and failures from BR bank, we were able to determine the total number of records containing xx years of experience in the BR bank.

Because we had this information, we were able to use it as the denominator in the equation:

$$\frac{P(S_{BR} \cap Y_{BR})}{P(Y_{BR})}$$

We are now able to simply insert our known data into the equation and solve for *P*(*S*|*Y*).

$$P(S|Y) = \frac{P(S_{BR} \cap Y_{BR})}{P(Y_{BR})}$$

$$P(S|Y) = \frac{82}{179} = .4581005587$$

- Utilizing the same methods as above, we made the remainder of the calculations, as shown below:

***P*(*F*|*Y*) = .xxxx**

***P*(*S*|*T*) = .xxxx**

***P*(*F*|*T*) = .xxxx**

***P*(*S*|*C*) = .xxxx**

***P*(*F*|*C*) = .xxxx**

This information gives us an <u>estimate</u> of the chances that a loan workout will succeed considering the three separate pieces of criteria from William Levitz's loan.

For instance, *P*(*S*|*Y*) = .xx means that:

- The fraction of times that a loan workout, with a borrower who has 13 years of experience, succeeds out of a huge number of trials will approach *P*(*S*|*Y*).

From here, we can use our newly calculated probabilities to compute an expected value for each of the given circumstances.

Expected Value with Y, T and C

Let Z_Y be the random variable giving the amount of money, in dollars, that Acadia Bank receives from a future loan work out attempt to a borrower with xx years experience. Z_Y can assume only the full value, $xx, of the loan or the default value, $xx.

Using the following formula, we were able to compute the expected value of our loan considering that our borrower had 13 years of experience:

$E(Z_Y)$ = Full Value of loan · $P(Z = \text{xx})$ +
Default Value of loan · $P(Z\ \text{xx})$

$E(Z_Y)$ = $

- We utilized the same methods as above to calculate $E(Z_T)$, the expected value of our loan considering that the borrower has a graduate degree and $E(Z_C)$, the expected value of our loan considering that the economy is booming:

$E(Z_Y)$ = $xx

$E(Z_T)$ = $xx

$E(Z_C)$ = $xx

- The Expected Value of our loan considering Mr. Levitz has xx years of experience is **$xx**.
- The Expected Value of our loan considering that Mr. Levitz has a Graduate Degree is **$xx**
- The Expected Value of our loan considering that the economy is in a state of economic boom is **$xx**.

These dollar amounts are arbitrary, however, without recognizing their "real world" values.

- The Expected Value of Z_Y means that if this loan experiment were conducted a huge number of times, and the value of the random variable of xx years of experience is noted in each trial, then the average of these values will approach **$xx.**
- The Expected Value of Z_T means that if this loan experiment were conducted a huge number of times, and the value of the random variable of possessing a Graduate's Degree is noted in each trial, then the average of these values will approach **$xx.**
- In turn, the Expected Value of Z_C means that if this loan experiment were conducted a huge number of times, and the value of the random variable of a booming economic state is noted in each trial, then the average of these values will approach **$xx.**

Thus these numbers are not guarantees, but rather indications of probable outcomes over time, that we can utilize in our decision-making process.

Bayes' Theorem

At this point, we have found the probabilities necessary to utilize Bayes' Theorem to our advantage, and find the probability of success given that a borrower has thirteen years of experience, possesses a Graduate's Degree, and is currently facing an economic boom. In essence, we want to find $P(S|Y \cap T \cap C)$. Conversely, we want to find the probability of failure given the same conditions above. Bayes' Theorem states the following:

$$P(S|Y \cap T \cap C) = \frac{P(Y \cap T \cap C \mid S) \cdot P(S)}{P(Y \cap T \cap C \mid S) \cdot P(S) + P(Y \cap T \cap C \mid F) \cdot P(F)}$$

- From our conditional probability calculations, we have the needed quantities to complete the Bayes Theorem and calculate both $P(S|Y \cap T \cap C)$ and $P(F|Y \cap T \cap C)$.

$P(Y \cap T \cap C|S) = P(Y|S) \cdot P(T|S) \cdot P(C|S)$ = .xxxxx

$P(Y \cap T \cap C|F) = P(Y|$

Therefore:

$$P(S|Y \cap T \cap C) = \frac{P(Y \cap T \cap C \mid S) \cdot P(S)}{P(Y \cap T \cap C \mid S) \cdot P(S) + P(Y \cap T \cap C \mid F) \cdot P(F)}$$

$$P(S|Y \cap T \cap C) = \frac{xxxxx}{(xxx) + (xxx)}$$

***P*(*S*|*Y* ç *T* ç *C*) = .xx**

Likewise, we use the same formula to calculate $P(F|Y \cap T \cap C)$:

***P*(*F*|*Y* ç *T* ç *C*) = .xx**

- The probability of a successful workout given that a borrower has xx years experience, a graduate degree *and* times are in an economic boom is approximately **xx%.**

- The probability of a failed workout given that a borrower has xx years experience, a graduate degree, *and* times are in an economic boom is approximately **xx%.**

From the above probabilities, we clearly see that the probability of success (approximately xxx%) given William Levitz's conditions is greater than the probability of failure (approximately xxx%). Again, it must be stated that these figures do not determine our final decision. These quantities are simply additional tools that are considered in the decision to foreclose or work out.

Expected Value of *Z*

Using $P(S|Y \cap T \cap C)$ and $P(F|Y \cap T \cap C)$, we can derive even more critical information. Here, we introduce the random variable, Z, which represents the event that a borrower has 13 years experience, a graduate degree, *and* times are in an economic boom. By finding the Expected Value of Z, we can indicate the dollar amount that would be approached if a similar loan experiment were conducted a large number of times, and the value of the random variable of Z was noted in each trial and averaged.

Full Value $xx

Foreclosure Value $xx

Default Value $xx

Expected Value $xx

$E(Z)$ = Full Value · $P(S|Y\ \ T\ \ C)$ + Default Value · $P(F|Y\ \ T\ \ C)$
= xx

$E(Z)$ = $x

• This expected value has considerable significance in our decision making process.

The expected value is **$xx** less than our known foreclosure value, and only **xx%** of the full value of the loan. At this point in our findings, if we were to consider no other factors or calculations, the expected value of Z would indicate the decision to foreclose.

- However, as with every other dollar value we have calculated, there are discrepancies concerning real world significance and anomalies throughout the data.

Therefore, our expected value cannot instantaneously be taken at its face value. We must continue our analysis to include a variety of conditions that could affect our loan data, and question the sensitivity of various factors that may play a significant role in our decision.

Ranges

One of the most anomalous pieces of criteria in our given situation is the number of years of experience. Throughout our experimentations with the criteria, we have come across a discrepancy that significantly affects the expected value of our loan workout, and consequently our decision to foreclose or workout.

Our given number of **xx** years of experience for Mr. Levitz, only provides us with **xx** records from the database which correspond with our condition. Because this is such a small number in comparison to the 8,226 records that the entire database contains, we have decided to explore the possibilities of having different numbers for the years of experience.

After changing the years of experience to **xx** years, we calculated that there was a jump to **xxxx** records that matched our requirement of xx years. This minor adjustment to the years of experience significantly changed not only our chances of success, but also increased our expected value to **$xxxx**.

Number Successful	Number Successful With *10 years Experience*	Number Failed	Number Failed With 10 years Experience	Number With *10 years Experience*
1,470	138	1,779	92	230

Expected Value
[redacted]

After considering the meaning of this change in numbers, we decided that a person with 13 years of experience is just as qualified to run a business as a person with 10 years, and perhaps even more so. Therefore, we made a decision to broaden our years of experience requirement to include a <u>range of numbers</u>. We decided that a **range from 10 years up to 13 years** would be a plausible adjustment to the criteria. After making this slight adjustment, the expected value for out loan workout increased to **$xxxx**.

Number Successful	Number Successful With *a Range from 10 to 13 years*	Number Failed	Number Failed With a *Range from 10 to 13 years*	Number With *Range from 10 to 13 years*
1,470	404	1,779	408	812

Expected Value
[redacted]

Conclusion

After surveying all of the computations and the overall situation concerning Mr. Levitz's loan, we have decided that a **workout** would be the best choice for our client.

Mr. Levitz's esteemed qualifications, in the areas of experience and education, along with the fact that the economy is currently in an economic boom, have given us confidence that Mr. Levitz is a qualified individual who has high potential to prosper in a business setting. However, this level of confidence is supported by the extensive mathematical calculations that were made in order to come to a conclusion resolving Mr. Levitz's loan situation.

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