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The Librarians' Axiom: a "flat earth" theory? The case of the Saldanha Municipality Libraries during the Great Recession

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A minor dissertation submitted in *partial fullfilment* of the requirements for the award of the degree of Masters in Library Science

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COMPULSORY DECLARATION

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

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Abstract

The Librarians' Axiom is the theory that library usage goes up during an economic recession. This Axiom is supported by anecdotal evidence in the literature, but lacks statistical support. This dissertation attempts to fill that gap by looking at library use of the 10 libraries in the Saldanha Bay Municipal area during the 2008/2009 economic recession. Using the coincident index as the economic indicator and circulation data as the indicator of library use, a fixed effects dummy variable panel data model is created. Multiple regressions are run, but the Axiom is not supported. Suspecting that the effect of the regression might not be immediate, the index is led and lagged up to six time periods. There is still no statistical evidence to support the Axiom. Several reasons to explain this result is explored, but none are found to justify the lack of evidence that the Axiom holds in this case.

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The Librarians' Axiom: a "flat earth" theory? The case of the Saldanha Municipality Libraries during the Great Recession

Chapter 1: Introduction to the problem

There is a significant body of literature that claims that library use is affected by the economic cycle. The idea that economic recessions induce an increase in use of libraries is taken for granted by the library community and has been termed "the Librarian's Axiom" (James, 1985: 255). This dissertation tests if this assumption holds true for the 10 libraries in the Saldanha Bay Municipality, by running a series of statistical regressions using circulation data. The use of statistical methods complements the anecdotal evidence that the literature provides. By restricting the study to only one area, a reliable panel dataset can be created over a relatively small time period, namely the 2008/2009 recession.

Before any statistical tests are explained, some contextualization is given. This begins with a description of the area in general terms. In the next chapter, a background is given on the history of economic recessions. This chapter concludes with an examination of the literature on the interaction between libraries and recessions.

The third chapter explains the statistical methodology and the variables used. Chapter four gives the results of the statistical tests. It will be shown that there is great variation in the results. Chapter five shows that there is no logical explanation for the variation in results and concludes that the Librarians' Axiom appears to be false, at least in the area tested.

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1.1 How recessions could affect libraries, and the significance thereof

The second chapter of this dissertation will give an account of how the libraries are affected by recessions, as reported in the literature. What follows here is a summary of that, given here because it will contextualize the importance of this study.

The recessionary effects that libraries experience can be separated into two broad categories: the effects on use and the effects on library resources. These are detailed below.

1.1.1 Recessionary effect on library use

According to the Librarian's Axiom, during economic hard times use of public libraries increases. This is not supported by statistical evidence, although anecdotal evidence is plentiful. According to this anecdotal evidence, there are several reasons why library usage should increase.

a. Free entertainment

In times when financial resources are limited, families and individuals seek entertainment at a cheaper price. Libraries offer this. Instead of buying books, libraries offer them free. Libraries offer videos and DVDs, which users borrow instead of paying the rental fee at the video store. Many libraries offer free internet, yet another source of entertainment. The entertainment is not limited to a certain group of users. Mothers can take books to read to their children. Adults can read fiction and non-fiction, as to their fancy. Those that do not like to read can watch the DVDs and videos, or explore the web. Even teenagers, a group notoriously reluctant to read, can come in to page through the latest magazines on a variety of topics.

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b. Library as a place

Along with recessions comes unemployment. Unemployment brings a reduction of cash flow, which in turn reduces options of the activities that one can do. The library offers a destination for those who need to escape from their homes, but do not have the cash to go to the cinema, for example. The library is a place where friends can meet, and a place to meet new friends. For those that have lost their homes, the library offers a dry roof, a variety in scenery, and a comfortable place to sit.

c. Job seeking

Libraries offer resources to those looking for work. Free computers with word processing programmes are available to those who wish to type up a professional-looking curriculum vitae. The free internet that many libraries offer allows users to email their documents to prospective employers. Many users page through the daily newspapers, surveying the classifieds for job advertisements. Public libraries have books on interview preparations and other books to assist in job seeking. There are usually books on starting one's own business, surviving unemployment and how to deal with one's money wisely. Even librarians are called on as a resource for job seekers, for spell checks and help with filling out forms and such.

d. Do-it-yourself

Finally, libraries offer many books on how to "do it yourself". So instead of calling the plumber, a user can find a book and learn how to fix the plumbing him/herself. In a time where financial resources are limited, saving money on not calling the plumber can be very attractive. This analogy can be extended. Housewives can learn how to redecorate their own living rooms, saving money on interior decorating. Children can learn how to make their own birthday cards, so that those do not need to be bought.

These factors should contribute to a greater circulation of both adult and children's books, for both fiction and non-fiction. Videos and DVDs should be used more. Internet

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usage should increase and queues might be longer. In-library use should be higher and more people should enter the library.

However, this is only based on anecdotal evidence in the literature, with no supporting statistical research. This dissertation aims to fill that gap. In South Africa, there is very little literature on library use in times of the recession.

1.1.2 Recessionary effect on library resource

Recessions are also reported to have an effect on the budgets of libraries, as well as on the publishing industry. This impacts a library's ability to provide an effective service.

a. Budgets

During a recession period library budgets are cut. This is because libraries are largely funded by tax revenue. In times of economic recessions and deepening unemployment, government income from taxes is reduced. So government spending might be curtailed, unless they explore alternative methods of funding. In the United States library funds come directly from housing tax. In the 2008/2009 recession house prices in the United States dropped dramatically and the tax along with it. Thus libraries received less funding than they normally would have. In South Africa the funding of public libraries is complicated, as Anderson (2005) shows. In the Western Cape, public libraries are partly funded by the provincial governments, and partly by municipal governments. The Province usually provides the collection and the resources necessary to maintain them, and the municipal government the physical library building and equipment, as well as the staff (Anderson, 2005). Budgets are set once a year, and so are not as sensitive to tax revenue changes as the American libraries are. This is not to say that South African library budgets are not affected though.

Budgets might also decrease because governments could divert funds from non-essential services, of which libraries are one, to more essential services like schools and hospitals. Whatever the reason might be the Axiom claims the budgets decrease during an economic recession.

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Staffing

One of the responses that a library could have to a decrease in funding is to cut staff. So hours worked by casual staff could be reduced, contracts not renewed or staff could even lose their jobs. These are drastic measures. Less drastic measures could include a reduction on staff training, or less spending on involvement in the greater professional community. Some American librarians have reported that they did not renew their membership to the American Library Association's special groups.

Hours

Cutting staff is quite a drastic measure, many libraries have preferred simply to cut hours. Fewer hours means staff is paid a little less and running costs are reduced. In a time where usage is expected to increase, cutting library hours could result in a remarkable increase in library use as the users try to cram their library use into limited hours. However, it could also have the opposite effect. Few hours mean that there are fewer available hours within which users can visit the libraries. Some users might respond by simply not going to the library at all. In the very worst case scenario, library hours could be cut down to absolutely nothing, and the library could close. Many libraries reported that this was a significant possibility for them.

Collection

The easiest method of dealing with budget cuts is to reduce spending on the collection. This could involve cutting down on subscriptions to journals, magazines and electronic resources or, perhaps, less spending on books, buying fewer titles or fewer copies. Librarians can be driven to make more prudent decisions regarding which titles to buy.

b. Effect on publishing

The recession could also have an effect on the publishing world, which in turn affects collection development in libraries. Smaller publishing houses might not weather the economic storm. This could reduce the number of titles published. Resources could be

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diverted away from research, affecting the quality of the non-fiction material produced. This effect that a recession could have on the publishing world is probably the most subtle effect experienced by libraries. The recession might turn more publishers to producing e-books. This is yet another effect that libraries would have to contend with.

1.1.3 Significance of this problem

If the Librarians' Axiom holds, then during an economic recession, libraries can be faced with an increased demand on resources as well as a decrease in the capacity with which to respond to the increased demand. If librarians had strong evidence that demand does increase during recessionary periods, then they would have a strong argument against budgetary (and other resource) cuts. Even if such an argument was not successful, librarians could, at the very least, prepare for the increased demand mentally.

Currently there is no statistical evidence to show that demand increases. This dissertation arose from this lack, as an attempt to provide librarians with the proof they needed to fight for their budgets. However, this research failed to find sufficient statistical evidence to support the Librarians' Axiom. This leaves libraries with the challenge to find a new argument in order to protect their shrinking budgets.

Now that the broader problem of this dissertation has been explained, some context about the Saldanha Bay will be given. This is the geographical area of interest.

1.2 About the Saldanha Bay Municipality

This section provides some context for the study by giving background to the Saldanha Bay Municipal area. It will aid in framing the discussion about the libraries and their use that will follow.

Saldanha Bay Municipal area is on the West Coast of South Africa, and includes the towns of Vredenburg, Saldanha, Langebaan, Hopefield, St. Helena Bay and the nearby fishing villages. The main industries can be said to be fishing and tourism. The Saldanha

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Bay harbour is one of the seven international harbours in South Africa and brings in some business, notably the steel and iron ore exports.

A detailed breakdown of the demographics is included in Appendix 1. There one can see that Afrikaans is the dominant language and Coloured is the most common population group[1] reported. The area is generally poor, with the largest number of households with no income living in Vredenburg. Vredenburg also has the highest number of households earning over a million rand per annum, followed closely by Saldanha. Langebaan, Diazville and Louwville also have their share of millionaire households. Only seven per cent of the population of the Saldanha Bay Municipality has an education level higher than a Grade 12; 22% have Grade 12. This makes the populace of the area largely uneducated in the formal sense. Langebaan has the greatest percentage of retired people, where retirement is assumed to be after an age of 65. This is followed by Hopefield. Diazville is the most densely populated area, with over 7 000 people living within its area of one square kilometre.

A more detailed discussion of the libraries in the area is given in chapter three, along with their geographical locations.

Now that the area of interest has been put into context, a background to economic recessions and the related theory will be given. This will provide some history to the 2008/2009 recession. An explanation of this recession, which is also termed the Great Recession, will follow.

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1.3 Economic recessions

The geographical context was outlined in the previous section; what follows here is the economic context. It begins with definitions of some key terms, moves on to the historical narrative of recession theory, then onto the 2008/2009 recession and how South Africa experienced it.

[1] Population group categories in South Africa are Black, White, Coloured and Indian/Asian, as used by Statistics South Africa (2011).

1.3.1 Definition of recession, depression and business cycles

Recessions are defined as periods of two consecutive quarters of negative GDP growth (*Economist*, 2010: Recession). GDP is the abbreviation given to Gross Domestic Product, which is a measure of the economic activity in a country that is calculated by looking at how much a country has produced in a certain period (*Economist*, 2010: GDP). It is measured four times a year in all countries. Therefore, where an economy does not show that economic activity is on the increase for two consecutive quarters, the country is said to be in recession. Recessions are usually associated with an increase in unemployment.

Because GDP is a lagged measure, which means it is measured by looking at historical data, a country could show two quarters of negative GDP growth, and already be in recovery when the second quarter GDP figures are out. GDP is thus not a good figure to use for making predictions on what will happen in the future. However, lagged indicators are usually the easiest to measure and therefore the most reliable figures.

A depression is nothing more than a prolonged recession (*Economist*, 2010: Depression). There is, as yet, no consensus among economists on the quantification of "prolonged"; for some it is three quarters of negative growth, for others it is longer. The worst depression in history is referred to as the Great Depression, which hit the economies of the world in the late 1920s.

The studies of economic recessions and depressions form part of the greater study on business cycles, which is "the long-run pattern of economic growth and recessions" (*Economist*, 2010: Business cycles). Many economists have studied business cycles and have come up with various theories on why they happen and what to do about them.

1.3.2 History of recession theory

According to Samuelson (1998: 34) the first recession was in the 17th century when the market for Dutch tulips fell. Tvede (2006: 25) claims that the first recession occurred in 1720 and was named the South Sea Bubble, some years after the introduction of paper money in France. Theories on economic crises and business cycles were pieced together

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with other, seemingly unrelated, theories. For example, Cantillon's exposition of the velocity of money; Smith's "invisible hand"; Say's law that supply creates its own demand; and Ricardo's marginal effects (Tvede, 2006: 45) all formed part of the narrative on business cycles.

The first economist to write about crises as business cycles was Clement Juglar in 1862. Although he did not offer any substantive causative theory on recessions, he recognized that recessions and prosperity were part of the same cycle, each as unavoidable as the other. His key phrase was "The only cause of depression is prosperity" (Tvede, 2006: 70). By studying figures over a long period, Juglar claimed that cycles happen in eight- to nine-year periods. This finding became known as Juglar cycles (Tvede, 2006: 20).

Mitchell was the next big name in the line of business cycle economists. In 1920, he founded the National Bureau of Economic Research (NBER) with Burns (Tvede, 2006: 102). The NBER is a "private, nonprofit, nonpartisan research organization dedicated to promoting a greater understanding of how the economy works" (National Bureau of Economic Research, 2011) and is still in operation today. With a team of economists, Mitchell and Burns tried to group economic indicators into lagging, coincident and leading indicators (Tvede, 2006: 102). That is, indicators that are calculated by looking at historical figures (lagged), indicators that are calculated by looking at current figures (coincident) and indicators that are calculated by looking at future figures (leading). They identified pig iron production and share trading to be coincident indicators (Burns & Mitchell, 1946: 372, 376), but were hesitant in identifying leading or lagging indicators (Burns & Mitchell, 1946: 223), as these did not stand testing over a long period. Leading indicators are of great interest as they can be used to predict future economic movements. Coincident indicators show the activity of the economy at a particular time, and thus give a measure of the current economic state. Lagging indicators are only of interest as an historical indication of economic activity.

The economists of the NBER were not the only ones who were looking at past data to try to identify business cycles, or how economies move through periods of growth and recession. Looking at bank clearings, prices and interest in the United States and Great

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Britain between 1890 and 1920, Kitchin identified a cycle of about 40 months, which he referred to as a minor cycle (Kitchin, 1923). Two, or sometimes three, of these minor cycles made up a major cycle or trade cycle. Underlying this would be a fundamental movement or trend (Kitchin, 1923: 10). The 40-month cycle is referred to as the Kitchin cycle.

Kuznets was the next economist to write about the length of business cycles. The Kuznets cycle is spread over 20 years. Kondratief, a Russian economist, discovered cycles that lasted approximately 50 years. The fact that different economists all discovered different time periods for their economic cycles is not strange when one considers that each of them was basing their theory on different indicators. Kitchin looked at inventories, Juglar at capital investment, Kuznets at property prices and Kondratief at technological inventions (Tvede, 2006: 103, 104 respectively). This is shown in Figure 1.1.

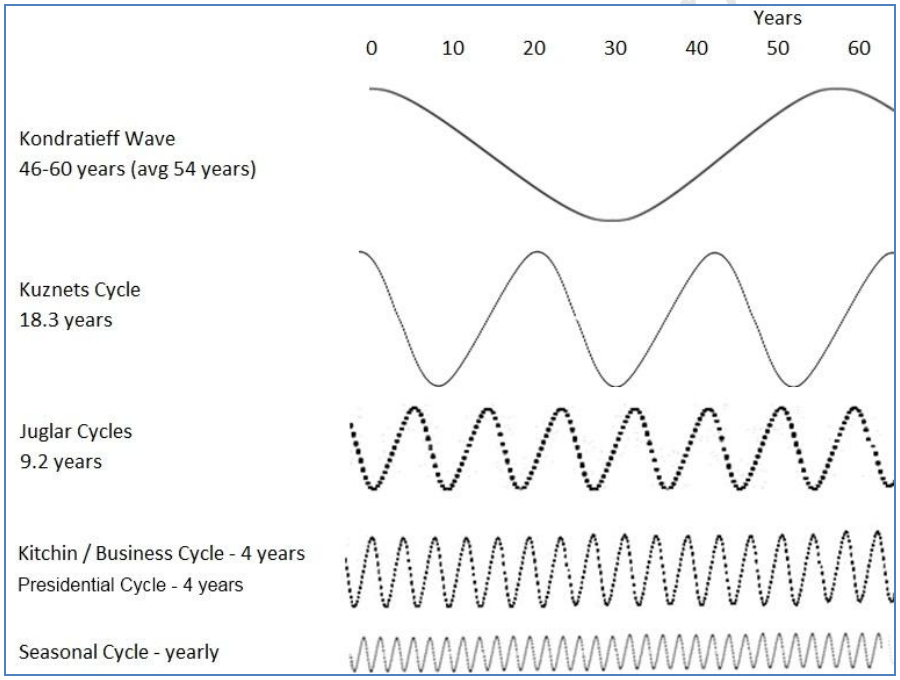

Figure 1.1: Kondratieff, Kuznets, Juglar and Kitchin cycles (Moore, 2010)

The Great Depression was foreshadowed by two Austrians: von Hayek and his teacher, Von Mises. They theorized what one could do to prevent a recession (Tvede, 2006: 118). Their theory was that a recession was a result of building economic expansion on credit.

Their solution, they proposed, was to encourage saving. This would create a strong economic foundation on which economic expansion can reliably be built (Tvede, 2006: 118, 124).

In the late 1920s, the Great Depression had begun, and economists were strongly encouraged to think of solutions to rescue dying economies. The most successful of these was Keynes. He had had a fund invested, which initially suffered a loss, but recovered quite well before the end of the recession, earning 45% in 1933 (Tvede, 2006: 134). In 1936 he published his seminal work, *The General Theory of Employment, Interest and Money* (Tvede, 2006: 139), and his theories are still being implemented today.

However, not everyone saw Keynes' theories as the solution. Schumpeter, an Austrian, believed that capitalism was not as stable as Keynes claimed (Tvede, 2006: 147). This was not a bad thing, though: through instability, innovation is born. Innovation, Schumpeter claimed, was the key to economic growth, coining the term "creative destruction" (Tvede, 2006: 145). The theory that innovation is the root of economic growth is still taught to young economists today, although more seasoned economists might question it.

Economists have not yet conclusively discovered what makes economies grow, why recessions happen, or what to do about them. An outline of the theory gives some context in which recessions in general can be understood. With that in mind, a short explanation of the 2008/2009 recession, or Great Recession as it is now known, follows.

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Brief account of the 2008/2009 recession

As explained by Allen (2009: 113-116), the boom phase of 1980-2006 was largely financed by American debt. So-called NINJAs (people who had no income, no jobs or assets) were allowed to secure mortgages without adequate, or any, collateral and limited means of servicing the debt. These subprime mortgages were repackaged and sold as good financial instruments, drawing more investors into the web of shaky deals. In autumn of 2006, the housing bubble burst. Suddenly houses were worth less than the original purchase price and mortgages acquired negative equity. Many mortgages were

forced to default on payments, leaving banks with unsellable properties and rising debts; this, in turn, led to a loss of confidence in the banking system and interbank lending came to a standstill. Banks and other financial institutions started defaulting, the most memorable being the Lehman Brothers in September 2008. Once the United States was in the throes of a recession, it quickly spread to other countries. Economists call this spread "contagion". It is through contagion that the South African economy fell into recession too.

South Africa in the 2008/2009 recession

The recession started in South Africa in the fourth quarter of 2008, where the GDP figures fell by 0.7% (Statistics South Africa, 2010: 5). This was later than most developed economies. The recession lasted three quarters. Although South Africa did experience some job losses, the South African banks had not exposed themselves to repackaged untrustworthy assets and were largely free from the direct effects of the subprime crisis (Jammine, 2009: 4, 5).

The theoretical framework of economic recession has been given in this chapter, along with an account of the Great Recession and the South African experience of it. This provides the context in which this study was performed, along with the background to the geographical area of interest. The following chapter outlines the recessionary effect on libraries, as shown in the literature. Before that is done, a discussion of the importance of this study is given.

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1.4 Importance of this study

Deep economic recessions have an impact on many aspects of society. Employment is usually negatively affected as spending slows. Some industries are countercyclical; they improve as the economy worsens. Given the importance that libraries have in society, the effect that an economic recession might have on libraries is of great interest. If usage goes up, then the question becomes does funding go up? In many countries, libraries are funded by taxes. If personal incomes go down, tax revenue goes down too. If the country decided to counter the recession by increasing government spending, libraries are a

potential benefactor, provided it can be shown that libraries are more used during a recession.

However, if this study shows that libraries are not used more in an economic recession, then it could provide the necessary motivation for government and other funding agencies to withdraw funds in order to channel them to services that are more essential. Whatever the case, this study will give librarians a platform from which they can plan library services during an economic recession.

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Chapter 2: Literature review

The previous chapter gave a background to this study in terms of the economic theory of recessions and the geographical area of interest. This chapter gives the background of how libraries have experienced economic recessions as it is shown in the literature. This review will outline that libraries in all countries have reported to be affected by recessions, regardless of type of library or recessionary period. The literature is mostly anecdotal and not statistically rigorous. However, it does provide an insight into the possible effects that an economic recession could have on a library and the response that librarians have given.

2.1 Libraries in times of economic recessions

Probably the most comprehensive study can be found in Moore's research into public library trends in the United Kingdom. While not specifically focused on recessions, one can none-the-less glean some insights. Moore showed that the recession post World War I slowed library growth (Moore, 2004: 32). During the Great Depression of the 1930s, books issued went up as there were "many unemployed people with time on their hands" (Moore, 2004: 32). Library budgets were not affected, however, probably due to the fact that libraries were operating on a limited budget already (Moore, 2004: 36). Book prices did go up by 30% between 1939 and 1941, and this would have had a direct effect on the buying power of the libraries (Moore, 2004: 37). During the recession of the 1970s, book budgets fell by 10%, staffing decreased by almost the same amount, libraries closed down and hours were cut (Moore, 2004: 43). While usage was reported to have increased during this period, Moore attributes this to the libraries' boom period in the late 1960s. The declines continued in the 1980s and the 1990s (Moore, 2004: 44, 45 respectively), although book prices fell in the 1980s which would increase the purchasing power of library budgets (Moore, 2004: 46). Whether this fall was due to a recession, is not explicitly stated. Table 2.1 gives a summary of the trends identified by Moore.

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Date	Trend
1918+	Slowed library growth
1929-1939	Book issues increased; no effect on library budgets
1939-1941	Book prices increased by 30%
1973-1975	Budgets, staffing, hours cut; usage increases
1980s	Budgets, staffing, hours cut more; book prices fall
1990s	Budgets, staffing, hours cut even more

Table 2.1: Summary of Moore's trends

Pre-1980s there are few mentions of libraries in recession times. Bundy (2009: 3) reported that: "During the Great Depression of the 1930s, apparently not a single library closed in the US", implying that libraries had been affected, but how and to what extent is not certain. A study on the budgetary effects was done on 10 American libraries in 1933 (Duffus, 1933), but with little mention on how the Great Depression affected library usage. There was a mention in 1977, where Gilbert M. Simmons Public Library in Wisconsin was awarded $20 000 in anti-recession aid (Anti-recession aid hailed, 1977).

Post-1980s, the literature becomes more prolific. In speculating on the effect that the crash of 1980 might have on libraries, Cherry explains that budgets are likely to be cut (Cherry, 1987: 900). For academic libraries, this could be as a result of the recession affecting the endowments that fund universities (Cherry, 1987: 900) or, for public libraries, because of the devaluation of property, which reduces the property tax revenues which is the main source of public library funding in the United States (Cherry, 1987: 900).

Balarabe reported that the recession of the 1980s affected university libraries in many African countries (1995: 334). For example, the book budgets of Zambian academic libraries were cut, Tanzania saw the banning of overseas book purchases, during the 1991-1992 academic year, the Medical Library in Cameroon's University of Yaounde cancelled 80 of their 107 journal subscriptions, the big universities in Ghana did not have more than 50 journal subscriptions during that period, and many other African university libraries reported gaps in their international journal collections (Balarabe, 1995: 334-335). There was also a dramatic decline in the number of books per student in many African university libraries (Balarabe, 1995: 335). In Nigeria, one of the government's

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responses to the recession of the 1980s was to put into place the Structural Adjustment Programme which led to the dramatic devaluation of the local currency, the Naira (Balarabe, 1995: 337). As a result, international acquisitions of books and journals were severely curtailed (Balarabe, 1995: 337). The devaluation of the Naira affected local book production. This had serious implications for collection development at the time.

Aguolu (1996: 265) reported that the Nigerian oil glut of the 1980, and the subsequent depression, resulted in funding cuts to universities and their libraries. This had an adverse effect on both the quality and quantity of the physical stock, as well as on library building maintenance (Aguolu, 1996: 267). In an effort to ensure that libraries received some funding, the National Universities Commission (NUC) of Nigeria recommended that the allocation by the university to its library services should be at least five per cent of the university's budgeted amount, and that new libraries receive 10%, but they had trouble enforcing this (Aguolu, 1996: 268). In 1993, the NUC revised their recommendations of 1977, and changed the amount for existing libraries to 10%. From this, 40% was to be spent on books and journals, while 40% on staffing. The remainder of the library expenditure was to be covered by the university (Aguolu, 1996: 271). The NUC was also investigating new methods of enforcing their recommendations (Aguolu, 1996: 271). In the same year, a two per cent educational tax was put into effect. The revenue from this tax was directly used to fund universities and other educational institutions, and so their libraries (Aguolu, 1996: 272).

Ghana was similarly affected. The Structural Adjustment Programme of the 1980s was born out of Ghana's economic recession in that time (Asamoah-Hassan, 1998). This programme saw drastic budget cuts to universities and to their libraries. This affected staffing and book/journal stocks (Asamoah-Hassan, 1998). Another effect of that recession was that it had a negative effect on the stability of electricity supplies (Asamoah-Hassan, 1998). This meant that access to electronic resources and interlibrary loan services was also unstable (Asamoah-Hassan, 1998).

Libraries out of Africa were not immune to the 1980s crash. Cronin (1983: 213) reported that university and research libraries in West Germany saw their stock budgets being cut

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by anything between 30% and 70%. Public libraries reported reductions in services: from opening hours to the number of service points (Cronin, 1983: 214). At the same time, politicians were encouraging the unemployed to read, which resulted in a greater demand for public library services (Cronin, 1983: 214).

Special libraries in Canada were also affected by the recession of the 1980s. Daum (1987) provided several suggestions to deal with static or shrinking budgets. For example, a good collection development policy can aid in handling shrinking collection budgets and hiring clerical staff could supplement shrinking staff hours (Daum, 1987: 300).

Anticipating a budget cut, Platt (1983) examines different areas where funding can be reduced. He does this by calculating the per capita price for space, staffing, collection, and administration (Platt, 1983: 216-217). Once having established which area is most expensive, he discusses the practicalities of reducing funding to each area. He concludes that reducing opening hours, or charging for library services, are the best ways to handle a situation where library funds are cut (Platt, 1983: 217, 218).

In the Youngstown and Mahoning Counties in Ohio, during the recession of the 1980s, public libraries reported that many users were coming into the library to use the resources for job searching (Youngstown & Mahoning County faces the recession, 1981: 284). While circulation figures were reported not to have increased during this period, door counts did (Youngstown & Mahoning County faces the recession, 1981: 284).

The literature on the impact that the 1990 recession had on libraries primarily focuses on budgets. For example, the budget cuts that Buffalo and Erie County in New York experienced due to the 1990 recession almost saw the retrenchment of over 400 staff (Alexander, 1992: 200). Finland also reported budget cuts to libraries, which resulted in few acquisitions and staff cuts. Purchasing power too has been reduced (Tornudd, 1994: 103).

Ivey (1993) surveyed library and information science jobs in South African during the recession of 1993. The rationale behind doing this survey was that during recessions,

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funding is directed to “areas of national development” and away from libraries and their staffing (Ivey, 1993: 43). Unfortunately, her study proves to be inconclusive. No mention is made if any visible increase, decrease or stationary staffing situation was in anyway significant.

According to Amey (1993: 70) “[r]ecessionary pressures have had a negative impact on the morale of library workers”. She suggests that marketing within the library will improve the sentiments of the library workers. While marketing outside the library will bring even more patrons to the library in a time where the library is overrun by them, it does have the distinct advantage of acting as a tool to garner more funding (Amey, 1993).

During the 1990 recession, the Colorado Alliance of Research Libraries grouped together to provide a document delivery service in order to cut costs (UnCovering Blackwell's document delivery service, 1993). This shows that recession can breed innovation even in libraries.

In India, during the recession of 2000, Vasanthi (2001) reports that funding to education and libraries was cut. This resulted in book budgets being reduced and fewer journal subscriptions being opened or renewed. Added to this, subscription prices to electronic resources increased (Vasanthi, 2001: 2). Her response is to encourage more resource sharing between libraries (Vasanthi, 2001: 3).

From the perspective of a corporate librarian, Corcoran (2002) shows that while it might appear that the number of corporate libraries decrease during a recession, what they actually do is “implode”, that is, are absorbed into other structures. Then once these structures tire of running information centres, the libraries are re-established (Corcoran, 2002: 76). However, she feared that the recession of 2000 could have been different in view of the amount of information that is freely accessible via the internet (Corcoran, 2002: 76). She encourages corporate librarians to prove their usefulness in business terms (Corcoran, 2002: 77).

Rooney-Brown's article (2009) attempts to give some measure of the impact that the 2008 recession has had on public libraries. She acknowledges that at that point “very little

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official research has been conducted to investigate the impact that this latest recession has had on public library usage" (Rooney-Brown, 2009: 342). However, she reports that usage figures in US public libraries are up in all areas, and a similar picture emerges for the UK libraries (Rooney-Browne, 2009: 343, 344 respectively). It is assumed that usage increases as libraries offer free services in a time where disposable income is scarce (Rooney-Browne, 2009: 343). Anecdotal evidence is given to show how libraries support job searching (Rooney-Browne, 2009: 345). Libraries also market their services more during a recession time (Rooney-Browne, 2009: 346), and one is left to wonder to what extent the increase in usage can be attributed to the marketing efforts, and to the recession itself. At the time of writing, Rooney-Brown did not report budget cuts, although they were anticipated (Rooney-Browne, 2009: 347).

Fletcher et al. (2009) surveyed 113 special libraries in America. She asked if they were facing recessionary cutbacks, what strategies they were taking to preventing the cutbacks and what strategies were working. A total of 61% of the respondents reported that they were facing budget cuts (Fletcher et al., 2009). The best strategies were marketing to the greater organization, and marketing to management. However, 77% felt that libraries would still close due to budget cuts, despite these efforts (Fletcher et al., 2009). After looking at two case studies of libraries that successfully averted the budget cuts and two cases where they did not, she concludes that there are four main strategies that special libraries could employ: marketing, knowing the user group, embedding the library firmly within the organization, and keeping good statistics (Fletcher et al., 2009).

Every year Foster (2009) runs a business information survey. The survey run in 2009 included interviews of 23 corporate librarians (Foster, 2009). Most seemed to be concerned that the recession would affect budgets (Foster, 2009: 15), staffing (Foster, 2009: 18) and relations with data vendors (Foster, 2009: 23). At the time of writing, however, it seemed that very few of the respondents had experienced any significant effect of the 2009 recession.

An increase in users who are using the library for job finding was reported by the Australasian libraries in the most recent recession (Bundy, 2009: 3).

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The recession of 2009 was reported to have the likely effect of reducing funding to research. For example, Houghton (2009: 23) reported that as the recession affects investment funds, so it will affect funding to universities as much of their revenue comes from investing in such funds. Funding to research and development could also be cut (Houghton, 2009: 23) as money is diverted to sustain core business activities.

Beck, the current president of the Reference and User Services Association in USA, reports anecdotally on some of the effects of the 2009 recession: "We have become part job counsellors, part life coaches, and part lifesavers" (Beck, 2009: 10). Users came into the library to look for jobs, to socialize, and to take "refuge from the effects of the recession" (Beck, 2009: 10). Academic libraries were seeing the effect that more students were asking for information on the recession (Beck, 2009: 8). Associations within the librarian community are also affected, because fewer renewals of institutional and personal memberships occur (Beck, 2009: 9).

Curzon (2009) offers some tips on how to weather the recessionary storm. For example: knowing what users expect, protecting library buildings from being taken over from other departments and dealing with staff fears. She does not offer any insight into the actual effects of the recession.

Having gone through numerous recessions, Bates (2009) offers some tips to freelance librarians. For example, a recession could be a good time to increase learning to ensure that one will be employable in five years' time. Another is to cut costs, although one should ensure that the costs that are cut are not detrimental to long term sustainability. Finally, even though it is a recession, one should not hesitate to ask for funding.

On a less practical and more philosophical note, McMenemy (2009a) argues that in light of the most recent recession, neoliberalism has been revealed to be a complete failure. He further questions the extent to which this failed neoliberalist philosophy will be applicable to current day libraries. Library discourse is currently filled with neoliberalist ideas, and in the wake of this failure, libraries "could be left with a vacuum of ideas" (McMenemy, 2009a: 404).

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Very few studies reported a statistical examination of the recessionary effects on libraries. Lynch (2002) reported on a study done by the Library Research Centre of the Graduate School of Library and Information Science at the University of Illinois at Urbana-Champaign. The study looked at how circulation figures reflect the economic crisis of the early 2000s. However, Lynch fails to make a convincing case. The circulation figures for post-2001 are forecasted and the study is based on these forecasted figures. No effort is made to explain how the forecasting was done, besides basically to fit it into a trend line going back four years. In addition, there is no discussion of the statistical rigour of the study.

The second study was done by James (1985, 1987) on the recession of the 1980s. Looking at several city libraries in America, over a period of 19 years, James concludes that there is no statistical evidence which links public library usage to the effects that the economy might have on it. While his study bears up to statistical scrutiny, its use of economic theory is questionable. He uses unemployment, inflation and a combination of the two as his three possible economic indicators. All three of these are lagged indicators, reporting on an economic situation that happened prior to the reporting. He then lags these indicators further, without explaining why this might be relevant. The structure of this dissertation was inspired by the structure presented by James (1985, 1987) in his papers.

In addition to Ivey (1993) already discussed, Mnkeni-Saurombe (2010) offers some insight into how South African libraries are affected by recessions. By surveying provincial library directors and librarians of the Metropolitan Municipality of Tshwane, he discovered that the directors were of the opinion that municipal libraries were not overly affected by the recession (Mnkeni-Saurombe, 2010: 93). Perceived usage, however, was reported (Mnkeni-Saurombe, 2010: 97), which could have been a result of the abolition of membership fees rather than the recession (Mnkeni-Saurombe, 2010: 98). Mnkeni-Saurombe does not include the interview questions in his article. It is unknown if the way he phrased the questions could have affected the reported perception. He also does not provide figures showing an actual increase which would support the claim of the perceived increase in use.

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This literature study shows that recessionary effects experienced by libraries are not limited to a particular recessionary period, a particular type of library, or to a particular nation. The literature leads one to think that a recession would have a definite impact on any library in any country, and the anecdotal evidence supports this as shown in the following section.

2.2 Anecdotal evidence of possible effects that the most recent recession has had on libraries

During the 2008/2009 recession, the effects of that recession were often reported anecdotally. From this, one can gather that the effects of the recession could be grouped in two categories: the effect on budgets and the effects on use.

2.2.1 Effects on budgets

"... [P]ublic libraries offer easy routes to saving large sums of money, since they encompass a network of buildings and a large number of staff to allow them to function. They are also open for large parts of the day and take a lot of money in upkeep and security. That they enhance their community is without a doubt, but equally that they are lower down the priority order than other services such as schools and social work is also evident." (McMenemy, 2009b: 558-559).

a. Budget cuts could result in staff cuts, a reduction of hours, and sometimes closures:

"Trustees also approved reducing the hours of operation, reducing salaries by 5 percent, cutting Bookmobile services and reorganizing the library's administration." (Lane Public Libraries, Ohio) (Wilson, 2009)

"Two Troy branches will shut Feb. 2 and seven employees will be dismissed to deal with a 17 percent cut in the 2009 budget." (Crowe, 2009)

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"Ironically, just as library usage is booming, cities like Duluth [Minnesota] have cut back with reduced hours or even closures." (Renalls, 2009)

"Notices appeared in September that the Free Libraries of Philadelphia...would shut down...the whole system, all 54 libraries, shut down."(Quint, 2009)

"The high-profile library closures in Wirral and Swindon are being followed by others: the *Nottingham Evening Press* has reported that the city's service is facing closures, and last week the Wolverhampton *Express & Star* reported that all 16 libraries in Walsall will shut on Mondays." (Page, 2009: 8)

"Fewer days, shorter hours. Staff cuts. Fewer material purchased." (*Financial Tech Spotlight*, 2009)

b. Budget cuts could affect collections:

Elizabeth Caruso, Library Director of Bethel-Tulpehocken Library, Pennsylvania, "plans to buy as few items [books] as possible to stay within the budget." (Negley, 2010)

"Librarians said they had not to make major increases in purchases of books and DVDs, only shrewder ones – buying extra copies of, say, a John Grisham novel and cutting back on books that might not have as large a readership." (Berger, 2009)

2.2.2 Effects on use

The budgetary effects aside, during a recession, the literature reports that libraries see an increase in use. This could be due to any number of reasons, such as:

a. Free entertainment:

"Now they're borrowing books instead of buying them, checking out movies instead of renting them, and using free Internet when money problems force them to go truly wireless." (Hicks, 2009)

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"[S]tory time for toddlers that used to draw 20 or so children now commands three times as many…as parents tightening their wallets search for cheap entertainment." (Gowen, 2009)

b. Getting out of the house:

"[O]ne family actually said they come to the library just to get out of a crowded house." (Davis, 2009)

"The library can be a place to escape into fiction or confront the economic downturn by reading up on the news or scanning local job listings. For some, it's a place to catch a few moments of peace or catch up with friends." (Barry, 2009)

c. Job searching:

"[I]t's less about borrowing the latest bestselling book or popular film, and more about looking for work, updating resumes and researching state and federal programs…" (Dymski, 2009)

"As the bankruptcies mount and layoffs increase… a lot of people using the library's job searching resources." (Roller, 2008)

d. Do-it-yourself:

"People who are looking to fix something in their homes will come here and get fix-it books instead of paying someone." (Sandra McCandless, director of the Decatur Public Library, Illinois, quoted by Godbey, 2009)

Kay Pennell, Director of North Las Vegas Library District, "has noticed a demand lately for „do-it-yourself car repair, handyman-project type of (books) – do-your-own landscaping, those kinds of things, that maybe, before, they were able to have someone else do for them.'" (Przybys, 2010)

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2.3 In summary

The literature suggests that one can expect libraries to be affected by economic recessions in a variety of different ways. Budgets decrease, which lead to cuts in hours and/or staff, or to a decrease in spending on collection development. On the other side, usage increases as libraries become a source of cheap entertainment, a place to go, and a resource for finding employment. The literature reveals that these recessionary effects are not limited to a specific country, a specific type of library, nor to a specific recession.

However, there seems to be no statistical evidence to back-up the anecdotal observations. This study attempts to fill that gap, but concludes that the necessary statistical support is not evident.

The following chapter will describe the statistical methodology used in researching the link between the 2008/2009 economic recession and library use in the Saldanha Bay Municipal Libraries.

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Chapter 3: Research methods

The previous chapters gave some background to the research discussed in the dissertation and positioned it the context of the body of existing literature. This chapter explains the method of research. This includes defining the study space by explaining how libraries have been selected for the inclusion in the study, the variables used and the time period of interest. Data sources are given, and finally the statistical procedure is explained.

3.1 Overview of the approach

3.1.1 Libraries of interest

Although the economic recession should affect all types of libraries, this research is focused on public libraries. Academic and corporate libraries are subject to the recessionary pressures on the parent institutions that they serve. National libraries have a different focus, with their mandate as keepers of the nation's written heritage. They are strongly supported by the government, and do not rely so heavily on usage to prove their worth. Public libraries, however, serve a population that is directly affected by a recession. The recession effect is not transferred, as it is in the case of academic and corporate libraries.

This dissertation will focus on South African public libraries. There is a lack of literature on the use of South African public libraries during economic hard times. This dissertation will assist in filling that gap. It will complement the research done in developed countries, and add to the literature on public library usage in developing countries. As the South African economic climate is often different to those in other countries, it will be interesting to see if this difference is mirrored in public library usage during economic difficulties.

Unfortunately, there are no nationally-coordinated and published figures for public library use in South Africa (Fourie, 2007: 32). The Western Cape Provincial Library Service did at one stage publish their figures, but the most recent publication was in 2002

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(Western Cape Provincial Library Service, 2002). Given time and financial limitations, this study focuses only on one municipal system of public libraries: the 10 libraries in the Saldanha Bay Municipality. The libraries are named after the areas where they are located. They are: Vredenburg, Louwville, Diazville, Saldanha, Langebaan, Harold Krumm, Hopefield, Paternoster, Laingville and St. Helena Bay. Vredenburg and Louwville are in the same town, with Vredenburg Library referring to the library in Vredenburg located in the richer part of town and Louwville Library in the poorer suburb of Louwville. Similarly with Saldanha and Diazville, Langebaan and Harold Krumm, St. Helena Bay and Laingville. The first of the pair refers to the library in the richer part of the town, and the second to the poorer. Paternoster and Hopefield are the only libraries in their respective towns. The figure below shows the geographical layout of the towns, names written in red, along with the approximate locations of the libraries, written in black.

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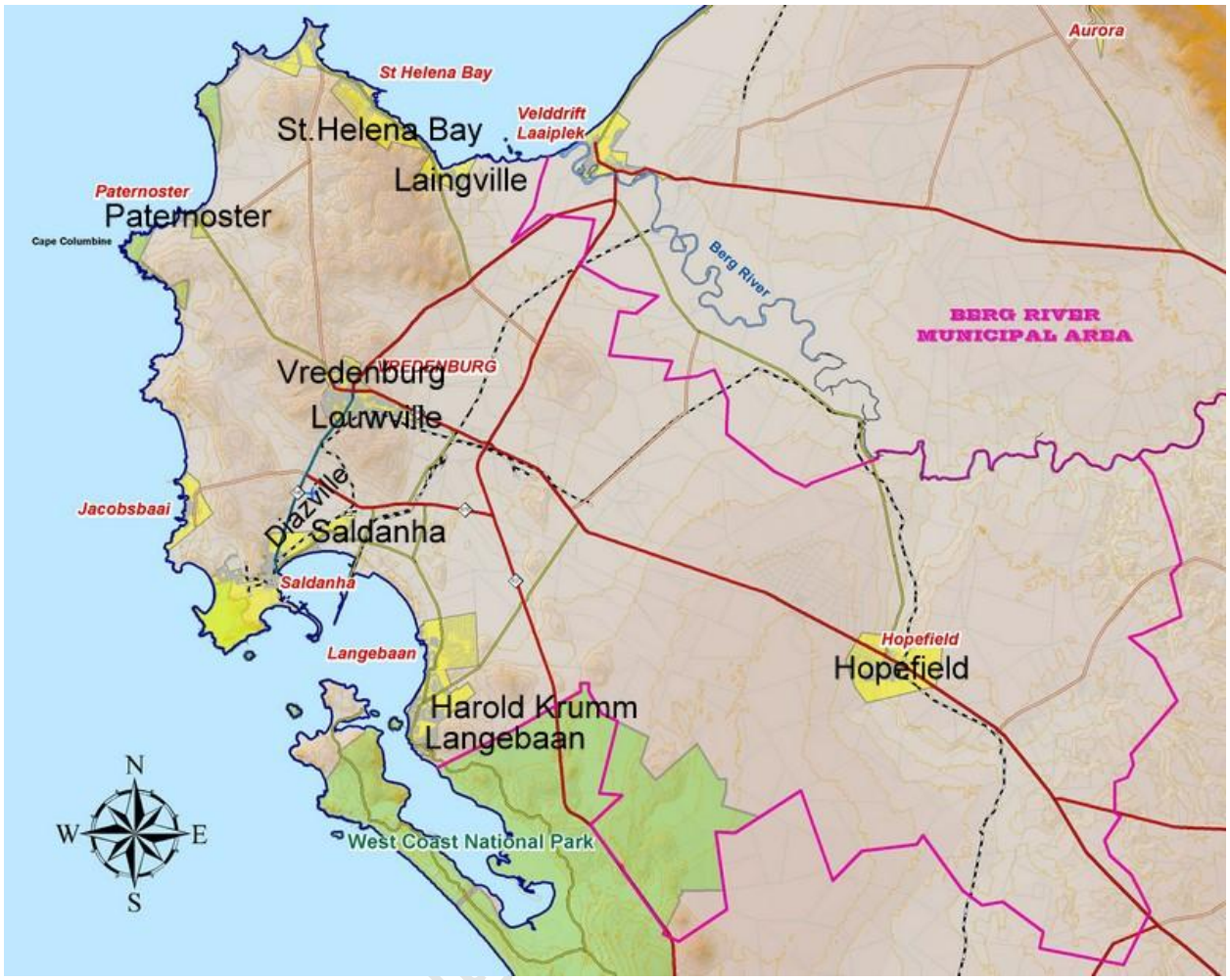

Figure 3.1: Map of Saldanha Bay Municipal area (Saldanha Bay Municipality, 2010)

3.1.2 Variables

Many variables could be used to evaluate the effect that an economic recession could have on public library use. Circulation figures are the one measure that most libraries use to evaluate use. Other measures include in-library use of library material, door counts, and "bums-on-seats". Unfortunately, the variables used are limited to the variables that are collected by the libraries. In the Saldanha Bay Municipality, the statistics are gathered at the request of the Provincial Library Service, and it was not considered possible to ask the staff of the libraries concerned to undertake additional collection of statistics not already covered by normal operations. The circulation figures are used by the Provincial

Library Service for collection management, and are thus collected. The library collections mirror the proportion of issues.

Focusing on one municipal area ensures that the figures gathered are comparable. This municipal area includes a large demographic variation between smaller areas within it. For example, Hopefield is considered to be poor, Louwville Coloured, and Paternoster is primarily a fishing village. Focusing on only one municipal area does, however, limit the study to only those statistics which are readily available.

All 10 libraries keep figures of registered users, breaking them down between adults and children. Children are users under 12-years old. None of the libraries keep good track of inactive users, which means that the number of registered users tends only to increase, and never decrease because the register of users is rarely weeded. Only occasionally do the libraries reflect a decrease in users. As the figure only increases, it makes it difficult to use as an accurate measure. Calculating the change each month only will show new users, not a nett change. Provided that these limitations are kept in mind, one can still use the figure as a reflection of use. One can imagine that in harsh economic times more users would wish to register to use the library. Anyone can register to use the library; the only requirement is that they provide a municipal account, such as a water and electricity account, when they register.

For all 10 libraries the following monthly circulation figures are gathered:

- Adult fiction by locally used languages, namely Afrikaans, English and Xhosa
- Adult non-fiction
- Children's or junior fiction by locally used language, namely Afrikaans, English and Xhosa
- Children's or junior non-fiction

There are other monthly circulation figures that are not reliably captured:

- Works of Art
- Magazines

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- CDs
- Tape Cassettes
- Videos
- DVDs

In addition to these, St. Helena Bay collects the following monthly statistics:

- Telephone enquiries on renewals and other
- Reference queries on tourism, local questions and other
- In-library book use
- Use of magazines and newspapers
- Photocopies
- Use of pamphlets
- And interlibrary loan requests.

Given these figures, the following measures will be used in this study:

a. Total circulation of books

This will be used as the primary measure of library use. The Axiom states that library use should increase during an economic recession, so this figure should be inversely correlated with economic activity.

b. Adult non-fiction

Non-fiction books include do-it-yourself books and books on careers and job finding. So the use of these should increase during a recession, although perhaps not as much as with fiction.

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c. Junior books

The circulation of both junior fiction and non-fiction is expected to rise during economic hard times. As libraries are used for free entertainment, parents should bring their children to the library to find books for them to page through, or to read together at home.

d. Adult fiction

Once again, this is a measure of how library use changes for entertainment purposes during a recession. This figure should increase more than any of the others.

This dissertation does not examine how DVD and video usage changes during economic hard times. Within the time period of interest, the libraries were in the process of replacing the video-cassette collections with more DVDs. This changeover could affect the usage more than the economy. For many months the libraries captured the two figures interchangeably, making it impossible to have a reliable circulation figure for DVDs.

None of the libraries offer internet services. The Saldanha Bay Municipality does provide free internet in a municipal run internet café which is located next to the Louwville Library. One could imagine that locating the internet service here would have a slight marketing effect on the library, that is users go to use the internet, and while they are there they go into the library. However, there are no reliable figures kept for internet usage.

It would have been illuminating to see if the books on writing CVs and job searching circulated more than the other non-fiction books, but this is not possible. All 10 libraries still operate with a card catalogue, so creating a definitive list of career books is extremely challenging. In addition, as they do not have a computerized issue system, book use is impossible to work out. One would think that counting the number of times each book is issued by looking at the date stamps might provide some insight, but the stamps do not have a year and are not stamped sequentially. In Vredenburg, the career

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books have been moved to the reference collection, and no-one monitors the use. When asked, the librarians said that it is mostly children who use them for school projects[2].

For recessionary effects relating to the budget, the budget itself can be examined. For effects on staffing, number of full time staff could be used as well as the hours worked by casual staff. In terms of collection development, the number of books received and weeded could be used. For the Saldanha Bay Municipality, the libraries' budget is a central one, which the head librarian then splits between the 10 branches. Staffing is also managed centrally. The collection is managed by the Provincial Library Service.

3.1.3 Time period

This study restricts itself to a three year period, from January of 2007 to December of 2009. The recession of 2008/2009 hit South Africa in the fourth quarter of 2008. By June the following year South Africa was in recovery. So this three year period from 2007 to 2009 includes 21 months of economic prosperity, nine months of economic recession, and six months of recovery. This restriction was done for simplicity's sake. As with all studies, a longer time period will reveal more detail, but for this study only three years were necessary to capture the desired effect.

3.2 Data sources and collection strategies

3.2.1 Economic data

Business cycle indicators are separated into three broad groups: leading, lagged and coincident. Leading indicators are the most elusive as they refer to a future economic climate. Lagged indicators are the easiest to measure as they refer to historical economic climate. Coincident indicators show the climate of a current time (Mohr, 2000: 71).

Although economic recessions are measured by GDP growth, GDP figures are only issued quarterly. GDP is also a lagged indicator; the figure refers to the three months prior and is no indication of current or future situations. So rather than using GDP in this

[2] S. Cleopas. Personal conversation with L. Skelly, 29 June 2010. [Unpublished]. Vredenburg.

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study, the coincident index, which is calculated by the South African Reserve Bank, is used. This is a monthly figure which shows business activity *at the current moment*. It includes inflation and unemployment, which is why those two indicators are not separately included in the model.

Ideally, an economic indicator specific for the geographical area would be used. However, there is no such variable available.

3.2.2 Population data

Details of the population for the Saldanha Bay Municipality are taken from Census 2001, provided by the South African Marketers Map (SAMM). Such out-date data is not ideal, but no other study includes the necessary detail. Later studies give figures for the Municipality as a whole, whereas the interest of this research lies in the variation within the region. There is scope for an update on this research once the census of 2011 has taken place.

3.2.3 Library circulation data

The library data was provided by the libraries themselves, and supported by personal observation. The circulation data is quite complete. Only the February 2008 circulation figures for Paternoster and St. Helena Bay libraries are missing. These figures are filled in by linear interpolation, and checked against the other years to ensure that it is a reasonable estimation.

3.3 Analytical procedure

The assumption is that there are many factors which might influence library use, the economy being only one of them. For circulation, if the Axiom holds true, the more registered users there are, the more books should be issued. In bad weather users might prefer to stay at home than go to the library. During school terms many children use the library as a place to do their homework and use the library resources to do their projects. During holidays, many readers request to take more books to read when they go away on

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holiday. The number of hours that the library is open to the public could also affect use. In a month with many public holidays, it is conceivable that there will be fewer books issued than a month with less public holidays. The demographic difference between the different areas could account for the difference in use between the different libraries. For example, in Vredenburg the level of education is higher than in Louwville. So one can expect Vredenburg library to be used more than Louwville library. Income too might be an influencing factor. The residents of the relatively wealthy Langebaan should have been less affected by the recession than the poorer residents near the Harold Krumm library. The distances to the libraries that users need to travel could also affect use. Hopefield library, for example, stands in the middle of an empty lot. To get to the library many children walk barefoot. In hot days, perhaps this might be enough to dissuade them from going to the library. In St. Helena Bay, due to the structure of the town, it is very difficult for most of the users to walk to the library. In economic hard times where money for petrol is scarce, some people might want to save their petrol resources for something more important than the library. Laingville on the other hand, is situated in the very centre of the small town, making it easy for children and adults to walk to the library. As the area is close to the sea, it might be the case that many users prefer going to the beach in good weather, and the circulation figures might reflect this. Another factor is that in November of 2007 a shopping mall in Langebaan opened, bringing the first bookstore into the area. Another mall opened in Vredenburg in March 2009, with two more bookstores. These bookstores could have a negative effect on the libraries' circulation as it moves activities away from the libraries. However, it could have a positive effect if people link shopping to a visit to the library.

Four statistical models were created. These models examined the effects that the recession might have on total circulation, on the circulation of adult fiction, adult non-fiction and juvenile material. While many factors influence circulation, the economy was the only independent variable used.

These models examined using the multiple regression method. Multiple regression is a statistical method which allows one to see the magnitude and the direction of the effect of

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several explanatory variables on one dependent variable (Koop, 2009: 90). In this study, the dependent variable will be circulation data for the first four models.

When running the four models, the data from the 10 libraries can be pooled to create what the economists call panel data. Creating a panel with the data has several advantages, as explained by Hsiao (1989: 1-2).

> "Panel data sets…gives the researcher a large number of data points, increasing the degrees of freedom and reducing the collinearity among explanatory variables. …longitudinal data allow a researcher to analyse a number of important economic questions that cannot be addressed in using cross-sectional or time-series data sets."

Restating this, creating panel data sets allows one to have greater confidence in the results than one would have if several statistical tests were run independently rather than together. It also allows differences between sets (in this case, libraries) and over time to emerge.

There are several different models that one can create using panel data. In this case it is assumed that both the coefficients and the intercepts vary across libraries. This is a reasonable assumption: the intercepts, which measure library circulation, even when there is nothing influencing it, will vary between the libraries. Bigger libraries will circulate more books, smaller ones fewer.

The coefficients, which measure the degree to which the economy is affecting circulation is assumed to be varying as this will tease out the possible effects that the economy could be having on libraries. It will also reveal if the circulation of the different libraries is influenced uniformly across the libraries, that is to say that the coefficients do not change between libraries.

As the economy is not the only thing that influences circulation, the error variable in this model will not be random. The error variable will include the effects of anything else which might influence circulation. These three factors, the varying coefficient and intercepts, and the non-random error, determine that this panel data model is what is known as a fixed effects or least-squares dummy variable model.

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In creating this model, nine dummy variables representing the nine different libraries are introduced. Dummy variables are always one fewer in number than the variables they represent, in this case there are 10 libraries and so nine dummy variables. The tenth library will be reflected in the intercept of the model. These dummy variables capture the varying intercepts of the nine other libraries.

These dummy variables are then allowed to interact with the measure of the economy, the coincident index. In order to provide a simply understood result, both the logarithm of the values of the coincident index and the dependent variables is used. This then shows how a percentage change in the one is reflected as a percentage change in the other. A percentage change facilitates an easy comparison of figures. Written mathematically, the four models are thus:

$$Y_{it} = \alpha_1 + \alpha_2 D_{2i} + \alpha_3 D_{3i} + \alpha_4 D_{4i} + \alpha_5 D_{5i} + \alpha_6 D_{6i} + \alpha_7 D_{7i} + \alpha_8 D_{8i} + \alpha_9 D_{9i} + \alpha_{10} D_{10i} + \beta_2 (D_{2i} C_{it}) + \beta_3 (D_{3i} C_{it}) + \beta_4 (D_{4i} C_{it}) + \beta_5 (D_{5i} C_{it}) + \beta_6 (D_{6i} C_{it}) + \beta_7 (D_{7i} C_{it}) + \beta_8 (D_{8i} C_{it}) + \beta_9 (D_{9i} C_{it}) + \beta_{10} (D_{10i} C_{it}) + \lambda C_{it}$$

Where:

- $Y_{i\,t}$ is the *logarithm of the* circulation data of 1) all the books, 2) adult fiction, 3) adult non-fiction, 4) juvenile material
- α are the intercepts of the 10 libraries
- D_i is the dummy variable relating to the ith library
- β are the coefficients of interest
- λ is the coefficient of the omitted library
- C_i is the logarithm of the coincident index
- i is the ith cross-sectional unit (or in this case the ith library)
- t is the time period

This model was largely based on the example used by Gujarati (2003: 645).

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3.3.1 Leading and lagging

It is possible that the effect of the recession could reach the Saldanha Bay area sooner than the rest of the country. The Bay has one of South Africa's international ports, and the import/export activity would slow down as other countries experience their recessions. On the other hand, Saldanha Bay is a rural area. Typically, rural areas feel economic effects after urban areas, so it is possible that the area experiences a delay in the effects of the recession.

To counter for both the possibility of the area leading the effect of the recession and lagging it, the logged coincident index will be shifted in both directions and run again. This will allow one to see how the economic climate of the previous month has affected this month's circulation, how the economic climate two months ago has affected this month's circulation, and so on until six months back. In order to ascertain whether the economic prospects have any effect on the monthly circulation the model will be run again, with the period of leading increasing over the range one month to six months. At each stage the regression will be run, giving a total of 13 regressions per model. Leading and lagging will also show how the effect changes over time, if it does change.

An example of this illustrated in Figure 3.2. The green line, labelled a, represents the coincident index; the red line, b, circulation. Looking at the way they are lined up over time, would show that there is little correlation between the index and circulation. However, if the index is moved in the direction of the arrows then the two lines would correlate perfectly. This would show that the index has a lagged correlation with circulation.

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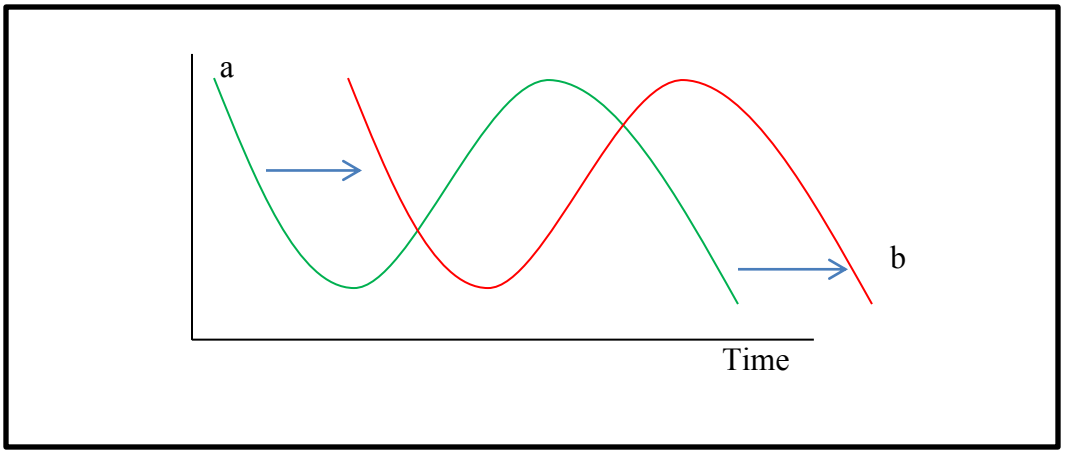

Figure 3.2: An illustration of the effects that could be shown by lagging the economic index

For budgetary effects, no statistical method will be applied. Conclusions will simply be drawn from examining the evidence presented. Anecdotal evidence will be heavily used to support conclusions. This method will be used to examine the effects that a possible budgetary change would have on staffing and hours.

As collection development is managed by the Provincial Library Service, an examination of the budgetary effects on the collection of these public libraries is better suited for a study looking at the possible effects that the economic recession had on the Provincial Library Service.

A closer examination of the effects that the economic recession had on the publishing industry was outside the scope of this research.

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Chapter 4: Results

This chapter gives the results of the statistical analyses done. It will be shown that the Librarians' Axiom does not hold across all of the libraries. In fact, the libraries where it does hold are in the minority. When looking across the different sections of circulation, namely adult fiction, adult non-fiction and juvenile circulation, there is also no evidence of the Axiom being true.

This then implies that the reasons why it is suspected that libraries are used more during an economic recession might not hold true. One cannot then say that libraries are used more to provide children's entertainment or adult entertainment. Libraries are not used more as job-finding resources or for do-it-yourself books.

Where there is a relationship between circulation data and the index, the relationship will be small, almost too small to be noticeable. Possible reasons for this will be discussed in the next chapter.

This chapter will close with an anecdotal examination on how the libraries' budget has changed over the period of interest. No significant change was found.

The full statistical results are included in Appendix 2. What follows here highlights some of the more interesting outcomes. Firstly the direct regressions where the coincident index is neither led nor lagged will be discussed. Secondly, the results of the lagged regressions will be revealed. This is where the study examines how the past economic climate of the country might affect the current circulation of the area. Finally, the results of the led regressions will be shown. The led regressions examine how the future economic conditions of the country might affect current circulation in Saldanha Bay.

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4.1 General note on the validity of the multiple regression models

In multiple regression analysis, there are two measures that one should look at in order to determine whether or not the model created provides a good explanation of the variation observed in the dependent variable. These two measures are the R-Squared and the F-Statistic. The R-Squared gives a measure of how much of the variation in the dependent variable is actually explained by the explanatory variables. Keller and Warrack (2003: 622) show R-Squared to be calculated with the following equation:

$$R^2 = [\text{covariance}(X, Y)]^2 / \text{StdDev}_x^2 \text{StdDev}_y^2$$

As one can see the R-Squared includes a measure of covariance which is how the variables move together. In all regressions that were run, the R-Squared was sufficiently high, as one would expect given how the model had been constructed, which means that the model is a good predictor of actual circulation figures.

The second measure is the F-Statistic. The higher the F-Statistic is, the more statistically significant the model is. Keller and Warrack (2003: 476-7) show that the F-Statistic is calculated with the following formula:

$$F = (\text{Mean square for treatments}) / (\text{Mean square for error})$$

However, the F-Statistic needs to be adjusted for the amount of explanatory variables as well as the sample size. In this instance, any figure above 1.88 (at the 0.1% probability) is considered to be statistically significant (Keller & Warrack, 2003: B-16).

All the models created to predict the variance in the total circulation are very good fits, with regard to both the R-Squared and the F-Statistic. The figures are given in Appendix 2.

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4.2 Direct regressions

Table 4.1 shows the summary of the adjusted coefficients of the coincident index, with the exception of Vredenburg which is not adjusted. The adjustment is due to the way the model is constructed. The coefficients that come out of the regression are the difference from the coefficients shown by the omitted library, which in this case is Vredenburg. The figures for the other nine libraries are adjusted to take this into account, and so Table 4.1 shows the actual relationships. Vredenburg was randomly chosen as the omitted library; any other could have been used instead.

The figures in Table 4.1 are percentage changes, reflecting that if the economy were to change by one per cent, circulation would reflect an adjustment equal to the figure shown in Table 4.1. The adjustment would be in the same direction in the case of positive coefficients, and in the opposite direction in the case of negative coefficients. For example, if the library showed a coefficient of 1, then one could say that it was perfectly correlated with the economy, that is to say, if the economy strengthened by one per cent then this would relate to the circulation figures going up by one per cent. A negative coefficient shows that the circulation moves in an opposite direction to the economy. So a coefficient of -1 would show that circulation would go down by one per cent and the economy would be strengthened by one per cent. These coefficients do not reveal a causal relationship between the economy and circulation however, just a simple correlation. If the Librarians' Axiom holds true, then one would expect all of the coefficients to be negative.

Only statistically significant figures will be taken into account in the discussion. No reliable conclusions can be drawn from figures that are not statistically significant and will thus not feature in the discussion. Throughout this chapter and the next, negative and statistically significant figures are shown in red, while positive and statistically significant figures are highlighted in yellow, unless otherwise stated.

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Library	Total circulation	Adult fiction	Juvenile circulation	Adult non-fiction
Vredenburg	-1.288**	-0.47048	-3.2857***	-2.724***
Diazville	0.4563**	0.45886	0.4409***	0.514**
Harold Krumm	1.4463***	1.49748***	1.1542***	2.937***
Hopefield	0.0982*	0.14121	0.1124***	0.123**
Laingville	0.6318***	0.07511	1.1093***	1.036***
Langebaan	-0.4309	-0.37565	-0.6131**	-0.439
Louwville	-0.4666	0.66719**	-1.6464	-1.392
Paternoster	-0.8608	-1.20998	-0.3153**	-1.261
Saldanha	0.3695**	0.67044**	-0.2793**	-0.475
St. Helena Bay	-0.2692	-0.12253	-0.6803**	2.159

Table 4.1: Adjusted coefficients of the coincident index for regressions run on total circulation, adult fiction, juvenile circulation and adult non-fiction (*significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level; negative and statistically significant figures are shown in red, while positive and statistically significant figures are highlighted in yellow)

4.2.1 Total circulation

Focusing on the column of total circulation, only Vredenburg shows a negative relationship between its total circulation and the coincident index, and then only a ratio of 1 to -1.3 approximately. This is hardly noticeable. Harold Krumm shows the strongest positive relationship, around 1 to 1.4. Once again, this is hardly noticeable. From this initial analysis, the Axiom does not hold true. However, it is possible that the Axiom might hold for a particular section of circulation. With this in mind, the regressions were re-run using adult fiction, adult non-fiction and juvenile circulation as dependent variables.

4.2.2 Adult fiction

It is hypothesized that the circulation of adult fiction should increase during an economic recession, as people seek out cheaper forms of entertainment. However, this does not reflect in the regressions. Instead, what Table 4.1 shows is that adult fiction is read *less* as the recession deepens. The effect is minimal though; a maximum of 1.49% less in the case of Harold Krumm.

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4.2.3 Juvenile circulation

If the Axiom were to hold true, one would expect to see a statistically significant negative relationship between the circulation of juvenile material and the index in the case of all libraries. This would be because it is expected that libraries would be used more to provide cheap entertainment to children during times of economic hard times. Looking at Table 4.1, this is not the case. Four of the 10 libraries show a positive relationship, while five show a negative one. If one were to only look at these five libraries, one might conclude that children do read more during economic recessions, up to three per cent more for each percentage that the economy dropped in the case of Vredenburg. However, the four libraries with positive relationships paint a different picture. Thus one cannot categorically say that juvenile books are used more during an economic recession.

4.2.4 Adult non-fiction

The final recessionary effects that these direct regressions examine are the assumption that adult non-fiction books are used more. This could be for several reasons. Non-fiction is read for entertainment purposes and the demand for cheap entertainment should go up. This is unlikely though, given the discussion around the relationship between adult fiction and the economy.

Other reasons could be that libraries provide do-it-yourself books, which could be one way in which households attempt to cut costs during times of economic hardship. Similarly, the non-fiction sections in libraries should house resources for job seekers. As unemployment increases during recessions, one would expect that these resources are used more often.

Table 4.1 shows this to be clearly not the case. Only in Vredenburg does the circulation of non-fiction books go up as the economy declines, and then by less than three per cent. In four other libraries the circulation goes down as the recession deepens. There is no evidence to support the claim that use of non-fiction should go up during an economic recession in all libraries.

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4.2.5 In summary

There is no evidence to support the claim that libraries are used more during economic recessions. Even when separating out the different parts of circulation in an attempt to see the differing effects that the economy might have on the different parts of circulation, the Axiom does not hold. Where a significant relationship is revealed, it is a small one with a maximum change of about three per cent for every percentage change in the economy.

It is interesting to note that of the three sections of circulation, juvenile circulation seems to be most sensitive to the economy. Of the 10 libraries, nine have a statistically significant relationship with the index. However, a full exploration of the effects of an economic recession on the entertainment habits of children is outside the scope of this dissertation.

It could be that the relationship between circulation and the index is not an immediate one, that it might be delayed as people adjust to the new economic climate. For this reason, the coincident index is lagged, and the regressions were rerun. This will be discussed in the next section.

4.3 Lagged regressions

The assumption that the economic state of the nations at a particular time has a direct result on the circulation of a specific library in the same month could be a completely erroneous assumption. For example, people might take some time to adjust their library lending rates to their new economic circumstances. Another reason could be that because the Saldanha Bay area is a rural one, it is slightly behind the economic climate of the rest of the country. In order to examine how economic climates of the previous months affect the circulation of a particular month, the index was lagged over different time periods and the regressions were rerun. This will perhaps answer why the Axiom did not hold to be true when the regressions were run initially.

The figures in the tables of this section represent something very similar to those in Table 4.1, namely that they are the adjusted coefficients from the regressions and show a

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percentage change. This will hold for all tables in this chapter. In the tables of the lagged regressions, the columns labelled Mx will represent a lag of x months. For example, column M5 will give the coefficients of the regression run when the index is lagged five months. The index series would then start at July 2006 and go 36 months to June 2009. The circulation data would not be shifted, and remain a series from January 2007 to December 2009. The column labelled "No" is where no lag is applied; the index series runs from January 2007 to December 2009. These figures were introduced in Section 4.2.

4.3.1 Total circulation

Table 4.2 shows the coefficients of the regressions run with total circulation as the independent variable. The Axiom would suggest that one would expect all the coefficients, which represent the relationships between the economy and library use, to be negative. Only Vredenburg shows this negative relationship. It is interesting to note that the relationship between total circulation and the economy seems to weaken as the index is lagged further and further back. This can be seen in the amount of libraries that show to have a statistically significant relationship, by how the statistical significance declines and how the magnitude of the relationship lessens as the index is lagged further and further back.

In Section 4.2 it was concluded that the Axiom does not hold. By lagging the index, the idea that there might be a delay between the economic climate and the effect on library circulation was explored. From Table 4.2, it would appear that there is not a delayed response. However, this could be because the relationship is only evident in one part of circulation and the lack of a relationship in the other parts is obscuring this relationship. In order to examine this, circulation will be broken up as before, into adult fiction, juvenile circulation and adult non-fiction. These will be discussed next.

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Library	M6	M5	M4	M3	M2	M1	No
Vredenburg	-0.7566	-0.9556	-1.0247*	-1.0813*	-1.1957**	-1.2691**	-1.288**
Diazville	0.0254	0.1713	0.2147	0.3459*	0.3439**	0.3661**	0.4563**
Harold Krumm	0.1322	0.5078	0.7953**	1.0581***	1.2015***	1.2788***	1.4463***
Hopefield	-0.2728	-0.2661	-0.2342	-0.1642	-0.085	-0.032	0.0982*
Laingville	-0.9228	-0.7188	-0.5663	-0.178	0.0308	0.2638**	0.6318***
Langebaan	-0.4876	-0.522	-0.5591	-0.5235	-0.5139	-0.5088	-0.4309
Louwville	-0.006	-0.1815	-0.3466	-0.4122	-0.4833	-0.4934	-0.4666
Paternoster	-0.4985	-0.6587	-0.786	-0.8304	-0.8308	-0.8931	-0.8608
Saldanha	0.0587	0.1405	0.2057	0.2936*	0.3136*	0.3213*	0.3695*
St. Helena	-0.6348	-0.6138	-0.5322	-0.4347	-0.3857	-0.3848	-0.2692

Table 4.2: Adjusted coefficients of lagged regressions on total circulation. Mx represents lagging the index x months, and "No" represents the direct regression introduced in Section 4.2 (*significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level; negative and statistically significant figures are shown in red, while positive and statistically significant figures are highlighted in yellow)

4.3.2 Adult fiction

Taking adult fiction as the dependent variable, Table 4.3 shows the results of the regressions run. If one assumes that the Axiom is true, and that there is a delayed response between the economic climate and circulation habits, then one would expect the relationships shown in Table 4.3 to be negative and statistically significant. The opposite is found. Few libraries have statistically significant relationships, and those that have, showed up to be positive. Only Paternoster has a negative relationship, and then only when the index is lagged by six months, making it the distinct exception.

There is no evidence that the economic recession would have a future effect on how the library is used to provide more adult entertainment. It could still be the case that use by children has a delayed reaction to the economic climate. This will be discussed in the next section.

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Library	M6	M5	M4	M3	M2	M1	No
Vredenburg	-0.43769	-0.70036	-0.7118	-0.6368	-0.55974	-0.5308	-0.47048
Diazville	0.4369	0.24923	0.3654	0.3766*	0.423864*	0.4099	0.45886
Harold Krumm	1.4845***	0.97547**	1.1988***	1.3146***	1.479556***	1.452***	1.49748***
Hopefield	0.08283	0.18145	0.2008	0.1999	0.180434	0.1146	0.14121
Laingville	0.20261	-1.05798	-0.9149	-0.7976	-0.34476	-0.1694	0.07511
Langebaan	-0.36164	-0.40794	-0.432	-0.4662	-0.43451	-0.4293	-0.37565
Louwville	0.59954*	0.71792**	0.7189**	0.6872**	0.684455**	0.6659**	0.66719**
Paternoster	-1.35835*	-0.58824	-0.8138	-0.9911	-1.10323	-1.194	-1.20998
Saldanha	0.6831**	0.41647*	0.5173*	0.5824**	0.658649**	0.6517**	0.67044**
St. Helena	-0.14754	-0.22913	-0.2478	-0.2239	-0.17603	-0.1947	-0.12253

Table 4.3: Adjusted coefficients of lagged regressions on adult fiction. Mx represents lagging the index x months, and "No" represents the direct regression introduced in Section 4.2 (*significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level; negative and statistically significant figures are shown in red, while positive and statistically significant figures are highlighted in yellow)

4.3.3 Juvenile circulation

It is not the case that more juvenile books are taken out in response to a past recession. It is only the case in some libraries, as Table 4.4 shows. Some libraries do not have a significant relationship, and others have a positive. Looking at which lags come up statistically significant, it would appear that past economic conditions have a weaker relationship with juvenile circulation of a particular month. There is not much evidence to support the claim that libraries are used more for children's entertainment in the months following the onset of an economic recession.

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Library	M6	M5	M4	M3	M2	M1	No
Vredenburg	-0.66822	-1.3647	-1.8154*	-2.2103**	-2.6831***	-3.0398***	-3.2857***
Diazville	-0.28689	-0.1016	-0.0183	0.1786*	0.2262**	0.2941**	0.4409***
Harold Krumm	-1.02645	-0.4998	-0.0352	0.3802*	0.6295**	0.8268***	1.1542***
Hopefield	-0.79009	-0.7968	-0.7281	-0.5533	-0.3571*	-0.1642**	0.1124***
Laingville	-0.63427	-0.4336	-0.3185	0.1446*	0.357**	0.6277***	1.1093***
Langebaan	-0.82331	-0.882	-0.9053	-0.8362	-0.8031	-0.7859*	-0.6131**
Louwville	-0.76391	-1.1286	-1.4409	-1.5595	-1.7065	-1.6953	-1.6464
Paternoster	-0.3617	-0.4415	-0.4835	-0.5118	-0.4472*	-0.4426**	-0.3153**
Saldanha	-0.53916	-0.559	-0.5362	-0.4315	-0.4198*	-0.3965**	-0.2793**
St. Helena	-1.72181	-1.5997	-1.375	-1.1399	-1.0071	-0.9645	-0.6803**

Table 4.4: Adjusted coefficients of lagged regressions on juvenile circulation. Mx represents lagging the index x months, and "No" represents the direct regression introduced in Section 4.2 (*significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level; negative and statistically significant figures are shown in red, while positive and statistically significant figures are highlighted in yellow)

4.3.4 Adult non-fiction

The final part of total circulation examined is adult non-fiction. This section of a library's collection housed the resources for job seeking as well as do-it-yourself books. Both are hypothesized to be used more during an economic recession. When this was examined in section 4.2.4 it was discovered that only in Vredenburg does this seem to be the case.

Table 4.5 shows the results of the regressions run on the lagged index. This was done to see if it is possible that the effect that the economy has on the circulation of adult non-fiction might be a delayed effect. This does not seem to be the case. Much the same relationships that were shown in section 4.2.4 are repeated. Only Vredenburg shows a consistently negative relationship. The statistical significance seems to decrease as the index is lagged over longer time periods. Thus adult non-fiction is not used more in a delayed response to an economic recession.

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Library	M6	M5	M4	M3	M2	M1	No
Vredenburg	-0.89565	-1.38413	-1.699	-1.9594*	-2.2995**	-2.5747**	-2.724***
Diazville	-0.15874	0.017922	0.1071	0.2682	0.3063*	0.3847**	0.514**
Harold Krumm	2.22907*	2.517785**	2.6639***	2.8107***	2.9719***	3.0004***	2.937***
Hopefield	-0.58089	-0.58252	-0.4754	-0.3563	-0.2257	-0.0703*	0.123**
Laingville	-2.54032	-1.95902	-1.4093	-0.6266	-0.099	0.3996**	1.036***
Langebaan	-0.34706	-0.4122	-0.5135	-0.4813	-0.4831	-0.4958	-0.439
Louwville	-1.79731	-1.7436	-1.5639	-1.5712	-1.5767	-1.6256	-1.392
Paternoster	-2.45742	-2.33421	-2.3941	-2.3864	-1.8973	-1.6492	-1.261
Saldanha	-1.62805	-1.38425	-1.1702	-0.9008	-0.757	-0.6351	-0.475
St. Helena	-0.96829	-0.95815	-0.7635	-0.6864	-0.5725	-0.5738	-0.565

Table 4.5: Adjusted coefficients of lagged regressions on adult non-fiction. Mx represents lagging the index x months, and "No" represents the direct regression introduced in Section 4.2 (*significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level; negative and statistically significant figures are shown in red, while positive and statistically significant figures are highlighted in yellow)

4.3.5 In summary

It does not appear to be the case that the past economic climate has the type of relationship on current circulation that the Axiom would predict. This is true when examining total circulation, and when breaking total circulation into adult fiction, juvenile circulation and adult non-fiction. This could be because the reaction is not delayed at all, or it could be that the region does not feel the effects of the economic recession after the rest of the country. Perhaps the region feels the effects of the recession before the rest of the country. If this is the case then the relationship will reveal itself if the index is led. This is discussed in the next section.

In all the regressions run on the lagged index, where the relationship is statistically significant it is a small one. This is true for both the positive and the negative relationships. The reasons behind this slight relationship will be discussed in the next chapter.

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4.4 Led regressions

Saldanha Bay Harbour is one of the international harbours in the country. When an economic recession of a country is caused by the international economic climate it is called contagion. Contagion happens because countries are linked through linked currencies and international trade. During an economic recession, production in a country slows down. This means that there is less to trade, and trade slows down. In this case, it could be that the contagion is reaching the Saldanha Bay area sooner than the rest of the country because of the harbour. If trade slows down, the harbour activity would slow down, possibly slowing down the economic activity of the area.

If the economy of the area is slowing down sooner than the rest of the country, then it could explain why the relationship between the index and circulation is not showing up as particularly significant when the index is lagged. Perhaps if the index is led some months forward a stronger relationship will reveal itself. In order to discover this, exactly that was done. The index was led and the regressions were rerun. This section discusses the results of those regressions. It will be shown that leading the index does not reveal the Axiom to be true.

As before, the figures in this section represent something similar to those shown before. In the tables in this section, the columns labelled Px will represent a lead of x months. For example, column P3 will give the coefficients of the regression run when the index is led three months. The index series would then start at April 2007 and go 36 months to March 2010. The circulation data would not be shifted, and remain a series from January 2007 to December 2009. The column labelled "No" is where no lag or lead is applied; the index series runs from January 2007 to December 2009. These figures were introduced in Section 4.2.

As before, the regressions run on total circulation will be discussed first. Then, the three sections of adult non-fiction, adult fiction, juvenile circulation, will be discussed. This is to test the hypotheses that during economic recessions libraries will be used more for entertainment for both adults and children, and that the libraries are used more for job

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searching resources and do-it-yourself books. It will be shown that there is not a consistently negative relationship regardless of what section of circulation is explored. However as the index is led more months forward, more libraries show to have a statistically significant relationship. This shows that perhaps the economic climate of Saldanha Bay is ahead of that of the rest of the country.

4.4.1 Total circulation

Running the regressions with the led index as the independent variable and total circulation as the dependent variable does not reveal anything different from what has already been discovered in the previous sections. Table 4.6 shows the results of these regressions. Once again, the minority of libraries show a negative relationship between the index and total circulation. In these libraries one could say that the Librarians' Axiom holds true, that they are used more as the economy declines. But given that there are so many libraries where the relationship is opposite to what would expect from the Axiom, it can hardly be said that the Axiom holds true throughout all libraries.

Even if circulation is separated into different sections, the conclusion remains the same. This will be shown in the rest of section 4.4.

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Library	No	P1	P2	P3	P4	P5	P6
Vredenburg	-1.288**	-1.3223**	-1.3319***	-1.3587***	-1.3781***	-1.36243***	-1.3766***
Diazville	0.4563**	0.4695**	0.4291**	0.3722**	0.2853**	0.2368**	0.17378**
Harold Krumm	1.4463***	1.5356***	1.6005***	1.6139***	1.6008***	1.55318***	1.44299***
Hopefield	0.0982*	0.1819**	0.2244**	0.265**	0.2939**	0.31035**	0.32371**
Laingville	0.6318**	0.8467***	0.9009***	0.9573***	0.875***	0.8328***	0.75088***
Langebaan	-0.4309	-0.3979	-0.355	-0.3106	-0.2774	-0.24465	-0.21466
Louwville	-0.4666	-0.5028	-0.5023	-0.5276	-0.5535	-0.5485	-0.55147
Paternoster	-0.8608	-0.9897	-1.0343	-1.1594	-1.2444	-1.39877	-1.42165
Saldanha	0.3695**	0.4074**	0.3978**	0.3782**	0.3377**	0.31555**	0.26032**
St. Helena	-0.2692	-0.2382	-0.1958	-0.1503*	-0.1377*	-0.11384*	-0.13891*

Table 4.6: Adjusted coefficients of led regressions on total circulation. Fx represents leading the index x months, and "No" represents the direct regression introduced in Section 4.2 (*significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level; negative and statistically significant figures are shown in red, while positive and statistically significant figures are highlighted in yellow)

4.4.2 Adult fiction

Only a minimal number of libraries show to have a statistically significant relationship between the circulation of their adult fiction and the led index, and only one shows a negative relationship, as Table 4.7 shows. Thus it cannot be said that adult fiction is read more during recessions, even when taking into account that the economic climate of Saldanha Bay might not be perfectly aligned with that of the rest of the country.

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Library	No	P1	P2	P3	P4	P5	P6
Vredenburg	-0.47048	-0.43769	-0.38635	-0.35996	-0.34334	-0.31172	-0.3082
Diazville	0.45886	0.4369	0.37568	0.30392	0.21057	0.15711	0.0831
Harold Krumm	1.49748***	1.4845***	1.46987***	1.40697***	1.35686***	1.23038**	1.0504**
Hopefield	0.14121	0.08283	0.06947	-0.00272	-0.03211	-0.08367	-0.1765
Laingville	0.07511	0.20261	0.23508	0.28033	0.23238	0.21595	0.1772
Langebaan	-0.37565	-0.36164	-0.32638	-0.28713	-0.25781	-0.22122	-0.1973
Louwville	0.66719**	0.59954*	0.56305*	0.49975	0.42972	0.35542	0.2446
Paternoster	-1.20998	-1.3583*	-1.42807*	-1.56587**	-1.61049**	-1.7047**	-1.673**
Saldanha	0.67044**	0.6831**	0.65215*	0.61747*	0.56137	0.52561	0.4464
St. Helena	-0.12253	-0.14754	-0.16156	-0.15682	-0.19764	-0.2235	-0.2861

Table 4.7: Adjusted coefficients of led regressions on adult fiction. Fx represents leading the index x months, and "No" represents the direct regression introduced in Section 4.2 (*significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level; negative and statistically significant figures are shown in red, while positive and statistically significant figures are highlighted in yellow)

4.4.3 Juvenile circulation

Juvenile circulation shows a surprisingly strong relationship with the index, although the relationship is not in the same direction. Four libraries have a positive relationship, and the rest show a negative relationship. A negative relationship indicates that the libraries are used more as the economy declines, as the Axiom assumes. Why some libraries have a positive relationship and others a negative one will be the subject for the following chapter.

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Library	No	P1	P2	P3	P4	P5	P6
Vredenburg	-3.2857***	-3.5289***	-3.7253***	-3.9217***	-4.0644***	-4.1177***	-4.1875***
Diazville	0.4409***	0.4927***	0.4839***	0.4513***	0.3759***	0.3376***	0.2934***
Harold Krumm	1.1542***	1.3679***	1.517***	1.627****	1.6608***	1.7153***	1.691***
Hopefield	0.1124***	0.3774***	0.5114***	0.6647***	0.7565***	0.8386***	0.9548***
Laingville	1.1093***	1.4133***	1.4735***	1.5288***	1.3896***	1.2987***	1.1434***
Langebaan	-0.6131**	-0.5103**	-0.439***	-0.3738***	-0.3309***	-0.3055***	-0.2529***
Louwville	-1.6464	-1.6435	-1.6136*	-1.5997*	-1.5858**	-1.4956**	-1.3874**
Paternoster	-0.3153**	-0.4225**	-0.4198***	-0.5421***	-0.7187***	-0.99**	-1.1394**
Saldanha	-0.2793**	-0.211***	-0.2078***	-0.2409***	-0.2909***	-0.3192***	-0.3582***
St. Helena	-0.6803**	-0.4465**	-0.2373***	-0.0891***	0.0662***	0.2334***	0.2826***

Table 4.8: Adjusted coefficients of led regressions on juvenile circulation. Fx represents leading the index x months, and "No" represents the direct regression introduced in Section 4.2 (*significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level; negative and statistically significant figures are shown in red, while positive and statistically significant figures are highlighted in yellow)

4.4.4. Adult non-fiction

Table 4.9 shows the results of the regressions run on the led index and adult non-fiction. When the index is led six months, the relationships mirror those seen in section 4.4.3 where juvenile circulation was discussed. This could be because non-fiction books are often used by children for school projects. Whatever the reason, Table 4.9 shows that the Axiom does not hold in this case, as it has not for any other case.

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Library	No	P1	P2	P3	P4	P5	P6
Vredenburg	-2.724***	-2.881***	-3.0351***	-3.161***	-3.2795***	-3.336***	-3.4316***
Diazville	0.514**	0.605**	0.5722**	0.507***	0.4158***	0.353***	0.2802***
Harold Krumm	2.937***	2.937***	2.9294***	2.696***	2.3956***	2.117***	1.7622***
Hopefield	0.123**	0.253**	0.3076**	0.425**	0.4947***	0.543***	0.6008***
Laingville	1.036***	1.447***	1.6102***	1.761***	1.7419***	1.808***	1.8237***
Langebaan	-0.439	-0.409*	-0.3702*	-0.351**	-0.3244**	-0.33**	-0.3264**
Louwville	-1.392	-1.432	-1.2691	-1.242	-1.17	-1.084	-0.9787*
Paternoster	-1.261	-0.951	-0.639*	-0.284**	0.044**	0.388***	1.0479***
Saldanha	-0.475	-0.27*	-0.1283**	0.03**	0.1376**	0.252**	0.361***
St. Helena	-0.565	-0.604	-0.5488*	-0.466*	-0.4278**	-0.425**	-0.4127**

Table 4.9: Adjusted coefficients of led regressions on adult non-fiction. Px represents leading the index x months, and "No" represents the direct regression introduced in Section 4.2 (*significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level; negative and statistically significant figures are shown in red, while positive and statistically significant figures are highlighted in yellow)

4.4.5 In summary

It was thought that due to the presence of the international harbour in Saldanha Bay, that economic contagion might reach the area sooner, and so the future economic climate of the country will have a statistically significant relationship with the libraries' circulation in the area. This was found to be the case, as the more the index is led, the more libraries show to have a statistically significant relationship. Notably adult non-fiction and juvenile circulation seem to be most sensitive to the economic climate.

However, this relationship is not consistently negative or positive. The Axiom prescribes that the relationship should be negative throughout. As there is strong evidence to the contrary, the conclusion is that the Axiom is false.

The following chapter will attempt to discover why there is this difference between the libraries by examining the libraries in light of their difference. It will also discuss why the relationship, where there is one, is so small. However, there is still a recessionary effect that is to be examined: the effect that the recession might have on the budget of the libraries. It will be shown that there is not a noticeably significant effect on the budget.

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4.5 Recessionary effects of the budget

From the literature on the effects of an economic recession on the budget of a library one would expect the library budget to decrease significantly during an economic recession. An anecdotal examination of the budget of the libraries in the Saldanha Bay area shows this not to be the case.

The budget for the libraries in the Saldanha Bay Municipality is set centrally for all 10 libraries. The financial year runs from July to June of the following year. Table 4.10 shows the budgeted amounts for the period of interest. Each budget includes a projected budget for the following two years. These are also included into the table. The figures are colour coded for easy comparison. For example, all the figures in green relate to the 2008/2009 financial year.

Financial year	Budget	Projection: 1 year forward	Projection: 2 years forward
2006/2007	2 328 087	2 467 688	2 615 546
2007/2008	2 596 147	2 771 440	2 958 463
2008/2009	3 241 262	3 483 761	3 744 425
2009/2010	3 769 749	4 222 119	4 728 774

Table 4.10: Saldanha Bay libraries' budget (Data taken from Saldanha Bay Municipality, 2006-2010; black figures refer to 2006/7 financial year, red to 2007/8, green to 2008/9 and blue to 2009/10 for easy comparison)

The economic recession hit South Africa in the last quarter of 2008. By the end of the second quarter of 2009, the country was in recession. One would then expect that the 2008/2009 and 2009/2010 budgets to be much less than projected. This does not seem to be the case. Each year, the budget set has been consistently greater than the projection from the previous year. From this it would seem that the economic recession did not have a deleterious effect on the budget of the libraries.

4.6 Results conclusion

This section set out to show that the Axiom does not hold for the 10 libraries in the Saldanha Bay area for the 2008/2009 economic recession. It cannot be said that these

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libraries were all used more to provide cheap adult entertainment nor inexpensive entertainment for children. These libraries were not all used for their job finding resources, nor their do-it-yourself books. In only some of the libraries did this seem to be the case.

As an attempt to explore the seeming lack of relationship between circulation and the index in some libraries, the index was led and lagged six months and the regressions were re-run. From these regressions, it was shown that circulation has a more statistically significant relationship if the index is led further months into the future. This could be because economic contagion is reaching the area sooner than the index shows. However, leading and lagging the index does not explain why some libraries have a positive relationship and others have a negative one. This is what will be discussed in the next chapter.

This chapter closed with a brief discussion on how the economic recession affected the libraries' budget. It did not appear to have any deleterious effect at all.

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Chapter 5: Discussion

The previous chapter presented the results of this study, and drew the conclusion that the Librarians' Axiom does not hold true. The relationship between circulation and the economy, as measured by the coincident index, is not a consistently negative relationship, even if the relationship is not taken as a direct one. That is to say, the Axiom cannot be demonstrated to be true regardless of whether the index is lagged or led.

This chapter discusses possible reasons for this inconsistency in the direction of the relationship between the index and circulation. It does so first by looking at factors which could account for the differences in the libraries, such as the size of the community and the industry which is dominant in the town. These factors will not explain the varying relationship, although income comes close.

Secondly, this chapter looks at reasons why the relationship, where it exists, is a small one. It was expected that the libraries would be used more for a number of reasons: that the libraries would be used more to provide cheap entertainment to both adults and children and that libraries would be used more for job searching and do-it-yourself. However, the previous chapter showed that this is not the case. It could be that there are other factors, such as increasing use of the internet and television, which could be drawing use away from the libraries. It will be shown that these factors could well be affecting the use of libraries, far more than the recession could be.

This study and chapter concludes by looking, once again, at the choice of variables. Here suggestions will be made of how this study can be modified to perhaps produce a better result. For example, extending the time period of interest will definitely provide for a more robust analysis. While the choice of variables used in this study might account for the varying results, it by no means invalidates this study.

Before discussing the factors which could explain the differences between the libraries, factors that are not taken into consideration, such as the weather, are discussed.

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5.1 Factors not taken into consideration

There are some factors which influence library use, but should not influence the results of the study. For example the weather of the region affects all libraries. But throughout the region it is a very similar weather pattern, which is recorded by a single weather station. This recording does not take into account the varying micro-climates that would differ between the locations of the libraries. Thus it is not a variable that could be used to explain the varying relationship between the index and the circulation of the different libraries.

Similarly, the school terms and holidays could have some influence on the usage patterns of the libraries. As the school children have more projects and essays during the school term, it is expected that the library will be used more during that time. Many families are away on holiday and, during that period, usage of the library decreases. However, the school calendar that influences these libraries is the same calendar throughout the region. Therefore it could hardly account for the variances in the results of this study.

5.2 Factors that could explain the variance between libraries

Setting aside the factors that are not taken into consideration, there are several factors which could account for the different relationships that the libraries display. These factors are where the regions that the different libraries serve differ in some way. For example, it could be that the libraries that serve the richer communities have responded differently to the recession than those that serve the poorer communities. This will be shown to be a likely case.

Other factors that will be discussed and dismissed are population size, average age, average income, industry and geographical location. With the exception of geographical location, the data for these factors are taken from the 2001 national census. The data is thus somewhat out of date, but it is the most recent data with sufficient detail. It is likely

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that this data does not accurately reflect the situation in the area of interest during the time period examined. However, it is the best possible data available, and so will be used.

5.2.1 Population

The population size of the communities that the different libraries serve cannot account for the sometimes positive, sometimes negative relationships between circulation and the index. Table 5.1 shows the libraries sorted by population size. The rest of the table contains the coefficients that were first introduced in Table 4.1. If population was the explanation of why the relationships vary, one would expect that all the libraries with negative relationships would be grouped, and those with positive ones would be grouped. This is clearly not the case.

Library	Total circulation	Adult fiction	Juvenile circulation	Adult non-fiction	Population^
Vredenburg	-1.288**	-0.47048	-3.2857***	-2.724***	10096
Saldanha	0.3695**	0.67044**	-0.2793**	-0.475	9757
Louwville	-0.4666	0.66719**	-1.6464	-1.392	8185
Diazville	0.4563**	0.45886	0.4409***	0.514**	5021
St. Helena Bay	-0.2692	-0.12253	-0.6803**	2.159	3644
Langebaan	-0.4309	-0.37565	-0.6131**	-0.439	2348^^
Laingville	0.6318***	0.07511	1.1093***	1.036***	1765
Hopefield	0.0982*	0.14121	0.1124***	0.123**	1198
Paternoster	-0.8608	-1.20998	-0.3153**	-1.261	960
Harold Krumm	1.4463***	1.49748***	1.1542***	2.937***	Not specified

Table 5.1: Libraries by population (^Data calculated from Statistics South Africa, 2001; ^^Includes area served by Harold Krumm Library; *significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level)

5.2.2 Age

Similarly, Table 5.2 shows the libraries arranged by the average age of the population. This average age does not vary greatly, which could explain why age is not the factor which explains the varying relationship. Taking a closer look at the two libraries that serve the retirement communities, Langebaan and Hopefield, if age were to explain why some libraries have a positive relationship, and others a negative one, then one would

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expect that the relationships that Langebaan and Hopefield show would be similar. Langebaan shows a negative relationship between juvenile circulation and the index, while Hopefield has a positive one. Clearly age is not the influencing factor.

Library	Total circulation	Adult fiction	Juvenile circulation	Adult non-fiction	Average age^
Langebaan	-0.4309	-0.37565	-0.6131**	-0.439	37.94293^^
Hopefield	0.0982*	0.14121	0.1124***	0.123**	36.82053
Vredenburg	-1.288**	-0.47048	-3.2857***	-2.724***	35.70642
Paternoster	-0.8608	-1.20998	-0.3153**	-1.261	34.56354
Saldanha	0.3695**	0.67044**	-0.2793**	-0.475	34.34435
Laingville	0.6318***	0.07511	1.1093***	1.036***	34.20397
Diazville	0.4563**	0.45886	0.4409***	0.514**	33.85899
Louwville	-0.4666	0.66719**	-1.6464	-1.392	33.67098
St. Helena Bay	-0.2692	-0.12253	-0.6803**	2.159	32.85741
Harold Krumm	1.4463***	1.49748***	1.1542***	2.937***	Not specified

Table 5.2: Libraries by age (^Data calculated from Statistics South Africa, 2001; ^^Includes area served by Harold Krumm Library; *significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level)

5.2.3 Income

Arranging the libraries reveals an interesting picture. Taking a look at the Juvenile circulation column in Table 5.3 one can see that all the libraries with a statistically significant negative relationship are matched with libraries that serve a community with a higher average income. Therefore, the contention that the Librarians' Axiom holds true for richer communities is plausible. The only exception is Louwville, where the relationship with juvenile circulation is not significant. Although the finding is not unanimous, there is sufficient evidence to suggest that average income is a good candidate for being considered a strong explanatory variable.

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Library	Total circulation	Adult fiction	Juvenile circulation	Adult non-fiction	Average income~
Vredenburg	-1.288**	-0.47048	-3.2857***	-2.724***	4621.94
Saldanha	0.3695**	0.67044**	-0.2793**	-0.475	4298.52
Langebaan	-0.4309	-0.37565	-0.6131**	-0.439	4128.19^^
St. Helena Bay	-0.2692	-0.12253	-0.6803**	2.159	1948.12
Paternoster	-0.8608	-1.20998	-0.3153**	-1.261	1715.31
Laingville	0.6318***	0.07511	1.1093***	1.036***	1464.48
Hopefield	0.0982*	0.14121	0.1124***	0.123**	1361.77
Louwville	-0.4666	0.66719**	-1.6464	-1.392	1336.09
Diazville	0.4563**	0.45886	0.4409***	0.514**	1115.63
Harold Krumm	1.4463***	1.49748***	1.1542***	2.937***	Not specified

Table 5.3: Libraries by income (^Data calculated from Statistics South Africa, 2001; ^^Includes area served by Harold Krumm Library; *significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level)

5.2.4 Industry

Table 5.4 shows the libraries arranged by their predominant industry. Once again, this does not appear to be the explanation as to why the libraries show the differing relationships.

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Library	Total circulation	Adult fiction	Juvenile circulation	Adult non-fiction	Industry^
Vredenburg	-1.288**	-0.47048	-3.2857***	-2.724***	Manufacturing
Diazville	0.4563**	0.45886	0.4409***	0.514**	Manufacturing
Saldanha	0.3695**	0.67044**	-0.2793**	-0.475	Manufacturing
Hopefield	0.0982*	0.14121	0.1124***	0.123**	Agriculture, hunting; forestry and fishing
Laingville	0.6318***	0.07511	1.1093***	1.036***	Agriculture, hunting; forestry and fishing
St. Helena Bay	-0.2692	-0.12253	-0.6803**	2.159	Agriculture, hunting; forestry and fishing
Paternoster	-0.8608	-1.20998	-0.3153**	-1.261	Agriculture, hunting; forestry and fishing
Langebaan	-0.4309	-0.37565	-0.6131**	-0.439	Community, social and personal services^^
Louwville	-0.4666	0.66719**	-1.6464	-1.392	Wholesale and retail trade
Harold Krumm	1.4463***	1.49748***	1.1542***	2.937***	Not specified

Table 5.4: Libraries by industry (^Data calculated from Statistics South Africa, 2001; ^^Includes area served by Harold Krumm Library; *significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level)

5.2.5 Geography

The Saldanha Bay Municipality contains several towns. Some of these towns have a library in them, and some have two. Table 5.5 shows how the libraries are collocated. For example, Vredenburg library and Louwville library are in the same town, as are Diazville and Saldanha libraries.

Grouping the libraries in this way does not appear to explain why some libraries have a positive and others a negative relationship. Looking at Langebaan and Harold Krumm libraries for example, the former has a negative relationship and the latter positive; both are statistically significant when looking at juvenile circulation. So clearly geography cannot explain the variance.

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Library	Total circulation	Adult fiction	Juvenile circulation	Adult non-fiction
Vredenburg	-1.288**	-0.47048	-3.2857***	-2.724***
Louwville	-0.4666	0.66719**	-1.6464	-1.392
Diazville	0.4563**	0.45886	0.4409***	0.514**
Saldanha	0.3695**	0.67044**	-0.2793**	-0.475
Hopefield	0.0982*	0.14121	0.1124***	0.123**
Langebaan	-0.4309	-0.37565	-0.6131**	-0.439
Harold Krumm	1.4463***	1.49748***	1.1542***	2.937***
Paternoster	-0.8608	-1.20998	-0.3153**	-1.261
Laingville	0.6318***	0.07511	1.1093***	1.036***
St. Helena Bay	-0.2692	-0.12253	-0.6803**	2.159

Table 5.5: Libraries by geography (*significant at the 0.1 level, **significant at the 0.05 level, ***significant at the 0.01 level)

5.2.6 Variance factors in summary

Of all of the factors examined, population, age, income, industry and geography, only income provides a possible explanation for the variance in the relationship between circulation and the index. The richer libraries show a negative relationship, as one would expect from the Librarians' Axiom and the poorer libraries a positive one. However, among the libraries that display a statistically significant relationship, are libraries with relationships that are not statistically significant. This prevents the conclusion being drawn that income is the determining factor between libraries where the Axiom holds, and libraries where it does not.

5.3 Factors that could be affecting the relationship

The initial assumption is that the usage of libraries increases during an economic recession. This is for several reasons. As an individual's budget typically goes down during an economic recession; it is expected that this individual will seek out cheaper sources of entertainment. Libraries provide one source of cheap entertainment, in terms

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of fiction material for both adults and children and to a certain extent non-fiction materials too. Non-fiction materials could also be used for do-it-yourself, another cost saving mechanism that individuals could employ during a recession time. Employment usually decreases during a recession, and the job-seeking material that a library supplies could be in greater demand.

However, libraries are not the only source of cheap entertainment. Television could be another source. The internet and cell-phones could also be another source of relatively cheap entertainment. During the time period that is the focus of this study, two shopping malls were opened in the area, providing yet another source of entertainment.

The internet is also a source of information for finding out how to do things oneself, as it is a source for finding employment by means of online classifieds. Job advertisements are typically found in newspapers, another form of competition for libraries.

The use of these factors, television, internet, cell-phones, malls and newspapers, could be affecting the expected library usage, as they provide logical substitutes to libraries. Looking at how these factors were used in the 36 months between 2007 and 2009 might shed some light on why the expected library usage is not seen, and where it is seen; in the case of Vredenburg for example, the effect is minimal.

It will be shown that none of these factors provide the necessary explanation for the minimal recessionary effects. Some factors might provide some insight, but lack of empirical evidence prevents any conclusions from being drawn.

5.3.1 Adult entertainment

The first assumption that this study makes is that libraries will be used more during economic recessions as they provide a cheap source of adult entertainment. However, there are other sources of entertainment. For example, television, internet and cell-phones can be used for entertainment, and all are relatively cheap. During the time period of

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interest there were two malls opened in the region, which could also be providing entertainment to adults.

These four factors will be examined but the results of the analysis of the changing patterns of use over the period 2007 to 2009 will be found to be insufficient to explain the variations in use.

a. Television

Television provides an obvious alternative to reading. Table 5.6 shows how the number of adults in the Western Cape that reported to have at least one television in their household has changed. The increase between 2007 and 2008 was much bigger than that between 2008 and 2009. That is to be expected. Televisions are relatively expensive, thus less of them would be bought during economic hard times. What is more interesting is how many adults say they watched television during a weekday. The number rises to 100% in 2008, and drops in 2009. As South Africa's economic recession fell predominantly in 2009, one would have expected television viewing to remain at the high level. The conclusion is thus that television does not provide an alternative source of cheap entertainment, as television watching fell in 2009.

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Year	Have at least one TV	Watched TV weekday
2007	92%	96%
2008	94%	100%
2009	95%	98%

Table 5.6: Percentage of television ownership and watching habits in the Western Cape for persons over the age of 19 (Data from South African Advertising Research Foundation, 2011)

b. Internet

Like television, the internet could provide an alternative source of adult entertainment to books; however the evidence shows that this is probably not the case. Table 5.7 shows the percentage of adults in the Western Cape that reported to have accessed the internet in the previous seven days. As with television viewing, the figure rose from 2007 to 2008

and fell between 2008 and 2009. This shows that the internet was probably not used as a substitute for books during the recession time.

Year	Accessed internet last 7 days
2007	14%
2008	15%
2009	13%

Table 5.7: Percentage of persons over the age of 19 in the Western Cape that reported to have accessed the internet in the past 7 days (Data from South African Advertising Research Foundation, 2011)

c. Cell-phones

Cell-phones are increasingly used for entertainment. They are used to browse the internet, communication and listening to music, to name some of their entertainment features. However, the usage pattern of cell-phones follows that of television and the internet, it does not markedly increase during the recession period. Table 5.8 shows the ownership patterns of cell-phones over the period of interest.

Year	Own a cell-phone
2007	58%
2008	63%
2009	63%

Table 5.8: Percentage of cell-phone ownership in the Western Cape for persons over the age of 19 (Data from South African Advertising Research Foundation, 2011)

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d. Malls

Palmer (1981: 334) citing several sources, claims that there is a strong likelihood that people combine their shopping with trips to the library. This would then mean that the presence of malls could lead to a greater library use. In November 2007 and March 2009, two malls opened in the Saldanha Bay area, one in Langebaan and one in Vredenburg respectively. Although there is no empirical evidence to show that this has happened in the Saldanha Bay area, it is one plausible explanation of the lack of evidence that the libraries are used more in the area.

e. In summary

The assumption that libraries are used more during economic recessions as they provide a source of adult entertainment was proved to be false in this study. Even where the use of adult fiction increases during the recession period, the increase is not as large as it would be expected. One reason that this could be is that adults are transferring their entertainment preferences onto something other than books, such as television, cell-phones or the internet. However this was shown not to be the case. Adults could still be finding their entertainment elsewhere, such as at one of the two malls in the area. So the lack of positive recessionary effect is not without possible explanation.

5.3.2 Children's entertainment

The second assumption is that libraries will be used more during economic hard times as they provide entertainment to children. As with adult entertainment only some libraries show this to be the case, and the relationship between the circulation of juvenile material and the economy seems slight. Once again, children could be transferring their entertainment choices onto something else, such as television, the internet or cell-phones. However the usage patterns of these are not very different from those of adults, and do not provide the necessary explanation for why library usage is what it is.

a. Television

Table 5.9 shows the television ownership and viewing habits of children between the ages of 15 and 19 over the period of interest. The libraries define juveniles to be under the age of 12. Figures for the age group 15 to 19 were the nearest ones available, and so were used.

Television ownership increases at a steady rate, while viewing habits decrease during the recession. This indicates that television is not drawing child readers away from the library, and so cannot explain the slight relationship that juvenile circulation has with the economy.

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Year	Have at least one TV	Watched TV weekday
2007	95%	96%
2008	96%	100%
2009	97%	98%

Table 5.9: Percentage of television ownership and watching habits in the Western Cape for persons between the ages of 15 and 19 (Data from South African Advertising Research Foundation, 2011)

b. Internet

The internet, another alternative to reading books, could be another reason why the usage of libraries has not gone up as expected. Table 5.10 shows the internet usage of children in the Western Cape. The usage is increasing over the time period, but between 2007 and 2008 - an economically good time - there is an increase of 12%. Between 2008 and 2009 the increase is only three per cent. The recessionary growth is far smaller than that that during the time of economic growth. Thus the internet does not offer a viable alternative to reading in this study.

Year	Accessed internet last 7 days
2007	10%
2008	22%
2009	25%

Table 5.10: Percentage of persons between the ages of 15 and 19 in the Western Cape that reported to have accessed the internet in the past 7 days (Data from South African Advertising Research Foundation, 2011)

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c. Cell-phone

Children use cell-phones more and more for entertainment purposes. While this would appear to be one of the reasons why library usage has not increased as expected during the economic recessions, Table 5.11 shows that it is not. During the recession cell-phone ownership did not increase among children between the ages of 15 and 19 in the Western Cape.

Year	Own a cell-phone
2007	57%
2008	69%
2009	69%

Table 5.11: Percentage of cell-phone ownership in the Western Cape of persons between the ages of 15 and 19 (Data from South African Advertising Research Foundation, 2011)

d. In summary

Television, the internet and cell-phone use are thus not demonstrated to be plausible alternatives to reading among children during the recessionary period. None of these seem to be an explanation of why juvenile material was not used more during the recessionary period. However, as with adults, the malls in the area could be providing an alternative entertainment source. An empirical analysis of the effect that these malls have had on the library use is outside the scope of this study.

5.3.3 Job finding

The third assumption that this study tested is that libraries are used more during an economic recession as libraries contain job finding resources. These resources could be in the form of newspapers which contain job advertisements, or they could be in the form of books on how to apply for a position. However, the previous chapter showed that this is probably not the case.

As an alternative to using library resources, people could use the internet to find and apply for positions. Table 5.12 shows this not to be the case, and will be discussed in more detail below. Similarly, newspaper readership could be an indication of where the readership expected in libraries is being diverted. But again, this will be shown not to be the case.

a. Internet

Table 5.12 shows some of the activities related to job searching that people in the Western Cape reported to have done. Those activities that increased between 2007 and 2008, showed a decrease between 2008 and 2009. Other activities remained constant

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throughout the time period. It would appear then that the internet is not being used as an alternative to libraries for job searching.

Year	Search	Directory Services	Mail	Research	Read a newspaper
2007	15%	2%	14%	13%	4%
2008	17%	2%	15%	14%	4%
2009	15%	2%	12%	10%	4%

Table 5.12: Possible job searching internet activities in the Western Cape (Data from South African Advertising Research Foundation, 2011)

b. Newspapers

Newspapers, a source of job advertisements, could provide an alternative to libraries in terms of job finding. Table 5.13 shows this is not the case, as newspaper readership fell steadily during the period of interest.

Year	Read any newspaper
2007	66%
2008	65%
2009	63%

Table 5.13: Percentage of persons in the Western Cape that reported to have read any newspaper (Data from South African Advertising Research Foundation, 2011)

c. In summary

Looking at two possible alternatives to libraries, the internet and newspapers, does not reveal why the non-fiction section of the libraries, which house the job finding materials, is used so little during the recession period. Other explanations might exist, but a thorough exploration of them is outside the scope of this study.

5.3.4 Do-it-yourself

The internet also provides a source of do-it-yourself information. The fourth and final assumption was that libraries would be used more because they provide books on how to do things oneself. Table 5.14 shows that the internet is probably not the alternative, as the activities which are probable do-it-yourself related activities fell during the recession.

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Year	Search	Research
2007	15%	13%
2008	17%	14%
2009	15%	10%

Table 5.14: Possible do-it-yourself internet activities in the Western Cape (Data from South African Advertising Research Foundation, 2011)

5.3.5 Other variables

Looking at obvious alternatives, such as the internet, to libraries as a source of information and entertainment did not explain why the recessionary effect, where positive, has been shown to be so small. Alternatives are not the only exogenous variables that could be affecting library use. Two others will be considered from a theoretical point-of-view, but no conclusions will be drawn because of the lack of evidence.

a. Interactions between libraries

The 10 libraries in the Saldanha Bay Municipality work as a system. Members of any one library can take out books at any of the other nine. The issue statistics, then, are not as independent as this study assumes. If a family moved their membership from, say, Saldanha to Vredenburg, then Saldanha would show a decrease in circulation and Vredenburg an increase, *ceteris paribus*. Such moves would be difficult to record and quantify, but might explain the varying relationship that this study showed to be evident between circulation and the economy. There is no data on why users would change their library of preference. One possible reason, a change in the education system, will be discussed next.

b. Outcomes based education

Curriculum 2005, an outcomes based education scheme, was launched in 1997 (Botha, 2002: 362). This new curriculum was implemented in both junior schools and secondary schools around the country. One of the changes that it brought about is that learners needed to do more independent research, which usually involved the library.

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The schools in the Saldanha Bay area have small libraries, if they have libraries at all. The increasing demand for information that arose from the new curriculum was felt most keenly by the libraries as more learners had more projects that they needed additional resources for. This clearly would be reflected in the issue statistics of the libraries, and could be obscuring the recessionary effects.

5.3.6 In summary

There could be many factors that influence the use of libraries. These factors could be obscuring the expected recessionary effect completely, or be causing it to show up only slightly. Obvious choices for these factors could be alternatives to the library such as the internet or television, but looking at the usage of these alternatives does not show this to be likely. Other less obvious factors include the newly constructed malls, the possible interaction between libraries and the changing school curriculum. Lack of empirical evidence prevents a conclusion from being drawn, and a more thorough discussion of these factors is outside the scope of this study.

5.4 Choice of variables

Aside from the exogenous factors that could be influencing the library use, there could also be endogenous factors. Particularly, the choice of variables would have an effect on the outcome of this study. Using different variables might have shown a different relationship between library use and the economy which might have been more aligned with the Librarians' Axiom. Looking more closely at these variables will be the final part of this study.

5.4.1 Circulation as a measure of library use

Issuing out library material is only one way in which libraries are used. Library material could also be used without being issued. For those who are worried about library fines, particularly in a time when money is short, in-library use might be very attractive.

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In the Saldanha Bay Municipality one can only get a library card if one has a municipal statement, such as an electricity account. During a recession people lose their homes, and so a municipal statement would be hard to come by. Library material can be used in the library by anyone, whether they hold a library card or not. Perhaps during the recession, in-library use rose. However, there are few figures kept for in-library use.

Libraries are also reported to be used as a place. The homeless visit the library as a place to get out of harsh weather conditions. The unemployed might visit the library as an excuse to leave their homes. In-library usage figures and circulation figures do not reflect these other recessionary uses of the library.

Whilst there are other uses of a library other than issuing out material, this study was restricted by what data was available. So too, the conclusions were restricted by what variables were available. A study that included other measures of library use might reveal a different relationship between library use and the falling economy.

5.4.2 Coincident index as a measure of the economy

If circulation data might be considered to render a highly-selective view of library use, the coincident index also has its flaws as a measure of economic activity. The coincident index is a measure of economic activity of the whole country, and might not be sensitive enough as a measure of economic activity in Saldanha Bay.

The coincident index includes unemployment and inflation in its calculation. Perhaps using unemployment or inflation might have shown a different relationship. Economic recessions are usually measured by falling GDP (gross domestic product) figures. GDP data would then be the best measure of economic activity and would be best suited for this study. However, it too is not available for only the Saldanha Bay area. In addition, it is a quarterly figure, where the coincident index is a monthly one. This makes it an unattractive measure, given the time period of interest.

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5.4.3 Time period

The time period of interest, January 2007 to December 2009, could be too limited to show the true relationship between library use and the economy. Perhaps if the time period was widened to include several recessions a clearer image of the relationship would emerge. Thirty-six months is a relatively short period of time to study economic movements and their effects.

It is possible that the Librarians' Axiom held for all previous recessions, and that the recession of 2008/2009 was anomalous. Perhaps libraries do have a negative relationship with the economy, except for the most recent recession. This, however unlikely, is a possibility. Extending the time period of interest might reveal the truth in this possibility.

5.4.4 Libraries of interest

This study focused only on 10 South African libraries. It could be that the Librarians' Axiom holds for other South African libraries, or for libraries in other countries. Just because it was found that the Axiom does not hold for these libraries does not mean that one can assume that it does not hold anywhere else. It does call into question whether the recessionary effect should be elevated to the extent that it is considered axiomatic.

5.4.5 Perceptions of what libraries provide

It could be that the perceptions of what libraries provide are false. For example, one assumption is that libraries provide a cheap source of entertainment. Reading is evidently a source of entertainment and librarians assume that it is cheap as the user does not have to pay directly to borrow material. But this does not factor in the opportunity cost, the cost of giving up doing something else when choosing to read or go to the library. Librarians can underestimate this cost and this could prove the assumption of cheap entertainment wrong.

Another assumption that this study made was that the material in the non-fiction section was used to help with do-it-yourself activities and job searching. This might not be the case. Books in a public library are often perceived to be old. This might make them

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unattractive sources of information for both do-it-yourself and job searching. It could also be that the libraries in the Saldanha Bay area are simply not used for these purposes, that they are purely used for entertainment. This might give some explanation of why the relationship was revealed for what it was.

5.4.6 In summary

The conclusions that this study has reached were most certainly shaped by the variables that were chosen. Looking at a different set of libraries, over a different time period, using different indicators of library use and economic activity would have shown different results. These results could have been different enough to show the Librarians' Axiom to hold. This study showed that the Axiom does not hold in this case. Another case would show a different result.

5.5 Conclusion

The literature around recessionary effects on libraries revealed that libraries are expected to be used more during an economic recession for a variety of reasons. They provide cheap entertainment to both adults and children. Libraries contain material that can be used to do things oneself, another cost saving strategy that people could employ during recessions. They also have books on job finding, a valuable resource during times of decreasing employment opportunities.

This study examined the effects of the 2008/2009 recession on a system of 10 municipal libraries in the Saldanha Bay area. It did so by using the coincident index as a measure of economic activity and circulation as a measure of library use to create a panel data set. With this data set, an ordinary least squares fixed effects model was created and multiple regressions were run.

The results were varying. Some libraries showed a statistically significant positive relationship, others a negative. Some were not statistically significant. Running these regressions on total circulation, adult fiction, adult non-fiction and juvenile circulation showed a very similar varying result. By looking at the different sections of total

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circulation it was hoped that the different reasons for using a library more could be examined.

The index was then lagged and led up to six months and the regressions were rerun. This was to test if perhaps the relationship between the economy and library use was not as immediate as first expected. It was not found to be the case. The relationship strengthened in both degree and significance the more the index was led, showing the relationship to be more complex than expected from the Axiom. The statistical results were contrary to what was expected from looking at the literature. This makes the Axiom something of a "flat earth" theory, a theory that only appears true but does not stand up to closer scrutiny.

The final chapter of this study explored reasons why the results were as discovered. Both exogenous and endogenous factors were discussed. Income levels could be a possible explanation behind the variance in the relationship, but no reason for the slight result was found. Possible causes were given, but a deeper exploration is outside the scope of this study.

The Librarians' Axiom is often used to motivate for continuing or even increasing funding for libraries during a recessionary period. This dissertation showed that the Axiom cannot be used for this purpose. Libraries are therefore faced with a new challenge of how to argue for the maintenance or raising of funds during a time of financial shortage.

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Appendix 1: Demographics of the Saldanha Bay Municipality

All figures were taken from:
Unilever Institute. 2001. *South African Marketers' Map (SAMM): Census 2001*. [Electronic database]. Available at University of Cape Town Libraries [2010, September 24].

Note:

- Saldanha includes Diazville
- Diazville excludes RDP area
- Langebaan includes area the Harold Krumm Library serves
- Vredenburg includes Louwville
- St. Helena includes Laingville

General figures

	Saldanha Bay Municipality	Saldanha	Diazville	Hopefield	Langebaan	Paternoster	Vredenburg	Louwville	St. Helena	Laingville
Population	70,429	21,637	7,579	1,827	3,428	1,452	27,085	12,135	7,875	2,674
Households	18,707	5,594	1,549	445	1,078	372	7,318	2,728	2,004	530
Area (km^2)	1,909.47	10.25	1	7.98	21.65	0.8	12.18	2.43	19	1.36
People per km^2	36.88	2,110.93	7,579.00	228.95	158.34	1,815.00	2,223.73	4,993.83	414.47	1,966.18

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Population group profile

	Saldanha Bay Municipality	Saldanha	Diazville	Hopefield	Langebaan	Paternoster	Vredenburg	Louwville	St. Helena	Laingville
African	11,957	4,711	374	4	119	132	4,708	1,394	1,977	51
Asian	338	166	90	0	12	3	145	100	3	3
Coloured	44,828	13,567	7,097	1,423	1,531	1,216	17,138	10,608	5,266	2,613
White	13,321	3,192	16	403	1,766	97	5,099	32	633	7

Gender profile

	Saldanha Bay Municipality	Saldanha	Diazville	Hopefield	Langebaan	Paternoster	Vredenburg	Louwville	St. Helena	Laingville
Male	34,938	10,877	3,715	864	1,671	716	13,457	6,052	3,789	1,277
Female	35,501	10,760	3,862	965	1,757	733	13,633	6,082	4,091	1,397

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Age profile

	Saldanha Bay Municipality	Saldanha	Diazville	Hopefield	Langebaan	Paternoster	Vredenburg	Louwville	St. Helena	Laingville
0-4 years	6,825	2,146	736	160	268	141	2,669	1,104	781	250
5-9 years	6,693	2,087	674	158	287	147	2,556	1,172	751	270
10-14 years	6,818	2,096	950	196	240	154	2,612	1,341	782	342
15-19 years	6,570	2,149	892	143	226	149	2,535	1,364	755	298
20-24 years	6,352	2,036	705	154	217	92	2,533	1,169	830	235
25-29 years	6,872	2,169	573	131	310	129	2,702	1,047	845	180
30-34 years	6,613	2,023	569	115	322	131	2,545	931	826	248
35-39 years	5,717	1,790	522	130	267	109	2,195	897	627	197
40-44 years	4,953	1,525	554	128	224	113	1,962	911	484	171
45-49 years	3,666	1,114	438	128	188	60	1,425	681	380	160
50-54 years	2,850	871	356	111	186	81	1,020	519	258	112
55-59 years	2,107	599	223	78	204	37	704	365	226	98
60-64 years	1,628	407	160	60	173	52	558	250	160	61
65-69 years	1,244	292	108	66	143	22	466	200	93	28
70-74 years	733	166	60	28	92	21	265	100	43	17
75-74 years	417	96	38	23	52	5	165	46	24	7
80-84 years	249	45	13	12	26	6	103	17	10	0
85 years plus	122	26	8	6	3	3	70	21	0	0

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Language profile

	Saldanha Bay Municipality	Saldanha	Diazville	Hopefield	Langebaan	Paternoster	Vredenburg	Louwville	St. Helena	Laingville
Afrikaans	56,402	16,363	7,230	1,777	2,842	1,349	21,653	10,681	5,821	2,620
English	3,048	1,028	103	50	525	23	972	236	140	14
IsiXhosa	9,993	3,947	230	0	40	74	3,847	1,036	1,903	35
IsiZulu	105	29	5	0	0	0	58	13	3	0
Ndebele	19	0	0	0	0	0	19	5	0	0
Sepedi	63	43	0	0	0	0	17	0	0	0
Sesotho	480	99	0	0	3	0	357	117	14	5
Setswana	111	35	0	0	3	0	73	21	0	0
Seswati	44	30	0	0	0	0	14	3	0	0
Venda	27	4	0	0	0	0	20	3	0	0
Xitsonga	37	15	3	0	0	0	22	4	0	0
Other	100	41	5	0	15	0	35	17	0	0

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Annual household income

	Saldanha Bay Municipality	Saldanha	Diazville	Hopefield	Langebaan	Paternoster	Vredenburg	Louwville	St. Helena	Laingville
None	2,048	729	74	17	33	17	1,085	279	67	9
R 1 - 4 800	538	189	24	9	12	15	222	44	28	0
R 4 801 - 9 600	1,536	499	137	26	45	57	523	180	174	31
R R9 601 - 19 200	3,157	978	301	69	90	67	1,112	443	434	53
R 19 201 - 38 400	3,790	1,184	460	114	178	86	1,329	619	499	136
R 38 401 - 76 800	3,599	935	336	123	253	75	1,372	701	502	193
R 76 801 - 153 600	2,567	658	171	67	257	36	1,083	371	239	81
R 153 601 - 307 200	1,098	311	41	18	146	13	462	76	52	23
R 307 201 - 614 400	246	76	5	0	49	4	91	7	3	0
R 614 401 - 1 228 800	59	14	0	0	12	0	20	3	0	0
R 1 228 801 - 2 457 600	31	15	3	0	4	0	6	0	0	0
R2 457 601 and more	21	7	0	0	3	0	11	0	0	0

Highest education level reached

	Saldanha Bay Municipality	Saldanha	Diazville	Hopefield	Langebaan	Paternoster	Vredenburg	Louwville	St. Helena	Laingville
None	2,226	524	257	51	72	49	885	554	232	63
Some Primary	7,476	2,226	872	182	190	193	2,829	1,309	949	294
Complete Primary	4,340	1,319	488	136	164	153	1,444	732	679	253
Some Secondary	16,601	5,387	1,884	456	673	293	6,609	2,902	1,920	629
Std 10/Grade 12	9,588	2,892	749	254	898	144	3,746	1,417	800	173
Higher	3,307	810	74	95	410	27	1,205	240	232	104

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```
> summary(TCNo_lm)

Residuals:
     Min       1Q   Median       3Q      Max
-0.4576  -0.02904  0.01117  0.04659  0.22108

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)    6.772     1.1337   5.973 5.86E-09 ***
DV            -3.9818    1.6033  -2.483 0.013492 *
HK             -7.084    1.6033  -4.418  1.34E-05 ***
HF            -3.0958    1.6033  -1.931 0.054331 .
LV            -4.7942    1.6033   -2.99 0.002991 **
LB            -2.1814    1.6033  -1.361 0.174546
LO            -2.0453    1.6033  -1.276 0.202944
PN            -2.0688    1.6033   -1.29 0.197808
SA            -3.8135    1.6033  -2.379 0.017935 *
SH             -3.038    1.6033  -1.895 0.058964 .
CI             -1.288    0.5222  -2.467 0.014134 *
CIDV           1.7443    0.7385   2.362 0.018737 *
CIHK           2.7343    0.7385   3.703 0.000249 ***
CIHF           1.3862    0.7385   1.877 0.061359 .
CILV           1.9198    0.7385     2.6 0.009734 **
CILB           0.8571    0.7385   1.161 0.246591
CILO           0.8214    0.7385   1.112  0.26676
CIPN           0.4272    0.7385   0.579 0.563307
CISA           1.6575    0.7385   2.245 0.025438 *
CISH           1.0188    0.7385    1.38   0.1686
---


Residual standard error: 0.07952 on 340 degrees of freedom
Multiple R-squared: 0.9648, Adjusted R-squared: 0.9629
F-statistic: 490.7 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(TCM1_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.44958  -0.02851   0.01053   0.04569   0.22176

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)    6.732     1.1604   5.802 1.50E-08 ***
DV            -3.7463     1.641  -2.283 0.023048 *
HK            -6.6811     1.641  -4.071 5.82E-05 ***
HF             -2.773     1.641   -1.69 0.091973 .
LV            -3.9554     1.641   -2.41 0.016467 *
LB            -1.9719     1.641  -1.202 0.230323
LO            -1.9466     1.641  -1.186 0.236357
PN            -1.9579     1.641  -1.193 0.233657
SA             -3.669     1.641  -2.236  0.02601 *
SH            -2.7467     1.641  -1.674 0.095093 .
CI            -1.2691     0.5342 -2.375 0.018083 *
CIDV           1.6352     0.7555  2.164 0.031135 *
CIHK           2.5479     0.7555  3.372 0.000832 ***
CIHF           1.2371     0.7555  1.637  0.10249
CILV           1.5329     0.7555  2.029 0.043249 *
CILB           0.7603     0.7555  1.006 0.314965
CILO           0.7757     0.7555  1.027 0.305295
CIPN            0.376     0.7555  0.498 0.619077
CISA           1.5904     0.7555  2.105 0.036026 *
CISH           0.8843     0.7555   1.17 0.242647
---


Residual standard error: 0.0799 on 340 degrees of freedom
Multiple R-squared: 0.9645, Adjusted R-squared: 0.9625
F-statistic: 485.8 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(TCM2_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.44438  -0.02827  0.009618  0.046844  0.220768

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   6.5735     1.1961   5.496 7.65E-08 ***
DV              -3.54     1.6916  -2.093 0.037118 *
HK            -6.3559     1.6916  -3.757 0.000202 ***
HF            -2.4994     1.6916  -1.478 0.140454
LV             -3.291     1.6916  -1.945 0.052539 .
LB            -1.8019     1.6916  -1.065 0.287525
LO            -1.8096     1.6916   -1.07 0.285474
PN            -1.9342     1.6916  -1.143 0.253661
SA            -3.4941     1.6916  -2.066 0.039624 *
SH            -2.5859     1.6916  -1.529 0.127272
CI            -1.1957     0.5505  -2.172 0.030556 *
CIDV           1.5396     0.7785   1.978 0.048785 *
CIHK           2.3972     0.7785   3.079 0.002245 **
CIHF           1.1107     0.7785   1.427 0.154622
CILV           1.2265     0.7785   1.575 0.116093
CILB           0.6818     0.7785   0.876 0.381794
CILO           0.7124     0.7785   0.915 0.360836
CIPN           0.3649     0.7785   0.469 0.639553
CISA           1.5093     0.7785   1.939 0.053373 .
CISH             0.81     0.7785    1.04 0.298902
---


Residual standard error: 0.08023 on 340 degrees of freedom
Multiple R-squared: 0.9642, Adjusted R-squared: 0.9622
F-statistic: 481.8 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(TCM3_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.44144  -0.02879  0.009514  0.046281  0.218972

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   6.3259     1.2421   5.093 5.85E-07 ***
DV           -3.2967     1.7566  -1.877  0.06141 .
HK           -5.7974     1.7566    -3.3  0.00107 **
HF           -2.0796     1.7566  -1.184  0.23728
LV           -2.5895     1.7566  -1.474  0.14136
LB           -1.5329     1.7566  -0.873  0.38347
LO           -1.7161     1.7566  -0.977  0.32928
PN           -1.6867     1.7566   -0.96  0.33763
SA           -3.2032     1.7566  -1.824   0.0691 .
SH           -2.2315     1.7566   -1.27  0.20482
CI           -1.0813     0.5715  -1.892  0.05932 .
CIDV          1.4272     0.8082   1.766  0.07831 .
CIHK          2.1394     0.8082   2.647  0.00849 **
CIHF          0.9171     0.8082   1.135  0.25726
CILV          0.9033     0.8082   1.118  0.26446
CILB          0.5578     0.8082    0.69  0.49057
CILO          0.6691     0.8082   0.828   0.4083
CIPN          0.2509     0.8082    0.31  0.75639
CISA          1.3749     0.8082   1.701  0.08981 .
CISH          0.6466     0.8082     0.8   0.4242
---


Residual standard error: 0.08054 on 340 degrees of freedom
Multiple R-squared: 0.9639, Adjusted R-squared: 0.9619
F-statistic: 477.9 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(TCM4_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.43658  -0.03004  0.007683  0.043966  0.218499

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   6.2036     1.3019   4.765 2.80E-06 ***
DV           -2.8897     1.8412  -1.569  0.11746
HK           -5.1046     1.8412  -2.772  0.00587 **
HF           -1.8052     1.8412   -0.98  0.32756
LV           -1.6229     1.8412  -0.881  0.37869
LB           -1.3329     1.8412  -0.724  0.46961
LO           -1.7362     1.8412  -0.943  0.34636
PN           -1.6604     1.8412  -0.902  0.36779
SA             -2.89     1.8412   -1.57  0.11742
SH            -1.897     1.8412   -1.03   0.3036
CI           -1.0247     0.5988  -1.711  0.08794 .
CIDV          1.2394     0.8468   1.464   0.1442
CIHK            1.82     0.8468   2.149  0.03232 *
CIHF          0.7905     0.8468   0.934  0.35119
CILV          0.4584     0.8468   0.541   0.5886
CILB          0.4656     0.8468    0.55  0.58282
CILO          0.6781     0.8468   0.801  0.42383
CIPN          0.2387     0.8468   0.282  0.77816
CISA          1.2304     0.8468   1.453  0.14715
CISH          0.4925     0.8468   0.582   0.5612
---


Residual standard error: 0.08079 on 340 degrees of freedom
Multiple R-squared: 0.9637, Adjusted R-squared: 0.9617
F-statistic: 474.8 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(TCM5_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.43703  -0.03196  0.007623   0.04442  0.212274

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   6.0542     1.3795   4.389 1.52E-05 ***
DV           -2.6458     1.9509  -1.356   0.1759
HK           -4.3306     1.9509   -2.22   0.0271 *
HF           -1.5859     1.9509  -0.813   0.4168
LV           -1.1413     1.9509  -0.585   0.5589
LB           -1.2637     1.9509  -0.648   0.5176
LO           -1.9456     1.9509  -0.997   0.3193
PN            -1.787     1.9509  -0.916   0.3603
SA            -2.599     1.9509  -1.332   0.1837
SH           -1.5695     1.9509  -0.805   0.4217
CI           -0.9556     0.6342  -1.507   0.1328
CIDV          1.1269     0.8969   1.256   0.2099
CIHK          1.4634     0.8969   1.632   0.1037
CIHF          0.6895     0.8969   0.769   0.4426
CILV          0.2368     0.8969   0.264   0.7919
CILB          0.4336     0.8969   0.483   0.6291
CILO          0.7741     0.8969   0.863   0.3887
CIPN          0.2969     0.8969   0.331   0.7409
CISA          1.0961     0.8969   1.222   0.2225
CISH          0.3418     0.8969   0.381   0.7034
---


Residual standard error: 0.08108 on 340 degrees of freedom
Multiple R-squared: 0.9634, Adjusted R-squared: 0.9614
F-statistic: 471.4 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(TCM6_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.43641  -0.03128  0.006713  0.046972  0.208326

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   5.6217     1.4437   3.894 0.000119 ***
DV           -1.8962     2.0417  -0.929 0.353667
HK           -3.0812     2.0417  -1.509 0.132188
HF            -1.139     2.0417  -0.558 0.577306
LV           -0.2646     2.0417   -0.13 0.896943
LB           -0.9059     2.0417  -0.444 0.657524
LO           -1.8948     2.0417  -0.928 0.354035
PN           -1.7028     2.0417  -0.834 0.404861
SA           -1.9888     2.0417  -0.974 0.330702
SH           -1.0912     2.0417  -0.534 0.593376
CI           -0.7566     0.6636   -1.14 0.255026
CIDV           0.782     0.9384   0.833 0.405248
CIHK          0.8888     0.9384   0.947 0.344272
CIHF          0.4838     0.9384   0.516 0.606488
CILV         -0.1662     0.9384  -0.177 0.859535
CILB           0.269     0.9384   0.287  0.77453
CILO          0.7506     0.9384     0.8  0.42438
CIPN          0.2581     0.9384   0.275  0.78349
CISA          0.8153     0.9384   0.869 0.385548
CISH          0.1218     0.9384    0.13 0.896777
---


Residual standard error: 0.08129 on 340 degrees of freedom
Multiple R-squared: 0.9632, Adjusted R-squared: 0.9612
F-statistic: 468.9 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(TCP1_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.46314  -0.03091   0.01385   0.04674   0.21788

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   6.8455     1.1125   6.153 2.13E-09 ***
DV           -4.0837     1.5733  -2.596 0.009852 **
HK           -7.3501     1.5733  -4.672 4.31E-06 ***
HF           -3.351      1.5733  -2.13  0.033897 *
LV           -5.3335     1.5733  -3.39  0.000781 ***
LB           -2.3268     1.5733  -1.479 0.140091
LO           -2.0405     1.5733  -1.297 0.195525
PN           -1.8632     1.5733  -1.184 0.237146
SA           -3.9688     1.5733  -2.523 0.012105 *
SH           -3.179      1.5733  -2.021 0.044109 *
CI           -1.3223     0.5126  -2.58  0.010309 *
CIDV          1.7918     0.7249   2.472  0.01393 *
CIHK          2.8579     0.7249   3.943 9.79E-05 ***
CIHF          1.5042     0.7249   2.075 0.038724 *
CILV          2.169      0.7249   2.992 0.002972 **
CILB          0.9244     0.7249   1.275 0.203113
CILO          0.8195     0.7249   1.131 0.259037
CIPN          0.3326     0.7249   0.459 0.646655
CISA          1.7297     0.7249   2.386 0.017574 *
CISH          1.0841     0.7249   1.496 0.135691
---


Residual standard error: 0.07903 on 340 degrees of freedom
Multiple R-squared: 0.9652, Adjusted R-squared: 0.9633
F-statistic: 497 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(TCP2_lm)

Residuals:
      Min        1Q    Median        3Q       Max
 -0.46833  -0.03047   0.01484   0.04713     0.212

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   6.8653      1.099   6.247 1.25E-09 ***
DV           -4.0154     1.5543  -2.583 0.010198 *
HK           -7.5094     1.5543  -4.831 2.05E-06 ***
HF           -3.4628     1.5543  -2.228  0.02654 *
LV           -5.4703     1.5543   -3.52 0.000491 ***
LB             -2.44     1.5543   -1.57 0.117383
LO           -2.0617     1.5543  -1.326 0.185583
PN           -1.7871     1.5543   -1.15 0.251038
SA           -3.9676     1.5543  -2.553 0.011126 *
SH           -3.2909     1.5543  -2.117 0.034957 *
CI           -1.3319     0.5065  -2.629 0.008945 **
CIDV           1.761     0.7164   2.458 0.014461 *
CIHK          2.9324     0.7164   4.093  5.32E-05 ***
CIHF          1.5563     0.7164   2.172 0.030509 *
CILV          2.2328     0.7164   3.117 0.001984 **
CILB          0.9769     0.7164   1.364 0.173586
CILO          0.8296     0.7164   1.158 0.247672
CIPN          0.2976     0.7164   0.415 0.678047
CISA          1.7297     0.7164   2.415 0.016282 *
CISH          1.1361     0.7164   1.586 0.113685
---


Residual standard error: 0.07883 on 340 degrees of freedom
Multiple R-squared: 0.9654, Adjusted R-squared: 0.9635
F-statistic: 499.7 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(TCP3_lm)

Residuals:
      Min        1Q    Median        3Q       Max
 -0.47089  -0.02881   0.01479   0.04584   0.20329

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   6.9223     1.0919    6.34 7.31E-10 ***
DV           -3.9487     1.5441  -2.557 0.010984 *
HK           -7.5944     1.5441  -4.918 1.36E-06 ***
HF           -3.6077     1.5441  -2.336  0.02005 *
LV            -5.649     1.5441  -3.658 0.000294 ***
LB           -2.5938     1.5441   -1.68 0.093918 .
LO           -2.0643     1.5441  -1.337 0.182155
PN           -1.5736     1.5441  -1.019 0.308871
SA           -3.9817     1.5441  -2.579 0.010339 *
SH           -3.4467     1.5441  -2.232 0.026255 *
CI           -1.3587     0.5034  -2.699 0.007306 **
CIDV          1.7309     0.7119   2.431 0.015567 *
CIHK          2.9726     0.7119   4.175  3.79E-05 ***
CIHF          1.6237     0.7119   2.281 0.023189 *
CILV           2.316     0.7119   3.253 0.001256 **
CILB          1.0481     0.7119   1.472 0.141884
CILO          0.8311     0.7119   1.167 0.243891
CIPN          0.1993     0.7119    0.28 0.779666
CISA          1.7369     0.7119   2.44 0.015215 *
CISH          1.2084     0.7119   1.697 0.090559 .
---


Residual standard error: 0.07861 on 340 degrees of freedom
Multiple R-squared: 0.9656, Adjusted R-squared: 0.9637
F-statistic: 502.6 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(TCP4_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.47235  -0.02754   0.01449     0.045   0.19255

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   6.9634     1.0888   6.395 5.30E-10 ***
DV           -3.8012     1.5399  -2.469 0.014059 *
HK           -7.6057     1.5399  -4.939 1.23E-06 ***
HF           -3.7112     1.5399   -2.41 0.016478 *
LV           -5.5109     1.5399  -3.579 0.000395 ***
LB           -2.7069     1.5399  -1.758 0.079668 .
LO           -2.0496     1.5399  -1.331 0.184061
PN           -1.4312     1.5399  -0.929 0.353329
SA           -3.9347     1.5399  -2.555 0.011046 *
SH           -3.5153     1.5399  -2.283 0.023056 *
CI           -1.3781     0.5022  -2.744 0.006391 **
CIDV          1.6634     0.7102   2.342 0.019753 *
CIHK          2.9789     0.7102   4.194 3.50E-05 ***
CIHF           1.672     0.7102   2.354 0.019132 *
CILV          2.2531     0.7102   3.172  0.00165 **
CILB          1.1007     0.7102    1.55  0.12213
CILO          0.8246     0.7102   1.161 0.246435
CIPN          0.1337     0.7102   0.188 0.850807
CISA          1.7158     0.7102   2.416 0.016226 *
CISH          1.2404     0.7102   1.746  0.08163 .
---


Residual standard error: 0.07859 on 340 degrees of freedom
Multiple R-squared: 0.9656, Adjusted R-squared: 0.9637
F-statistic: 502.8 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(TCP5_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.47028  -0.02807   0.01453   0.04355   0.17785

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  6.92838    1.09202   6.345 7.12E-10 ***
DV          -3.66071    1.54435  -2.370 0.018327 *
HK          -7.46618    1.54435  -4.835 2.02E-06 ***
HF          -3.71154    1.54435  -2.403 0.016783 *
LV          -5.38357    1.54435  -3.486 0.000555 ***
LB          -2.74305    1.54435  -1.776 0.076596 .
LO          -2.02581    1.54435  -1.312 0.190487
PN          -1.06259    1.54435  -0.688 0.491889
SA           -3.8514    1.54435  -2.494 0.013111 *
SH          -3.53198    1.54435  -2.287 0.022807 *
CI          -1.36243    0.50386  -2.704 0.007196 **
CIDV         1.59923    0.71257   2.244 0.025455 *
CIHK         2.91561    0.71257   4.092 5.35E-05 ***
CIHF         1.67278    0.71257   2.348 0.019471 *
CILV         2.19523    0.71257   3.081 0.002233 **
CILB         1.11778    0.71257   1.569 0.117655
CILO         0.81393    0.71257   1.142 0.254157
CIPN        -0.03634    0.71257  -0.051 0.959351
CISA         1.67798    0.71257   2.355 0.019099 *
CISH         1.24859    0.71257   1.752 0.080635 .
---

Residual standard error: 0.07858 on 340 degrees of freedom
Multiple R-squared: 0.9656, Adjusted R-squared: 0.9637
F-statistic: 503 on 19 and 340 DF, p-value: < 2.20E-16
```

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> summary(TCP6_lm)

Residuals:

Min	1Q	Median	3Q	Max
-0.46917	-0.03117	0.01348	0.0432	0.17091

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	6.95824	1.10042	6.323	8.06E-10	***
DV	-3.55387	1.55623	-2.284	0.023009	*
HK	-7.25637	1.55623	-4.663	4.49E-06	***
HF	-3.77016	1.55623	-2.423	0.015931	*
LV	-5.23543	1.55623	-3.364	0.000855	***
LB	-2.83802	1.55623	-1.824	0.069083	.
LO	-2.04959	1.55623	-1.317	0.188719	
PN	-1.04376	1.55623	-0.671	0.502871	
SA	-3.76141	1.55623	-2.417	0.016175	*
SH	-3.5076	1.55623	-2.254	0.024839	*
CI	-1.3766	0.50789	-2.71	0.00706	**
CIDV	1.55038	0.71826	2.159	0.031587	*
CIHK	2.81959	0.71826	3.926	0.000105	***
CIHF	1.70031	0.71826	2.367	0.018479	*
CILV	2.12748	0.71826	2.962	0.003272	**
CILB	1.16194	0.71826	1.618	0.106651	
CILO	0.82513	0.71826	1.149	0.251447	
CIPN	-0.04505	0.71826	-0.063	0.950028	
CISA	1.63692	0.71826	2.279	0.023285	*
CISH	1.23769	0.71826	1.723	0.085766	.

Residual standard error: 0.0788 on 340 degrees of freedom

Multiple R-squared: 0.9655, Adjusted R-squared: 0.9635

F-statistic: 500.1 on 19 and 340 DF, p-value: < 2.20E-16

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```
> summary(AFNo_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.28479  -0.02395  0.006472  0.036987  0.195966

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.84772    0.87062   5.568 5.24E-08 ***
DV          -2.31754    1.23124  -1.882 0.060652 .
HK          -5.56064    1.23124  -4.516 8.69E-06 ***
HF            -1.565    1.23124  -1.271  0.20457
LV          -1.99203    1.23124  -1.618 0.106609
LB          -0.51559    1.23124  -0.419 0.675657
LO          -2.86657    1.23124  -2.328 0.020487 *
PN           0.42352    1.23124   0.344 0.731072
SA          -2.69178    1.23124  -2.186  0.02948 *
SH           -1.5786    1.23124  -1.282 0.200674
CI          -0.47048    0.40099  -1.173   0.2415
CIDV         0.92934    0.56709   1.639 0.102179
CIHK         1.96796    0.56709    3.47 0.000587 ***
CIHF         0.61169    0.56709   1.079  0.28151
CILV         0.54559    0.56709   0.962 0.336689
CILB         0.09483    0.56709   0.167 0.867291
CILO         1.13767    0.56709   2.006 0.045631 *
CIPN          -0.7395    0.56709  -1.304 0.193102
CISA         1.14092    0.56709   2.012 0.045019 *
CISH         0.34795    0.56709   0.614 0.539904
---


Residual standard error: 0.06107 on 340 degrees of freedom
Multiple R-squared: 0.9802, Adjusted R-squared: 0.9791
F-statistic: 886.5 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(AFM1_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.27944  -0.02445  0.007438  0.038408  0.195267

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   4.9791     0.8891     5.6 4.42E-08 ***
DV           -2.3429     1.2573  -1.863  0.06327 .
HK           -5.5944     1.2573  -4.449 1.17E-05 ***
HF           -1.6387     1.2573  -1.303  0.19335
LV           -1.5925     1.2573  -1.267  0.20618
LB           -0.5302     1.2573  -0.422  0.67352
LO           -2.9957     1.2573  -2.383  0.01774 *
PN            0.2584     1.2573   0.206  0.83728
SA           -2.7829     1.2573  -2.213  0.02754 *
SH           -1.5531     1.2573  -1.235   0.2176
CI           -0.5308     0.4093  -1.297  0.19559
CIDV          0.9407     0.5789   1.625  0.10509
CIHK          1.9828     0.5789   3.425  0.00069 ***
CIHF          0.6454     0.5789   1.115  0.26569
CILV          0.3614     0.5789   0.624  0.53284
CILB          0.1015     0.5789   0.175  0.86089
CILO          1.1967     0.5789   2.067  0.03947 *
CIPN         -0.6632     0.5789  -1.146  0.25275
CISA          1.1825     0.5789   2.043  0.04186 *
CISH          0.3361     0.5789   0.581  0.56192
---


Residual standard error: 0.06122 on 340 degrees of freedom
Multiple R-squared: 0.9801, Adjusted R-squared: 0.979
F-statistic: 881.9 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(AFM2_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.27675  -0.02433  0.006584   0.03767  0.193736

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 5.042396   0.914414   5.514 6.94E-08 ***
DV           -2.4369   1.293176  -1.884 0.060359 .
HK          -5.71876   1.293176  -4.422 1.32E-05 ***
HF          -1.84513   1.293176  -1.427  0.15455
LV          -1.27461   1.293176  -0.986 0.325008
LB           -0.5818   1.293176   -0.45 0.653072
LO          -3.09983   1.293176  -2.397 0.017066 *
PN          -0.00116   1.293176  -0.001 0.999287
SA          -2.86191   1.293176  -2.213 0.027556 *
SH          -1.65684   1.293176  -1.281 0.200991
CI          -0.55974   0.420856   -1.33 0.184409
CIDV        0.983603    0.59518   1.653 0.099332 .
CIHK        2.039295    0.59518   3.426 0.000687 ***
CIHF        0.740173    0.59518   1.244 0.214499
CILV        0.214975    0.59518   0.361 0.718179
CILB        0.125234    0.59518    0.21 0.833471
CILO        1.244194    0.59518    2.09  0.03732 *
CIPN         -0.54349   0.59518  -0.913 0.361808
CISA        1.218388    0.59518   2.047 0.041417 *
CISH        0.383709    0.59518   0.645 0.519561
---


Residual standard error: 0.06133 on 340 degrees of freedom
Multiple R-squared: 0.98, Adjusted R-squared: 0.9789
F-statistic: 878.7 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(AFM3_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.27638  -0.02479  0.004227  0.037341  0.190315

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   5.0697    0.94853   5.345 1.66E-07 ***
DV           -2.54886   1.34142    -1.9  0.05826 .
HK           -5.67229   1.34142  -4.229 3.03E-05 ***
HF           -1.88907   1.34142  -1.408  0.15997
LV           -0.94338   1.34142  -0.703  0.48237
LB           -0.60225   1.34142  -0.449  0.65375
LO           -3.12234   1.34142  -2.328  0.02052 *
PN           -0.11678   1.34142  -0.087  0.93068
SA           -2.86914   1.34142  -2.139  0.03316 *
SH           -1.67379   1.34142  -1.248  0.21297
CI            -0.5721    0.4364  -1.311  0.19076
CIDV          1.03476   0.61717   1.677  0.09453 .
CIHK          2.01719   0.61717   3.268  0.00119 **
CIHF          0.76013   0.61717   1.232  0.21893
CILV          0.06249   0.61717   0.101   0.9194
CILB           0.1346   0.61717   0.218  0.82749
CILO           1.2541   0.61717   2.032  0.04293 *
CIPN          -0.4901   0.61717  -0.794  0.42769
CISA          1.22128   0.61717   1.979  0.04864 *
CISH          0.39137   0.61717   0.634  0.52641
---


Residual standard error: 0.06151 on 340 degrees of freedom
Multiple R-squared: 0.9799, Adjusted R-squared: 0.9788
F-statistic: 873.6 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(AFM4_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.27297  -0.02634  0.005156  0.037957  0.189333

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   5.2108     0.9955   5.234 2.91E-07 ***
DV           -2.5032     1.4079  -1.778 0.076296 .
HK           -5.5309     1.4079  -3.929 0.000103 ***
HF           -2.0561     1.4079   -1.46 0.145086
LV           -0.4579     1.4079  -0.325 0.745174
LB           -0.6807     1.4079  -0.483 0.629064
LO           -3.2753     1.4079  -2.326 0.020582 *
PN           -0.4116     1.4079  -0.292 0.770204
SA           -2.8656     1.4079  -2.035 0.042581 *
SH           -1.7208     1.4079  -1.222 0.222441
CI           -0.6368     0.4578  -1.391 0.165199
CIDV          1.0134     0.6475   1.565 0.118498
CIHK          1.9514     0.6475   3.014 0.002774 **
CIHF          0.8367     0.6475   1.292 0.197172
CILV         -0.1608     0.6475  -0.248 0.804016
CILB          0.1706     0.6475   0.264 0.792317
CILO           1.324     0.6475   2.045 0.041645 *
CIPN         -0.3543     0.6475  -0.547 0.584579
CISA          1.2192     0.6475   1.883 0.060559 .
CISH          0.4129     0.6475   0.638 0.524149
---


Residual standard error: 0.06178 on 340 degrees of freedom
Multiple R-squared: 0.9798, Adjusted R-squared: 0.9786
F-statistic: 865.8 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(AFM5_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.27452  -0.02674  0.007367  0.036792  0.181985

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   5.3745     1.0573   5.083 6.14E-07 ***
DV           -2.6428     1.4953  -1.767 0.078047 .
HK           -5.4438     1.4953  -3.641 0.000314 ***
HF            -2.222     1.4953  -1.486 0.138204
LV           -0.3659     1.4953  -0.245  0.80683
LB           -0.9182     1.4953  -0.614 0.539578
LO           -3.5085     1.4953  -2.346 0.019531 *
PN           -0.9601     1.4953  -0.642 0.521264
SA           -2.8881     1.4953  -1.931 0.054255 .
SH           -1.8323     1.4953  -1.225 0.221269
CI           -0.7118     0.4861  -1.464 0.144026
CIDV          1.0772     0.6875   1.567 0.118052
CIHK          1.9106     0.6875   2.779  0.00575 **
CIHF          0.9126     0.6875   1.328 0.185214
CILV         -0.2031     0.6875  -0.295 0.767886
CILB          0.2798     0.6875   0.407 0.684289
CILO          1.4307     0.6875   2.081 0.038165 *
CIPN          -0.102     0.6875  -0.148 0.882114
CISA          1.2291     0.6875   1.788 0.074683 .
CISH           0.464     0.6875   0.675 0.500188
---


Residual standard error: 0.06214 on 340 degrees of freedom
Multiple R-squared: 0.9795, Adjusted R-squared: 0.9784
F-statistic: 855.5 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(AFM6_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.27467  -0.02833  0.006398  0.037002  0.175649

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  5.34997    1.11089   4.816 2.21E-06 ***
DV          -2.36579    1.57103  -1.506  0.13303
HK            -4.934    1.57103  -3.141  0.00183 **
HF          -2.15543    1.57103  -1.372  0.17097
LV          -0.02954    1.57103  -0.019  0.98501
LB          -0.94589    1.57103  -0.602  0.54752
LO          -3.48221    1.57103  -2.217  0.02732 *
PN          -1.42587    1.57103  -0.908  0.36473
SA          -2.64452    1.57103  -1.683  0.09323 .
SH          -1.84838    1.57103  -1.177   0.2402
CI          -0.70036     0.5106  -1.372  0.17108
CIDV         0.94959     0.7221   1.315  0.18938
CIHK         1.67583     0.7221   2.321  0.02089 *
CIHF         0.88181     0.7221   1.221  0.22287
CILV        -0.35762     0.7221  -0.495  0.62075
CILB         0.29242     0.7221   0.405  0.68576
CILO         1.41828     0.7221   1.964  0.05033 .
CIPN         0.11212     0.7221   0.155   0.8767
CISA         1.11683     0.7221   1.547  0.12288
CISH         0.47123     0.7221   0.653  0.51446
---

Residual standard error: 0.06255 on 340 degrees of freedom
Multiple R-squared: 0.9792, Adjusted R-squared: 0.9781
F-statistic: 844.2 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(AFP1_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.28778  -0.02515  0.007357  0.035845  0.190802

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.77621    0.85663   5.576 5.03E-08 ***
DV          -2.19802    1.21146  -1.814 0.070503 .
HK          -5.45984    1.21146  -4.507 9.06E-06 ***
HF           -1.3667    1.21146  -1.128 0.260055
LV          -2.19719    1.21146  -1.814 0.070609 .
LB          -0.47476    1.21146  -0.392 0.695382
LO          -2.64777    1.21146  -2.186 0.029526 *
PN           0.81614    1.21146   0.674 0.500967
SA          -2.64724    1.21146  -2.185 0.029558 *
SH          -1.45289    1.21146  -1.199 0.231249
CI          -0.43769    0.39468  -1.109 0.268226
CIDV         0.87459    0.55816   1.567 0.118066
CIHK         1.92219    0.55816   3.444 0.000645 ***
CIHF         0.52052    0.55816   0.933 0.351709
CILV          0.6403    0.55816   1.147 0.252124
CILB         0.07605    0.55816   0.136 0.891701
CILO         1.03723    0.55816   1.858 0.063991 .
CIPN        -0.92066    0.55816  -1.649 0.099979 .
CISA         1.12079    0.55816   2.008 0.045435 *
CISH         0.29015    0.55816    0.52 0.603521
---


Residual standard error: 0.06085 on 340 degrees of freedom
Multiple R-squared: 0.9804, Adjusted R-squared: 0.9793
F-statistic: 892.8 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(AFP2_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.28955  -0.02493   0.00889   0.03726   0.18285

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.66449    0.84793   5.501 7.44E-08 ***
DV          -1.95314    1.19916  -1.629 0.104291
HK          -5.31523    1.19916  -4.432 1.26E-05 ***
HF          -1.22592    1.19916  -1.022 0.307358
LV          -2.15574    1.19916  -1.798  0.07311 .
LB          -0.43981    1.19916  -0.367  0.71402
LO          -2.45641    1.19916  -2.048 0.041284 *
PN           1.07807    1.19916   0.899 0.369279
SA          -2.46784    1.19916  -2.058 0.040355 *
SH          -1.31086    1.19916  -1.093 0.275102
CI          -0.38635    0.39082  -0.989 0.323574
CIDV         0.76203     0.5527   1.379 0.168878
CIHK         1.85622     0.5527   3.358 0.000873 ***
CIHF         0.45582     0.5527   0.825 0.410107
CILV         0.62143     0.5527   1.124 0.261655
CILB         0.05997     0.5527   0.109  0.91366
CILO          0.9494     0.5527   1.718 0.086749 .
CIPN        -1.04172     0.5527  -1.885 0.060309 .
CISA         1.0385      0.5527   1.879 0.061104 .
CISH         0.22479     0.5527   0.407 0.684478
---


Residual standard error: 0.06082 on 340 degrees of freedom
Multiple R-squared: 0.9804, Adjusted R-squared: 0.9793
F-statistic: 894 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(AFP3_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.29108  -0.02551  0.008247  0.037252   0.17065

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.60694    0.84408   5.458 9.30E-08 ***
DV          -1.73968    1.19371  -1.457  0.14594
HK          -5.12013    1.19371  -4.289 2.34E-05 ***
HF          -1.01176    1.19371  -0.848  0.39727
LV          -2.19617    1.19371   -1.84  0.06667 .
LB          -0.46765    1.19371  -0.392  0.69548
LO          -2.26114    1.19371  -1.894  0.05904 .
PN           1.43333    1.19371   1.201  0.23069
SA          -2.33459    1.19371  -1.956  0.05131 .
SH          -1.26374    1.19371  -1.059   0.2905
CI          -0.35996    0.38918  -0.925  0.35567
CIDV         0.66388    0.55038   1.206  0.22857
CIHK         1.76693    0.55038    3.21  0.00145 **
CIHF         0.35724    0.55038   0.649  0.51673
CILV         0.64029    0.55038   1.163   0.2455
CILB         0.07283    0.55038   0.132  0.89481
CILO         0.85971    0.55038   1.562  0.11921
CIPN        -1.20591    0.55038  -2.191  0.02913 *
CISA         0.97743    0.55038   1.776  0.07664 .
CISH         0.20314    0.55038   0.369  0.71229
---


Residual standard error: 0.06077 on 340 degrees of freedom
Multiple R-squared: 0.9804, Adjusted R-squared: 0.9793
F-statistic: 895.5 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(AFP4_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.29073  -0.02534  0.008259  0.036239  0.156441

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.57063    0.84346   5.419 1.14E-07 ***
DV          -1.50076    1.19283  -1.258   0.2092
HK          -4.97411    1.19283   -4.17 3.87E-05 ***
HF          -0.91175    1.19283  -0.764   0.44518
LV          -2.05569    1.19283  -1.723   0.08573 .
LB          -0.49514    1.19283  -0.415   0.67833
LO          -2.07263    1.19283  -1.738   0.08319 .
PN           1.56516    1.19283   1.312   0.19036
SA          -2.17619    1.19283  -1.824   0.06897 .
SH          -1.13905    1.19283  -0.955    0.3403
CI          -0.34334    0.38903  -0.883   0.37811
CIDV         0.55391    0.55017   1.007   0.31475
CIHK          1.7002    0.55017    3.09   0.00216 **
CIHF         0.31123    0.55017   0.566   0.57197
CILV         0.57572    0.55017   1.046    0.2961
CILB         0.08553    0.55017   0.155   0.87654
CILO         0.77306    0.55017   1.405    0.1609
CIPN        -1.26715    0.55017  -2.303   0.02187 *
CISA         0.90471    0.55017   1.644   0.10101
CISH          0.1457    0.55017   0.265   0.79131
---


Residual standard error: 0.06088 on 340 degrees of freedom
Multiple R-squared: 0.9803, Adjusted R-squared: 0.9792
F-statistic: 892.1 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
>           summary(AFP5_lm)

Residuals:
            Min         1Q          Median      3Q          Max
  -0.29001     -0.0257     0.00858      0.0363     0.13891

Coefficients:
            Estimate    Std.        Error       t           value       Pr(>|t|)
(Intercept)    4.50185     0.84768       5.311    1.98E-07 ***
DV            -1.31593      1.1988      -1.098    0.273111
HK            -4.63011      1.1988      -3.862    0.000134 ***
HF            -0.73124      1.1988       -0.61    0.542287
LV            -1.95108      1.1988      -1.628    0.104552
LB            -0.50583      1.1988      -0.422    0.673331
LO            -1.84246      1.1988      -1.537    0.125244
PN             1.83681      1.1988       1.532    0.126402
SA            -2.02943      1.1988      -1.693    0.091395 .
SH            -1.01436      1.1988      -0.846    0.398066
CI            -0.31172     0.39112      -0.797     0.42601
CIDV           0.46883     0.55313       0.848    0.397265
CIHK            1.5421     0.55313       2.788    0.005603 **
CIHF           0.22805     0.55313       0.412    0.680387
CILV           0.52767     0.55313       0.954    0.340781
CILB            0.0905     0.55313       0.164    0.870137
CILO           0.66714     0.55313       1.206    0.228615
CIPN          -1.39297     0.55313      -2.518     0.01225 *
CISA           0.83733     0.55313       1.514    0.131008
CISH           0.08822     0.55313       0.159    0.873382
---


Residual    standard    error:         0.06099 on             340 degrees    of          freedom
Multiple    R-squared: 0.9803,   Adjusted   R-squared:     0.9792
F-statistic:      888.7 on                19 and              340 DF,        p-value:    <             2.20E-16
```

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```
> summary(AFP6_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.28913  -0.02584  0.007724  0.037445  0.126448

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   4.4941     0.8575   5.241 2.81E-07 ***
DV           -1.1478     1.2127  -0.946 0.344579
HK           -4.2316     1.2127  -3.489 0.000548 ***
HF           -0.5224     1.2127  -0.431 0.666916
LV           -1.8593     1.2127  -1.533  0.12615
LB           -0.5501     1.2127  -0.454 0.650402
LO           -1.5944     1.2127  -1.315 0.189479
PN            1.7766     1.2127   1.465 0.143836
SA           -1.8496     1.2127  -1.525 0.128131
SH           -0.8711     1.2127  -0.718 0.473066
CI           -0.3082     0.3958  -0.779 0.436636
CIDV          0.3913     0.5597   0.699 0.484902
CIHK          1.3586     0.5597   2.427 0.015726 *
CIHF          0.1317     0.5597   0.235 0.814099
CILV          0.4854     0.5597   0.867  0.38636
CILB          0.1109     0.5597   0.198 0.842988
CILO          0.5528     0.5597   0.988 0.323997
CIPN         -1.3656     0.5597   -2.44 0.015203 *
CISA          0.7546     0.5597   1.348 0.178497
CISH          0.0221     0.5597   0.039 0.968532
---

Residual standard error: 0.0614 on 340 degrees of freedom
Multiple R-squared: 0.98, Adjusted R-squared: 0.9789
F-statistic: 876.7 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
>
>              summary(ANFNo_lm)

Residuals:
              Min          1Q           Median      3Q          Max
  -0.85139   -0.05247    0.01126     0.07437    0.60331

Coefficients:
              Estimate  Std.        Error       t             value        Pr(>|t|)
(Intercept)       8.695       2.193       3.964    8.98E-05 ***
DV               -7.097       3.102      -2.288     0.02275 *
HK              -13.731       3.102      -4.427    1.29E-05 ***
HF               -6.117       3.102      -1.972      0.0494 *
LV               -8.621       3.102      -2.779     0.00575 **
LB               -5.279       3.102      -1.702     0.08969 .
LO               -3.602       3.102      -1.161     0.24639
PN               -5.129       3.102      -1.654     0.09914 .
SA               -5.077       3.102      -1.637     0.10257
SH               -5.576       3.102      -1.798     0.07311 .
CI               -2.724        1.01      -2.696     0.00736 **
CIDV              3.238       1.429       2.267     0.02404 *
CIHK              5.661       1.429       3.963    9.03E-05 ***
CIHF              2.847       1.429       1.993     0.04707 *
CILV               3.76       1.429       2.632     0.00889 **
CILB              2.285       1.429         1.6     0.11058
CILO              1.332       1.429       0.933     0.35165
CIPN              1.463       1.429       1.024     0.30651
CISA              2.249       1.429       1.574      0.1164
CISH              2.159       1.429       1.511     0.13161
---


Residual     standard     error:            0.1538  on                340  degrees    of           freedom
Multiple     R-squared:  0.947,        Adjusted     R-squared:       0.944
F-statistic:        319.7  on                    19  and               340  DF,         p-value:     <              2.20E-16
```

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```
> summary(ANFM1_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.8418   -0.05232   0.01058   0.07171   0.60583

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   8.3729     2.2346   3.747  0.00021 ***
DV           -6.4939     3.1602  -2.055 0.040653 *
HK           -13.548     3.1602  -4.287 2.36E-05 ***
HF           -5.3752     3.1602  -1.701 0.089875 .
LV           -6.9181     3.1602  -2.189 0.029267 *
LB            -4.832     3.1602  -1.529 0.127196
LO           -2.7702     3.1602  -0.877 0.381338
PN           -3.9627     3.1602  -1.254 0.210727
SA           -4.4078     3.1602  -1.395 0.163999
SH           -5.2339     3.1602  -1.656  0.09861 .
CI           -2.5747     1.0289  -2.502 0.012802 *
CIDV          2.9594      1.455   2.034 0.042733 *
CIHK          5.5751      1.455   3.832 0.000152 ***
CIHF          2.5044      1.455   1.721 0.086123 .
CILV          2.9743      1.455   2.044 0.041709 *
CILB          2.0789      1.455   1.429 0.153991
CILO          0.9491      1.455   0.652 0.514654
CIPN          0.9255      1.455   0.636 0.525155
CISA          1.9396      1.455   1.333 0.183409
CISH          2.0009      1.455   1.375 0.169981
---


Residual standard error: 0.1539 on 340 degrees of freedom
Multiple R-squared: 0.947,  Adjusted R-squared: 0.944
F-statistic: 319.5 on 19 and 340 DF,  p-value: < 2.20E-16
```

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```
> summary(ANFM2_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.82691  -0.05375   0.01209   0.07018   0.60988

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   7.7773     2.3002   3.381 0.000806 ***
DV            -5.728     3.2529  -1.761 0.079157 .
HK          -12.8929     3.2529  -3.963 9.00E-05 ***
HF            -4.4418    3.2529  -1.365 0.173004
LV            -5.2394    3.2529  -1.611 0.108178
LB            -4.2635    3.2529  -1.311 0.190858
LO            -2.2792    3.2529  -0.701 0.483985
PN            -2.8266    3.2529  -0.869 0.385487
SA            -3.5466    3.2529   -1.09 0.276357
SH            -4.6405    3.2529  -1.427 0.154627
CI            -2.2995    1.0586  -2.172 0.030535 *
CIDV           2.6058    1.4971   1.741 0.082674 .
CIHK           5.2714    1.4971   3.521 0.000489 ***
CIHF           2.0738    1.4971   1.385 0.166905
CILV           2.2005    1.4971    1.47 0.142544
CILB           1.8164    1.4971   1.213  0.22587
CILO           0.7228    1.4971   0.483 0.629567
CIPN           0.4022    1.4971   0.269 0.788344
CISA           1.5425    1.4971    1.03 0.303593
CISH            1.727    1.4971   1.154 0.249495
---


Residual standard error: 0.1543 on 340 degrees of freedom
Multiple R-squared: 0.9467, Adjusted R-squared: 0.9437
F-statistic: 317.8 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(ANFM3_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.80498   -0.0531  0.008568  0.075065  0.602494

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   7.0398     2.3821   2.955 0.003341 **
DV           -4.9081     3.3687  -1.457 0.146052
HK          -11.8074     3.3687  -3.505 0.000518 ***
HF           -3.4205     3.3687  -1.015 0.310658
LV           -3.3554     3.3687  -0.996 0.319939
LB           -3.5295     3.3687  -1.048 0.295512
LO           -1.5527     3.3687  -0.461 0.645147
PN           -1.0248     3.3687  -0.304 0.761165
SA            -2.496     3.3687  -0.741 0.459243
SH            -3.655     3.3687  -1.085 0.278703
CI           -1.9594     1.0959  -1.788  0.07469 .
CIDV          2.2276     1.5499   1.437 0.151564
CIHK          4.7701     1.5499   3.078 0.002256 **
CIHF          1.6031     1.5499   1.034 0.301706
CILV          1.3328     1.5499    0.86  0.39042
CILB          1.4781     1.5499   0.954 0.340935
CILO          0.3882     1.5499    0.25 0.802352
CIPN          -0.427     1.5499  -0.275 0.783116
CISA          1.0586     1.5499   0.683  0.49507
CISH           1.273     1.5499   0.821 0.412031
---


Residual standard error: 0.1545 on 340 degrees of freedom
Multiple R-squared: 0.9466, Adjusted R-squared: 0.9436
F-statistic: 317 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(ANFM4_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.78925  -0.04771  0.009576  0.079925   0.60131

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   6.4752      2.493   2.597   0.0098 **
DV           -3.9934     3.5257  -1.133  0.25815
HK          -10.9258     3.5257  -3.099   0.0021 **
HF           -2.5966     3.5257  -0.736  0.46195
LV           -1.0884     3.5257  -0.309  0.75774
LB           -2.8947     3.5257  -0.821  0.41221
LO           -1.0026     3.5257  -0.284  0.77631
PN           -0.4415     3.5257  -0.125  0.90042
SA           -1.3451     3.5257  -0.382  0.70306
SH           -2.9223     3.5257  -0.829  0.40777
CI            -1.699     1.1466  -1.482  0.13933
CIDV          1.8061     1.6215   1.114  0.26614
CIHK          4.3629     1.6215   2.691  0.00748 **
CIHF          1.2236     1.6215   0.755    0.451
CILV          0.2897     1.6215   0.179  0.85833
CILB          1.1855     1.6215   0.731   0.4652
CILO          0.1351     1.6215   0.083  0.93367
CIPN         -0.6951     1.6215  -0.429  0.66845
CISA          0.5288     1.6215   0.326  0.74452
CISH          0.9355     1.6215   0.577  0.56436
---


Residual standard error: 0.1547 on 340 degrees of freedom
Multiple R-squared: 0.9464, Adjusted R-squared: 0.9434
F-statistic: 315.9 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(ANFM5_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.77456  -0.04575  0.006338  0.079701  0.589022

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 5.791715   2.635695   2.197  0.02866 *
DV         -3.11606   3.727436  -0.836  0.40375
HK         -9.92672   3.727436  -2.663  0.00811 **
HF          -1.6797   3.727436  -0.451  0.65254
LV         0.791767   3.727436   0.212  0.83191
LB         -2.43098   3.727436  -0.652  0.51472
LO         0.072932   3.727436    0.02   0.9844
PN         0.113688   3.727436   0.031  0.97569
SA         -0.19504   3.727436  -0.052   0.9583
SH         -1.81479   3.727436  -0.487  0.62666
CI         -1.38413   1.211767  -1.142  0.25416
CIDV       1.402053   1.713698   0.818  0.41385
CIHK       3.901916   1.713698   2.277  0.02341 *
CIHF       0.801613   1.713698   0.468  0.64025
CILV       -0.57489   1.713698  -0.335  0.73748
CILB       0.971926   1.713698   0.567  0.57099
CILO       -0.35947   1.713698   -0.21  0.83398
CIPN       -0.95008   1.713698  -0.554  0.57967
CISA       -0.00012   1.713698 -6.84E-05  0.99995
CISH       0.425984   1.713698   0.249  0.80384
---


Residual standard error: 0.1549 on 340 degrees of freedom
Multiple R-squared: 0.9463, Adjusted R-squared: 0.9433
F-statistic: 315.1 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(ANFM6_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.77175  -0.05286  0.007583  0.081489  0.579915

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.72979    2.75241   1.718   0.0866 .
DV          -1.66981    3.89249  -0.429   0.6682
HK           -8.2381    3.89249  -2.116    0.035 *
HF          -0.62097    3.89249   -0.16   0.8733
LV           3.11945    3.89249   0.801   0.4235
LB          -1.51053    3.89249  -0.388   0.6982
LO           1.25269    3.89249   0.322   0.7478
PN           1.44498    3.89249   0.371   0.7107
SA           1.39807    3.89249   0.359   0.7197
SH          -0.73025    3.89249  -0.188   0.8513
CI          -0.89565     1.2651  -0.708   0.4794
CIDV         0.73691    1.78913   0.412   0.6807
CIHK         3.12472    1.78913   1.747   0.0816 .
CIHF         0.31476    1.78913   0.176   0.8605
CILV        -1.64467    1.78913  -0.919   0.3586
CILB         0.54859    1.78913   0.307   0.7593
CILO        -0.90166    1.78913  -0.504   0.6146
CIPN        -1.56177    1.78913  -0.873   0.3833
CISA         -0.7324    1.78913  -0.409   0.6825
CISH        -0.07264    1.78913  -0.041   0.9676
---


Residual standard error: 0.155 on 340 degrees of freedom
Multiple R-squared: 0.9462, Adjusted R-squared: 0.9432
F-statistic: 314.8 on 19 and 340 DF, p-value: < 2.20E-16
```

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> summary(ANFP1_lm)

Residuals:

	Min	1Q	Median	3Q	Max
-0.853	-0.05465	0.01002	0.07465	0.60229	

Coefficients:

<table>
<tr><th></th><th>Estimate</th><th>Std.</th><th>Error</th><th>t</th><th>value</th><th>Pr(>|t|)</th></tr>
<tr><td>(Intercept)</td><td>9.034</td><td>2.16</td><td>4.183</td><td>3.66E-05</td><td>***</td><td></td></tr>
<tr><td>DV</td><td>-7.632</td><td>3.054</td><td>-2.499</td><td>0.01293</td><td>*</td><td></td></tr>
<tr><td>HK</td><td>-14.067</td><td>3.054</td><td>-4.606</td><td>5.82E-06</td><td>***</td><td></td></tr>
<tr><td>HF</td><td>-6.737</td><td>3.054</td><td>-2.206</td><td>0.02805</td><td>*</td><td></td></tr>
<tr><td>LV</td><td>-9.852</td><td>3.054</td><td>-3.226</td><td>0.00138</td><td>**</td><td></td></tr>
<tr><td>LB</td><td>-5.682</td><td>3.054</td><td>-1.86</td><td>0.06368</td><td>.</td><td></td></tr>
<tr><td>LO</td><td>-3.853</td><td>3.054</td><td>-1.262</td><td>0.20798</td><td></td><td></td></tr>
<tr><td>PN</td><td>-6.141</td><td>3.054</td><td>-2.011</td><td>0.04515</td><td>*</td><td></td></tr>
<tr><td>SA</td><td>-5.861</td><td>3.054</td><td>-1.919</td><td>0.05581</td><td>.</td><td></td></tr>
<tr><td>SH</td><td>-5.83</td><td>3.054</td><td>-1.909</td><td>0.05713</td><td>.</td><td></td></tr>
<tr><td>CI</td><td>-2.881</td><td>0.995</td><td>-2.896</td><td>0.00403</td><td>**</td><td></td></tr>
<tr><td>CIDV</td><td>3.486</td><td>1.407</td><td>2.477</td><td>0.01372</td><td>*</td><td></td></tr>
<tr><td>CIHK</td><td>5.818</td><td>1.407</td><td>4.135</td><td>4.49E-05</td><td>***</td><td></td></tr>
<tr><td>CIHF</td><td>3.134</td><td>1.407</td><td>2.227</td><td>0.0266</td><td>*</td><td></td></tr>
<tr><td>CILV</td><td>4.328</td><td>1.407</td><td>3.076</td><td>0.00227</td><td>**</td><td></td></tr>
<tr><td>CILB</td><td>2.472</td><td>1.407</td><td>1.757</td><td>0.07985</td><td>.</td><td></td></tr>
<tr><td>CILO</td><td>1.449</td><td>1.407</td><td>1.03</td><td>0.30398</td><td></td><td></td></tr>
<tr><td>CIPN</td><td>1.93</td><td>1.407</td><td>1.371</td><td>0.17117</td><td></td><td></td></tr>
<tr><td>CISA</td><td>2.611</td><td>1.407</td><td>1.855</td><td>0.06442</td><td>.</td><td></td></tr>
<tr><td>CISH</td><td>2.277</td><td>1.407</td><td>1.618</td><td>0.10658</td><td></td><td></td></tr>
</table>

Residual standard error: 0.1534 on 340 degrees of freedom

Multiple R-squared: 0.9473, Adjusted R-squared: 0.9443

F-statistic: 321.6 on 19 and 340 DF, p-value: < 2.20E-16

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```
> summary(ANFP2_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.84667  -0.05687  0.006473  0.074455  0.597399

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   9.3659     2.1368   4.383 1.56E-05 ***
DV           -7.8926     3.0219  -2.612 0.009406 **
HK          -14.3802     3.0219  -4.759 2.89E-06 ***
HF           -7.1881     3.0219  -2.379 0.017927 *
LV          -10.5365     3.0219  -3.487 0.000553 ***
LB           -6.0986     3.0219  -2.018 0.044363 *
LO           -4.5402     3.0219  -1.502 0.133914
PN            -7.151     3.0219  -2.366 0.018522 *
SA           -6.5016     3.0219  -2.151 0.032141 *
SH           -6.2824     3.0219  -2.079 0.038372 *
CI           -3.0351     0.9849  -3.082 0.002226 **
CIDV          3.6073     1.3928    2.59 0.010012 *
CIHK          5.9645     1.3928   4.282 2.41E-05 ***
CIHF          3.3427     1.3928     2.4 0.016935 *
CILV          4.6453     1.3928   3.335 0.000946 ***
CILB          2.6649     1.3928   1.913 0.056544 .
CILO           1.766     1.3928   1.268 0.205691
CIPN          2.3961     1.3928    1.72 0.086282 .
CISA          2.9068     1.3928   2.087 0.037631 *
CISH          2.4863     1.3928   1.785 0.075133 .
---

Residual standard error: 0.1533 on 340 degrees of freedom
Multiple R-squared: 0.9474, Adjusted R-squared: 0.9445
F-statistic: 322.3 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(ANFP3_lm)

Residuals:
     Min        1Q    Median      3Q       Max
-0.83801   -0.0557   0.01039   0.0772   0.59281

Coefficients:
            Estimate  Std.   Error   t         value   Pr(>|t|)
(Intercept)   9.637    2.13   4.525   8.38E-06 ***
DV           -8.022   3.012  -2.663   0.008107 **
HK          -14.143   3.012  -4.695   3.87E-06 ***
HF           -7.714   3.012  -2.561   0.010871 *
LV          -11.133   3.012  -3.696   0.000255 ***
LB            -6.41   3.012  -2.128    0.03404 *
LO           -4.871   3.012  -1.617   0.106801
PN           -8.191   3.012  -2.719   0.006874 **
SA           -7.115   3.012  -2.362   0.018741 *
SH           -6.733   3.012  -2.235   0.026044 *
CI           -3.161   0.982  -3.219   0.001411 **
CIDV          3.668   1.389   2.641    0.00864 **
CIHK          5.857   1.389   4.218   3.17E-05 ***
CIHF          3.586   1.389   2.582   0.010232 *
CILV          4.922   1.389   3.544   0.000449 ***
CILB           2.81   1.389   2.023   0.043847 *
CILO          1.919   1.389   1.382    0.16795
CIPN          2.877   1.389   2.071   0.039081 *
CISA          3.191   1.389   2.297   0.022209 *
CISH          2.695   1.389   1.941   0.053136 .
---

Residual standard error: 0.1533 on 340 degrees of freedom
Multiple R-squared: 0.9473, Adjusted R-squared: 0.9444
F-statistic: 321.9 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
>           summary(ANFP4_lm)

Residuals:
            Min        1Q         Median     3Q         Max
   -0.8271   -0.05448    0.01196    0.07624    0.58529

Coefficients:
            Estimate  Std.       Error      t          value      Pr(>|t|)
(Intercept)    9.891     2.1279      4.648   4.79E-06 ***
DV           -8.0778     3.0092     -2.684   0.007623 **
HK          -13.7434     3.0092     -4.567   6.93E-06 ***
HF           -8.1185     3.0092     -2.698   0.007327 **
LV          -11.3447     3.0092      -3.77   0.000192 ***
LB           -6.7235     3.0092     -2.234   0.026115 *
LO           -5.2822     3.0092     -1.755   0.080102 .
PN           -9.1579     3.0092     -3.043   0.002522 **
SA           -7.6034     3.0092     -2.527   0.011968 *
SH           -7.0705     3.0092      -2.35   0.019365 *
CI           -3.2795     0.9814     -3.342   0.000926 ***
CIDV          3.6953      1.388      2.662   0.008128 **
CIHK          5.6751      1.388      4.089   5.42E-05 ***
CIHF          3.7742      1.388      2.719   0.006879 **
CILV          5.0214      1.388      3.618   0.000342 ***
CILB          2.9551      1.388      2.129   0.033967 *
CILO          2.1095      1.388       1.52   0.129473
CIPN          3.3235      1.388      2.395   0.017182 *
CISA          3.4171      1.388      2.462   0.014314 *
CISH          2.8517      1.388      2.055   0.040684 *
---

Residual    standard   error:         0.1536 on           340 degrees   of         freedom
Multiple    R-squared: 0.9472,    Adjusted   R-squared:     0.9442
F-statistic:     320.8 on                19 and            340 DF,       p-value:   <          2.20E-16
```

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```
> summary(ANFP5_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.8154   -0.05799   0.01094   0.07575   0.57647

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   10.011      2.137   4.684 4.06E-06 ***
DV            -8.061      3.022  -2.667 0.008014 **
HK           -13.258      3.022  -4.387 1.54E-05 ***
HF            -8.342      3.022   -2.76 0.006091 **
LV           -11.605      3.022   -3.84 0.000147 ***
LB            -6.833      3.022  -2.261 0.024404 *
LO             -5.59      3.022   -1.85 0.065222 .
PN           -10.022      3.022  -3.316 0.001011 **
SA            -7.971      3.022  -2.637 0.008738 **
SH            -7.197      3.022  -2.381 0.017803 *
CI            -3.336      0.986  -3.383   0.0008 ***
CIDV           3.689      1.395   2.645 0.008539 **
CIHK           5.453      1.395   3.911 0.000111 ***
CIHF           3.879      1.395   2.781 0.005714 **
CILV           5.144      1.395   3.689 0.000262 ***
CILB           3.006      1.395   2.156 0.031782 *
CILO           2.252      1.395   1.615  0.10718
CIPN           3.724      1.395    2.67 0.007945 **
CISA           3.588      1.395   2.573 0.010507 *
CISH           2.911      1.395   2.087 0.037588 *
---

Residual standard error: 0.1538 on 340 degrees of freedom
Multiple R-squared: 0.947, Adjusted R-squared: 0.9441
F-statistic: 320 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(ANFP6_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.79264  -0.05779  0.007981  0.075387  0.558549

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  10.2159     2.1478   4.757 2.91E-06 ***
DV           -8.1083     3.0374   -2.67  0.00796 **
HK          -12.6925     3.0374  -4.179 3.73E-05 ***
HF           -8.6724     3.0374  -2.855 0.004565 **
LV          -11.8443     3.0374  -3.899 0.000116 ***
LB           -7.0445     3.0374  -2.319 0.020973 *
LO           -6.0232     3.0374  -1.983 0.048169 *
PN          -11.6577     3.0374  -3.838 0.000148 ***
SA           -8.4121     3.0374   -2.77 0.005922 **
SH           -7.4288     3.0374  -2.446  0.01496 *
CI           -3.4316     0.9913  -3.462 0.000605 ***
CIDV          3.7118     1.4019   2.648  0.00848 **
CIHK          5.1938     1.4019   3.705 0.000247 ***
CIHF          4.0324     1.4019   2.876 0.004276 **
CILV          5.2553     1.4019   3.749 0.000209 ***
CILB          3.1052     1.4019   2.215  0.02742 *
CILO          2.4529     1.4019    1.75 0.081063 .
CIPN          4.4795     1.4019   3.195 0.001527 **
CISA          3.7926     1.4019   2.705 0.007165 **
CISH          3.0189     1.4019   2.153 0.031983 *
---


Residual standard error: 0.1538 on 340 degrees of freedom
Multiple R-squared: 0.947,  Adjusted R-squared: 0.9441
F-statistic: 319.9 on 19 and 340 DF,  p-value: < 2.20E-16
```

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```
> summary(JCNo_lm)

Residuals:
      Min        1Q    Median        3Q       Max
 -0.69015  -0.05073   0.02327   0.07446    0.2988

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  10.4483     1.9341   5.402 1.24E-07 ***
DV           -8.0723     2.7353  -2.951 0.003385 **
HK          -10.4775     2.7353   -3.83 0.000152 ***
HF           -7.2036     2.7353  -2.634 0.008835 **
LV           -9.8747     2.7353   -3.61 0.000352 ***
LB           -6.1476     2.7353  -2.248 0.025248 *
LO           -3.5053     2.7353  -1.282 0.200884
PN            -7.407     2.7353  -2.708 0.007112 **
SA           -6.7366     2.7353  -2.463 0.014279 *
SH           -6.4762     2.7353  -2.368  0.01846 *
CI           -3.2857     0.8908  -3.688 0.000263 ***
CIDV          3.7266     1.2598   2.958 0.003313 **
CIHK          4.4399     1.2598   3.524 0.000483 ***
CIHF          3.3981     1.2598   2.697 0.007339 **
CILV           4.395     1.2598   3.489 0.000549 ***
CILB          2.6726     1.2598   2.121 0.034611 *
CILO          1.6393     1.2598   1.301 0.194079
CIPN          2.9704     1.2598   2.358 0.018951 *
CISA          3.0064     1.2598   2.386 0.017561 *
CISH          2.6054     1.2598   2.068  0.03939 *
---


Residual standard error: 0.1357 on 340 degrees of freedom
Multiple R-squared: 0.8992, Adjusted R-squared: 0.8935
F-statistic: 159.5 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(JCM1_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.67967  -0.04991   0.02232   0.07641   0.30453

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   9.9168     1.9797   5.009 8.80E-07 ***
DV           -7.2223     2.7997   -2.58 0.010307 *
HK           -9.2358     2.7997  -3.299 0.001073 **
HF           -6.0715     2.7997  -2.169 0.030802 *
LV           -8.2981     2.7997  -2.964 0.003251 **
LB           -5.2402     2.7997  -1.872   0.0621 .
LO           -2.8665     2.7997  -1.024  0.30663
PN           -6.5989     2.7997  -2.357 0.018988 *
SA           -5.9503     2.7997  -2.125 0.034277 *
SH           -5.3271     2.7997  -1.903 0.057917 .
CI           -3.0398     0.9115  -3.335 0.000947 ***
CIDV          3.3339      1.289   2.586 0.010114 *
CIHK          3.8666      1.289       3 0.002902 **
CIHF          2.8756      1.289   2.231 0.026341 *
CILV          3.6675      1.289   2.845 0.004708 **
CILB          2.2539      1.289   1.749 0.081278 .
CILO          1.3445      1.289   1.043 0.297669
CIPN          2.5972      1.289   2.015 0.044704 *
CISA          2.6433      1.289   2.051 0.041067 *
CISH          2.0753      1.289    1.61 0.108322
---

Residual standard error: 0.1363 on 340 degrees of freedom
Multiple R-squared: 0.8982, Adjusted R-squared: 0.8925
F-statistic: 157.8 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(JCM2_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.67256  -0.04932   0.01899     0.077   0.30648

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   9.1443     2.0432   4.475 1.04E-05 ***
DV           -6.3026     2.8896  -2.181  0.02986 *
HK           -8.0353     2.8896  -2.781  0.00572 **
HF           -4.8797     2.8896  -1.689  0.09219 .
LV           -6.9381     2.8896  -2.401  0.01688 *
LB           -4.4298     2.8896  -1.533  0.12619
LO           -2.0683     2.8896  -0.716  0.47462
PN           -5.8159     2.8896  -2.013  0.04493 *
SA           -5.1268     2.8896  -1.774  0.07692 .
SH           -4.4611     2.8896  -1.544  0.12355
CI           -2.6831     0.9404  -2.853  0.00459 **
CIDV          2.9093     1.3299   2.188  0.02938 *
CIHK          3.3126     1.3299   2.491  0.01322 *
CIHF           2.326     1.3299   1.749  0.08119 .
CILV          3.0401     1.3299   2.286  0.02287 *
CILB           1.88      1.3299   1.414  0.15839
CILO          0.9766     1.3299   0.734  0.46325
CIPN          2.2359     1.3299   1.681  0.09364 .
CISA          2.2633     1.3299   1.702   0.0897 .
CISH           1.676     1.3299    1.26  0.20845
---


Residual standard error: 0.137 on 340 degrees of freedom
Multiple R-squared: 0.8971, Adjusted R-squared: 0.8913
F-statistic: 156 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(JCM3_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.66785  -0.05107   0.01599   0.07714   0.3117

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   8.1189     2.1248   3.821 0.000158 ***
DV           -5.1739     3.0049  -1.722 0.086016 .
HK           -6.4684     3.0049  -2.153 0.032053 *
HF           -3.4275     3.0049  -1.141 0.254831
LV           -5.4513     3.0049  -1.814 0.070542 .
LB           -3.3318     3.0049  -1.109 0.268311
LO           -1.3608     3.0049  -0.453 0.650934
PN           -4.6497     3.0049  -1.547 0.122709
SA           -4.0755     3.0049  -1.356 0.175914
SH           -3.1463     3.0049  -1.047 0.295825
CI           -2.2103     0.9776  -2.261 0.024391 *
CIDV          2.3889     1.3825   1.728 0.084907 .
CIHK          2.5905     1.3825   1.874 0.061825 .
CIHF           1.657     1.3825   1.199 0.231548
CILV          2.3549     1.3825   1.703 0.089417 .
CILB          1.3741     1.3825   0.994 0.320974
CILO          0.6508     1.3825   0.471 0.638154
CIPN          1.6985     1.3825   1.229 0.220101
CISA          1.7788     1.3825   1.287 0.199107
CISH          1.0704     1.3825   0.774 0.439323
---


Residual standard error: 0.1378 on 340 degrees of freedom
Multiple R-squared: 0.896,  Adjusted R-squared: 0.8902
F-statistic: 154.1 on 19 and 340 DF,  p-value: < 2.20E-16
```

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```
> summary(JCM4_lm)
```

Residuals:

Min	1Q	Median	3Q	Max
-0.66187	-0.0506	0.0154	0.07933	0.31448

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	7.2621	2.2264	3.262	0.00122	**
DV	-3.8892	3.1487	-1.235	0.21762	
HK	-4.7087	3.1487	-1.495	0.13572	
HF	-2.1903	3.1487	-0.696	0.48713	
LV	-3.5876	3.1487	-1.139	0.25534	
LB	-2.3241	3.1487	-0.738	0.46094	
LO	-0.7606	3.1487	-0.242	0.80926	
PN	-3.8542	3.1487	-1.224	0.22177	
SA	-2.9908	3.1487	-0.95	0.34285	
SH	-1.7773	3.1487	-0.564	0.57281	
CI	-1.8154	1.024	-1.773	0.07714	.
CIDV	1.7971	1.4481	1.241	0.21546	
CIHK	1.7802	1.4481	1.229	0.21981	
CIHF	1.0873	1.4481	0.751	0.45325	
CILV	1.4969	1.4481	1.034	0.30203	
CILB	0.9101	1.4481	0.628	0.53011	
CILO	0.3745	1.4481	0.259	0.79611	
CIPN	1.3319	1.4481	0.92	0.35834	
CISA	1.2792	1.4481	0.883	0.37767	
CISH	0.4404	1.4481	0.304	0.76124	

Residual standard error: 0.1382 on 340 degrees of freedom
Multiple R-squared: 0.8954, Adjusted R-squared: 0.8896
F-statistic: 153.2 on 19 and 340 DF, p-value: < 2.20E-16

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```
> summary(JCM5_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.66184  -0.05267   0.01403   0.08209   0.31482

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   6.2832     2.3575   2.665  0.00806 **
DV           -2.7291      3.334  -0.819   0.4136
HK           -2.7195      3.334  -0.816  0.41524
HF           -1.0613      3.334  -0.318  0.75043
LV           -2.3582      3.334  -0.707  0.47984
LB           -1.3951      3.334  -0.418  0.67588
LO           -0.4599      3.334  -0.138  0.89036
PN           -2.9663      3.334   -0.89  0.37425
SA            -1.962      3.334  -0.588  0.55659
SH           -0.3088      3.334  -0.093  0.92626
CI           -1.3647     1.0839  -1.259  0.20885
CIDV          1.2631     1.5328   0.824  0.41048
CIHK          0.8649     1.5328   0.564  0.57293
CIHF          0.5679     1.5328    0.37  0.71126
CILV          0.9311     1.5328   0.607  0.54396
CILB          0.4827     1.5328   0.315  0.75304
CILO          0.2361     1.5328   0.154  0.87769
CIPN          0.9232     1.5328   0.602  0.54737
CISA          0.8057     1.5328   0.526  0.59946
CISH          -0.235     1.5328  -0.153  0.87825
---


Residual standard error: 0.1386 on 340 degrees of freedom
Multiple R-squared: 0.8948, Adjusted R-squared: 0.8889
F-statistic: 152.2 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(JCM6_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.66085  -0.05566   0.01534   0.08129   0.31154

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 4.768773   2.465067   1.935   0.0539 .
DV          -0.81144   3.486132  -0.233   0.8161
HK          -0.05897   3.486132  -0.017   0.9865
HF          0.438922   3.486132   0.126   0.8999
LV             -0.407  3.486132  -0.117   0.9071
LB          -0.00795   3.486132  -0.002   0.9982
LO          0.261704   3.486132   0.075   0.9402
PN          -1.62513   3.486132  -0.466   0.6414
SA          -0.49034   3.486132  -0.141   0.8882
SH          1.472253   3.486132   0.422   0.6731
CI          -0.66822   1.133031   -0.59   0.5557
CIDV        0.381329   1.602348   0.238    0.812
CIHK        -0.35823   1.602348  -0.224   0.8232
CIHF        -0.12187   1.602348  -0.076   0.9394
CILV        0.033953   1.602348   0.021   0.9831
CILB        -0.15509   1.602348  -0.097    0.923
CILO        -0.09569   1.602348   -0.06   0.9524
CIPN        0.306519   1.602348   0.191   0.8484
CISA        0.129064   1.602348   0.081   0.9358
CISH        -1.05359   1.602348  -0.658   0.5113
---


Residual standard error: 0.1388 on 340 degrees of freedom
Multiple R-squared: 0.8944, Adjusted R-squared: 0.8885
F-statistic: 151.6 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(JCP1_lm)

Residuals:
      Min        1Q    Median        3Q       Max
 -0.69821   -0.0527   0.02391   0.07164   0.29145

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  10.9737      1.898   5.782 1.67E-08 ***
DV           -8.7099     2.6842  -3.245  0.00129 **
HK          -11.4658     2.6842  -4.272 2.52E-05 ***
HF           -8.3039     2.6842  -3.094  0.00214 **
LV          -11.0591     2.6842   -4.12 4.76E-05 ***
LB           -6.8966     2.6842  -2.569  0.01061 *
LO           -4.0384     2.6842  -1.505  0.13337
PN           -7.6999     2.6842  -2.869  0.00438 **
SA           -7.4104     2.6842  -2.761  0.00608 **
SH           -7.5096     2.6842  -2.798  0.00544 **
CI           -3.5289     0.8745  -4.035 6.74E-05 ***
CIDV          4.0216     1.2367   3.252  0.00126 **
CIHK          4.8968     1.2367    3.96 9.15E-05 ***
CIHF          3.9063     1.2367   3.159  0.00173 **
CILV          4.9422     1.2367   3.996 7.89E-05 ***
CILB          3.0186     1.2367   2.441  0.01516 *
CILO          1.8854     1.2367   1.525  0.12829
CIPN          3.1064     1.2367   2.512  0.01247 *
CISA          3.3179     1.2367   2.683  0.00766 **
CISH          3.0824     1.2367   2.492  0.01316 *
---


Residual standard error: 0.1348 on 340 degrees of freedom
Multiple R-squared: 0.9004, Adjusted R-squared: 0.8948
F-statistic: 161.7 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
> summary(JCP2_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.70605  -0.05342   0.02474   0.07302   0.28821

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  11.3971     1.8718   6.089 3.07E-09 ***
DV           -9.1136     2.6472  -3.443 0.000648 ***
HK          -12.2114     2.6472  -4.613 5.63E-06 ***
HF           -9.0178     2.6472  -3.407 0.000737 ***
LV          -11.6118     2.6472  -4.386  1.54E-05 ***
LB           -7.4751     2.6472  -2.824 0.005026 **
LO           -4.5279     2.6472   -1.71 0.088092 .
PN           -8.1295     2.6472  -3.071 0.002305 **
SA           -7.8407     2.6472  -2.962 0.003273 **
SH           -8.3871     2.6472  -3.168 0.001672 **
CI           -3.7253     0.8627  -4.318  2.07E-05 ***
CIDV          4.2092     1.2201    3.45 0.000631 ***
CIHK          5.2423     1.2201   4.297  2.27E-05 ***
CIHF          4.2367     1.2201   3.472 0.000582 ***
CILV          5.1988     1.2201   4.261  2.64E-05 ***
CILB          3.2863     1.2201   2.694 0.007421 **
CILO          2.1117     1.2201   1.731 0.084394 .
CIPN          3.3055     1.2201   2.709 0.007086 **
CISA          3.5175     1.2201   2.883  0.00419 **
CISH           3.488     1.2201   2.859 0.004515 **
---


Residual standard error: 0.1343 on 340 degrees of freedom
Multiple R-squared: 0.9012,  Adjusted R-squared:  0.8957
F-statistic: 163.3 on 19 and 340 DF,  p-value: < 2.20E-16
```

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```
> summary(JCP3_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.70919  -0.05688   0.02534   0.07296   0.27772

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  11.8201     1.8563   6.368 6.22E-10 ***
DV           -9.4656     2.6251  -3.606 0.000358 ***
HK          -12.8718     2.6251  -4.903 1.46E-06 ***
HF           -9.7729     2.6251  -3.723 0.000231 ***
LV          -12.1538     2.6251   -4.63 5.22E-06 ***
LB           -8.0397     2.6251  -3.063 0.002369 **
LO           -4.9821     2.6251  -1.898 0.058562 .
PN           -8.2877     2.6251  -3.157 0.001736 **
SA            -8.192     2.6251  -3.121 0.001959 **
SH           -9.1316     2.6251  -3.479  0.00057 ***
CI           -3.9217     0.8559  -4.582 6.47E-06 ***
CIDV           4.373     1.2104   3.613 0.000348 ***
CIHK          5.5487     1.2104   4.584 6.41E-06 ***
CIHF          4.5864     1.2104   3.789 0.000179 ***
CILV          5.4505     1.2104   4.503 9.21E-06 ***
CILB          3.5479     1.2104   2.931 0.003604 **
CILO           2.322     1.2104   1.918    0.0559 .
CIPN          3.3796     1.2104   2.792 0.005531 **
CISA          3.6808     1.2104   3.041 0.002541 **
CISH          3.8326     1.2104   3.166 0.001683 **
---


Residual standard error: 0.1336 on 340 degrees of freedom
Multiple R-squared: 0.9021,  Adjusted R-squared:  0.8967
F-statistic:   165 on 19 and 340 DF,  p-value: < 2.20E-16
```

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```
> summary(JCP4_lm)

Residuals:
      Min        1Q    Median        3Q       Max
-0.71127  -0.05489   0.02546   0.07281   0.27665

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  12.1265      1.847   6.565 1.94E-10 ***
DV           -9.6081     2.6121  -3.678 0.000273 ***
HK          -13.2503     2.6121  -5.073 6.46E-07 ***
HF          -10.2777     2.6121  -3.935 0.000101 ***
LV          -12.1572     2.6121  -4.654 4.67E-06 ***
LB           -8.4394     2.6121  -3.231 0.001355 **
LO            -5.32     2.6121  -2.037 0.042458 *
PN           -8.2116     2.6121  -3.144 0.001815 **
SA           -8.3903     2.6121  -3.212 0.001444 **
SH           -9.7748     2.6121  -3.742 0.000214 ***
CI           -4.0644     0.8519  -4.771 2.73E-06 ***
CIDV          4.4403     1.2048   3.686 0.000266 ***
CIHK          5.7252     1.2048   4.752 2.98E-06 ***
CIHF          4.8209     1.2048   4.001 7.73E-05 ***
CILV           5.454     1.2048   4.527 8.29E-06 ***
CILB          3.7335     1.2048   3.099 0.002104 **
CILO          2.4786     1.2048   2.057  0.04042 *
CIPN          3.3457     1.2048   2.777  0.00579 **
CISA          3.7735     1.2048   3.132 0.001887 **
CISH          4.1306     1.2048   3.428 0.000682 ***
---

Residual standard error: 0.1333 on 340 degrees of freedom
Multiple R-squared: 0.9026, Adjusted R-squared: 0.8972
F-statistic: 165.9 on 19 and 340 DF, p-value: < 2.20E-16
```

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```
>            summary(JCP5_lm)

Residuals:
             Min        1Q         Median     3Q         Max
  -0.70722   -0.05639   0.0243     0.07442    0.2836

Coefficients:
             Estimate   Std.       Error      t          value      Pr(>|t|)
(Intercept)  12.2387    1.8507     6.613      1.46E-10   ***
DV           -9.637     2.6174     -3.682     0.000269   ***
HK           -13.4793   2.6174     -5.15      4.42E-07   ***
HF           -10.5671   2.6174     -4.037     6.68E-05   ***
LV           -12.0713   2.6174     -4.612     5.65E-06   ***
LB           -8.6068    2.6174     -3.288     0.001113   **
LO           -5.6289    2.6174     -2.151     0.03221    *
PN           -7.7366    2.6174     -2.956     0.003336   **
SA           -8.4415    2.6174     -3.225     0.001381   **
SH           -10.2494   2.6174     -3.916     0.000109   ***
CI           -4.1177    0.8539     -4.822     2.15E-06   ***
CIDV         4.4553     1.2077     3.689      0.000262   ***
CIHK         5.833      1.2077     4.83       2.07E-06   ***
CIHF         4.9563     1.2077     4.104      5.09E-05   ***
CILV         5.4164     1.2077     4.485      9.98E-06   ***
CILB         3.8122     1.2077     3.157      0.001739   **
CILO         2.6221     1.2077     2.171      0.030605   *
CIPN         3.1277     1.2077     2.59       0.010012   *
CISA         3.7985     1.2077     3.145      0.001805   **
CISH         4.3511     1.2077     3.603      0.000362   ***
---

Residual     standard   error:     0.1332     on         340        degrees    of         freedom
Multiple     R-squared: 0.9028,    Adjusted   R-squared: 0.8974
F-statistic: 166.3      on         19         and        340        DF,        p-value:   <          2.20E-16
```

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```
>           summary(JCP6_lm)

Residuals:
            Min        1Q         Median     3Q         Max
  -0.70455  -0.05496      0.021   0.07582    0.28846

Coefficients:
            Estimate   Std.       Error      t          value      Pr(>|t|)
(Intercept)  12.3874     1.8596      6.661   1.09E-10 ***
DV           -9.6899     2.6298     -3.685   0.000266 ***
HK          -13.5743     2.6298     -5.162   4.17E-07 ***
HF          -10.9672     2.6298      -4.17   3.87E-05 ***
LV          -11.8827     2.6298     -4.518   8.61E-06 ***
LB           -8.8697     2.6298     -3.373    0.00083 ***
LO           -6.0129     2.6298     -2.286   0.022845 *
PN            -7.562     2.6298     -2.875   0.004289 **
SA           -8.5058     2.6298     -3.234   0.001339 **
SH          -10.5044     2.6298     -3.994   7.96E-05 ***
CI           -4.1875     0.8583     -4.879   1.64E-06 ***
CIDV          4.4809     1.2138      3.692   0.000259 ***
CIHK          5.8785     1.2138      4.843   1.94E-06 ***
CIHF          5.1423     1.2138      4.237   2.92E-05 ***
CILV          5.3309     1.2138      4.392   1.50E-05 ***
CILB          3.9346     1.2138      3.242   0.001306 **
CILO          2.8001     1.2138      2.307   0.021659 *
CIPN          3.0481     1.2138      2.511   0.012493 *
CISA          3.8293     1.2138      3.155   0.001749 **
CISH          4.4701     1.2138      3.683   0.000268 ***
---

Residual    standard   error:        0.1332 on            340 degrees   of         freedom
Multiple    R-squared: 0.9029,   Adjusted   R-squared:   0.8974
F-statistic:      166.3 on              19 and            340 DF,       p-value:   <            2.20E-16
```

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