

# **Contents**

1 INTRODUCTION

2 DATA COLLECTION & PRESENTATION

3 DATA ANALYSIS & INTERPRETATION

4 CONCLUSIONS

5 EVALUATIONS

6 BIBLIOGRAPHIES

# **1**

## **INTRODUCTION**

## 1.1 INTRODUCTION



Bangor is a town of approximately 80,000 people in County Down, Northern Ireland. Bangor is on the east coast of Northern Ireland on the southern side of Belfast Lough. It is a popular coastal town that has for many years been the tourist attraction of the area whether it is just for a day trip or a long weekend or even longer stays. It has rail and bus links to Belfast / Londonderry / Portadown / Enniskillen and even as far as Dublin. Bangor is also situated just 10 miles from George Best Belfast City Airport where aircraft come in from UK airports. About 40 miles further on is the Belfast International Airport where travellers can fly in from further a field.

Bangor grew up around the abbey founded in 586 by Saint Comgall, where the Antiphonarium Benchorensis (an ancient manuscript) was written. A copy of the manuscript can be seen today in the town's heritage centre. During the Dark Ages both the abbey and its university gained fame throughout the known world, but in the early 9<sup>th</sup> century a Viking attack saw some 900 of its monks slaughtered. The modern abbey now stands on the Newtownards Road just outside the town centre, right on the corner of Castle Park. The grounds include a small cemetery and cannon from the Amazon, a ship wrecked in nearby Ballyholme in 1780.

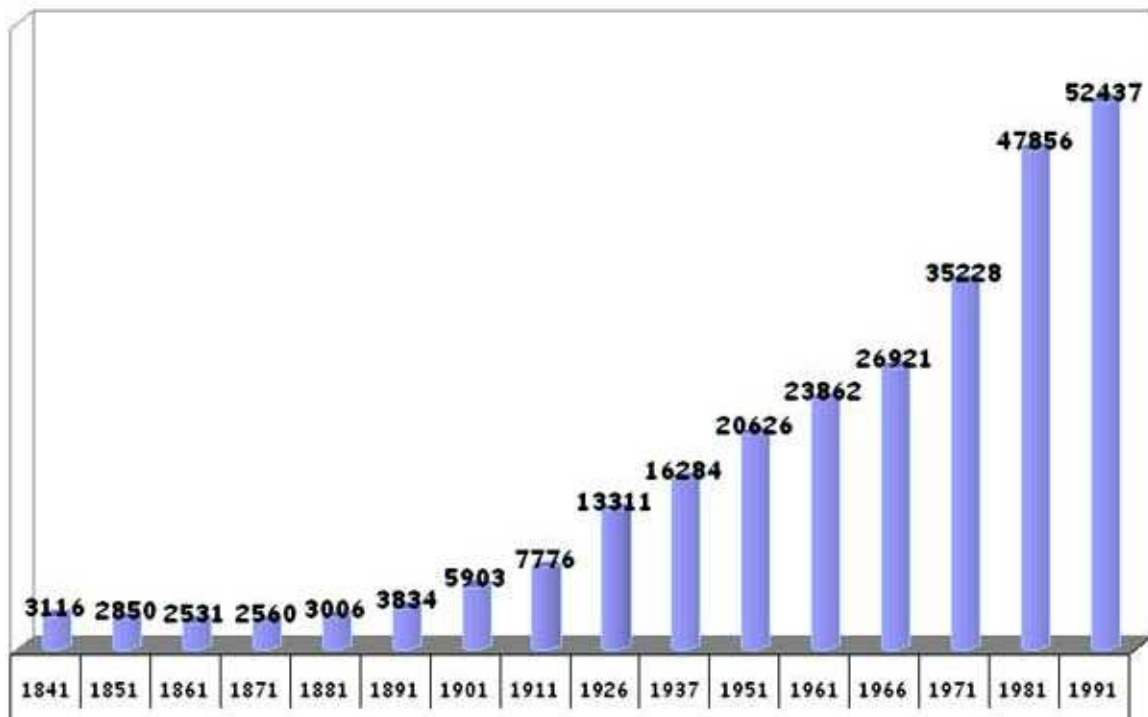
The town (the third largest in Northern Ireland) is the site of a large marina (one of the biggest in Ireland). It is primarily residential and can be viewed as a dormitory suburb of the Greater Belfast area, from which it is linked by the A2 road and a railway line. Light industry also exists. A notable building in the town is Bangor Old Custom House.

The name Bangor from the town as we know it, was derived from the Gaelic name 'Beannchor' which is in turn derived from 'beanna' (peaks) and 'chor' (curve) which scholars presume to be Bangor Bay. Irish place names link us with former inhabitants. The meaning of the name 'Bangor' has often caused discussion. For the ancients, the sea was the great highway. Movement by land was difficult and dangerous. So the theory that the name 'Bangor' comes from the shape of Bangor Bay's headlands, in Irish 'pointed like horns,' is the most convincing. It is easy to imagine the currachs of trading peoples, or of missionary monks returning to their homeland, seeking safe landfall between the twin points of Bangor Bay.

Celts, pre-Celtic people, Vikings, Normans, English and Scots have all in turn passed through, settled in, worshipped in or fought over Bangor.



## Population Demographics for Bangor from 1841 to 1991





This is Ballyholme Bay in the Victorian Times.



This is Ballyholme Bay today.



This is Dufferin Avenue in the Victorian Times.



This is Dufferin Avenue on the day of the Field Trip. You can see that little has changed since the houses were built.

## **1.2 The Project**

This project is to determine where the Central Business District is in Bangor by assessing a number of criteria, namely;

- 1. Land Use**
- 2. Building Height**
- 3. Rateable Value**
- 4. Pedestrian Flow**
- 5. Parking Restrictions**

Bangor was chosen for this data collection because;

- It is a compact town and easily covered on foot
- There is a wide range of commercial activity
- The streets selected seemed to cover the main commercial area
- The data sheet could cover building heights, land use i.e. ease of collection
- The rateable values were easily obtained from the rates office
- Pedestrian flow could easily be obtained by a number of people at different locations at the same time.



The two Hypotheses which will be stated and subsequently investigated are:

### **Hypothesis (Null $H_0$ )**

*<< The CBD can not be delimited using the following criteria – land use, pedestrian density, parking restrictions, building heights and rateable values >>*

### **Alternative Hypothesis ( $H_1$ )**

*<< The central business district can be delimited using the following criteria - land use, pedestrian density, parking restrictions, building heights and rateable values >>*

## **1.3 Models**

There are two types of models which have been developed to describe the developmental profile of a town or city. These are the Burgess and Hoyt models. Each has their own way of showing the CBD of a town or city. Burgess is a dartboard like shape with the CBD in the middle and Hoyt is a more detailed model with the CBD in the middle. The following describes each model in more detail.

### **1.3.1 Concentric Model (Burgess) – Functional Zones**

#### *Central Business District*

The innermost zone is the Central Business District (CBD). In Chicago, Burgess identified this as being the area called the Loop in that particular city. It is the core of the city – the centre of the commercial, social and civil life. It is also the focus of routes and is therefore, in theory, the most

accessible part of the settlement. It includes the main theatres, cinemas, clubs, department stores, specialist shops, hotels and head offices of large companies.

### *Transitional Zones*

This is also called the Twilight Zone, which surrounds the central core and contains older houses which are usually deteriorating and becoming either slum property or being taken over by the housing business or industry. This is the area which through necessity attracts immigrants and other poorer social groups.

### *Low Class Residential*

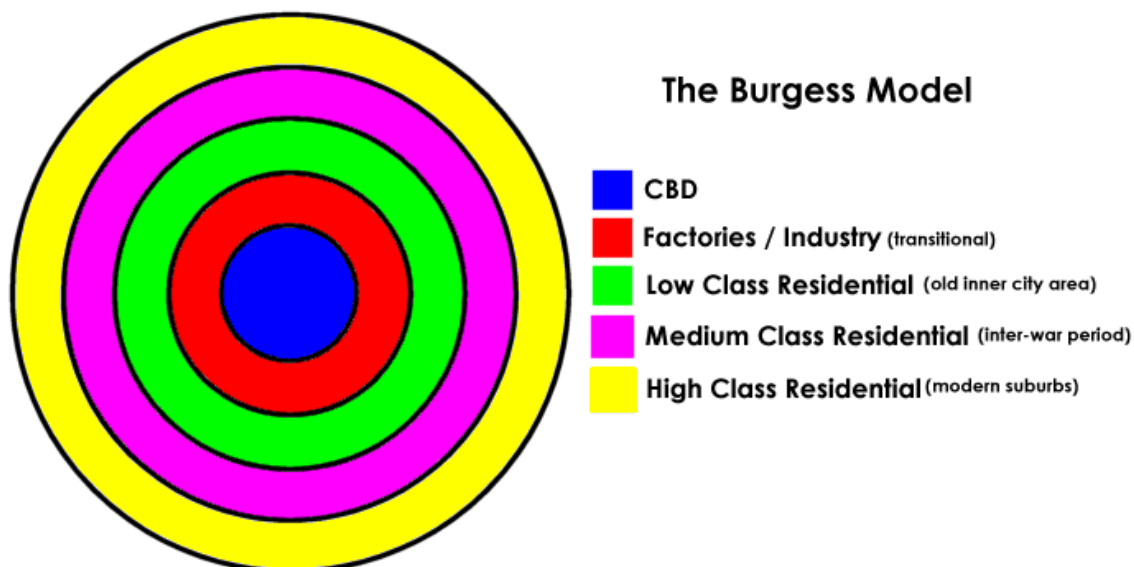
This zone contains the housing for the lower paid groups of people who have perhaps moved out from zone two but who are still compelled by travelling costs or rents to live near their work.

### *Medium Class Residential*

Outwards again is the residential zone containing better classed housing. These are largely single-family dwellings and may be private properties or council-owned.

### *High Class Residential*

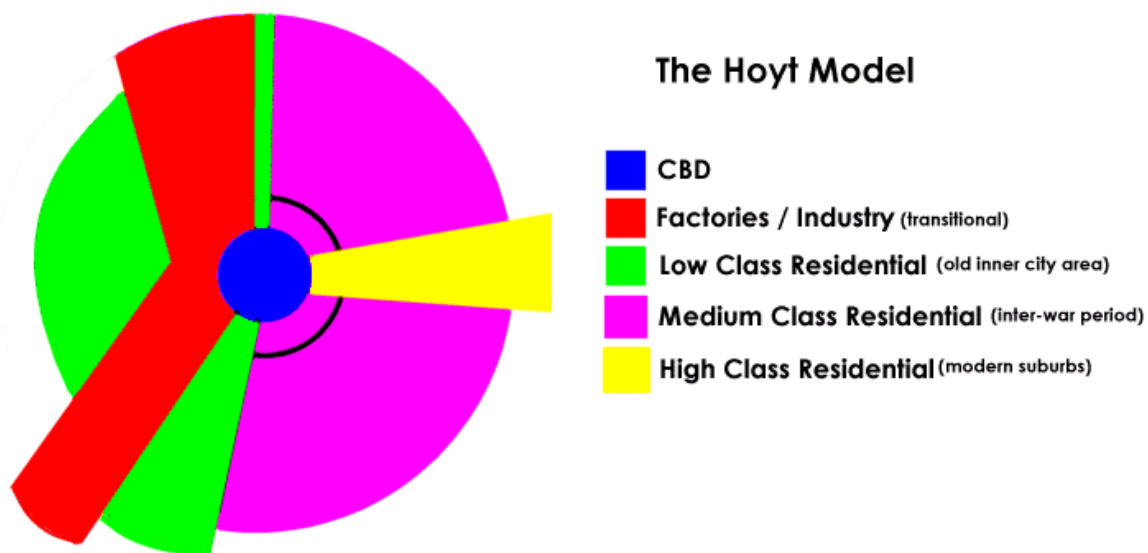
Finally there is the high class zone of residential properties where people can afford exclusive properties and



the high cost of commuting. This zone may be on the urban fringe or may take the form of commuter villages situated beyond the designated green belt of the settlement.

### 1.3.2 Section Model – Hoyt Model

H.S. Hoyt in 1939 supported Burgess's view that zones expand away from the city centre, but not concentrically. He suggested that once a sector of a city acquired certain characteristics, these would tend to be maintained as the sector expanded outwards with the urban growth. Thus, an industrial sector will tend to develop along a major route way out of a city centre and a high class residential sector will continue to grow outwards towards the urban-rural fringe.



**2**

**DATA COLLECTION  
& PRESENTATION**

## **2.1 DATA COLLECTION & PRESENTATION**

On the 31<sup>st</sup> May, we made a field trip to Bangor to collect data.

The five main areas of collection were;

- Land Use
- Building Heights
- Rateable Values
- Pedestrian Density
- Parking

The streets we chose were;

- Main Street
- High Street
- Bridge Street
- Central Avenue
- Hamilton Road
- Abbey Street
- Castle Street
- Dufferin Avenue

We chose these streets because they were easily covered on foot in one day. They have a wide range of commercial activity, so we have good opportunities for research. The chosen streets seem to cover main commercial area.

The data sheets could cover building heights and land use. While we were walking we could recover both sets of information at the same time. We took data for every building we passed. Land Use was marked on the Left side of the page and Building Heights on the right.

We used the following classification to abbreviate so we would save time;

- Commercial – C
- Pub/Restaurant – P
- Open Space – O

- Banks/Offices – B
- Hall/Church – H
- Park/Playing Field – PK
- Residential – R
- Derelict - D

## 2.2 Building Heights

For building heights, we used the height of the building in storeys.

## 2.2 Rateable Values

The rateable value is found by taking a few sample buildings from each main street. Measure the front footage and then find out rateable values from the Bangor Rates Office (Hamilton Road)

$$\text{Index} - \frac{\text{Rateable Value}}{\text{Front Footage}}$$

You then average this to give the rateable value of three types of building – Private Dwelling, Shop and Office. These rateable values are multiplied by the commercial or domestic rate to give the final rateable value which is paid to the council every year.

	Private	Shop	Office
High Street	140	1500	720
Central Avenue	90	295	80
Hamilton Road	40	340	690
Main Street	0	3350	245
Castle Street	78	2180	1200
Bridge Street	0	3150	270
Abbey Street	100	615	475
Dufferin Avenue	96	730	110
Average	68	1520	474

## 2.4 Pedestrian Density

Measurement of the Pedestrian Density in particular areas was another way of trying to determine the CBD of Bangor was located. Whilst collecting data in Bangor, 10 pedestrian counts were taken at certain locations moving further away from the town centre. These are shown on the location map; each count lasted 10 minutes counting the number of people heading towards the town centre. These results are shown below in the table and on the graph.

Location	Distance	Pedestrians
1	0	68
2	100	190
3	200	140
4	300	160
5	400	123
6	500	71
7	600	66
8	700	58
9	800	46
10	900	24

These results were the used as the basis for Spearman's Rank Correlation. The new table is as follows;

Distance	Rank	Pedestrians	Rank	D	D <sup>2</sup>
0	10	68	6	4	16
100	9	190	1	8	64
200	8	140	3	5	25
300	7	160	2	5	25
400	6	123	4	2	4
500	5	71	5	0	0
600	4	66	7	-3	9
700	3	58	8	-5	25
800	2	48	9	-7	49
900	1	24	10	-9	81

$$RS = 1 - \frac{6 \sum d^2}{n^3 - n}$$

$$\frac{1 - 6 \times 298}{990}$$

$$= 0.81$$

This result shows a strong negative correlation between the distance from the town centre and the number of pedestrians. In this case as you move away from the town of Bangor the number of pedestrians decreases.

## 2.5 Parking Restrictions

Parking restrictions (single, double yellow lines etc) were assessed to determine if the parking restrictions changed as you moved away from the CBD. The parking restrictions had to include extra streets so we could include the residential streets as well and not just the main, traffic heavy roads. Records were taken from both sides of the street.

## Spearman's Rank

This measures the relationship and degrees of association between two sets of data; in this case between the number of pedestrians and the town centre. The limits are +1 and -1, the greater the association, the closer the values will be between +1 and -1.

Rank 1 is given to the highest value, rank 2 to the next and so on. This is done for each set of data. When some values share the same rank, they are tied ranks and



assigned the median value of the 2 or more ranks. For example, if there are 2 rank values for rank 3, rank 3 and 4 will be added together and divided by 2, therefore giving a rank value of 3.5. The next rank after that would be 5. After putting each set of data into rank order, the difference in rank (D) between each value is squared ( $D^2$ ). The values of  $D^2$  are then summed giving  $\sum d^2$  which forms the basis of the formula:

$$RS = 1 - \frac{6 \times \sum d^2}{n^3 - n}$$

where  $n$  = the number of samples.

Once a value is obtained the critical value, tables are used to see the strength of significance. If the value is greater than the critical value it's possible to accept that there is a significant relationship between the two values, in this case, between pedestrians and distance from the town centre. Ten points were chosen throughout Bangor, these are indicated on the next map.

**3**

**DATA ANALYSIS &  
INTERPRETATION**

### 3.1 Building Heights

For building heights we were asked to test the following hypothesis:

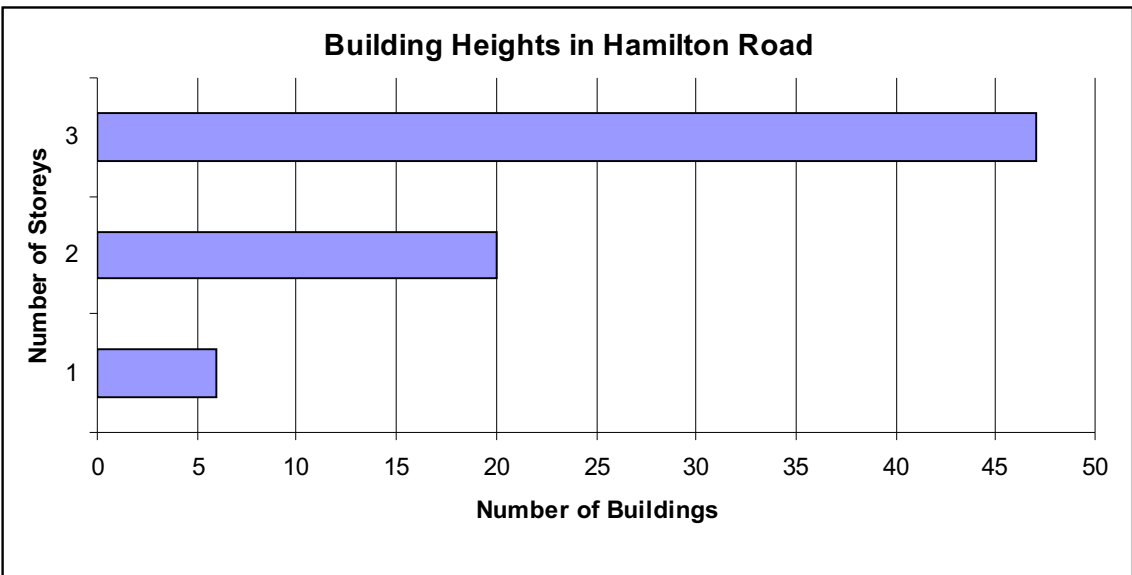
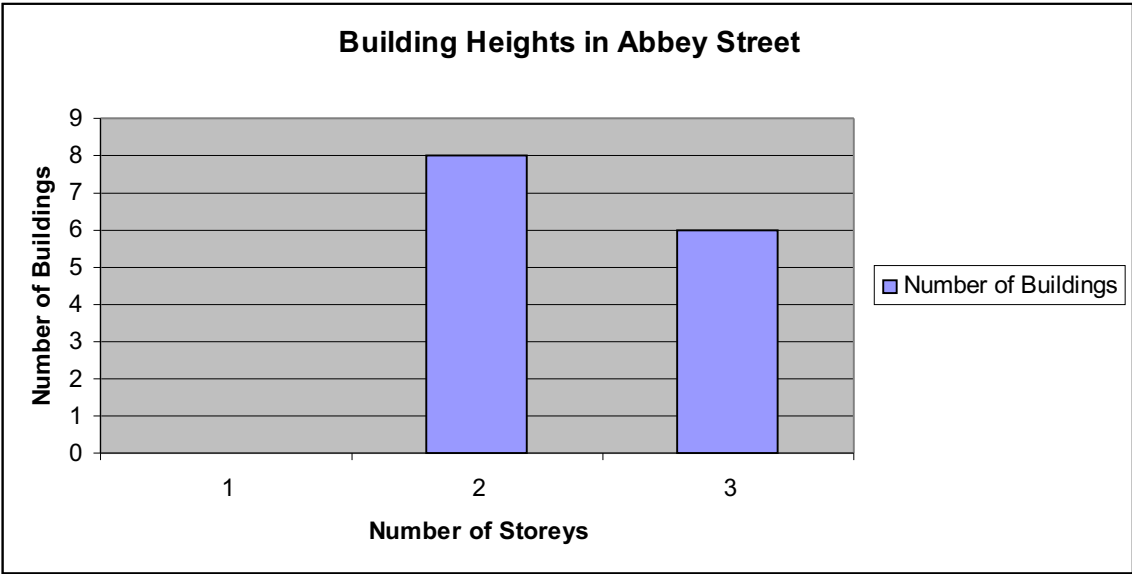
Hypothesis ( $H_0$ )

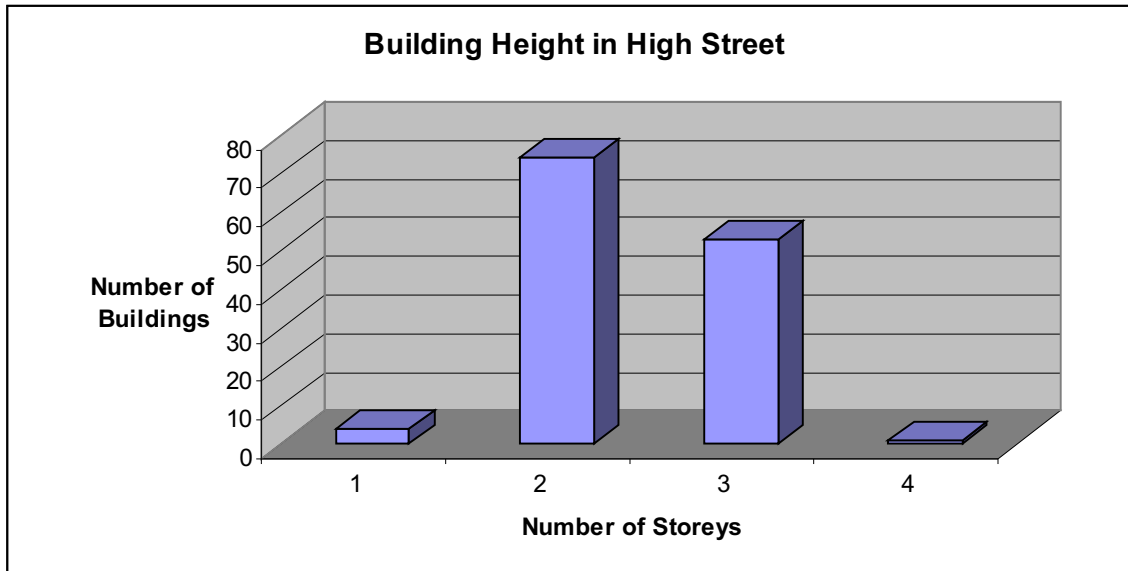
*<<There is no significant relationship between average building heights and distance from the town centre>>*

Alternative Hypothesis ( $H_i$ )

*<<There is a significant relationship between average building heights and distance from the town centre>>*

I decided to collect the data in a series of charts as follows on the next page:

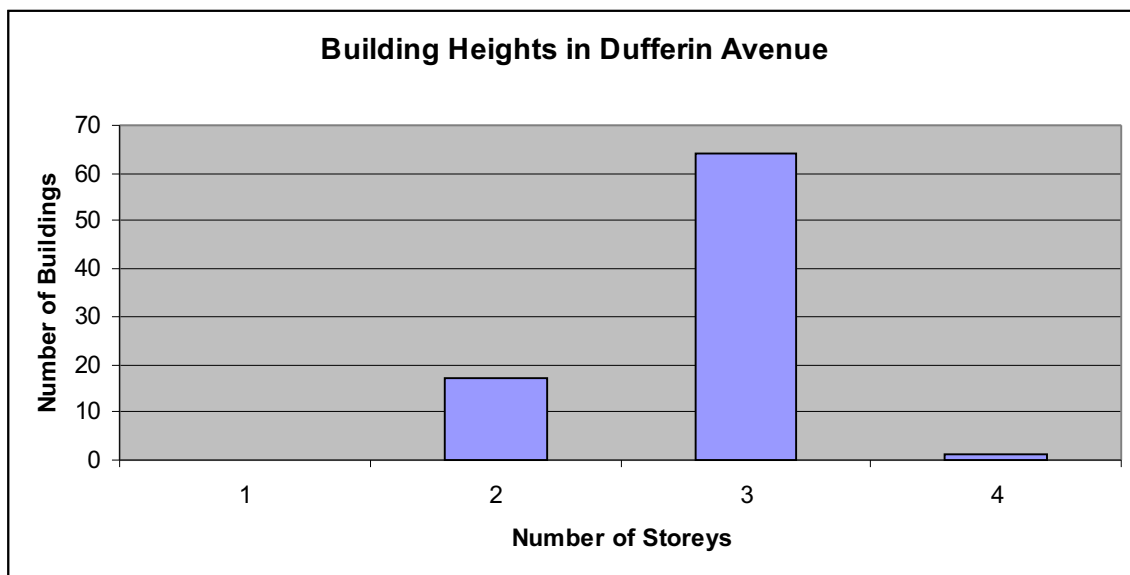




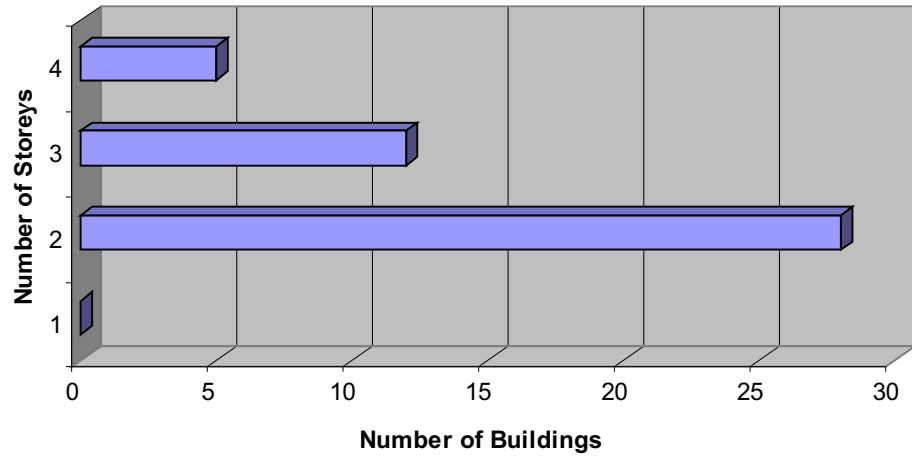
Picture showing the undulating building heights in High Street.

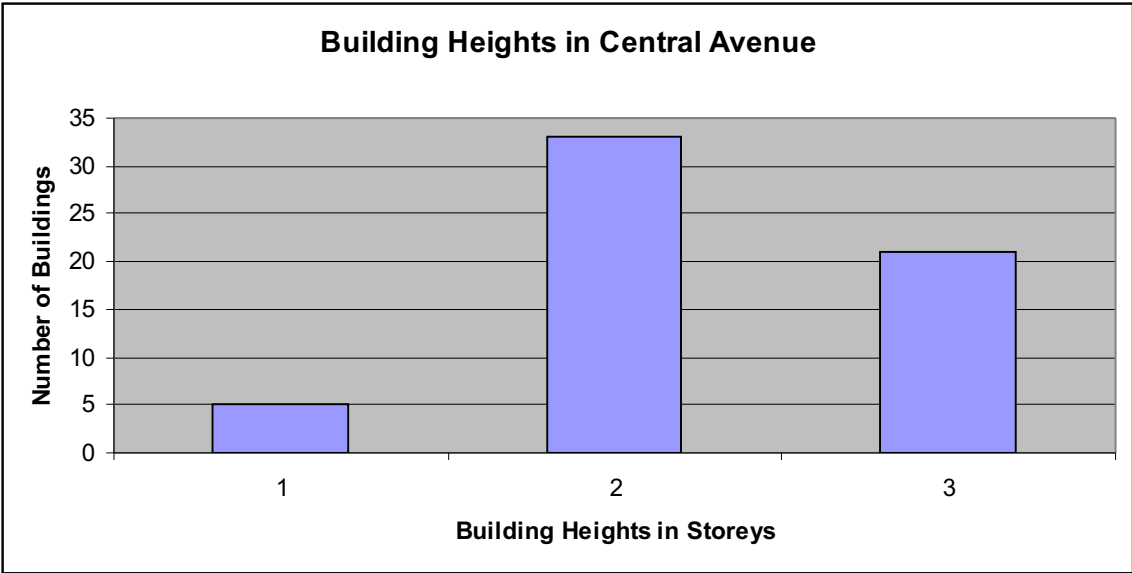


Picture showing the amount of 3-storey houses  
In Dufferin Avenue.



**Building Heights in Main Street**







You can see that High Street has the greatest number of two storey buildings, while Dufferin Avenue has the most three storey buildings.

I believe the reason for this is that the streets were all built at different times when different building styles were used. You can see this clearly in Dufferin Avenue as the Victorian terraces built near the start of the century all tended to be 3 storey buildings whereas 1970s style housing tended to be two storeys.

### **3.2 Land Use**

Assessment of land use data shows the type of buildings in a certain street, whether it was Commercial, Banks, Offices or Residential. We were asked to prove the following hypothesis;

Hypothesis ( $H_0$ )

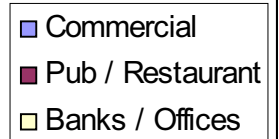
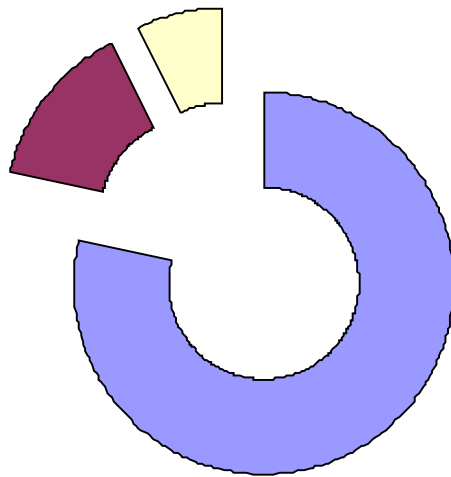
*<<There is no significant relationship between the average land use and the distance from the town centre>>*

Alternative Hypothesis ( $H_i$ )

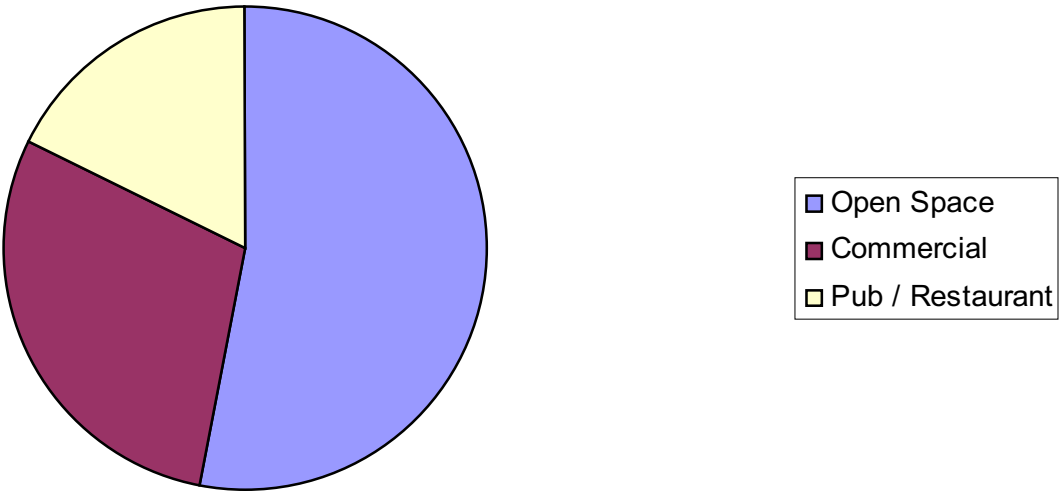
*<< There is a significant relationship between the average land use and the distance from the town centre>>*

The data gathered from each street was analysed and shown in the following charts;

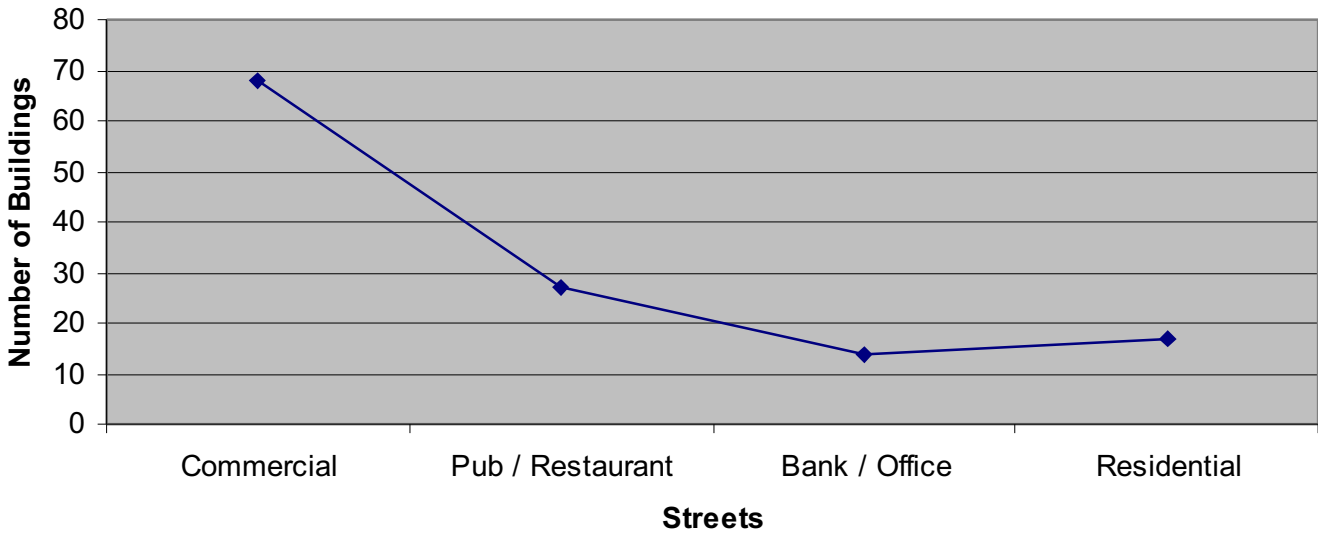
## Land Use in Abbey Street



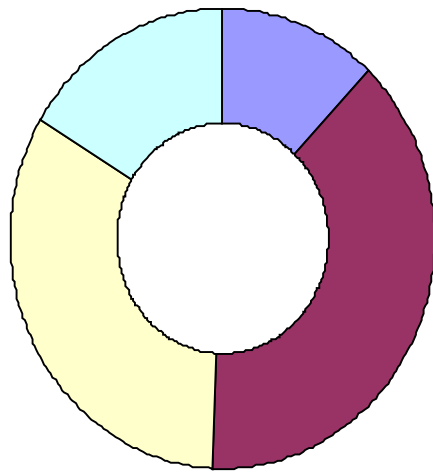
Land Use in Bridge Street



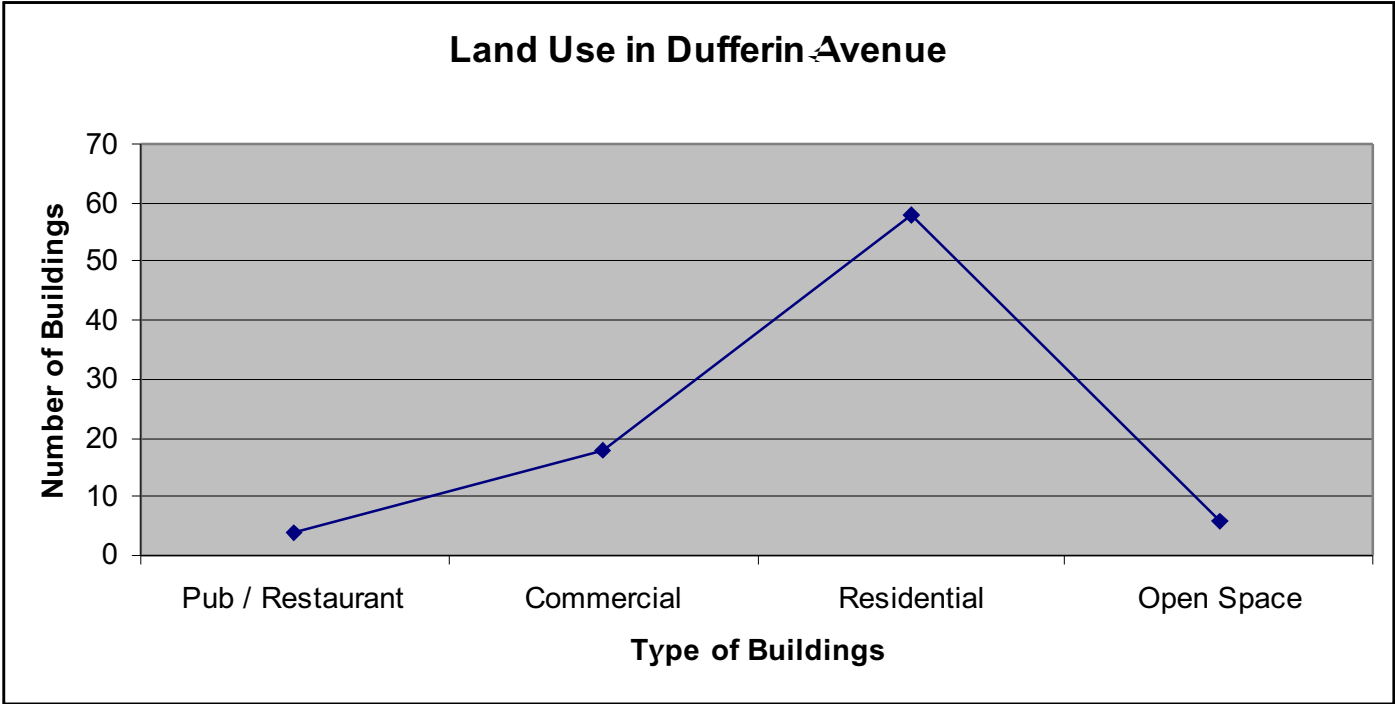
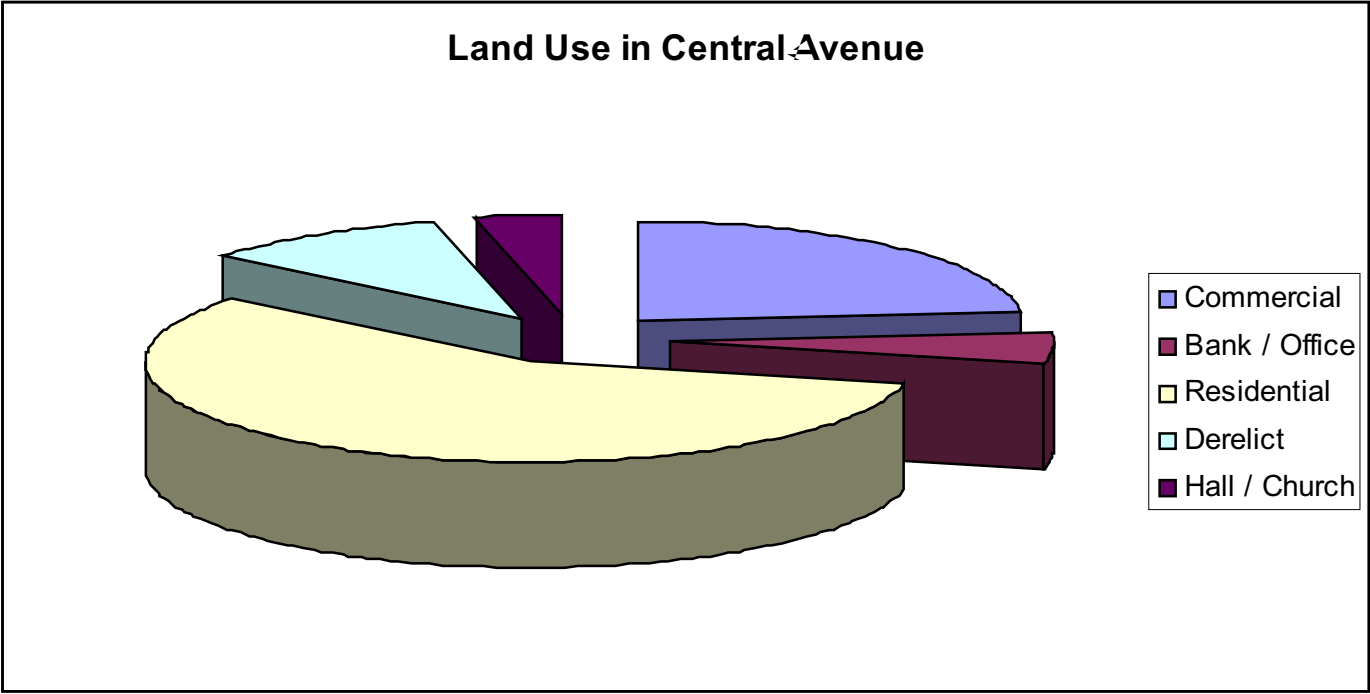
Land Use in High Street



## Land Use in Hamilton Road



- Commercial
- Residential
- Bank / Offices
- Hall / Church







### 3.3 Parking Restrictions

In Bangor, there are different types of parking permitted in certain areas. These streets can be seen on the enclosed parking sheets. The different types of parking were – limited parking, single yellow, double yellow, no restrictions and parking bays.

We were asked to prove the following hypothesis;

Hypothesis ( $H_0$ )

*<<There is no significant relationship between the average parking restrictions and the town centre>>*

Alternative Hypothesis ( $H_i$ )

*<<There is a significant relationship between the average parking restrictions and the town centre>>*

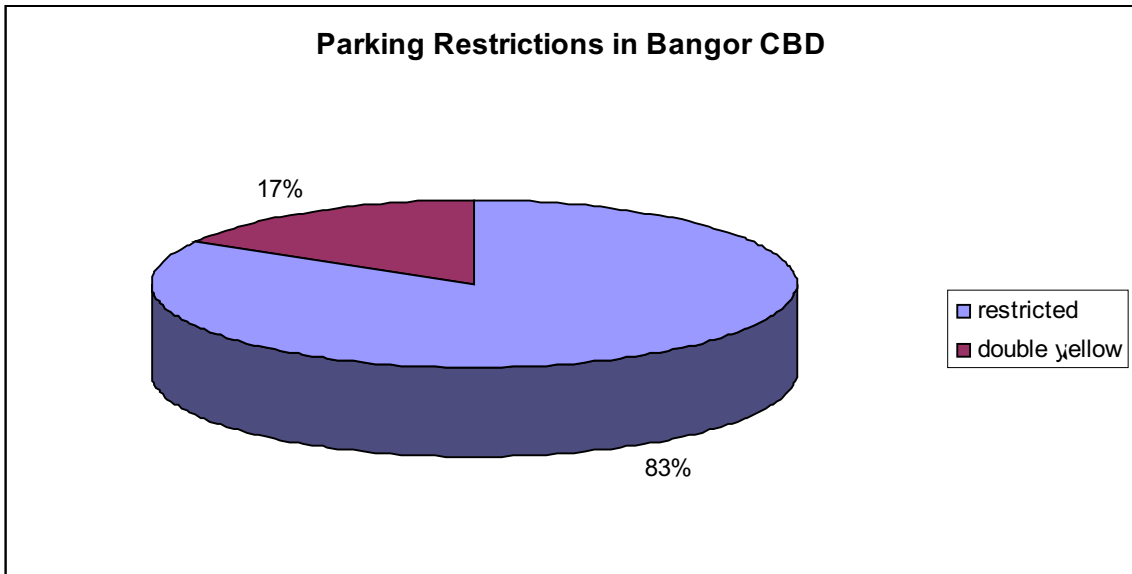
In the photo over the page you can see the parking restrictions in Main Street – namely Parking Bays and Double Yellow.

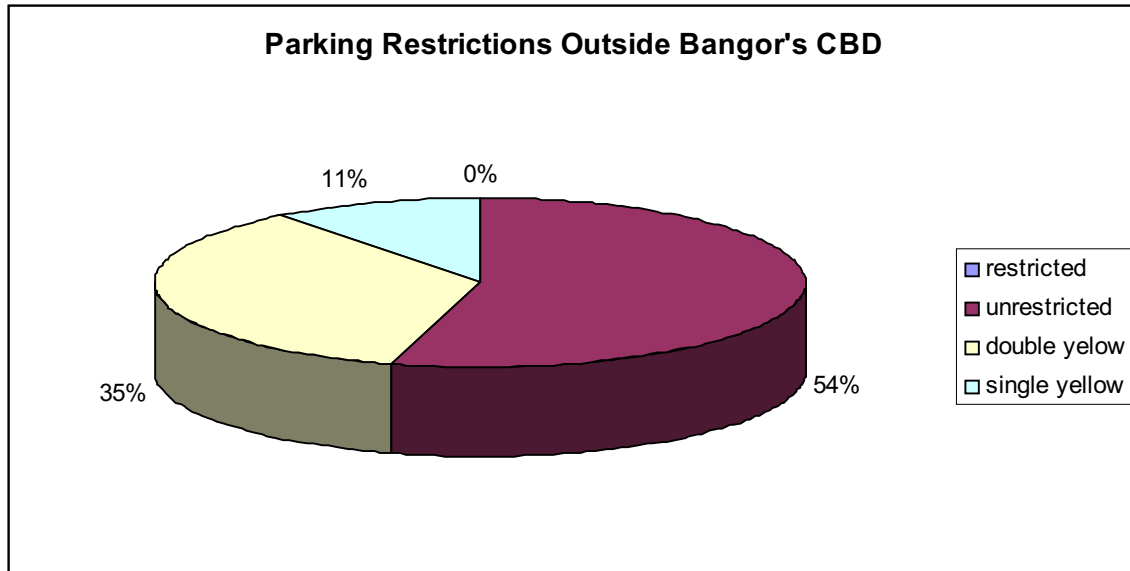




From the sheet of results there appears to be little correlation between distance from the town centre and parking restrictions. In the commercial area of Bangor, i.e. Main Street, High Street and Queens Parade, parking is essential, although badly formed parking would block up the busy roads leading to the seafront. The solution to this is parking bays created from the pavement. This works as it does not affect the size of the road and traffic flow while keeping customers is in close proximity to the shops.

As you move away from the town centre, there does not seem to be much deviation on parking restrictions. There are mostly room for residents parking only, forcing visitors to park in the out of town car parks provided. An example of this is Central Avenue shown in the photo overleaf;





Consequently, I believe analysis of the Parking Restrictions supports  $H_i$  as in the town centre parking is mainly restricted to remove as much congestion as possible whereas outside Bangor's CBD the parking is mainly unrestricted for residential areas and double yellow in the areas between Bangor's CBD and the residential areas.

### 3.4 Pedestrian Density

#### Spearman's Rank

This measures the relationship and degrees of association between two sets of data; in this case between the number of pedestrians and the town centre. The limits are +1 and -1, the greater the association, the closer the values will be between +1 and -1.

Rank 1 is given to the highest value, rank 2 to the next and so on. This is done for each set of data. When some values share the same rank, they are tied ranks and

assigned the median value of the 2 or more ranks. For example, if there are 2 rank values for rank 3, rank 3 and 4 will be added together and divided by 2, therefore giving a rank value of 3.5. The next rank after that would be 5. After putting each set of data into rank order, the difference in rank (D) between each value is squared ( $D^2$ ). The values of  $D^2$  are then summed giving  $\sum d^2$  which forms the basis of the formula:

$$RS = 1 - \frac{6 \times \sum d^2}{n^3 - n}$$

where  $n$  = the number of samples.

Once a value is obtained the critical value, tables are used to see the strength of significance. If the value is greater than the critical value it's possible to accept that there is a significant relationship between the two values, in this case, between pedestrians and distance from the town centre. Ten points were chosen throughout Bangor, these are indicated on the next map.

From these places on the map the number of people who walked past towards the CBD were counted in a ten minute period.

We were asked to decide which of the following hypothesis was the more conclusive;

Hypothesis ( $H_0$ )

*<<There is no significant relationship between pedestrian density and the distance from the town centre>>*

Alternative Hypothesis ( $H_i$ )

*<<There is a significant relationship between pedestrian density and the distance from the town centre>>*





You can see a busy area right in the middle of the CBD whereas another area away from the CBD is deserted (photo overleaf)



Analysis of this data shows that:

Distance	Rank	Pedestrians	Rank	D	D2
0	10	68	6	4	16
100	9	190	1	8	64
200	8	140	3	5	25
300	7	160	2	5	25
400	6	123	4	2	4
500	5	71	5	0	0
600	4	66	7	-3	9
700	3	58	8	-5	25
800	2	48	9	-7	49
900	1	24	10	-9	81

$$\text{Equation - } R_s = 1 - \frac{6 \times 318}{10^3 - 10}$$

$$R_s = -0.93$$

Therefore given that  $R_s$  is close to -1, we can conclude that there is a strong relationship between pedestrian data and the CBD. Hence, pedestrian count supports  $H_1$ . It is a negative correlation.

### **3.5 Rateable Values**

The rateable values were collected from the rates office on Hamilton Road in Bangor. Ten random properties were chosen from each street. These were then averaged to give the rateable value of three types of dwelling;

- Private
- Shop
- Office

These rateable values are multiplied by the commercial or domestic rate to give the final rateable value, which is paid to the Council each year.

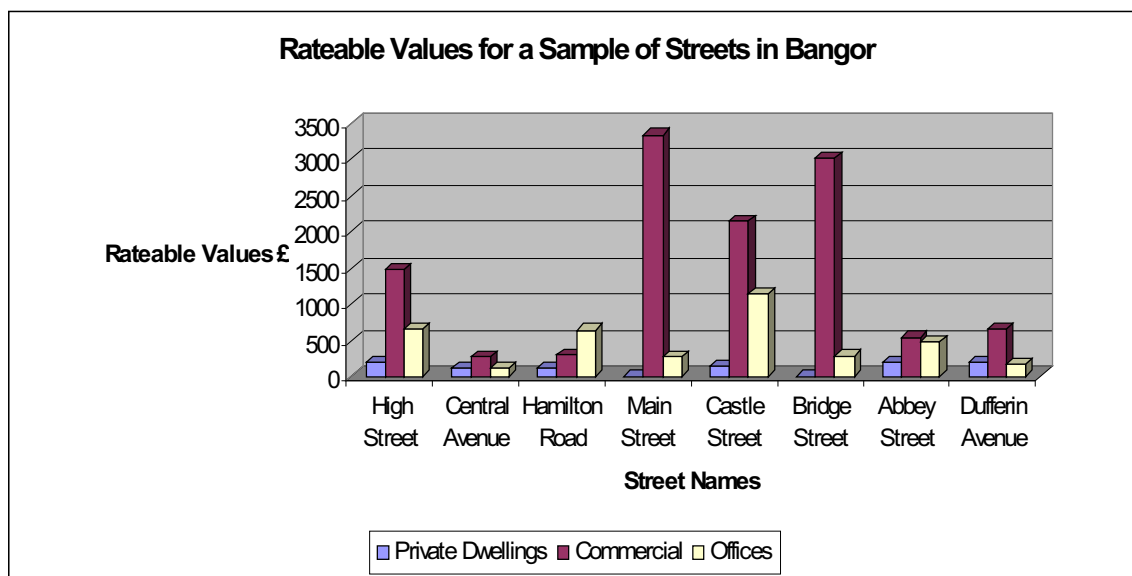
We were asked to prove the following Hypothesis.

Hypothesis ( $H_0$ )

*<<There is no significant relationship between rateable values and distance from the CBD>>*

Alternative Hypothesis ( $H_i$ )

*<<There is a significant relationship between rateable values and distance from the CBD>>*



On the combined bar chart of rateable values above, it shows that on every street, shops had the highest rateable value, second was offices and third were private dwellings. This shows that if the shops have the highest rateable value, they are likely to be placed near the CBD. Judging by the graph, I believe that the CBD of Bangor is in and around Main Street. High Street disagreed with my prediction of it being in the CBD as it has relatively low rates.

In addition, Main Street and Bridge Street has no private dwellings, further reinforcing the idea that they are in



the CBD. Assuming this, it could be assumed that rateable values would decrease with distance from the CBD. For example, the rateable values of in Dufferin Avenue are 75% lower than those in Main Street.

Analysis of rateable values supports the hypothesis  $H_i$  that the CBD of Bangor can be delimited using this data.

# **4**

## **CONCLUSIONS**

## 4.1 Land Use

Assessment of land use data showed that there was a direct relationship between the types of buildings on a certain street whether it was Commercial, Bank, Offices, Pub etc and the CBD.





From the picture above, it shows that land use in High Street is mainly Commercial with some Pubs / Restaurants. This is mainly the case the whole way to the top of the street.

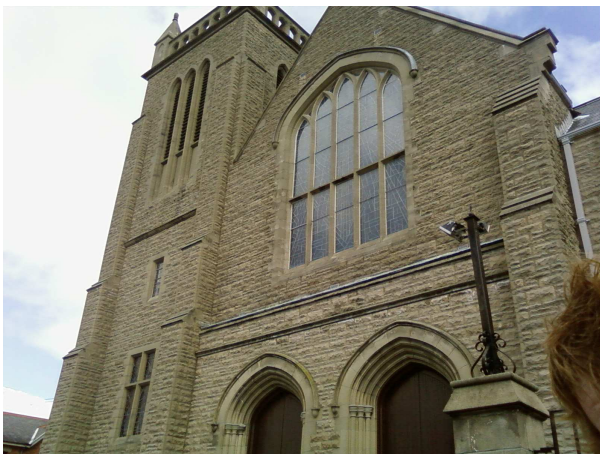


From the picture of Dufferin Avenue you can see it is nearly entirely Residential. Thus, you would expect it to be far away from the CBD, which it is.





From this picture of Hamilton Road you can see it is also residential, with a few Halls / Churches dotted along the road. Hamilton Road is also outside the CBD, which is reflected in its residential tendency's.



One of the churches on Hamilton Road.

The graph shown above is the comparison of land use for a sample of streets in Bangor. It shows the highest area of commercial buildings is in High Street followed by Main Street and decreasing as you move away from the CBD.

Consequently, land use supported  $H_i$ , as there is a significant relationship between land use and the distance from the CBD of Bangor.



The typical land use in Central Avenue

## 4.2 Building Heights

For building heights we were asked to test the following hypothesis:

Hypothesis ( $H_0$ )

*<<There is no significant relationship between average building heights and distance from the town centre>>*

Alternative Hypothesis ( $H_i$ )

*<<There is a significant relationship between average building heights and distance from the town centre>>*

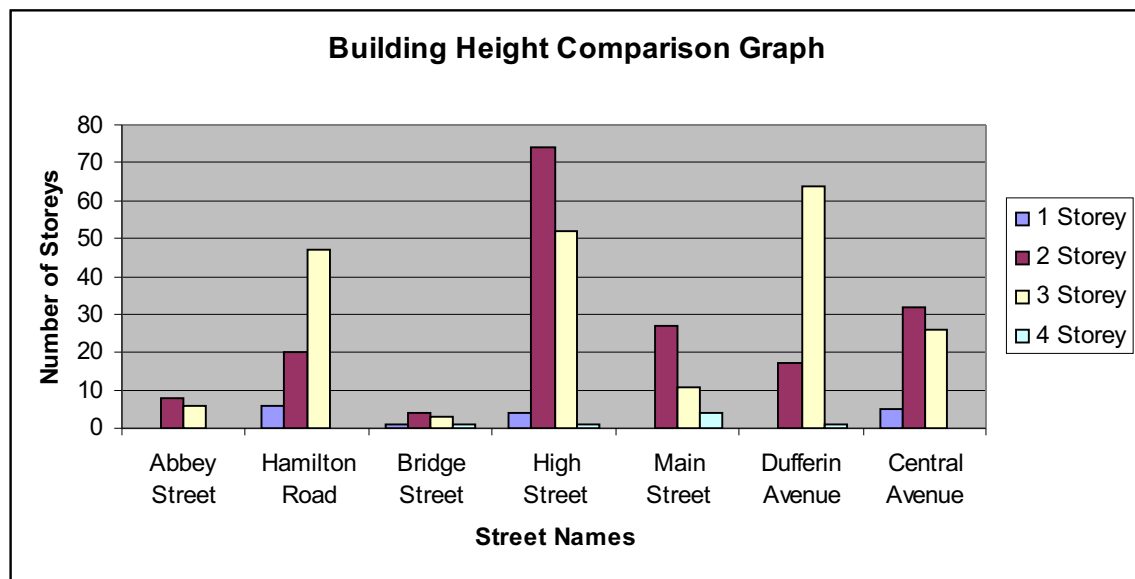
A photograph showing building heights in Main Street. You can see the different building heights along the street.







Building heights in Hamilton Road. These seem to be a lot more consistent although this is not the case everywhere.

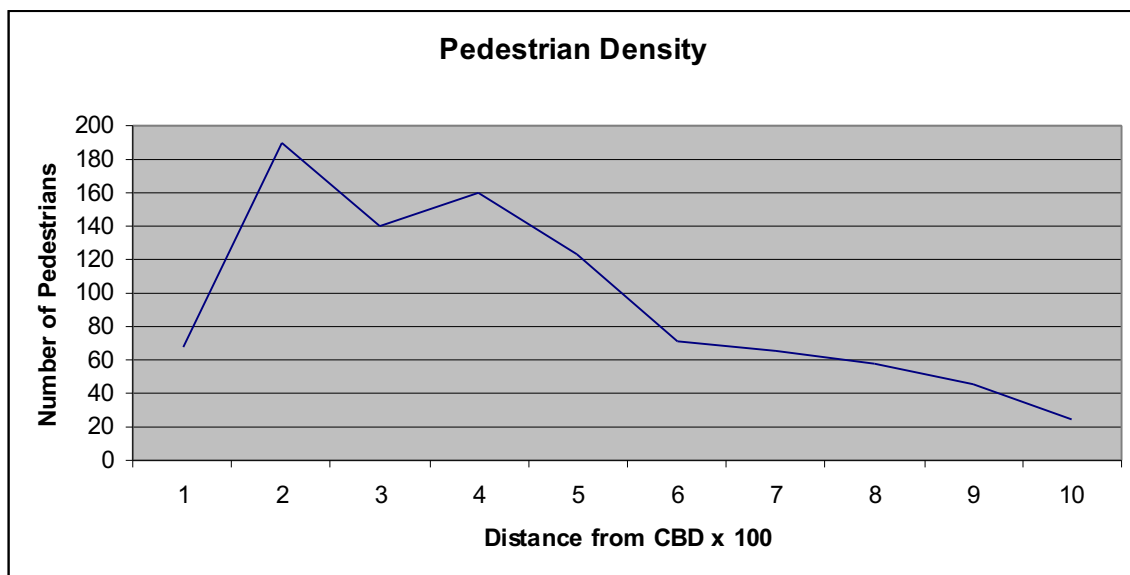


From the graph over the page you can see that High Street has the greatest amount of two storey buildings and Dufferin Avenue has the most 3 storey buildings.

By comparing the data on all the streets it is clear that there is absolutely no direct relationship between the heights of buildings and distance from the CBD. Therefore, my results supported the hypothesis  $H_0$ .

### 4.3 Pedestrian Density

In order to collect data for this, ten points were chosen on a map of Bangor and the people who walked past were counted and placed on a table.



The line graph above shows pedestrian density. It shows clearly that, with a few exceptions, the pedestrian density fell steadily the further away from the CBD you go.



The picture on the last page was taken outside the CBD, and you can clearly see the lack of pedestrians.





This photo was taken in the heart of the CBD and you can see the large amount of pedestrians.

Thus you can use the data recorded to prove that pedestrian count supported hypothesis  $H_1$  as it was a valid way of delimiting the CBD of Bangor.

#### **4.4 Rateable Values**

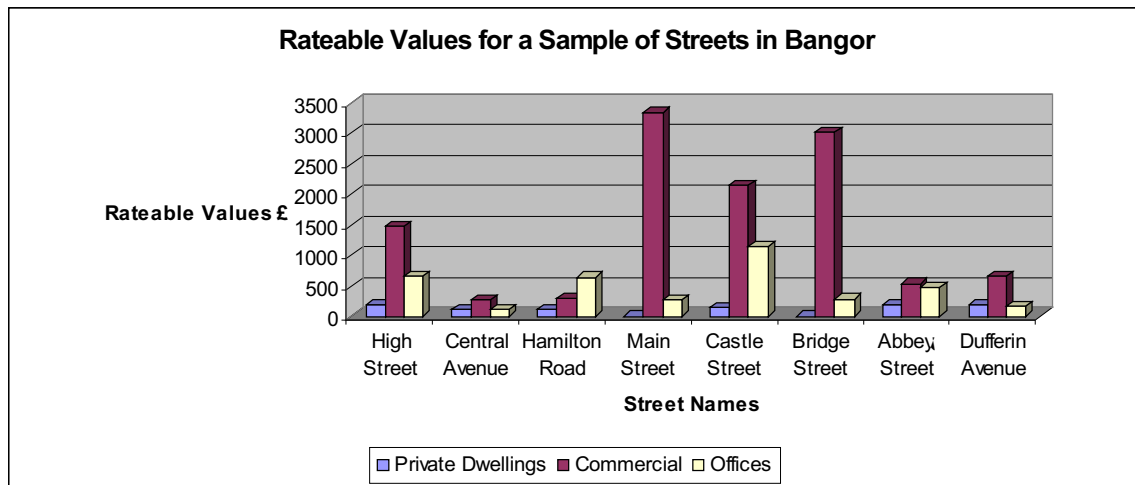
The information for the rateable values was gathered from the rate office on the Hamilton Road. The data showed that the rates for shops were the highest among all land uses. More importantly, the data was able to show that the further away from the town centre, the cheaper the rates got.



High Street (High Rates)



Central Avenue (Low Rates)



The assessment this data showed that the rateable value of property decreased with distance from the CBD of Bangor. This criteria supported hypothesis  $H_1$  that could be used to delimit the CBD of Bangor.



## 4.5 Parking Restrictions



Central Avenue – Double Yellow

To collect this data, streets were chosen and the data was logged on worksheets to investigate different types of parking restrictions in Bangor. The idea was that the more restricted the parking, the closer you would be to the CBD. The data here supported Hypothesis  $H_0$ . There was no valid way of showing the CBD of Bangor using these criteria.



# **5**

## **EVALUATION**

## 5 Evaluation

When I went to Bangor it was a very beautiful day with lots of pedestrians.

I think Bangor was an excellent area to study as it could easily be covered on foot in one school day and the layout of the route was well thought out. It was a simple town as well as it followed a scheme and it was not complicated by multiple CBD's etc.

I also think that if I was to extend the project I would enlarge my area of study to encompass outer boundary areas of interest such as Bloomfield Shopping Centre. It would be interesting to discover if the pedestrian density would increase as you neared the shopping centre.

