Introduction

Overall Aim:
To investigate aspects of the Central Business District (CBD) of Cambridge.

Origins of Cambridge:
Where the dense forests to the south and marshy Fens to the north met, was the lowest dependable fording position of the River Cam, or Granta. In the first century BC an Iron Age Belgic tribe settled there (now Castle Hill). In about AD40 the Romans took over the site and made it the crossing point for the Via Devana which linked Colchester with the legions in Lincoln and further. The Saxons followed, then the Normans under William the Conqueror, who constructed a castle on a steep mound as a base for fighting the Saxon rebel, Hereward the Wake, deep in the Fens at Ely. The motte of William's castle still stands and Ely Cathedral is visible from the top.

Fig 1: Situation map of Cambridge (north of London)

Growth of Cambridge:
Cambridge is no longer a sleepy university and market town, which is the regional capital of East Anglia. It is now a lively city of over 100,000 people and a modern industrial centre, with many science parks. The Central Business District (the commercial centre containing many shops and offices) of Cambridge has also grown, mainly due to the many universities located in the area and also due to more tourism. It is also very accessible with the M11 passing through Cambridge and good rail links with the rest of the country.
Cambridge has grown for many different reasons (see Fig 2). There was a plentiful water supply from the River Cam and having the river on three sides of the town made it a good defence site.
There are two Roman roads crossing through Cambridge making it a route convergence point.
Also it was a bridging point for the River Cam.

Fig 2: Site map of Cambridge showing reasons for its growth

The location map below shows the main CBD area, with the River Cam flowing on the left hand side of the map and many colleges all around the area.

Fig 3-Location map of Cambridge

Theoretical Background:

There are many different theories about how a city grows. Cities normally grow with recognisable shapes and patterns and these theories show that. Two land use models that can be used to show the growth in Cambridge are the Burgess concentric model and the Hoyt sector model.

The Burgess model below, says that the centre (core) of a town is the oldest part and building spreads out concentrically from the center. This will mean the newest part of the city is on the edge of the city.

The Hoyt sector model is similar to Burgess' idea but also thinks about industrial locations affecting the town's growth. This model was made after public transport was developed. He suggested that industrial areas developed in sectors by transport routes through of the city, with low-cost housing being built nearby (to house the workers).

Fig 4 & 5 - Urban land use models

Group work

Hypothesis 1: Pedestrian density decreases with distance from the centre of the Central Business District (CBD). The pedestrian density should be greater in the CBD as more people travel through the CBD for work, shopping etc….

Hypothesis 2: Building height decreases with distance from the CBD. As it is more costly to build more buildings in the CBD, builders have built upwards in the CBD. Therefore the buildings should be taller in the CBD, than in the other cheaper zones.

Hypothesis 3: Building age decreases with distance from the CBD. As the historic core of Cambridge is in the CBD, the population would have grown outwards from there.

Hypothesis 4: Land use will change with distance from the CBD from intensive, high density shops and offices, to lower density, industrial and residential. The CBD contains many shops and offices, so the residential and industrial areas are outside the CBD.

Hypothesis 5: Shoppers will travel further to Cambridge to buy higher-order goods
(comparison) goods than low order (convenience) goods. Low order goods have smaller
spheres of influence than high order goods, meaning shoppers will travel further for the higher
order goods.

Extension Work

Hypothesis: Banks should be clustered together in the CBD, not in sparse density. This is
because more people travel to and work in the CBD, than in other areas of Cambridge. These
people would want the banks close to where they go for convenience.

Hypothesis 1:
Pedestrian density decreases with distance from the centre of the Central Business District (CBD). The pedestrian density should be greater in the CBD as it is more accessible (with many people working there as well).

Method:

A number was allocated to each of the 41 people going to Cambridge. These numbers represented locations in and around the CBD. The people then counted the number of pedestrians walking past them in both directions in 10 minutes. The pedestrian count was conducted at the same time (as set by the teachers in charge) for everyone. The pedestrian count was recorded on the logging sheet and collected in at a later time.

Fig 1: Map showing pedestrian count locations (the highlighted one is my location)

Spearman’s Rank Correlation:
Site numberRank of distanceRank of pedestriansDifference between ranks
(D)$D^2$3412928784322272878431331.528.5812.2533431.527.5756.2538533.528.5812.253062
416277
33.526.5702.2516821131691391898118102212144241135.524.5600.252812.52613.5182.254
112.54
128.5812.253614392562535153823529116.5160.50.251716.5236.542.2526182574939191363
61520
2886437213716256402235.513.5182.251223914196292440162563251114196192619749142714
131
69828.5244.520.25228.5208.572.2523308224842531.5724.5600.252031.51714.5210.25733
1518324
11345298412135102562593630636437433108953833512252239122772910406341156641140160
0T
otal of D^2 column =18317.5

Spearman’s rank correlation formula: $(6 \times D^2)$
R=1 - where n= number of sites
$(n^3 - n)$ and D=difference between

ranks

Therefore: (6×18317.5)
R=1 - R= -0.596 (strong negative

(68921- 41) correlation)

Data Presentation and Analysis:

We recorded all the pedestrian data (see Appendix Fig 1) and were given that as raw data at a later date. From this raw data we produced an isoline map (Fig 1), which shows the pedestrian density - this is key evidence to prove our hypothesis.

Using the pedestrian count data we also measured the Spearman’s rank correlation (Fig 2) to see how strong the relationship between the number of pedestrians and distance from the CBD. The correlation must be a negative correlation to prove the hypothesis; negative correlation means that there are less pedestrians the further you move form the CBD. We produced a scattergraph (Fig 3) of this correlation so any pattern can be seen better (it is more visual and presentable).

The isoline map mainly showed that pedestrian density decreases with distance from the CBD, thus agreeing with the hypothesis. However there was one major anomaly at site number 30, where 412 people were counted. Surrounding this area were sites where only up to 50 people were counted in the pedestrian count. The reason why the number of pedestrians seen at site 30 was so high was because there was a shopping area there (Grafton Shopping centre).
Also on the isoline map the contours are not completely round, but usually oval. This is because there are many colleges in the area. The students walk around areas where there would not be very high pedestrian counts (as there are very few shops in the area so less people will be seen there).

The spearman’s rank and scattergraph show that there is a quite strong negative correlation between the number of pedestrians and distance from the CBD. This agrees with the hypothesis, but not completely even though the majority of points indicate there are less pedestrians further from the CBD. The scattergraph shows the clear anomaly at Site 30, as well (the point is isolated far away from all the others).

Conclusion:

The evidence from the data analysis seems to show that the hypothesis is correct, but not completely. The isoline map shows that mainly pedestrian density decreased with distance from the CBD, however shows some major anomalies. The Spearman’s Rank Correlation shows that although there is a negative correlation it is not strong enough to prove the hypothesis. The scattergraph, especially shows why the correlation doesn't agree with the hypothesis - there are some anomalies and you cannot clearly draw a best fit line.

We also could have improved the data collecting to improve our results. If we did it for a longer duration a better pattern may have been found. The pedestrian count was taken at around 11 am in sunny, hot conditions and this affects the results. Many people may not have left their houses to go out at that time (even though there was good weather) or could be at work/university. Also had there been bad weather conditions (e,g rain) we may have seen less pedestrians walking around Cambridge - they would either stay and home or use some other kind of transport (e.g a car so they are protected from the rain). So we cannot accurately measure whether the number of pedestrians decreases over distance from the CBD.

Hypothesis 2:
Building height decreases with distance from the CBD. As it is more costly to build more buildings in the CBD, builders have built upwards in the CBD. Therefore the buildings should be taller in the CBD, than in the other cheaper zones.

Method:
The 41 people on the trip were split into group of about 4/5 people. Each group was given a

different transect. Along each transect, every 50 paces, the number of floors (to determine building height) was measured of the building on the right hand side. 40 samples were measured per group and recorded in the logging sheet.

Fig 5: Map showing my transect; a similar map was given to all groups, except their transect was highlighted

Conclusion:
The results show that the hypothesis is not fully correct on my transect. The buildings in the CBD had varying heights, from 1 floor to 4 floors, but eventually settled at 3. However the building height did not reduce as expected until up to 1550 paces away from the CBD (sample 18, 900 paces away is an anomaly - it was a park). The final few samples (where there was no building height) were part of a large field. This does comply with the hypothesis, but the decrease in height was not in slow stages, through the different zones of the city. The height of the samples remained the same (at about 3 floors) was mainly because some of the samples actually measure the height of the same building (e.g - samples 26-32 are a college, however the college had different sections and so there were different heights). We saw very little residential housing, so we perhaps had not even exited the CBD until sample 34, when we reached the field. Also as there are many colleges (and they take up a large area so are often more than one sample) we are only actually measuring the height of one building, although it could have a different number of floors.
Building height does decrease with distance from CBD, but not in slow stages - it stays constant for a while. So the hypothesis is correct but not completely, as the height rapidly decreases when far away from the CBD. However the unique structure of Cambridge (with its colleges and large fields/parks) make this hypothesis very difficult to prove - we cannot conclusively say that the hypothesis is right or wrong.

Hypothesis 3:
Building age decreases with distance from the CBD. As the historic core of Cambridge is in the CBD, the population would have grown outwards from there.

Method:
The 41 people on the trip were split into group of about 4/5 people. Each group was given a different transect. Along each transect, every 50 paces, the age of the building was estimated. If there was no date on the building, we classed it into one of four groups: Pre-1900 buildings Interwar housing, 1950's or Modern. 40 samples were measured per group and recorded in the logging sheet.

Conclusion:
The results don't really prove the hypothesis as the building age never really decreases (with the exception of the modern housing at sample 39). I explained before that most of the samples are probably in the CBD, so we need more results to help prove the hypothesis. However from my results, we can see building age does not decrease with distance - so the hypothesis (and the Burgess model, what this was based on) are incorrect for Cambridge.
The method was slightly inaccurate as it was hard to determine exactly which age group a building fell into (unless there was a date on the building). There has been some redevelopment

in the CBD so although originally a building may be inter-war housing, we can only tell that it is
Modern housing. Also we would need to do a longer transect (e.g collect 80 samples) to see
whether the hypothesis is correct as most of the samples here are of buildings in the CBD.

Hypothesis 4:
Land use will change with distance from the CBD from intensive, high density shops and offices,
to lower density, industrial and residential. The CBD contains many shops and offices, so the
residential and industrial areas are outside the CBD.

Method:
The 41 people on the trip were split into group of about 4/5 people. Each group was given a
different transect. Along each transect, every 50 paces, the land use (the ground floor function)
was estimated. We used the following classifications:
R=Residential i.e - flats, houses
I=Industrial i.e - factories, building works
C=Commercial i.e - shops, warehouses, market, travel agent, petrol, car sales, garage, antiques
E =Entertainment i.e - hotel, sports centre, theatre, cinema, museum, pub, club, café, art gallery
P= Public buildings i.e - education, health, GPO, local government, church, police, job centre
O=Open space i.e-farmland, park, derelict building, sports field, cemetery, unused land, water
T=Transport i.e- railway, bus station, airport, car park,
S=Services i.e- bank, building society, doctor, dentist, optician, vet, solicitor, estate agent,
architect

Conclusion:
The hypothesis was proved completely incorrect with my results. No offices and industrial areas
were found on my transect at all. There was only one residential sample as well. Therefore we
saw no change from Commercial to Industrial and Residential. However there were many
Public buildings (colleges), so we saw a change of Commercial to Public buildings. Further
away from the CBD we saw a change of Public buildings to Open space (fields).
I doubt this hypothesis would have been proved correct on any transect as there are so many

colleges in Cambridge, especially around the CBD. The colleges were the main part of my transect so we only had a few classifications (6 in all - C, P, E, S, O and R).