Pedestrian flow and standard consumers; can they predict retail rents?

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Preface

This thesis is the result of my graduation research at the Technical University of Eindhoven, faculty of building technology, in the master Real Estate Management and Development. With this my study on pedestrian flows, standard consumer and rent prices comes to an end. Ten months ago this topic caught my attention by visiting DTZ Zadelhoff, the company who asked me to do this research. The influence of human behavior on real estate is something that has always been an interesting topic to me and therefore this was a chance I had to take.

I learned a lot during this graduation process. Not only how to write a thesis or trying to improve my English, also my traineeship at DTZ and going through this process by myself was something I learned from. Naturally, a graduation process means ups and downs and managing this was a challenge.

This management is something I could not have done without the help of my mentors at the Technical University of Eindhoven and DTZ Zadelhoff, family and friends. I would like to thank Gordon Brown and Rianne Appel-Meulenbroek of the Technical University of Eindhoven for their support and for providing me with the information needed during this study. Also, I’d like to thank Karen Strijker from DTZ Zadelhoff for her support, guidance and all provided data. Karen was a great mentor. Last, I’d like to thank all my family and friends for mental support and good advice.

Amsterdam, march 2008.

Lotti Jannink
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Summary

It has been acknowledged that the real estate market is professionalizing and that players on the market ask for information more often and need higher quality data (Laning, 2007). They seem to base their decisions on information as detailed as possible, which is not always that easy in the real estate market. Investigating the retail real estate market could give better insight in this market and new opportunities to respond to or influence it. The assumption exists that in the retail real estate market there is a relation between retail rent prices and the size of pedestrian flows and the amount of standard consumers. Factors influencing rent can be divided into three levels, namely macro (national), meso (regional) and micro (local) level. Standard consumers act on meso level. Pedestrian flows act on micro level, their behavior is influenced by spatial configuration and for example the branch mix of a shopping district.

After a literature review, the influence of pedestrian flow and standard consumer on rent is investigated by a statistical analysis. Then, the standard consumer will be further examined by an attempt to predict standard consumer for the future. Pedestrian flow will be further examined by the use of a spatial network analysis because spatial configuration is expected to have a big influence on pedestrian flow.

This leads to the following research questions:

1. What is pedestrian flow?
2. What is standard consumer?
3. What is rent?
4. What relation can be determined between pedestrian flow and rent?
5. What relation can be determined between the standard consumer and rent?
6. What is a spatial configuration?
7. What is spatial network analysis?
8. What influence does spatial configuration have on pedestrian flow and therefore on rent?

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Literature study shows that rent is mostly used in the Netherlands in three ways: market rent, actual rent and rental value. Usually market rent is meant, which is the current price a lessor can ask for its property. Actual rent is used regularly in stead of market rent because of rent protection. This is a characteristic of the Dutch real estate market that has a big influence on this market. It obstructs good insight in rent prices. By adapting rent prices every five years to comparables the forces of the market are impeded. The standard consumer is a theoretical consumer that buys all his product in one shopping district. It can give a very clear view on certain opportunities of an area because it indicates what region is responsible for what amount of sales. Also, the standard consumer can measure what shopping district is 'best' by calculating the number of standard consumer per square meter.

Pedestrian flows can be seen on two different levels. The size of pedestrian flow is important on meso level and influenced by the size of a catchment area and the size of market area. The behavior of pedestrian flow acts on micro level and is influenced by branch mix of a shopping district and spatial configuration. This spatial configuration is the space around you, the build environment, trees, water, etc. This spatial configuration can be analyzed by using a spatial network analysis. That is a way to represent, describe and evaluate spatial configurations or patterns created through building and urban design. (Brown, 1998)

Using an Analysis of Variance (ANOVA) the difference in rent prices for different groups of standard consumer and pedestrian flow is examined. Looking for a guideline to tell what retail rents will be based on the number of standard consumers or pedestrian flow, the statistical analysis was applied. Unfortunately, this approach of the influence of pedestrian flow and standard consumer on rent does not provide the useful tool hoped for. For the used ANOVA, the number of tested groups was not sufficient to provide a useful tool. Furthermore, the two variables pedestrian flow and standard consumer are of a different level. Where the most detailed level standard consumer can be used on meso level, pedestrian flow tells something on micro level. The statistical analyses shows that 15.8% of rent is explained by standard consumer and pedestrian flow together. This is not negligible and reason for further investigation of these variables.

The standard consumer is investigated further by exploring the possibilities of prediction. This attempt shows that prediction is possible and gives interesting possibilities such as the prediction of future rents. However, the input of this prediction, a demographic forecast and overview of projected developments, need to be improved to give a more adequate prediction.

By using a spatial network analysis the relation pedestrian flow-rent is examined further. Conducting a spatial network analysis for the Eggert center in Purmerend, the spatial network analysis resulted in some useful conclusions. Comparing pedestrian flow and rent in the Eggert center, supported by access complexity measures, showed a clear relation. Complexity measures show how hard it is to move through a shopping center by indicating its complexity.
The expectation of conducting a spatial network analysis on other shopping districts is that it can generate a general relation between pedestrian flow and rent on national level. However, the Eggert case also shows that there will be exceptions on this. Those exceptions can be categorized as general exceptions and unit specific exceptions. The first can be found in every shopping district. For example; anchor stores and high profile location have a different pedestrian flow-rent relation. The second type is unit specific exceptions that are due to characteristics of one single unit. Unit specific characteristics such as shape or form of the contract can influence the rent price of a unit.

Part of the spatial network analysis is access complexity measures that help identify the relation between pedestrian flow and rent. Because access complexity measures decompose those two variables more, it gives good insight in the relation. For example, in the Eggert center case, complexity measures helped giving an explanation for the fact that an entrance was not capable of attracting pedestrians from the passage across the street.

It can be stated that the Eggert case confirms that conducting a spatial network analysis is very useful in identifying the relation between pedestrian flow and rent. It visually shows a clear relation by matching colors. Spatial network analyses certainly contribute to a more adequate anticipation on problematic (spatial) situations in shopping centers.

Despite the fact that a lot of interesting information was showed in this study, the research goal has not been reached in the way it was supposed to. The study showed the qualitative relations pedestrian flow-rent and standard consumer-rent. The qualitative relation, however, could not be determined in detail. Although, the study does give a rough indication and does provide developers, investors, valuators, etcetera, a guideline to use. This study shows players on the market that although a quantitative relation between pedestrian flow and rent is still hard to define, a more qualitative relation is all the more important. Spatial network analysis provides important information that might help developers to optimize their designs. For investors, information on the quality of a shopping district can stimulate the decision making process when and where to invest. The case study on the Eggert center shows how valuators can benefit from a spatial network analysis to refine the valuation process. More information on a valuated property gives valuators more certainty in their valuation.

Recommendations for further investigation are refining the applied ANOVA such that more groups can be used. Testing the variables separately will give better insight in the two. If the goal of the research is to achieve the highest explanation of rent by using influencing factors, it is best to use as many factors as possible (Haringsma, 2002). Then, the number of tested variables has to be increased. Further research might find an optimum in what, and how many, variables to use to determine rent prices well.

As for the spatial network analysis, the research is only based on one case. Big improvement would be doing this on a larger scale to determine the general relation between pedestrian flow and rent.
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Also, comparing the spatial network with more social parameters, such as vacancies or crime levels, might give more opportunities.

Last point is that this research aimed at (A locations in) main shopping district in the Netherlands. This was done to make sure that as many influencing factors that are not investigated are eliminated as possible. Because finding consistent relationships between the investigated variables was difficult, this delineation should be preserved. After more insight in these relations is gained, the research can be extended by using other boundary conditions.
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Chapter 1 Introduction

1.1 Motivation

It has been acknowledged that the real estate market is professionalizing and that players on the market ask for information more often and need higher quality data (Laning, 2007). Players prefer to base their decisions on information as detailed as possible, which is not always that easy in the real estate market. Due to intransparency of the real estate market, detailed information is not always available. Investigating the retail real estate market could give better insight in this market and new opportunities to respond to or influence it. The assumption exists that in the retail real estate market there is a relation between retail rent prices and the size of pedestrian flows and the amount of standard consumers (Figure 1).

The relation between pedestrian flow and rent has been confirmed several times. Bolt (2005) writes about pedestrian flows in city centres and says that the main reason for an entrepreneur to establish on a specific location is the size of the pedestrian flow, as more pedestrians generate more turnover. In a research about factors influencing rent in main shopping districts, Bolt (2004) identifies a positive relation between a flow-index and the average rents per m². He compares rent mutations of 850 retail units in main shopping districts, with the amount of pedestrians in front of the unit and its width, depth and surface. The amount of pedestrians is hereby expressed in an index where 100 is the most crowded point in a shopping district. He finds a strong positive correlation between rent per m² and log Y of the pedestrian index of 0.75¹. In a research by Cushman & Wakefield Haley & Baker (Bakker, 2002), regarding average rent prices and pedestrian counts in 50 different main streets spread over the Netherlands, Bakker states that every pedestrian has to spend 2 eurocent to make sure an entrepreneur can pay his annual rent.

One can see that these studies all investigate the influence of pedestrian flow. It might be obvious that the more pedestrians there are the more purchases will be done, the more an entrepreneur can pay on rents. But looking closer at those pedestrians, gives the insight that not all those pedestrians purchase something when visiting a shopping district. Therefore, there is no direct

¹ Correlation coefficients always lie in a range from -1 to +1.
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relationship between pedestrians and rent prices. Bolt (2005) argues on this matter, in an article about the use and criticizing of main shopping districts, that to find out more about the actual behavior of the pedestrian flow, one should ask every pedestrian what amount of money they spent during their shopping time.

Rent can be paid by generating sales and the people that originally generate sales are the buyers in a shop. Buyers are the result of a stream of shoppers entering a shop, looking at all the merchandise, deciding if and what to buy. Those shoppers are, on its turn, generated from the pedestrian flow walking by a shop. This is visualized in Figure 2 where pedestrians, shoppers and buyers are presented in a funnel shape scheme.

Unlike several other countries, the Dutch retail market has no access to revenue figures. Since there are no data on how much money is spent per buyer, or on how many buyers there are per group of pedestrians in a certain shopping district, at least not on a large enough scale, one should look at data on shoppers. However, the amount of shoppers is also not known. There might be some shop owners who counted the amount of shoppers coming into their store but there is no database or other information regarding this on a scale that is large enough. This leads to the pedestrians, which is the only level in the funnel on which data are available.

This leads to the conclusion that to get better insight in the relation between pedestrians and rent one has to focus on the pedestrians, without further differentiation.

Focusing on the relation between pedestrian flow and rent also involves looking at the factors that generate and influence this pedestrian flow. Demand generates pedestrian flow. When do people go to a shop? When they desire or want something. And when they go to a shop they become part of the pedestrian flow. An important aspect influencing pedestrian flow is the spatial configuration of a shopping district. Changes in spatial configuration influence the behavior of people and thus the behavior of a pedestrian flow. Haringsma and Ter Sluis (2003) state that a good flow of pedestrians in a shopping centre contributes to an optimal use of space and indirectly contributes to the letting potential. Hillier et al. (1993, in Boisvert 2005) say that the urban grid is the main generator of pedestrian movement insofar as activities, especially activities as retailing, settle at locations according to the natural movement that originates from the street configuration. But, is spatial configuration really a generator? Spatial configuration is not able to create pedestrian movement. It can only lead, modify or otherwise influence a pedestrian flow. Before the spatial configuration can do something with the pedestrian flow, pedestrians first have to enter the spatial configuration concerned. So, spatial configuration distributes pedestrian flow. This is shown in Figure 5 by the using the factor pedestrian flow box two times; one representing pedestrian flow entering the spatial configuration and
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determining the size of pedestrian flow, and one representing the behavior of pedestrian flow
influenced by the spatial configuration. All together, to get a good understanding about pedestrian
flow, spatial configuration should be investigated, too.

A tool to investigate the spatial configuration and its relation with pedestrian flow is a Spatial Network
Analysis. This is a way to represent, describe and evaluate spatial configuration or patterns created
through building and urban design. It can transform the spatial configuration into a mathematical
network which can be analyzed and compare different characteristics of the spatial configuration with
each other (Brown, 1998). Spatial configuration exists on different levels. Figure 4 shows three different
levels of spatial configuration. The left picture shows cities interconnected by flight routes. This is on
the scale of a whole continent. A network of streets is shown in the middle picture.

Figure 4. Spatial configuration on different levels.

Here, spatial configuration is considered on city level. The right picture shows spatial configuration on
a much more detailed level, namely the map of an office floor. Because this thesis is based on the
situation in the Netherlands, the national level is the highest level here. This level is called the macro
level. Two more levels are considered here, namely meso and micro level. Meso level is the level of a
shopping district, micro level that of a shop. This thesis will explore which possibilities of spatial
network analysis can improve the knowledge regarding the relation between pedestrian flow and rent
in retail real estate. Because pedestrian flows involve movement of people on the level of a shopping
district, the spatial network analysis in this thesis will take place on meso level. The terms macro,
meso and micro will be explained in more detail later on.

The paragraphs above discussed the influence of pedestrian flow on rent and the factors influencing
pedestrian flow on its turn. Earlier, the assumption was uttered that standard consumer also influences
rent. In fact, there are many factors influencing rent and a lot of studies focusing on those. Haringsma
(2002) categorizes those factors on macro, meso and micro level. Paragraph 2.2.2 will discuss this
further. Standard consumer is a relatively new term developed by Locatus. There hasn’t been any
research regarding this term so it is interesting to see what this can contribute to the understanding of
rent. The standard consumer is a theoretical consumer that buys all his products in one shopping
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district. So, one standard consumer in a shopping district also stands for one person, but one that buys everything in that shopping district. Just as pedestrian flow, standard consumer is a demand term. The term standard consumer still needs some more explanation; this will be done in chapter 2.

Figure 5 combines the different factors and relations that were described above in one scheme. All elements are part of the retail real estate market.

Starting on the right side of the scheme with rent, one can see the different factors influencing rent. Two of them are sales and standard consumer. Since sales will be replaced by pedestrian flow, as explained and can be seen a little more to the left, the relation with pedestrian flow will be further investigated. Left from the factor pedestrian flow can be seen that this again is influenced by different factors. This thesis will focus on spatial configuration. The green box represents the tool spatial network analysis. It is important to say that this is a tool. It can be used to analyze factors it is embracing. Some factors can not be analyzed by a spatial network analysis, or need to be analyzed on a different scale. Because different scales exist in the spatial network (world, country, town, etc.), these analyses can be used on different scales. There are no techniques to connect these scale transitions and therefore it can not be treated in the same analysis. The research questions can be extracted from this figure, which will be discussed in paragraph 1.2.

![Figure 5. Placing factors and relations in context](image-url)
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As was discussed in this paragraph, there is still much to discover about the relation between pedestrian flow, standard consumer and rent. Exposing these relations will improve the way investors, valuators, developers and other parties concerned can say something about the current situation in the real estate market. This thesis aims to strengthen the ways of analyzing retail and therefore getting more grip on how rents are established.

1.2 Problem statement

The problem statement for this thesis is:

What are the relations between pedestrian flow, number of standard consumers and retail rents in a main shopping district and how can Spatial Network Analysis contribute to this?

The problem statement is divided into several research questions. Firstly, the relations between pedestrian flow, standard consumer and rent are investigated. The research questions, belonging to this first part, are:

[1] What is pedestrian flow?
[2] What is a standard consumer?
[3] What is rent?
[4] What relation can be determined between pedestrian flow and rent?
[5] What relation can be determined between the standard consumer and rent?

Secondly, the factor pedestrian flow is investigated by using Spatial Network Analysis. The research questions underlying this part of the thesis are:

[6] What is a spatial configuration?
[7] What is spatial network analysis?
[8] What influence does spatial configuration have on pedestrian flow and therefore on rent?

A visualization of the problem statement can be seen in Figure 6 in the form of a research model.
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1.3 Objective
Getting insight in the relations between pedestrian flow, number of standard consumers and retail rents in a main shopping district, to be able to predict these rents for the future and to get insight in how Spatial Network Analyses can contribute to this.

1.4 Research outline
From the problem statement can be deducted that this thesis consists of two main parts; these parts must lead to the answers to the research questions. This paragraph will show how these questions will be answered by discussing the research outline of this thesis. While explaining the way this research is modeled, there will also be paid attention to the research methods used.

The first part of the thesis, the introduction chapter, is based on a literature review. By studying literature the context of the thesis has been made clear and delineation has taken place. This literature review leads to the research questions discussed above.

After the introduction, chapter 2 will discuss the definitions of factors which play an important role in this thesis. Through literature review, the following research questions will be answered:

[1] What is pedestrian flow?
[2] What is standard consumer?
[3] What is rent?
[6] What is spatial configuration?
[7] What is spatial network analysis?

It will be explained how these definitions are used in general and, if necessary, how they are used in this thesis.
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In chapter 3 the relationship between pedestrian flow and rent will be determined by means of a statistical analysis. The same applies to the relation between standard consumer and rent. This statistical analysis will show if a plain relationship between the variables exists. The next partial questions will be answered:

[4] What relation can be determined between pedestrian flow and rent?
[5] What relation can be determined between the standard consumer and rent?

This might ask for different statistical techniques. Which technique is used for answering these questions, will be discussed later on.

After all these relations are examined, they will be used to make a prediction of the future rent, also discussed in chapter 3.

Chapter 4 contains the implementation of a spatial network analysis. The relation between pedestrian flow and rent will be applied on a case study of the Eggert Centre in Purmerend. The opportunities this might bring for an improvement of the knowledge about retail real estate will occur. This chapter contains answers to the last research question:

[8] What influence does spatial configuration have on pedestrian flow and therefore on rent?

The last chapter, chapter 5, contains conclusions about the thesis as a whole and recommendations for further investigation.

1.4 Delineation

This research focuses on the Dutch real estate market as such. Every country has its own real estate market and so does The Netherlands. Furthermore, The Netherlands has an extraordinary way of determining retail rents. Retail rents are often based on a revision of the normal rent prices and are called rent revision rents. How it actually works will be explained later. Besides the framework of the Dutch market, this research will have a specific interest in Purmerend and its direct region. Purmerend will serve as a case study of the investigated relations and the theories which might occur from that.

As for the investigated shopping districts, this thesis has its focus on main shopping districts (Locatus, 2005) which are suitable for the data set. Shopping centers are suitable when pedestrian flow figures and rent prices of the units in the centre are available. In addition to this, these are all dedicated shopping districts. Other categories of shopping districts might be enlightened to give good terms of reference and to give notice to opportunities for improvement of this research.
Chapter 2 Aspects of the real estate market

2.1 Retail real estate market

2.1.1 Overview

This research investigates different factors (see chapter one) in the context of the Dutch real estate market. This market has certain characteristics of which an overview will be given below. Not only does the Dutch real estate market differ from markets in other countries, the real estate market also differs from other economic markets. The characteristics of the real estate market make it unique. The real estate market is an opaque market, comparison of prices can only take place when a property's characteristics and the real estate market are analyzed. Current rents and the length of tenancy agreements, rent review rents and salability affect the value of retail properties. (Ten Have, 2007).

According to Ten Have (2007), intransparency is not the only characteristic of the real estate market. There are four more, to wit immobility, delay in price reactions, lack of sovereign power by consumers and the emotional connection with property by the consumer. Immobility causes environment characteristics to be important factors in determining the value of real estate. An identical building can have a different value when located somewhere else. Delay in price reactions which are caused by the intransparency of the market leads to less predictability of the market. And the fact that the individual consumer has no influence on the market behavior (no sovereign power) makes the consumer totally dependent on the market. Larger investors and developers on the other hand, can certainly have a large impact on the market. The last characteristic of the real estate market is that pricing depends on the emotional value people attach to their property. If a consumer values the property highly, he or she will be prepared to pay more. In addition, the consumer is more willing to buy when the purchase is urgent. All these characteristics lead to a market that no individual can influence. Prices of real estate are very difficult to determine too.

On the whole, this makes that certain aspects of the real estate market are not very predictable. The delay in price reactions and intransparancy as mentioned above cause uncertainties in the real estate market. Uncertainties, risks, for developers who want to put their property on the market, for investors who want to invest safely, and for valuators who want to make a proper valuation of the property (Bolt, 2004). It obstructs accurate insight in rent prices, which is a very important aspect on the market. After all, rent prices determine the actual yield a property will generate. To improve the information on which the real estate market can base its decisions, more insight in rent prices is desirable.
2.1.2 Trends

Besides the characteristics of the real estate market, trends are also determining the real estate market. The Dutch real estate market had a positive year in 2007. Sales went up in comparison to the years before. This favourable position leads to a greater need for new or better shops on A-locations (DTZ, 2007). However, with rising parking costs and costs made to supply stores also increasing A-locations there are also negative arguments that decrease popularity of A-locations (www.realtrends.nl, 2007). But, since there are not many possibilities to expand the amount of shops on A-locations, there will still be enough demand and even scarceness will occur on these locations. Scarceness will lead to increase of rent prices.

2007 was a positive year, during which the average consumer did not cease to buy products. Consumer confidence and retail sales increased (Klaver and Enk, 2007). Especially the non-food sector profited of the positive economic conditions. Stores selling leisure products and products related to education or personal (health) care were taking first positions when it comes to turnover rates (DTZ, 2007). For developers, new developments involving sports or leisure are popular (Klaver and Enk, 2007). Because turnover rates have everything to do with pedestrian flow, as seen in chapter one, this is important when investigating the relation between pedestrian flow and rent. For the relation standard consumer-rent this might also be important because increase of turnover rates means increase of the turnover each individual standard consumer is responsible for. Products tend to be more expensive, which has its effect on the total turnover rates also. In the first three quarters of 2007, these increase of prices counted for forty per cent of the turnover growth of the retail markets (DTZ, 2007).

However, the buying of products via the internet is still increasing in popularity. Especially electronics such as TV's, mp3-players and telephones are bought online frequently (DTZ, 2007). A second position is reserved for the buying of shoes and clothes via the companies' websites. Long waiting lines and crowds are thus being avoided. If this trend perseveres, it will have a large impact on the way stores are designed and the standards they have to meet. It could be argued that the location of a store at an A1 position is less important if many consumers buy their products on the internet. Nevertheless, retailers still wish to be located in A1 positions within shopping areas. They do not want to move to less expensive spots, which also shows from the trend that more retailers ask for A-locations (DTZ, 2007).

On the other hand, certain large companies, such as HEMA, do want to leave the expensive spots. HEMA decided to focus more on locations outside the central shopping area and wishes to open smaller shops in smaller towns. In addition, the bookstore Bruna intends to open up stores within housing areas. This company intents to become a more central part of peoples lives (DTZ, 2007). After all, reading is something you do mostly at home. (Or maybe also because internet is becoming a more central part of peoples lives?)
One of the newest trends is the so-called brand store. Brand stores are generally small stores that sell products of one brand. They combine the brand, the product and lifestyle related products. The store, which has thus a kind of central theme, focuses on the experience, rather than the actual buying process of the consumer (Klaver and Enk, 2007 and DTZ, 2007). Consumers are stimulated to buy products through real-life experience in the store itself. This way, consumers are forced to get away from their computer to buy their products. The trend of internet being more and more important can thus also be criticized. The importance of seeing, feeling or smelling a product before actually buying it, should not be underestimated. This experience-based decision process is one that the Internet will never be able to offer.

2.2 Rent

2.2.1 Different definitions of rent

When talking about rent, one usually means the *market rent*. Market rent is the current price a lessor can ask for its property. *Actual rent* is used regularly in stead of market rent because of rent protection which causes the effect that market rent often increases faster than the actual rent (Ten Have, 2003).

Rent protection is established by rent adjustment, an important character of the Dutch retail sector. In the Netherlands, when a tenancy agreement is closed, it covers 5 years including an option for 5 more years. Within these 10 years the lessor has only 2 legal reasons to dissolve the lease. The first reason involves the lessee not behaving properly. Second reason is when the lessor needs the property for personal use. If the lease is not dissolved, both the lessor and lessee have the right to ask for rent adjustment after the first 5 years. Rent adjustment means that the rent price is being revised before prolonging or renewing the contract. Rent revision rent is determined by comparing the rent of the retail property to that of 3 to 5 similar properties. Whether these comparables are representative is decided by the person determining the new rent price. The comparables indicate what the rent of the property should be. A new, reasonable, rent can be determined. This way rents will level with rents in comparable situations and will level out, causing that actual rents do not increase or decrease as hard as market rents. In Figure 7 this is illustrated for the situation where market rent is increasing.

![Figure 7. Rent revision rent.](image-url)
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Besides actual rent and market rent, some other terms regularly occur when talking about retail rent. *Rental value or fair market value* is the amount which would be paid for rental of similar property in the same condition in the same area (legal-explanations, 2007). So, the rental value is an estimated value based on other rents and market conditions indicating what the price of a real property should be. It is not the actual price paid for the property. When in this thesis the term *rent* is used, *actual rent* is meant. All rent prices used in this study are rent prices extracted from leases in the DTZ database.

### 2.2.2 Characteristics of rent

Characteristics of rent can be determined on different levels (Figure 9); to wit macro level, meso level and micro level (Haringsma, 2002). The macro level describes the characteristics of the shopping district the unit is in. These characteristics can be categorized into three groups of influential factors. The first influential factor is that of market area, which includes factors like number of inhabitants and size of the catchment area that belong to the shopping district concerned. The second is the supply component, which is composed of factors like anchor stores and age of the shopping district. Also belonging to this category is branch mix. That indicates the mix of different shops in a shopping district. Figure 8 gives an example of the branch mix in Purmerend. The third factor is the visitors' component, which contains pedestrian flows.

![Figure 8. Branch mix in Purmerend. (Locatus, 2007)](image-url)
Pedestrian flow and standard consumer; can they predict retail rents?

Not all factors have the same strength; the size of the catchment area, number of inhabitants, and size of the shopping district are of the biggest influence. When the bearing surface increases, the rents increase. The same applies for pedestrian flows.

On meso level quality of the location and size of the property are the most important influential factors.

Micro level is the most detailed level. Influential factors are the size and form of the unit and the branch. For instance, shops for clothing pay 20% more rent than average (Haringsma, 2002). This directly influences the proportion of income spent on rent.

This research will use actual rents, which are extracted from the DTZ Zadelhoff database. With these actual rents two influential factors are investigated; the pedestrian flow and standard consumer. The substantiation of this choice will be given in chapter 3.

Different studies have been conducted that regard retail rents. Those all try to give a limited list of factors that influence rent or focus on one of the factors that seems to be important. Bolt (2004) argues that rents are principally determined by the type of shopping centre a property is in, and the exact location within the centre, as well as the object specific characteristics. He tries to combine all factors that are of influence in one formula, to make the prediction of rents more accurate. However, he points out that even though the height of rent can be predicted by those factors on a rather reliable way, in every case corrections have to be applied for the specific situations. Every property has its specific characteristics such as the technical state of the specific shopping center, for which a correction on the rent has to be applied.

Haringsma (2002) investigated all factors that are likely to influence rent according to him in his research on department stores. As discussed before he divides those in three levels. Using a regression analysis, Haringsma concludes that all those factors taken into account can provide an accurate prediction of rent. The disadvantage of this method is that it is based on a certain amount of information, which has to be gathered before any prediction can be made. This is time consuming work. Also Koot (2007) did research on factors influencing rent. In a research on rent influencing factors in district shopping centers he divides the factors in the categories market, site, building and image, which is based on a research conducted by Mejia and Benjamin (2002). Koot concludes that very important consumer pulling factors are those on site level. He also states that those factors are difficult to measure. Besides that, factors on building and market level are also important. So, when
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looking at the research Haringsma and Koot conducted, they generally conclude the same. Factors influencing on the level of a shopping district are about as important as factors influencing within the shopping district and the building itself.

This research aims to add to these studies by taking a closer look at two factors influencing rent, namely the pedestrian flow and the standard consumer. Hereby, standard consumer is a factor influencing on meso level and pedestrian flow is a factor influencing on meso and micro level.

2.3 Standard consumer and its role in the real estate market

Before explaining the definition of standard consumer and discussing the role of the standard consumer in the real estate market, the term catchment area needs some more attention.

A catchment area is defined as an area of which the inhabitants are the market area concerning the shopping facilities (Keeris, 2003). The term ‘catchment area’ is not unambiguous and is used in different ways; one of them is explained here. Usually, the unit of measurement of a catchment area is its inhabitants. It can be subdivided into a primary and secondary catchment area, sometimes also a tertiary one. The primary catchment area is defined as the area which is responsible for 50% of the total turnover of a shopping area and the secondary catchment area is responsible for an additional 30%.

In this thesis the term ‘catchment area’ is used in combination with the standard consumer. However, a different unit of measurement defines the term catchment area, which is the standard consumer instead of the number of inhabitants.

The standard consumer is a standard for the functioning of a shopping district. The power of attraction in combination with the distance to this shopping district can be expressed in the standard consumer and be calculated for daily and non-daily goods. The standard consumer is defined by a person, which buys all his purchases in the same shopping facility (Bolt, 2003) The term standard consumer is defined by Locatus and therefore further information in this paragraph is based on information provided in the Locatus Verzorgingsgebieden Verkenner (Locatus, 2005). The exact calculation of standard consumer is classified information that will not be revealed here.

Consumers decide where to do their shopping on base of attractiveness of a shopping district and the distance to it. Bolt (2003) argues that difference in bonding with a shopping district lies within the size of a shopping district and the distance to it. Therefore, all shopping districts are indexed by the criteria of diversity of branch mix and size of the shopping district to determine the attractiveness for the calculation of standard consumers.
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Depending on the nature of the purchase, the distance consumers want to travel to buy something differs. The willingness to travel for a purchase is called the shopping horizon. It is clear that as soon as the distance to a shopping district increases, the willingness decreases.

![Image of shopping districts and consumer locations]

Figure 10. Chance a consumer buys in a shopping district. (Locatus, 2005)

Figure 11. Primary and secondary area. (Locatus, 2005)

With these data (distance and attractiveness), the chance that a consumer from a certain area purchases in a certain shopping district is calculated. This is done for every neighborhood in the Netherlands, which are 11,000 neighborhoods. If the total number of inhabitants of a catchment area is multiplied by the chance those inhabitants buy their purchases in that area (adhesion) the number of consumers that buy all their purchases in that area occurs. This fictive consumer is called the standard consumer.

An example; in Figure 10, the origin of the three arrows, the red dot, represents a person living in neighborhood 1. The chance that a person from that neighborhood buys his product in shopping center A, B or C is represented by the arrows. Table 1 shows these chances for neighborhood 1, and shopping center A. Multiplying the chance of buying by the number of inhabitants results in the number of standard consumer for that particular shopping district, from that particular neighborhood. (Locatus, 2007)

<table>
<thead>
<tr>
<th>Shopping center</th>
<th>Neighborhood</th>
<th>A</th>
<th>B</th>
<th># inhabitants</th>
<th># Standard consumer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20%</td>
<td>20%</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60%</td>
<td>60%</td>
<td>200</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75%</td>
<td>60%</td>
<td>400</td>
<td>300</td>
</tr>
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<td></td>
<td></td>
<td>50%</td>
<td>20%</td>
<td>1000</td>
<td>500</td>
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<td>50%</td>
<td>500</td>
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</tr>
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<td></td>
<td></td>
<td>20%</td>
<td>50%</td>
<td>500</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1. Calculation standard consumer. Locatus, 2007
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With these standard consumers a primary and secondary catchment area can be defined by allocating the standard consumer to the shopping districts (Figure 11). The primary catchment area is the area around a shopping district from where 50% of the standard consumers are allocated to that shopping district. A percentage of 80% applies to the secondary catchment area. This catchment area, with standard consumers as unit of measurement, tells what region is responsible for respectively 50% or 80% of the sales in a shopping district.

The reason that the standard consumer is brought into life is because this is a less static term than inhabitants. By changing the adhesion of a shopping district one can immediately influence the number of standard consumers in a shopping district. It is not possible to do this for inhabitants.

The standard consumer can give a very clear view on certain opportunities of an area. Functioning as a decision tool it can indicate where expanding opportunities are. Also, the standard consumer can measure what shopping district is 'best' by calculating the number of standard consumer per square meter. The more standard consumers, the more money is spent in a shopping district. If the relation between standard consumer and rent can be determined, the different rents can be compared. These reasons cause the intention to investigate the relation of standard consumer with rent. No research of this kind has been done before on this topic and it is possible that this relation gives more insight in how rent can be determined.

2.4 Pedestrian flow and its role the real estate market

Successful shopping facilities depend on the size of the pedestrian flow. The number of pedestrians passing by is the number one reason for an entrepreneur to establish somewhere. (Detailhandel magazine, 2004). As explained in chapter 1 pedestrian flow provides shoppers in a shopping district and those shoppers on their turn provide the shops buyers.

For years retailers wanted to have their shop on 'the best' location. This came down on the location where it was most crowded. The more people walk by, the more people incline on visiting the shop and buy something. So intense use of pedestrian passageways means a lot to retailers insofar pedestrian flows represent potential customer flows. For an entrepreneur, dimension of pedestrian flow is one of the most important reasons in the decision whether and where to settle on an A location. B locations differ in this, the quality of property is almost as important as the dimension of pedestrian flow. On B locations pedestrian flows are less important than on A locations (Bolt, 2005). While designing a shopping centre, station or public space, insight in pedestrian behavior is therefore necessary. To know the way pedestrians move and behave is essential to make a space 'work'. Therefore the factors that determine pedestrian behavior must be known and when possible controlled. (Daamen et. al, 2005)

According to Daamen et.al (2005) pedestrians behave the same in similar situations and can be seen in two different ways. Namely, the individual pedestrian and the pedestrian flow as a whole.
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The first approach involves treating pedestrians as individuals so their route through a shopping district can be tracked. The second approach where pedestrian flows are treated as a whole can only be used with large crowds. This approach is probably better in understanding the rules governing the overall behavior of these flows (Hughes, 2005). For this research, both approaches are important. Pedestrian flow as a whole, because this determines whether a shop is on an A or a B location or otherwise, and pedestrians as an individual because the individual eventually leads to rent.

Among others, the size of a pedestrian flow depends on the catchment area and the size of the shopping center. A larger catchment area supplies more inhabitants to a shopping district so the overall pedestrian flow will be bigger. A large shopping center attracts more consumers so that will also increase the overall pedestrian flow. These factors are different for every shopping district and therefore every shopping district has its own profile of pedestrian flows. The behavior of a pedestrian flow depends on the design of a shopping centre; the spatial configuration. Things that can influence the behavior of a pedestrian flow are anchor stores, width of a street or even a curb. This behavior can be studied using Spatial Network Analyses, something which will be explained later on.

So how are these pedestrian flows measured and can they be protracted?
A pedestrian flow is the number of passers by at a certain point in space. Depending on the company that provides the figures, the determination of pedestrian flow differs. The data used in this research is provided by Locatus and visualized by means of a GOAD. An example of a GOAD can be seen in Figure 12. Generally the method is counting pedestrians for a short period of time on an average day. These counts are corrected for time and day in such a way that a representative number for an average Saturday occurs. Locatus' pedestrian counts take place four Saturdays in a year. All employees of Locatus are gathered to count about 120 shopping districts. Herewith, several counting points are allocated to a shopping district. Each counting point is three times crewed for five minutes. Then, all pedestrians crossing an imaginary line drawn from that point on are counted. With a formula the pedestrian flow on an average Saturday is calculated using these counts.
2.5 Spatial Configuration and Spatial Network Analysis

The world around us consists of many parts that all together result in the spatial configuration. During the years important studies are conducted to create a better understanding of this spatial configuration. It plays an important role on different scales, from world, national, regional level to street and street sections level. Furthermore, it is important to realize that the concept of space is everywhere. Physics, astronomy, psychology, economics, they all have differing concepts of space. Thoughts about these concepts of space were already considered in the ancient Greece. (Brown, 2007)

Brown states: 'The everyday world in which we operate has the paradoxical quality of being suddenly visible when conditions and events are abnormal or exceptional yet virtually invisible in a normal state of affairs. Access is one of those phenomena that remains transparent, invisible or tacit until it is problematic. (.....) The problem of describing access is part of the larger problem of describing space.'

This problem of access comes forward in many studies on spatial configuration. Hillier and Vaughan (2007) describe the problem of integration and segregation. With integration-segregation the degree in which a city or part of a city is related to the whole is meant. An integrated section is one that has many links with the whole, easy to reach, a segregated section is one that is not. In Figure 12 an example is given of this regarding a building.
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The building exists of ten spaces linked with doors. Two graphs represent the integration of two rooms in the building, namely room 5 and 10. The shape of each graph shows the degree to which we must pass through other spaces to go from a particular space to all others. The shallow graph on the left means the space is integrated. The deep graph on the right means that space 10 is segregated in the building. (Hillier and Vaughan, 2007)

In somewhat the same way streets can be analyzed. Brown (2007), among others, uses lineal units or axial lines and convex units to analyze space, or in this case street patterns. Lineal units represent unbroken straight visual/walking lines; they relate to a person walking. Convex spaces, deformed circles that represent the largest unobstructed space within a 360° radius from a central point, relate to a person standing (Brown, 2007). 'A space is convex when any two of its points can be joined by a line that lies entirely within the space' (Peponis, et al., 1997). 'A spatial configuration can be described according to the pattern of convex spaces that it engenders and the connections between them'. 'A transition can be defined as a movement from one convex area to another.' The process of analyzing a street pattern is explained by using Figure 13, following the pictures from top to bottom and from left to right.
The street pattern on the left is first overlaid with lineal units so that there is one on each street as far as it extends. The number of links for each node are counted and indicated by a color code. Here, blue indicates nodes with the least number of links and red the most, which represents the strength of connection with other streets. To see, for example, the difference between location A and B, the same integration-segregation pattern can be made as done for the example of the building above. In this case that is done for 5th avenue.

The pattern of integration and segregation repeats itself within every level of the spatial configuration. Spatial patterns create movement flows, which means, that some locations in the pattern are naturally more movement-rich than others. (Hillier and Vaughan, 2007) This effect may be found at the area level, but will also be found at street level (one street busier than the other). And also on city level this phenomenon can be found; some cities function as main ports (Amsterdam, Rotterdam, etc.) while others don’t (Purmerend, Barendrecht, etc.). These differences in richness of movement also cause the fact that different activities and land uses are attracted to those spaces. Activities that benefit from movement, such as retail, will migrate to locations which are movement rich. Activities that benefit
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from movement poor places, such as domestic areas, will migrate to locations which are movement poor. (Hillier and Vaughan, 2007)

Here, it becomes clear why spatial network analyses can contribute to an optimization of retail areas. The richness of movement has everything to do with the retailers’ choice of location and the spatial configuration has everything to do with pedestrian movement. Looking at pedestrians on a detailed, local level, gives the insight that people always choose the way of less resistance and are influenced in their behavior by many and often seemingly unimportant things. They would rather take a shortcut crossing a green than walk on the pavement next to it, which is obviously made for them but is longer. If a space, for instance a shopping street, is bounded by a shopping window on one side and a solid brick wall on the other, people tend to walk near this window. If the same space is bounded by two solid brick walls, people tend to walk in the middle of this space. Why bother to take a closer look at that brick wall? (Underhill, 1999) (Figure 14)

Figure 14. Curiosity influences pedestrian behavior.

Some studies focused on the role of pedestrians in the spatial configuration. But not only this, they also focused on the role of spatial configuration regarding pedestrian flow. That there is a connection might be clear, but what does it look like and what aspects are part of it?

Techniques that try to give better insight in pedestrian flow, are techniques based on the assumption of a significant role of visual corridors on pedestrian flows (Hillier and Hanson, 1984 in Foltête and Plombini, 2007). Foltête and Plombini (2007) argue that landscape composition may also play a role. The role of visual corridors can be understood as the importance of the extent of view, in a quantitative meaning, it is justified by the psychological relationship of pedestrian to space. By taking into account only the visual corridors, spatial network analyses ignore the qualitative aspect of landscape, which is related to numerous visual features of streets. Foltête and Plombini assume in their research that the visual impact of urban features influences the pedestrian behavior. To find out the spatial preferences of walkers they investigated parameters on three levels. They are tested in relation to pedestrian frequency, with a stepwise regression testing the three levels of landscape variables. Here, the first level represents, among others, built form and vegetation. The second level breaks down the first.
Thus, vegetation includes green spaces, trees and so on. The last level applies only on the built forms and divides them according to their function (residential, commercial, etc.).

On the whole, the correlations between pedestrian frequency and the set of landscape variables are quite low. The research confirms the initial hypothesis according to which the configuration of the network is the main factor which influences the choices of pedestrian itineraries. Therefore, Spatial Network Analyses contribute to the modeling of pedestrian movements. Foltête and Piombini (2007) state that this is particularly through the calculation of integration indices. This integration index, as explained above, will be used in chapter 4 when conducting a Spatial Network Analysis. Besides the fact that the configuration of the spatial network is important, Foltête and Piombini conclude that some landscape preferences are also of significant influence on pedestrian behavior.

Recapitulating, spatial network analysis is a way to represent, describe and evaluate spatial configurations or patterns created through building and urban design (Brown, 1998). Making a mathematical network of a plan by using a spatial network analysis allows one to analyze such a plan. This is what this thesis intends to do. First, the relation between pedestrian flow, standard consumer and rent will be tested. After that, more insight in this on a local level will be given by using spatial network analysis.

2.6 Conclusion
When investigating the relation pedestrian flow-rent and standard consumer-rent, lots of influencing factors are involved. The current situation of the real estate market and its characteristics are the context in which the investigation takes place. Lack of knowledge regarding rent prices is one of the characteristics of this market and also an important motivation to do this research. Lack of knowledge causes risks and risks cost money. Hence, better insight in rent prices is something all players in the real estate market benefit. An important aspect of the Dutch real estate market that impedes market forces is that of rent revision rent. By adapting rent prices every five years to the rent of comparable properties good insight in rent prices is obstructed.

Important trends on the real estate market are a greater need for shops on A-locations and the growing interest of people for internet shopping. These two lead to the fact that A-locations are the most interesting to investigate, together with the fact that for A-locations pedestrian flows are more important than for B- or C-locations. The size of pedestrian flow in a shopping district is determined by the size of the catchment area of this district, together with the market area of the shopping district. The behavior of pedestrian flow is mainly influenced by spatial configuration (design of the shopping district) and branch mix. Besides looking at pedestrian flow, of which the relation with rent has been confirmed already, standard consumers are also investigated. Standard consumer is a relatively new term with new possibilities. An important character of standard consumer is that it is on meso level; shopping district level. All units in the shopping district have the same amount of standard consumer
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and therefore no statements can be given on a more detailed level than that. This difference with pedestrian flow must be kept in mind at all times.

Because spatial network analyses are expected to contribute to the knowledge on the relation pedestrian flow-rent, this will be used to examine this relation further. Spatial network analysis is a point of view not many players on the real estate market have (they are more focused on figures), therefore the expectation is that there is a lot to learn here.
Chapter 3 Relations between pedestrian flow, standard consumer and rent

3.1 Introduction

Before getting into a spatial network analysis to look at pedestrian flow more detailed and in a non-numeral way, a statistical analysis will take place. This will make clear if pedestrian flow and standard consumer are factors that are able to give accurate insight in rent prices can be given. Using pedestrian flow and standard consumer figures purely in a mathematical way for the prediction of rent, would give the real estate sector a good lead in the determination of retail rents. After all, people in the real estate sector are often more focused on figures than on visual aspects. They know how to handle figures very well.

Even years ago shop owners located their shops on places where many people passed by. City centers and especially corners in a center were favorite places to accommodate a new shop. Those corners guaranteed double front and more people walking by because the shop was located at more then one route. More people walking by apparently had a good influence on the shop (Bolt, 2003). This relation between the pedestrian flow and rent of a shop was investigated several times.

According to Bolt (2003) the market rent in retail is especially influenced by the center type and exact location in the shopping area. Adjacent to that the size of the shop matters, as do specific conditions of an object.

In a research by Cushman & Wakefield Healey & Baker (Bakker 2002) the relation between pedestrian flow and retail rents is investigated by using regression analyses. This research concludes that there is a positive relation between absolute rent in main shopping streets and pedestrian flow. Bakker even states that rents in main shopping streets can be calculated with the following formula:

\[
\text{Rent per m}^2 * 150 = \frac{\text{Pedestrian flow} \times x \times 50}{\text{Pedestrian flow}}
\]

Where:

- 150 = size of a standard retail unit
- 50 = amount of week in a year
- x = Saturday/week percentage
- Pedestrian flow = per average Saturday
- Rent per m² = per year
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This formula is based on the relation pedestrian flow - rent measured during several years between 1989 and 2000. The figures used are based on transaction data throughout these years, which means that they are not actual rent figures but rental value figures. This is not as precise as using rents. Bakker also concludes that rents are for approximately 50% explained by pedestrian flow, which he claims to be not very much. Other factors that determine rents are in this research responsible for the remaining 50%. One marginal note here, the research is carried out eight years ago and during time the investigated relation might have been changed.

As mentioned above, research on the relation between pedestrian flow and rent has been conducted before. But, to investigate the relation between pedestrian flow, standard consumer and rent and compare these two, the same dataset has to be used. This is one of the reasons that the relation between pedestrian flow and rent is investigated again. Another reason is that in this research data on actual rent prices are used instead of rental values, something that has not been done before. A third reason is that in the research on Spatial Network Analysis and its connection with pedestrian and indirect with its connection with rent is more consistent when the same data are used. Spatial Network Analysis is conducted with data that are extracted from the pedestrian flow data used in the statistical analysis.

The empirical analysis that is applied concerns the right part of the scheme which is shown in chapter 1. This figure represents the following research questions:

- What relation can be determined between pedestrian flow and rent?
- What relation can be determined between the standard consumer and rent?

Figure 15. Relations between pedestrian flow, standard consumer and rent.

The research unit for this scheme is a single retail unit in a main shopping district. These units are spread all over the Netherlands. However, even though main shopping district have the same characteristics overall, there is a chance the exact location of the district influences the relations mentioned. Thus, the influence of the geographical location of these units is also taken into account by measuring the influence of region on the relations between pedestrian flow and rent, and between standard consumer and rent. This alters the research scheme for this statistical research in the following way:
3.2 Gathering of data

To create a reliable dataset for comparing rents it is necessary that the context of the compared shops is as identical as possible. The context is identical when all features of the cases (compared shops) that might be able to influence rent are the same. There are many factors that influence retail rents as discussed in chapter 2. Here those factors where categorized into factors on macro, meso and micro level.

Factors on macro level, such as the size of catchment area in which the shopping centre is situated and number of inhabitants, are equalized by using a wide range of shopping districts. This wide range consists of 27 shopping districts spread over The Netherlands as can be seen in Figure 17.

According to Bolt (2003), there are more competitors for the better business locations within a shopping district when it concerns larger districts than when it concerns smaller districts. Because the supply of retail property is inelastic, given the limited space in inner cities, this competition is played by raising up the bid on rent prices. To eliminate the effect of the difference between larger shopping districts such as main shopping districts and smaller shopping districts like in a neighborhood, this research only concentrates on main shopping district properties.
Figure 17. Spread of main shopping districts in the Netherlands. (Locatus, 2007)
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Main shopping districts, for the greater part, all have similar characteristics on meso level. A main shopping district is always the largest in a city or town and has 100-400 shops (Locatus, 2006). The branch mix in these main shopping districts is mainly focused on non-daily goods since they all have a regional function.

Nevertheless, important differences can be found between main shopping districts. Rent price levels of main shopping districts in the conurbation of Western Holland are higher than rent prices in the east of the Netherlands for instance. Where shops in the West of the country have rent prices in a range of 316 to 489 Euro/sqm/yr, shops in the North have rent prices in a range of 250 to 447 Euro (DTZ Zadelhoff, 2006). It is important that this component is taken into account when analyzing the data. Therefore, the variable ‘region’ is added to the dataset. This will make the compared data more homogeneous. Hence, instead of one heterogeneous group four more homogeneous groups occur. The Netherlands are therefore divided into four regions, namely North, East, South and West.

In Table 2 the Dutch provinces are distributed into the 4 regions according to the CBS (centraal bureau voor de statistiek) division of the four regions. Because these regions are taken into account, more precise conclusions can be made. However, this division is disputable. In the category West the province Zeeland is also categorized. But, where North Holland, South Holland and Utrecht are belonging to the conurbation of Western Holland, Zeeland is not. Rent prices in Zeeland are significantly lower than in the other provinces (DTZ Zadelhoff, 2006). This means that including Zeeland in region West can give a different outcome than excluding it.

<table>
<thead>
<tr>
<th>Region</th>
<th>Province</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>Groningen, Friesland, Drenthe</td>
</tr>
<tr>
<td>East</td>
<td>Overijssel, Gelderland, Flevoland</td>
</tr>
<tr>
<td>South</td>
<td>North Brabant, Limburg</td>
</tr>
<tr>
<td>West</td>
<td>North Holland, South Holland, Utrecht, Zeeland</td>
</tr>
</tbody>
</table>

Table 2. Division of Dutch provinces into four regions.

While larger shopping districts differ mainly in rent their prices, the competition within these shopping districts is about the best location. Companies from different branches compete for locations with the highest pedestrian flow. And because these companies raise their bid when scarcity occurs, the highest bidders compete for the busiest streets, meaning A-locations (Bolt, 2004). To equalize these differences, and this way minimize the differences between all cases on micro level, only properties on A-locations are taken into account in this research.

Factors on micro level influencing rent are, among others, the amount of stories and technical state (Haringsma, 2006). These characters relate to the property itself and determine the quality of the building. It is important that these characteristics, too, are the same for all used cases if possible.
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In this research only properties are used of which the letting area lies between 100m² and 200m² because this is a common property size for retail property and therefore the most interesting for this research (Letteboer, 2007). Here, only ground floors are included. When valuating a property, the size figure is always available, this way it can be easily checked if the property meets this restriction.

It is more difficult to measure the technical state of the property or if there are any characteristics in the property that can change the quality such as the presence of large columns or an unusual shape. This statistical research does not take into account these kinds of characteristics. This way, the statistical research is more useful for the figure-minded people in real estate who just want to know the simple relation between the two factors. When conducting the spatial network analysis in a later stadium of this research, these micro level factors will be taken into account.

The rent prices used in the statistical analysis are all indexed to 12-31-2007. When indexing rent prices the presumption is made that when the expiration date is elapsed a new contract is signed on this date against the same rent. Index percentages are based on figures of ROZ-IPD index 2007.

After creating a dataset which satisfies the restrictions mentioned above, a statistical analysis has taken place to determine a correlation between the variables.

3.3 Research Method

3.3.1 Testing of the dataset

Before testing if there is a relation between pedestrian flow, standard consumer and rent, taken into account the regions, the data itself has to be tested. This way a suitable statistical test can be chosen to examine the relations mentioned. Hence, every statistical test has its own assumptions regarding data.

Firstly, data have to be checked for normality (Norusis, 2000). This is done by making a histogram of each variable, which can be found in Appendix 1. Although the independent variables Standard consumer (Nday_StdCons) and Pedestrians are a random sample of a probably normally distributed population, the samples are not normally distributed. The independent variable Region can not be normally distributed because it's a nominal variable. The dependent variable rent (IndexedRI) is normally distributed, though. Secondly, the level of measurement must be determined to find the most suitable statistical test. Except for Region, all variables have an interval level of measurement; hence every possible number can be measured. The variable Region is, as said, a nominal variable; that consists of only four categories which are all labeled without ranking the different labels. Thirdly, the number of measurements has to be taken into account. Since we are dealing with three independent variables we accordingly have three measurements.
Pedestrian flow and standard consumer: can they predict retail rents?

In 'Basic statistical analysis' by Sprinthall (2006) a search tree is used to determine the correct test for an analysis of the data. This search tree can be found in Appendix II. Following the correct steps leads to the use of a Factorial Analysis of Variance, an ANOVA.

### 3.3.2 Relation pedestrian flow-rent and standard consumer-rent

In the ANOVA the dataset of pedestrian flow is named Ped_Anova2, the dataset of standard consumer is called Nday_StrCons_Anova2 (non-daily standard consumers) and rent is named IndexedRI (indexed rental income). The variable Region represents the region the case is in.

A Factorial ANOVA is an Analysis Of Variance that can handle more than one independent variable. With a Factorial ANOVA there can be tested if there is a difference in rents when looking at different levels of pedestrian flow, different levels of standard consumer and the region in which the object is situated. This differs from a more commonly used method, the regression analysis. A regression examines the relation between variables, an ANOVA the difference between groups within these variables. Because of the fact that the independent variables pedestrian flow and standard consumer are non-parametric (not normally distributed), an ANOVA had to be used. Regression analyses cannot be used for non-parametric data.

The data must satisfy three assumptions before an ANOVA can take place (Norusis, 2000). These assumptions are:

- **Independent random samples have been taken from each population.** There must be no relationship between the observations in the different groups and between the observations in the same group.
- **The populations where the samples are from are normal.** The ANOVA is not heavily dependent on the normality assumption. As long as the data (groups) are not extremely non-normal there is no need to worry.
- **The population variances are all equal.** If the number of cases in each of the groups is similar, the equality of variance assumption is not too important.

When using a standard Factorial Analysis of Variance, the three variables mentioned (pedestrian flow, standard consumer and rent) are treated equally and the influence of three main effects is measured, as well as three interaction factors. This means also the influence of the two main effects together is measured. When the variable Region is taken into account the same way the other independent variables pedestrians and standard consumers are, the effect of Region will also be visible in the other variables. Thus, the main effects of standard consumer and pedestrian flow are still expressed with some effect of region in it, and vice versa, because these are automatically linked. However, for this study it is desirable that the influence of Region is excluded from the other variables so a pure relation between pedestrian flow, standard consumer and rent occurs. This is done by considering Region as a covariate. A covariate eliminates the influence of itself in other variables and puts itself aside.
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This all leads to three hypotheses that are tested in paragraph 3.4, after testing it will be decided whether they should be rejected or not.

H0-1: Retail rents are the same for both levels of pedestrian flow
H0-2: Retail rents are the same for both levels of standard consumer
H0-3: The relationship between retail rents and pedestrian flow is the same for both levels of standard consumer

This paragraph discussed what test will be used and what leads to the three hypotheses mentioned above. In the next paragraphs there will be discussed how this is done and what can be concluded from these tests.

3.4 Statistical analysis on pedestrian flow and rent

To know what the influence of pedestrian flow is on rent and use convenient categories for the ANOVA, these flows are divided into two groups representing cases (properties) with a low pedestrian flow and cases with a high pedestrian flow. The highest pedestrian flow which occurs in the used dataset is 41,300. Therefore, a low pedestrian flow includes all cases with a flow between 0 and 22,500 per average Saturday and a high pedestrian flow includes all cases with a flow between 22,500 and higher. The same is done for standard consumer; because the highest number of standard consumers is 104,198, a division is made in cases with a low number of standard consumers, 0 - 55,000, and cases with a high number of standard consumers, 55,000 or higher. The variable region is divided into four different categories, namely North, East, South and West.

With the factorial ANOVA it was tested if the rents for a unit from the lower pedestrian flow group are the same for the lower standard consumer group as for the higher standard consumer group. The same is done for the higher pedestrian flow group, etc. The full outcome of the ANOVA can be found in appendix III.

Figure 19 shows the line plot of how the two variables work together. The fact that the two lines are not parallel suggests that there is an interaction between the variables Pedestrian flow (Ped_Anova2) and Standard consumer (NdayStadCons_Anova2). Otherwise, the effect of another group of standard consumer should not make any difference in rent, while the pedestrian flow increases or decreases. Once again, all the effects of Region are removed from these relations.
Pedestrian flow and standard consumer: can they predict retail rents?

Estimated Marginal Means of IndexedRI

If the interaction of the main effects is important enough to take into account, it can be seen in Figure 19. The interaction term Pedestrian flow*Standard Consumer has a significance of 0.078. H0-3, the null hypothesis that there is no interaction between the two variables does not have to be rejected.

Tests of Between-Subjects Effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>1.122E+010</td>
<td>4</td>
<td>2803915787</td>
<td>5.142</td>
<td>.001</td>
</tr>
<tr>
<td>Intercept</td>
<td>8990219825</td>
<td>1</td>
<td>8990219825</td>
<td>16.486</td>
<td>.000</td>
</tr>
<tr>
<td>Region</td>
<td>5274397626</td>
<td>1</td>
<td>5274397626</td>
<td>9.672</td>
<td>.002</td>
</tr>
<tr>
<td>Ped_Anova2</td>
<td>3483560420</td>
<td>1</td>
<td>3483560420</td>
<td>6.388</td>
<td>.013</td>
</tr>
<tr>
<td>NdayStdCons_Anova2</td>
<td>2704580001</td>
<td>1</td>
<td>2704580001</td>
<td>4.960</td>
<td>.028</td>
</tr>
<tr>
<td>Ped_Anova2 * NdayStdCons_Anova2</td>
<td>1720310565</td>
<td>1</td>
<td>1720310565</td>
<td>3.155</td>
<td>.078</td>
</tr>
<tr>
<td>Error</td>
<td>5.998E+010</td>
<td>110</td>
<td>545309860.5</td>
<td>545309860.5</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4.759E+011</td>
<td>115</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>7.120E+010</td>
<td>114</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .158 (Adjusted R Squared = .127)

Figure 19. Factorial ANOVA
The next step is to test the hypothesis about the main effects of pedestrian flow and standard consumer.

Starting with the variable pedestrian flow, it is seen that the significance level is 0.013. So, H0-1, the null hypothesis that retail rents are the same for both levels of pedestrian flow, has to be rejected. The same conclusion can be given for H0-2, it seems unlikely that retail rents are the same for both levels of standard consumers, due to the significance level of 0.028.

The number at the bottom of Figure 20, R squared, shows how much of the dependent variable is explained by the independent variables. R squared is 0.158 here, which means that 15.8% of the variable rent is explained by pedestrian flow and standard consumer.

From Figure 19 a scheme can be conducted which answers the question of how large rents will be, taking a random property in a random main shopping district. This scheme can be found in Table 3.

<table>
<thead>
<tr>
<th>Pedestrian flow</th>
<th>Standard consumer</th>
<th>Rent (€ rental income/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 22,500</td>
<td>0 – 55,000</td>
<td>55,000</td>
</tr>
<tr>
<td>&gt; 22,500</td>
<td>&gt; 55,000</td>
<td>57,000</td>
</tr>
</tbody>
</table>

Table 3. Rental income scheme.

To know what the rent of an random object should be, first look in the left column to check to which group of pedestrian flow the object belongs. Then, check the middle column to see to which group of standard consumer it belongs. Last, in the right column the guide number of rental income per year can be seen. There must be kept in mind that this is a guide number that gives only a feeling of what the rental income should approximately be.

So, the relation is there, it explains 15.8% of the variable rent, but the guideline is very rough. Examining the datasets of pedestrian flow and standard consumer showed non-parametric data, causing the fact that a factorial ANOVA had to be used. The ANOVA would be more useful, if pedestrian flow and standard consumer are divided in more groups. However, trying different types of categories did not lead to a significant test, meaning that no reliable conclusion could be made.

It can be stated that the statistical analysis does not give an adequate tool or guideline to say something specific on the relation pedestrian flow-rent nor on the relation standard consumer-rent. To give the real estate sector better insight in this relation both pedestrian flow and standard consumer are investigated further. First, the possibilities of standard consumer will be investigated further. By looking at its possibilities more some advantages might occur that are useful tools in the real estate sector. Second, a spatial network analysis will go into pedestrian flow deeper to see what possibilities can be found there.
Pedestrian flow and standard consumer; can they predict retail rents?

3.5 Forecast standard consumer

3.5.1 Introduction

Because the statistical analysis has an explaining ability of 15.8%, it pays off to take a closer look at the factors involved. In chapter 4, a spatial network analysis will take a much closer look at pedestrian flows. In this paragraph the advantage and possibility of standard consumer will be investigated. This possibility involves the predictability of the standard consumer. Predicting standard consumer could lead to a better understanding of the future rent, something many players on the real estate market would be interested in.

There are different factors, which are important to make a proper prediction of the future standard consumer and thereby the prediction of the future rent. In chapter 2 it was explained that the standard consumer is calculated by multiplying the number of inhabitants of a catchment area by the chance those inhabitants buy their products in that area (adhesion). The distance to a shopping district and the attractiveness, which is expressed in the dimension, calculates this chance. The distance is a fixed factor but the dimension of a shopping centre is not. So if this dimension can be predicted the future standard consumer can occur. To find out if it is possible to predict the standard consumer this exercise is done for Purmerend and its direct surrounding. To work with a case at first gives the opportunity to see if it might be possible to do this on national level; hence this is more complex than working regional.

The reason for doing a case based on Purmerend is that this town has a favorable geographical position in relation to other municipalities. The number and dimension of surrounding shopping districts is comprehensible and therefore favorable to be used as a case. Another reason is that all rent prices of this shopping district are known. This creates the opportunity to relate future standard consumer to rent prices, which can lead to a prediction of rent prices. As for the most predictions, future rent prices, or at least an indication of this, is very interesting and valuable information. Insight in future rent prices will be valuable to everyone working with rents. These can be investors, retailers, valuators, etc. For valuators future rent prices could give more accurate information about the behavior of a property in the future. Besides the length of a tenancy agreement, this will make the view on a properties future behavior more complete. A third reason for choosing Purmerend as case study is because within the shopping district of Purmerend there is an enclosed, dedicated shopping centre called ‘Eggert center’. This enclosed shopping centre is situated on an A-location and the units inside are partly labeled as A-location units. This shopping centre is an interesting research object for Spatial Network Analyses, which will be discussed in Chapter 4.

3.5.2 Prediction standard consumer

A standard consumer is calculated by using demographic figures and the amount of shops. If these two are known and you put the prediction in the same calculation model as you would normally do when calculating the amount of standard consumer, a prediction of the standard consumer occurs.
Pedestrian flow and standard consumer: can they predict retail rents?

The prediction of standard consumers is valid until the year 2010. This is only 2 years because projected developments are not to be predicted on a longer term. Reason for this is that new schemes in the pipeline are not known by developers when it comes to two years ahead. Soft plans might be there but they are not tangible enough to say anything accurate about the projected developments. Mostly, there will not be a specification of the exact amount of retail floor surface. And there will not be a specification of retail floor surface for daily and non-daily goods at all. This specification has to be a known fact to calculate a standard consumer when it is specified to daily standard consumer or non-daily standard consumer. Hence, the catchment area of daily goods is different from that of non-daily goods. For non-daily goods a shopping centre will be able to attract people from a larger distance than for daily goods.

The first step taken to accomplish this, is a forecast of the inhabitants of Purmerend and all towns within a radius of approximately 10 kilometers (6.21 miles). This distance is large enough to cover the catchment area of Purmerend so the influence on the standard consumer can be measured. This forecast can be seen in table 4 on district level. The complete forecast on neighborhood level can be found in Appendix IV. In some towns the number of inhabitants decreases, in others its stays quite stable. The only towns where a noteworthy increase of inhabitants can be seen are Purmerend and
Pedestrian flow and standard consumer; can they predict retail rents?

Wormerland with an increase of respectively 2685 and 828 inhabitants. The increase in Purmerend is caused by a new housing development in the Southwest of Purmerend. The growth in Wormerland is natural, figures are based on CBS (2007). Because the total amount of inhabitants in The Netherlands is equal to the total amount of standard consumers, an increase or decrease will also effect both the same way on national level. On regional level, let's say Purmerend and its surroundings, an increase or decrease of inhabitants does not automatically mean the same change in standard consumer.

When, for instance, a significant grow of the population in Den Helder is determined (see Figure 20) the number of standard consumers in the catchment area might not increase because inhabitants are belonging to a shopping district outside the catchment area.

The second step in this forecast is to make an overview of the projected developments in the region of Purmerend. This is done for all towns within a radius of approximately 15 kilometers (9.32 miles). This distance is somewhat larger because the fact that people might be willing to travel to other shopping districts if it is more attractive then one nearby, has to be taken into account. So if the influence of mutations in other shopping districts has to be measured (expressed in standard consumer) then the whole area which is able to influence has to be mapped. This case treats the effect of the projected developments and demographic forecast on every municipality within the given radius and every shown effect is only based on mutations within this radius of approximately 15 km. To find out what the projected developments are, the list compiled by NEPROM is used. NEPROM publishes a list of projected developments every year. It is compiled by asking all (important) developers what their development will be. Taking this list as a starting point, it is extended by field research. In every municipality it was carefully investigated if there where any projected developments. This included desk research and field checks.

The projected developments of Purmerend and its surroundings are almost 135,000 m² (Appendix V). This is 100,000 m² more then NEPROM expected it to be. This big difference indicates that it is very important to conduct detailed research in order to get reliable figures.

The exact calculation of future standard consumer has been done by Locatus. In the calculation model for standard consumer the predicted figures of inhabitants and total amount of retail floor space are used as input. A part of the output can be seen in Table 4. Here, the change in percentage of inhabitants and standard consumer is given. One can see that a prediction can be made on a very detailed level. Per shopping center, regardless of size a prediction of standard consumer tells how much sales every shopping district will have in the future. Better insight in future rent can be gained if the relation between standard consumer and rent is determined in more detail. The full version of table 4 can be found in appendix VI.
Pedestrian flow and standard consumer; can they predict retail rents?

<table>
<thead>
<tr>
<th>Town</th>
<th>Shopping district</th>
<th>Shopping district type</th>
<th>% inhabitants in 2010</th>
<th>% standard consumer in 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkmaar</td>
<td>Center Alkmaar</td>
<td>Inner city</td>
<td>100,8</td>
<td>97,3</td>
</tr>
<tr>
<td>Almere</td>
<td>Center Almere</td>
<td>Main shopping district</td>
<td>96,8</td>
<td>97,3</td>
</tr>
<tr>
<td>Amsterdam</td>
<td>Beethovenstraat</td>
<td>Urban district shopping center</td>
<td>94,1</td>
<td>94,0</td>
</tr>
<tr>
<td>Avenhorn</td>
<td>Vijverhof</td>
<td>Principal shopping center</td>
<td>90,7</td>
<td>86,7</td>
</tr>
</tbody>
</table>

Table 4. Prediction of standard consumer.

Critical remarks have to be made though. PropertyNL (2007) states that the projected developments differ significantly from the square meters actually built. The actually built surface is much larger then expected. This means that even though the calculation of future standard consumer is adequate, the outcome is not very reliable. The used data is not reliable enough to base a prediction on. This also is seen when comparing the m² projected developments provided by NEPROM and those predicted by own research. Furthermore, the prediction of inhabitants on neighborhood level is doable but very time consuming. However, doing this on systematical basis would make the prediction a lot easier.
## Table 5. Demographic forecast Purmerend. (Based on: CBS, 2007)

<table>
<thead>
<tr>
<th>Purmerend</th>
<th>Edam-Volendam</th>
<th>Waterland</th>
<th>Oostzaan</th>
<th>Landsmeer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wijk 01 Centrum</td>
<td>4194 4130</td>
<td>7490 7437</td>
<td>10040 10040</td>
<td>9200 9201</td>
</tr>
<tr>
<td>Wijk 02 Overwhere</td>
<td>13393 13623</td>
<td>110 110</td>
<td>230 230</td>
<td>1280 1280</td>
</tr>
<tr>
<td>Wijk 03 Wheermolen</td>
<td>7532 7219</td>
<td>21070 20954</td>
<td>1850 1850</td>
<td>13060 13888</td>
</tr>
<tr>
<td>Wijk 04 Gors</td>
<td>9323 9393</td>
<td>14797</td>
<td>1910 1910</td>
<td>9323 9393</td>
</tr>
<tr>
<td>Wijk 05 Purmer-Noord</td>
<td>15190 14737</td>
<td>13365</td>
<td>430 430</td>
<td>15190 14737</td>
</tr>
<tr>
<td>Wijk 06 Purmer-Zuid</td>
<td>14451 18177</td>
<td>2160 2160</td>
<td>430 430</td>
<td>14451 18177</td>
</tr>
<tr>
<td>Wijk 07 Wijdevanne</td>
<td>15800 16628</td>
<td>6560 6715</td>
<td>8520 8520</td>
<td>15800 16628</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wijdevanne</th>
<th>Graaf-De Rijp</th>
<th>Beemster</th>
<th>Zeevang</th>
<th>2007 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wijk 00 Wormer</td>
<td>13060 13888</td>
<td>4020 4020</td>
<td>6060 6334</td>
<td>560 560</td>
</tr>
<tr>
<td>Wijk 01 Wijdevorwer</td>
<td>1610 1610</td>
<td>2560 2583</td>
<td>2460 2460</td>
<td>3353 3578</td>
</tr>
<tr>
<td>Wijk 02 Jisp</td>
<td>1130 1150</td>
<td>710</td>
<td>770</td>
<td>770</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pedestrian flow and standard consumer; can they predict retail rents?

3.6 Conclusion
In the previous paragraphs a factorial ANOVA has been used to test three hypotheses. The answers to these hypotheses are:

H0-1: Retail rents are the same for both levels of pedestrian flow, is rejected.
H0-2: Retail rents are the same for both levels of standard consumer, is rejected.
H0-3: The relationship between retail rents and pedestrian flow is the same for both levels of standard consumer, is not rejected.

From this, a scheme to give direction to what the rental income of a shop should be is originated.

<table>
<thead>
<tr>
<th>Pedestrian flow</th>
<th>Standard consumer</th>
<th>Rent (€ rental income/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 22,500</td>
<td>0 – 55,000</td>
<td>55,000</td>
</tr>
<tr>
<td>&gt; 22,500</td>
<td>&gt; 55,000</td>
<td>57,000</td>
</tr>
<tr>
<td>&gt; 22,500</td>
<td>0 – 55,000</td>
<td>58,000</td>
</tr>
<tr>
<td>&gt; 22,500</td>
<td>&gt; 55,000</td>
<td>92,000</td>
</tr>
</tbody>
</table>

Table 6. Rental income scheme.

This scheme can be a tool to give an indication of what the rental income should be of a random unit in the Netherlands. The fact that the factor region is taken out of these relations makes the indication applicable on different regions. When using the scheme the outcome has to be adapted to the particular situation the unit is in, also for the location in the country. For this, rental income data could be used. They are available of the whole Netherlands and can give a good indication of how to adapt these rental incomes.

The scheme’s disadvantage is that it shows only four different groups, namely two groups of pedestrian flow and two groups of standard consumer. Although it explains 15,8% of rent, four groups is a very rough indication for the many different main shopping districts and the differentiations that exist within these shopping districts. This may be cause by the use of the variables standard consumer and rent are used within the same test, while they are actually both working on a different level. The 115 tested units are divided over only 27 main shopping districts. Hence, there are only 27 different levels of standard consumer possible in this test.

The prediction of standard consumer is useful to say something about future rents, by telling something about future sales. The prediction here shows that in theory it can be done. Even in practice there is a quite useful result. It certainly is a result that indicates that there is a future for this. More insight in projected developments and a systematical approach for demographic forecast on neighborhood level is necessary to accomplish this.

Based on this research, it can be stated that the factors standard consumer and pedestrian flow together do say something about rent, but not very much. However, the research implies that the
Pedestrian flow and standard consumer; can they predict retail rents?

relations mentioned are relevant. For pedestrian flow, this and the literature discussed earlier leads to the wish to investigate the relation pedestrian flow-rent further. Chapter 4 will investigate further the relation between pedestrian flow and rent, by means of a spatial network analysis.

As for standard consumer, the fact that there is a relation and that it has future potential, asks for further investigation, too. Partly this has been done in paragraph 3.5 by examining the possibilities to give a prediction of standard consumer.
Chapter 4 Case study: Purmerend, Willem Eggert

In the previous chapters the relation between pedestrian flow, standard consumer and rent has been investigated. Conclusion is that on different levels of pedestrian flow and standard consumer, different rent prices occur. In this chapter the reason why pedestrian flow influences rent prices is investigated specifically. This will be done on a local level by using a spatial network analysis. Only pedestrian flow will be subject to this research because standard consumer is on shopping district level. Besides that, standard consumers don't have the characteristics of a person (pedestrian), which seems to be important in this.

To find out how pedestrian flow influences rent, the same case will be used as with the prediction of standard consumer; Purmerend. This time there will be focused on the Eggert center in Purmerend. Knowing all rent prices is very important, as well as having as much other local information as possible.

4.1 Eggert center
More than 25 years ago the Eggert shopping centre was build in the inner centre of Purmerend. The town was a growth center at the time and shops were needed to fulfill the growing amount of inhabitants. The Eggert center nowadays has a primary catchment area of 7,949 inhabitants for daily goods and 57,440 for non-daily goods.

The Eggert center is situated in the center of Purmerend and is integrated with the other shops serving the 72,976 inhabitants.

Surrounded by three pedestrian roads and one road for motorized traffic, it is embedded in the inner, pedestrian, area of the centre. (Figure 21)

The Eggert Centre is an enclosed shopping centre, which has four entrances connecting the centre with outside. There is one entrance on the first floor connecting with the parking

Figure 21. Eggert center in situation.
Pedestrian flow and standard consumer; can they predict retail rents?

garage that is directly attached to the centre. Parking costs are €1,50 per hour. The eggert centre has 77 shops divided over 2 stories and has 400 parking places. The centre was built in 1979 and renovated in 2004, the 77 units have a total revenue of €19,500 per square meter GLA. There are several anchor stores such as Hema, V&D, C&A and Etos and also small tradesman. In Figure 22 an overview of the shops can be seen that shows the branch mix.

First impression when visiting the Eggert Shopping Centre was the low ceiling on both floors. Together with the facts that the center is quite dark, has many corners, alcoves and columns, it makes that the centre is outdated. The centre is neat, though. The range of shops is good, with anchor stores as HEMA and V&D and national retail chains on the ground floor and a mix of specialty stores and retail chains on the first floor. Material use is mixed, construction elements and floor are out of date but the main entrance and shop windows are most of the time modern. The overall impression is dark and not conveniently ordered.

Figure 22. Branch mix. (www.eggertwinkelcentrum.nl, 2007)

Figure 24. Main entrance Eggert center.

Figure 25. Secondary entrance Eggert center.

Figure 26. Corridor within Eggert center.

Figure 27. Escalator in Eggert center.
4.2 Spatial network analysis applied on the Eggert centre

All this background information is necessary to conduct a firm spatial network analysis is. Because pedestrians are influenced by sometimes rather detailed things it is important to gather as much information as possible. The analysis will generate new information, which might contribute to a better understanding of the relation pedestrian flow-rent. A spatial network analysis can be used to influence pedestrian flows by changing the configuration of a mall or taking it into account while designing it. But by comparing different analysis it can also be used to give a value judgement. Briefly explained in chapter 2, the method will be explained here in more detail and applied to the Eggert centre in Purmerend.

First step made, is making sure an accurate plan of the Eggert center is available. The Eggert center consists of two floors, of which the plans can be seen in Figure 30 and 31. A larger version can be found in appendix VII. The plans where field checked and adapted where needed.

The second step is applying a shape recognition process that decomposes the spatial configurations of the plans into a set of elementary shapes that function as units of analysis. These elementary shapes are convex units and lineal units. As can be read in chapter two, convex units are deformed circles that refer to a person standing. Lineal units are straight lines that refer to a person walking. Convex spaces are overlaid on a plan following a protocol that begins with the largest, fattest spaces ending with the smallest, thinnest until all space is filled (Brown, 1998 and Hillier, 1984). For this, field checking is also important. In the field check can be seen if the plan lacks things that influence the shape of convex spaces. However, besides the rule of the fattest and largest space first, there are no guidelines to follow. In the search for large spaces preserving fatness, the balance is difficult to find. (Peponis et al., 1997) Peponis et al. (1997) answer in their study on shape and configuration inside buildings two questions; is it possible to draw a minimum partition? And will this minimum partition be unique? Peponis et al. come up with a method to draw a minimum partition (which will not be discussed here) but ‘have not found a way to ensure that this partition is specified uniquely in all cases.’ They illustrate this using Figure 27 where the upper line represents four different floor plans, the middle line the minimum partition of convex spaces, and the lower line an alternative partition. This means that overlaying a map two times with convex units can result in two different convex maps.

Figure 27. Partition of convex spaces
Pedestrian flow and standard consumer; can they predict retail rents?

Keeping this in mind, the partition of the convex units in the Eggert center is done following the basic rule (largest and fattest spaces) and taking into account the following (appendix VIII shows the result).

In the Eggert center, lots of shops have put merchandise and signs outside their shop. It seems they do this quite randomly, although always near the entrance of the shop. This merchandise and signs mostly have wheels and are all removed when the shop closes. Therefore, these are not to be considered to affect the space. Also, quite a few columns have a waste bin attached to them, because of the size of the column in relation to the size of these, they are also not considered to be affecting the space.

![Figure 28. Waste bin attached to a column.](image)

![Figure 29. Temporary stuff, signs and merchandise.](image)

Some of the units have a too large entrance to bound the adjoining convex space. In these cases the convex space partly enters the shop where it is bounded by merchandise. Figures 30 and 31 show the maps of the Eggert center where the entrances and staircases are numbered in red. The staircases, number 1005, 1006 and 1007, are all representing one convex space, which connects the ground floor with the first floor. Thus, to get from the ground floor to the second floor one always has to cross one convex space (1005, 1006 or 1007). Numbers 1008 and 1009 are connected by stairs but they are functioning as an entrance (explanation will follow).

As for lineal units, the basic rule is to start with the longest lines coming in from each entrance in such a way that all convex spaces are crossed and no axial line is free standing (Brown, 1998). This is done for both floor in the Eggert center and can be seen in appendix IX. Again, there is no unique way to overlay lineal units so doing this again could give another outcome.
Pedestrian flow and standard consumer: can they predict retail rents?

Figure 30. Ground floor plan Eggert center.

Figure 31. First floor plan Eggert center.
Pedestrian flow and standard consumer; can they predict retail rents?

After that, all convex and lineal units are tagged and a network linking these shapes is set up. The tagging process simply means numbering every convex unit and lineal unit. Then, using the convex and lineal units as nodes, they are linked to a network. Here, convex nodes are linked when two convex spaces are adjacent. Lineal nodes are linked when two axial units cross.

This process can be seen in appendix XI for the convex units and in appendix XII for the lineal units. The analysis focuses on the Eggert center as a whole instead of analyzing the two floors separately. Four links connecting the first and the second floor make sure both floors work together, thus should be seen as one. In Figures 30 and 31 the entrances and connections between the two floors are numbered 1001 to 1009. Here, 1001 trough 1004, 1008 and 1009 have to be seen as entrances because they provide the center of new pedestrians. They increase or decrease the number of pedestrians within the center by functioning as a gate. 1005 trough 1007 are links between the ground floor and first floor, they only move people within the center and therefore do not change the total amount of pedestrians.

The networks which occur after tagging the units can be observed from different points of view. For convex units as well as for lineal units these different viewpoints are used to rearrange the networks schematically. The results of this can be found in appendix XIII. Here, the networks are drawn with every entrance considered to be the origin. With these networks, the complexity of an entrance can be determined, which indicates how complex the situation of an entrance is.

The last step, interpreting syntactic measures and relating appropriate non-spatial parameters like pedestrian movement or vacancy is done by first calculating the access complexity of the center. The access complexity is a number that gives an indication of how complex a center is. It is calculated by using the Weighted Average of the convex and lineal units. (Brown, 1998) The WA measure will indicate whether there are relatively more nodes close to or further from the origin. The closer the WA measure is to 1.0, the more nodes are close to the origin. The WA measures of the Eggert center can be seen in Table 7.

It shows that those measures are separate for convex units and lineal units. To judge the Eggert centre on how complex it is those two are combined in the access complexity calculations. The access complexity number expresses how hard it is for pedestrians to move through the center from a certain point on. For the Eggert center, this is done for every entrance. The complexity measures will be discussed in the next paragraph, the calculations can be found in appendix XIV.

<table>
<thead>
<tr>
<th>Weighted average</th>
<th>convex</th>
<th>lineal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001</td>
<td>9,93</td>
<td>5,28</td>
</tr>
<tr>
<td>1002</td>
<td>13,37</td>
<td>4,69</td>
</tr>
<tr>
<td>1003</td>
<td>13,43</td>
<td>6,13</td>
</tr>
<tr>
<td>1004</td>
<td>10,56</td>
<td>4,67</td>
</tr>
<tr>
<td>1008</td>
<td>12,88</td>
<td>5,59</td>
</tr>
<tr>
<td>1009</td>
<td>13,15</td>
<td>5,74</td>
</tr>
</tbody>
</table>

Table 7. Weighted Average for convex and lineal units in the Eggert center.
4.3 Interpretation of syntactic measures and its relation with non spatial parameters

Before getting into complexity measures right away, the relationship pedestrian flow-rent, without taking other factors into account will be discussed.

Figure 32 (next page) shows the rent prices and pedestrian flow drawn into a map of the Eggert center. The colors of the units symbolize the height of rent of that unit, categorized. Exact rent figures are printed in the middle of the units (upper figure). Figures about rent are extracted from the DTZ database (2007). The strip following the front of all the units represents the amount of pedestrians passing that unit. Pedestrian flow figures come from Locatus (2007). Here also, exact figures are printed in the middle of the units (lower figure). Looking at the figure, it is remarkable to see that many colors match exactly or match with a difference of one level. There is an overall trend that when the number of pedestrians increase, rent also increases. However, there are exceptions. These can (most of the time) be explained.

Look at Hema on the right entrance (1002) of the Eggert center, it has a very big difference in rent price and pedestrian flow level. Explanation for this is that HEMA is a large unit, rent prices of large units are most of the time low (Bolt, 2003). Although not proven here, abnormality will also occur with (chain) stores that own the unit themselves.

Another remarkable point is the two shops directly on your left hand when entering at the left entrance (1004). Both having a pedestrian flow of 8300, there is a big difference in rent, respectively €240,- and €410,- sqm/yr. With almost the same surface and location, the difference must lie in the length of the contracts. An old contract means low rents because the rent price has been determined a long time ago. Where rent prices increased during the years the rent in this contract stayed the same. These examples show that it is important to realize that the connection between pedestrian flow and rent is there, but can vary with every particular case.
Pedestrian flow and standard consumer; can they predict retail rents?

The connection between pedestrian flow and rent levels is made by comparing the colors indications in Figure 32, which leads to Table 8. Here, the following remark must be made: at entrance 1002 the rent of the first unit on the left (when entering) is taken into account and not that of anchor store Hema because this is very different from the average rent in the rest of the center. This choice is made because it is important to see if an overall connection can be found in the center. After that, it would be interesting to find out what is going on with anchor stores. After all, they are the ones that are pulling the most pedestrians.

<table>
<thead>
<tr>
<th></th>
<th>Number of units</th>
<th>Same color ped-rent</th>
<th>1 level difference ped-rent</th>
<th>2 level difference ped-rent or more</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#</td>
<td>%</td>
<td>#</td>
<td>%</td>
</tr>
<tr>
<td>Ground floor</td>
<td>39</td>
<td>16</td>
<td>41</td>
<td>8</td>
</tr>
<tr>
<td>First floor</td>
<td>24</td>
<td>6</td>
<td>25</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 8. Differences in rent level and pedestrian levels in the Eggert center.
Pedestrian flow and standard consumer; can they predict retail rents?

Remarkable here is that on the first floor the differences in rent and pedestrian flow are bigger than on the ground floor. Where on the ground floor 48% of the levels pedestrian flow and rent match, only 25% matches on the first floor. On the first floor, the colors of rent are ‘warmer’ than those of the pedestrian flow, which means that the stores pay more for the same amount of pedestrians than stores on the ground floor.

Normally, the upper of many two-level shopping centers, particularly smaller, non-enclosed centers, is difficult to lease, especially to retail operations. Multi-level enclosed shopping centers can overcome this problem by providing direct exterior entrances to each level so they can function independently. (Brown, 1998). Here, in the Eggert center, the two floors can function independently because the first floor has its own access to the parking garage (1009).

The reason that the rents on the first floor are higher for the amount of pedestrians walking by, can be caused by the many connections between the two floors and the entrance connecting the parking garage with the first floor. Those connections make the two floors work together as one shopping center but give the first floor more value than, based on pedestrian flow, it should have.

Now, the complexity measures will be discussed. As said before the complexity gives an indication for how hard it is to move through the mall form a certain starting point, in this case the 6 entrances. For every entrance, an absolute access complexity (aac) and a relative access complexity (rac) is calculated. The absolute access complexity measure is (Brown, 2007):

\[ AAC = \frac{(N_c + L_c)}{(N_c - 1)} + \frac{(N_l + L_l)}{(N_l - 1)} \]

Where:
- \( AAC \) = absolute access complexity
- \( N_c \) = number of convex unit nodes
- \( L_c \) = number of convex unit links
- \( N_l \) = number of lineal unit nodes
- \( L_l \) = number of lineal unit links
- \( W_Ac \) = weighted average for convex units
- \( WA_l \) = weighted average for lineal units

The relative complexity measure is:

\[ RAC = \frac{(\log_{10}(AAC))}{AAC} \]

Where \( RAC \) = relative access complexity.

In Table 9 these can be found in the 2nd and 3rd column. The two columns next to those on the right are the pedestrian and rent figures.
Pedestrian flow and standard consumer; can they predict retail rents?

<table>
<thead>
<tr>
<th>entrance</th>
<th>r1ac</th>
<th>r2ac</th>
<th>ped</th>
<th>rent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001</td>
<td>4137,70</td>
<td>232,65</td>
<td>6800</td>
<td>370</td>
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<tr>
<td>1002</td>
<td>5290,47</td>
<td>270,83</td>
<td>8900</td>
<td>340</td>
</tr>
<tr>
<td>1003-1</td>
<td>5478,17</td>
<td>276,71</td>
<td>4500</td>
<td>200</td>
</tr>
<tr>
<td>1003-2</td>
<td>5478,17</td>
<td>276,71</td>
<td>8150</td>
<td>280</td>
</tr>
<tr>
<td>1004</td>
<td>4287,67</td>
<td>237,84</td>
<td>8300</td>
<td>240</td>
</tr>
<tr>
<td>1008</td>
<td>5218,95</td>
<td>268,57</td>
<td>8900</td>
<td>300</td>
</tr>
<tr>
<td>1009</td>
<td>5332,37</td>
<td>272,15</td>
<td>8900</td>
<td>255</td>
</tr>
</tbody>
</table>

Table 9. Complexity measures in the Eggert center.

The complexity of the main entrance, 1001, is the lowest. This means that from that entrance, it is, overall, the easiest to reach all stores in the Eggert center. Fortunately, because the main entrance should be that way. This entrance is, just as 1002 and 1004, situated at a pedestrian area. Bordering on a street with a pedestrian flow of only 6300, the location of the main entrance is not very favorable. Entrance 1004 is best regarding that. In appendix XV pedestrian counts can be found for the inner city of Purmerend. Also, the map of Purmerend where all shops are labeled A, B or C location shows something odd (Figure 33).

Figure 33 shows that the Eggert center is partly A location and partly labeled B location. With the best part of Purmerend, labeled A1, right in front of entrance 1004, it does not succeed in pulling those pedestrians into the mall and continue the A label. Because the access complexity is almost equal to that of the main entrance, this will not be the reason for this. Turning the center 45° counterclockwise, would not help increasing the pedestrian flow inside significantly. The reason for this matter has to be something else. Entering the Eggert center at entrance 1004 might give the impression that its accessibility is low because of the small passage and because there is not a long sightline. The access complexity measures prove this wrong. So what else can be the reason?

Figure 33. Center of Purmerend divided into A, B and C locations
Pedestrian flow and standard consumer; can they predict retail rents?

Going outside to take a look at the appearance of the entrance, shows that the attractiveness of the entrance is not very high. Picture 34 and 35 show this entrance, which is not inviting pedestrians inside much. Even though another passage-entrance is right in front of this Eggert center entrance does not optimally attract the pedestrian. Since the rest of the street is not that attractive also (no shops or anything else interesting), the reason appears to be the attractiveness of the entrance.

Figure 34. Situation entrance 1004.  
Figure 35. Entrance 1004.

After taking a look at entrance 1001 and 1004, entrance 1003 will be discussed now. Entrance 1003 is the most complex. From that entrance the rest of the center is most difficult to reach. It is split into a left and right entrance, because taking a left turn here, means a whole other pedestrian flow than taking a right turn. Comparing rent prices near entrance 1003 with the access complexity, shows a high complexity in combination with low rents. The more complex a unit is situated, the lower the rent prices.

For entrance 1002, the height of the pedestrian flow is not expected, regarding the rather high complexity of the entrance. The abnormality here is caused by anchor store HEMA. The store attracts more pedestrians than expected from complexity or rent. In fact, within every aspect of this spatial network analysis HEMA does not fit into the common relation between pedestrian flow and rent. There are two more anchor stores in the Eggert center, V&D and C&A, but those stores own the property themselves, so no rent prices are available. If those anchor stores differ this much from the rest of the shops, should they be taken into account when investigating or determining the overall relation between pedestrian flow and rent? The answer is yes and no. When determining this relation by looking at the figures, they should be removed from the data because they differ too much from the normal relation. But anchor stores do influence this relation, so when looking at this relation geometrically, they should be taken into account. The influence of anchor stores can not be denied but should not be used for determining the overall connection.

Looking at entrance 1009, one can see that pedestrian flow over there is the highest on the first floor. This strengthens the fact that the two floors are connected but can also function independently. Entrance 1009 clearly functions as a gate distributing 'new' pedestrians into the center. Remarkable
here is that pedestrian flows near the other connections between the two floors are a few levels lower on the first floor than on the ground floor. Even the pedestrian flow near the main connection (1005) looses strength. It is obvious here, that people are not likely to go to the first floor. They'd rather stay on the ground floor. This is why rent prices are lower on the first floor.

Discussing the different entrances of the Eggert center leads to information about the physical (configuration) in relation to the abstract (rent). Systematically analyzing a mall like this leads to more insight in the relation pedestrian flow-rent regarding the Eggert center. But can we also say something about what a general relation, applying on the Netherlands, looks like? Before answering this question, first an attempt is made to create a general relation like this for the Eggert center. To do this, the different categories of access complexity, rent and pedestrian flow are rank ordered (Table 10). Hereby, rank aac (absolute access complexity) and rank rac (relative access complexity) are ranked from 1 to 7, with 1 for the lowest aac and rac en 7 for the highest. Pedestrian flow and rent are ranked the same; 1 for the lowest rent/pedestrian flow and 7 for the highest. The coloring though, is the other way round for access complexity. Hence, the lower the complexity, the more pedestrians are expected. In the most right column of Table 10, the difference in levels between pedestrian flow and rent is given. Here, there is a remarkable high similarity. Out of seven, three match perfectly and one matches with only one level difference. There is one major exception, namely main entrance 1001. As noticed before, pedestrian flow is not as high as expected based on rent and complexity measures. (So maybe turn the center 45° counterclockwise after all?) In Table 10, also the differences in levels between pedestrian flow with access complexity and rent with access complexity is given. Here again, the similarity appears to be strong. For the relation access complexity-pedestrians, five out of seven entrances match with a maximum difference of two levels.

Table 10. Rank ordering of pedestrians, rent and access complexity.

The table does not only identify difference in levels, it also identifies if the difference has a positive or negative value. For entrance 1001, rents are higher then pedestrian flow would expect them to be. This phenomenon will occur in all Dutch shopping centers because the best visual location will not have more pedestrians passing by than their less visible neighbor, but their rents are higher.
Pedestrian flow and standard consumer; can they predict retail rents?

Explanation for this can be found in the funnel shape scheme discussed in chapter one. It seems that the best visible stores are able to filter more shoppers and buyers out of pedestrian flow. This causes the higher rent prices. Also, the fact that a good visible location has more exposure could be an explanation. This is in line with the trend (paragraph 2.1.2) that internet sales are still increasing. Companies operating on the internet might still need exposure in the physical world. Also branding encourages retailers to settle at a high profile (good visible) location. The better visible a brand, the more efficient the branding will be.

In the case of anchor stores, such as the HEMA at entrance 1002, it would be the other way round. HEMA is not taken into account in Table 11 as said before, but if it were, the rent would be ranked 2.

<table>
<thead>
<tr>
<th></th>
<th>rank</th>
<th>rank</th>
<th>rank</th>
<th>rank</th>
<th>difference ac-</th>
<th>difference ac-</th>
<th>Difference rank ped-rank rent</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEMA</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>-2</td>
<td>-4</td>
<td></td>
</tr>
</tbody>
</table>

Table 11 shows that the difference in pedestrians flow and rent level is -4. Since most anchor stores pay less rent than any other store (because of their size) this abnormality will generally occur.

<table>
<thead>
<tr>
<th></th>
<th>rank</th>
<th>rank</th>
<th>rank</th>
<th>rank</th>
<th>difference ac-</th>
<th>difference ac-</th>
<th>Difference rank ped-rank rent</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEMA</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>-2</td>
<td>-4</td>
<td></td>
</tr>
</tbody>
</table>

Table 11. Rank ordering for HEMA.

4.4 Conclusion

Previous tables show that ranking of pedestrian flow and rent levels leads to a visible relation between those two. In the Eggert center, the difference in pedestrian flow and rent levels is minimal. This means that when knowing only pedestrian flow, an adequate estimate of rent prices can be made. However, applying this technique on several other shopping centers would give a more reliable view on this relation. More of these analyses are necessary to determine an adequate general relation between pedestrian flow and rent that covers the Netherlands.

As shown in the Eggert center case, there are exceptions on this general relation. Exceptions can also be general, or they can be unit specific.

General exceptions on the relation pedestrian flow-rent can be found in every shopping district. It must be clear, that these exceptions also originate from characteristics of a specific unit. But within general exceptions these characteristics are similar in all shopping districts. In the Eggert center case, two general exceptions come forward. The first concerns the anchor store HEMA. HEMA attracts, like all anchor stores, a greater number of people then other stores. Because of their big size they pay less per square meter. The normal relation between pedestrian flow and rent is disturbed; pedestrian flows are actually too high for the rents (or the rents are too low). Second general exception is stores on high-profile locations. Those stores pay more rent then one would say, based on the pedestrian flow.
Pedestrian flow and standard consumer; can they predict retail rents?

In the Eggert center case, these are the stores near main entrance 1001 that pay more rent than what on base of their pedestrian flow would be reasonable. Unit specific exceptions are due to characteristics of one single unit. Units can have similar pedestrian flow and size but their rent can still differ. This is due to unit specific characteristics such as the shape of the unit or a special contract.

Besides considering the relation pedestrian flow-rent itself, calculating complexity measures is very useful. Access complexity measures give a good insight in the exact relation between those two, because they are more decomposed. Complexity measures contribute in a better understanding of this relationship. It is important to have that insight before saying anything about the relation pedestrian flow-rent. In the Eggert center case, complexity measures help giving an explanation for the fact that entrance 1004 is not capable of attracting pedestrians from the passage across the street. Since it is not the complexity within the center that is obstructing an optimal flow, it has to be the attractiveness of the entrance, which has to be improved. Complexity measures enable to anticipate better on problematic situations.
Chapter 5 Conclusions and recommendations

5.1 Conclusions

Looking at the goal and research questions of this study, it can be stated that the information gathered in the literature review and gained from the applied statistical and spatial network analysis did contribute in answering these questions and reaching this goal.

Literature review first examined rent, which showed that rent must not be confused with rental value. In the Netherlands, rent revision rent is an important aspect that strongly influences the Dutch real estate market. It can impede market forces because rent prices are adjusted every 5 years to level with comparable properties. Examination of pedestrian flow, showed that the size of pedestrian flow is, among others, influenced by size of catchment area and size of shopping center. Behavior of pedestrian flow is influenced by spatial configuration (width of a street, curb) and branch mix of the stores. The standard consumer is identified as a theoretical consumer buying all his products in one shopping district. Advantage of the standard consumer is that it is being predictable, less static than inhabitants and able to indicate opportunities to expand a shopping district. An attempt to predict the standard consumer for the year 2010 showed that this is doable. In theory, this leads to future rent. Despite the fact that this might be quite ambitious when the struggle for better insight in current rents is still going on, it is very interesting. Further perfection of the input data (demographic forecasts and projected developments) is needed though.

A statistical approach of the influence of pedestrian flow and standard consumer on rent does not provide the useful tool hoped for. Reason for that might be that the non-parametric dataset could not be used for a regression analysis. Also, for the used ANOVA, the number of tested groups was not sufficient to provide a useful tool. Furthermore, the two variables pedestrian flow and standard consumer are of a different level. Where the most detailed level standard consumer can be used on is meso level, pedestrian flow can also tell something on micro level. The statistical analyses does give an $R^2$ of 15.8. This means that 15.8% of rent is explained by standard consumer and pedestrian flow together. This is not negligible and reason for further investigation of these variables.

Using a spatial network analysis, the relation pedestrian flow-rent is examined further. Spatial network analysis is a way to represent, describe and evaluate spatial configurations or patterns created through building and urban design. Making a mathematical network of a plan by using a spatial network analysis allows one to analyze such a plan (Brown, 1998). This also makes it possible to relate the mathematical network with traditional measures like occupancy and revenues by location. A spatial network analysis can be used to influence pedestrian flows by changing the configuration of a mall or taking it into account while designing it. The spatial network is everything around us. Buildings, streets, waist bins, everything.
Pedestrian flow and standard consumer; can they predict retail rents?

Conducting a spatial network analysis for the Eggert center in Purmerend resulted in some useful conclusions. The Eggert center showed a clear relation between pedestrian flow and rent. The expectation of conducting this analysis on other shopping districts is that it can generate a general relation between pedestrian flow and rent (on national level).

However, the Eggert case provides enough information to conclude that there will be exceptions on this. Two types of exceptions can be determined. The first type is a general exception. General exceptions on the relation pedestrian flow-rent can be found in every shopping district. These exceptions are anchor stores that always have a higher pedestrian flow than would be expected based on their rent. Because the size of an anchor store is mostly bigger than an average store, the rents are lower. Pedestrian flow, on the contrary, is high because of the attraction of the store. Other general exceptions are stores on high-profile locations. High profile stores pay more rent then one would say based on the pedestrian flow. Second type are unit specific exceptions, due to characteristics of one single unit. Unit specific characters such as shape or form of the contract can influence the rent price of a unit. Even when, for example, the unit has a similar size as their neighbor.

Access complexity measures helped identify the relation between pedestrian flow and rent. Because access complexity measures decompose those two variables more, it gives good insight in the relation. For example, in the Eggert center case, complexity measures helped giving an explanation for the fact that an entrance was not capable of attracting pedestrians from the passage across the street. Because the position of the entrance in the center was not influencing this fact, this could be excluded from the possible explanations.

It can be stated that the Eggert case confirms that conducting a spatial network analysis is very useful in identifying the relation between pedestrian flow and rent. It visually shows a clear relation by matching colors. Spatial network analysis certainly contributes to a more adequate anticipation on problematic (spatial) situations in shopping centers.

Despite the fact that a lot of interesting information was showed in this study, the research goal has not been reached in the way it was supposed to. The study showed the qualitative relations pedestrian flow-rent and standard consumer-rent. The qualitative relation, however, could not be determined in detail. Although, the scheme introduced in paragraph 3.4 gives a rough indication and does provide developers, investors, valuators, etcetera, a guideline to use. The prediction of standard consumer can be used to analyze the possibilities of a shopping district (does a shopping district for example need to expand, be revised or redeveloped?). This study shows players on the market that although a quantitative relation between pedestrian flow and rent is still hard to define, a more qualitative relation is all the more important. Spatial network analysis provides important information that might help developers to optimize their designs. For investors, information on the quality of a shopping district can stimulate the decision making process when and where to invest. The case study on the Eggert
Pedestrian flow and standard consumer; can they predict retail rents?

Center shows how valuators can benefit from a spatial network analysis to refine the valuation process. More information on a valued property gives valuators more certainty in their valuation.

5.2 Recommendations

This research attempted to answer the research questions in an adequate way. However, some critical remarks have to be given to improve this research and answers.

The statistical analysis in chapter 3 showed an ANOVA where of every variable (pedestrian flow and standard consumer), two groups were tested. This led to an insufficient tool which is too rough to be really useful in practice. Testing the variables separately will give better insight in the two. As far as standard consumer is concerned, separate testing of the variable can lead to advantages in the use of this term. Now, standard consumer and pedestrian flow are tested together at first, but because they both operate on a different level, there can not be taken maximum advantage of their characteristics. The statistical tested model tries to explain rent by using both factors, while investigating the two factors separately can lead to more information on the relations separately. Also, the categorization in different regions can be refined. It might also be more useful to use a differentiation of properties lying inside or outside the conurbation of Western Holland.

If the goal of the research is to achieve the highest explanation of rent by using influencing factors, it is best to use as many factors as possible (Haringsma, 2002). Disadvantage of this is of course the time consuming work of gathering information on the data. Further research might find an optimum in what, and how many, variables to use to determine rent prices well. For the two variables used in this study, standard consumer and pedestrian flow, the interaction factor was not rejected because its significance is 0.078. This is close to 0.05, where the hypotheses would have been rejected. It is worth looking at this interaction factor because of this small difference.

As for the spatial network analysis, the research is only based on one case. Big improvement would be doing this on a larger scale to determine the general relation between pedestrian flow and rent. Also, comparing the spatial network with more social parameters, such as vacancies or crime levels, might give more opportunities. Then, spatial network analysis could also contribute to solving social problems such as the reason why there is more violence in one shopping district than there is in the other.

Last point is that this research aimed at (A locations in) main shopping district in the Netherlands. This was done to make sure that as many influencing factors that are not investigated are eliminated as possible. Because finding consistent relationships between the investigated variables was difficult, this delineation should be preserved. After more insight in these relations is gained, the research can be extended by using other boundary conditions.
Pedestrian flow and standard consumer; can they predict retail rents?

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