Geography Coursework

How does the demand for land and services change as we move away from the CBD of Houston?
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**Introduction and aims**

Geography moulds the world around us and affects the activities in our daily lives. It is present everywhere, from cities to mountains and from the oceans to the foothills. It establishes patterns and correlations between man and nature, which provide vital facts about settlements. This study investigates the patterns which exist in a city their variation as we travel to different locations.

**Purpose of study:** This investigation was based in downtown Houston and we examined various sites along a central transport route connecting to the heart of the city (Main St). We collected data to investigate or even discover a pattern existing in downtown Houston. As we all know, downtown Houston is the heart of the city and houses the CBD of Houston which is the central business district. The purpose of our study was to examine the demand for land and the services which were concentrated around the CBD. We noticed how these demands changed as we moved out of the CBD and towards the cheaper housing areas of Houston. Through this study, we hope to identify and explain patterns regarding the changing demand for land and services around the CBD and determine whether Houston conforms to any city model. The study would help me better understand the city sector models developed previously by other geographers such as Burgess and Hoyt. With all the collected data, I hope to put together a detailed research report based on my hypothesis. I will need to use a vast variety of data (primary and secondary) to explain the pattern seen. After collecting my part of the data, I will gather the other data from my teammates. With a full set of data, I will then manipulate it identifying anomalies and processing the raw data. With my processed data, I will produce graphs and diagrams and then start to analyze and identify patterns residing in my data set.

**Hypothesis:** How does the demand for land and services vary as we move away from the Central Business District (CBD) of Houston?
Data collection

Here is a map of the exact sampling points where data was collected.

Map to show Sampling Points

A: Discovery Green
B: Minute Maid Park
C: Main St at McKinney
D: Main St at Leeland
E: Main St at Gray
F: Main St at Elgin
G: Main St at Wheeler
H: Main St at Hermann Dr

Required Data: For my investigation, I will need to monitor factors such as traffic, attraction range, etc. Precisely, I will need to take into account the following data:

- Tax disc Survey results
- Traffic activity in and out of the city
- Quality of areas near CDB
- Pedestrian Count
- Litter Count
- Amenities Count

These will be used to justify reasons for changing demand

Justification of Primary Data collection methods:

- **Tax disc data**- County tax registration plate locations were noted. It is a legal document which is certified by the government of Houston.
- **Traffic Activity**- Vehicles on the street were counted giving an indication of congestion. With this method, we can also see the nature of vehicles which are entering the CBD, eg. Vans, SUVs or Cars.
- **Quality of areas near CBD**- Using a numerical scale based on certain specifications gives us an accurate indication compared to other methods. Through environmental quality can be graphed.
- **Litter Count**- Naming each piece of litter found is effective because it does not just gives the amount of litter but also gives the nature of it.
- **Amenities Count**- Each amenity found was named and listing. This gives us a nature of the amenities found and also allows us to group them according to their category. (E.g. convenience)
## Data collection methods and limitations:

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Data Name</th>
<th>Why was it collected?</th>
<th>How was it collected?</th>
<th>Where was it collected?</th>
<th>Limitations and problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Tax Disc Survey Results</td>
<td>To map a sphere of influence for the sampling point. (showing demand)</td>
<td>By noting down tax disc registration locations of the vehicles</td>
<td>It was collected at the nearest parking lot to the site.</td>
<td>There were little or no cars at some of the sites which made it hard to collect this data. Owners may have used rental vehicles travel which may give inaccurate data.</td>
</tr>
<tr>
<td>Primary</td>
<td>Traffic activity in and out of the city</td>
<td>To represent demand related to the influx and out flux of traffic into the CBD</td>
<td>By counting the number of vehicles passing a given point.</td>
<td>At the intersection of every site</td>
<td>On roads with tram systems or good public transport, personal vehicles may not be used giving us unreliable data for the sampling point</td>
</tr>
<tr>
<td>Primary</td>
<td>Quality of areas near CBD</td>
<td>Produce answers for the increase in demand of services near the CBD by monitoring the environmental quality</td>
<td>By observing the quality of environmental conditions. This was gauged in a scale of +3 to -3 where 3 was the best</td>
<td>It was collected around a small periphery of the site</td>
<td>This was a very effective method with a limitation: it was based on personal views. Different people could gauge the same thing differently, based on their opinions. To solve this problem, we had 2 people collecting this data and an average was used.</td>
</tr>
<tr>
<td>Primary</td>
<td>Litter count</td>
<td>To gauge the cleanliness of the areas, which could explain the various demands of the area</td>
<td>By counting each piece of litter found on the streets of the sampling site</td>
<td>It was collected around the site where litter was to be found</td>
<td>Some areas near the inner city had too much litter to be counted, which posed a problem when differentiating the two sites.</td>
</tr>
<tr>
<td>Primary</td>
<td>Amenity count</td>
<td>To gauge the amount invested by the government to maintain the demand of the area</td>
<td>By spotting each amenity near the site such as gas pumps or benches</td>
<td>It was collected around the site where amenities were found</td>
<td>It is hard to spot every amenity because; they can be very small or very large in size. Items such as poo collectors and churches are hard to notice or even consider as an amenity</td>
</tr>
<tr>
<td>Secondary</td>
<td>Room tariff for hotels near the CBD</td>
<td>To show the demand for land in the area with an economic perspective.</td>
<td>By averaging the tariff for hotels within each distance range.</td>
<td>Searched and found on internet on travel sites.</td>
<td>Different hotels could have different facilities which may result in cheaper or higher prices compared to the certain distance range. I will need to eliminate extreme data to solve this issue</td>
</tr>
</tbody>
</table>
**Data Presentation**

**Introduction**

This section will display the data collected during the study in a comprehensive format and also show the secondary data which was researched from the internet or other sources.

**Aerial image to show path taken during study**

After identifying the data collection methods, I need to present the data to support my hypothesis. The diagram/map show the path of the study and its exact distance (2.62 miles).
Presentation of Tax Disc Data

This data shows the sphere of influence for the certain sampling point and shows the demand for the area in general. A large demand equates to a wider spread with links from more counties which are further and more remote (Fig. 1.1 and 1.2). A low demand equates to a poor range of counties which are nearby and easily accessible by local transport routes (Fig. 1.3 and 1.4). We can conclude here that as we move away from the CBD, the sphere of influence becomes narrower.

I used this method of presentation as it gives a very vivid and visual representation of the data on a map, so that the geographical spreads and distances can be easily compared.
Presentation of traffic activity in and out of city

Displaying the demand of an area in regards to traffic activity, Fig. 2.1 shows the traffic count data of the various sites with data series on each vehicle type. The graph shows that traffic activity increases as we get away from the CBD with a few anomalies. Fig 2.2 shows pedestrian activity and we can clearly see that pedestrian activity is highest in the heart of the CBD. Fig 2.3 which shows the traffic in flow and out into the areas displays no clear trend but we can see that traffic flow is highest in the CBD.

This method was chosen as the proportion of traffic can be easily visualized providing effective means of comparison.
Figure 2.2

Pedestrian activity in and around the CBD of Houston

Figure 2.3

A bar graph type chart helps to provide representation which can be easily interpreted and understood.

Line graphs show a change in value over a certain distance which can be used to monitor changing continuous data such as traffic activity effectively.
Presentation of Environmental Quality Survey Data

Environmental Quality

Points

Distance from CBD

CBD  Inner City  Areas with slight urban regeneration  Inner Suburb  Outer Suburb

Photographs of the various areas highlighted in the above graph with annotations

Picture of the Houston CBD

A view of Downtown (CBD) from Minute Maid Park

Sky Scrapers with high end offices

Well landscaped areas

Organized car parks

A large variety of amenities such as bus stops and lights
Other characteristics of inner cities which we found:

Large amount of graffiti on shop walls and derelict buildings.

High litter count in the inner city, mainly consisting of plastic bottles and cans.

Poorly maintained amenities which suggest the reason for high litter count.

Pictures provide a very realistic approach to field work and display features which few graphs can. It gives hands on experience when we are analyzing data.
Picture of an area with slight urban regeneration

Multi storey car parks for office beside it

A pharmacy present across the car

Amenities added

Good landscaping, this has been recently added

Figure 3.4

A picture of an area in the inner suburbs:

A view from Elgin St and Main St

A pharmacy present across the car

Pedestrian walkways

Good landscaping with large amount of trees

Fountains present for beatification

A view of Herman Drive near the Herman Park entrance

Figure 3.5
Presentation of amenities audit data
The amenities found can be grouped into basic categories such as these: Services, Convenience, Transportation, Beautification

Site 1: Discovery Green

<table>
<thead>
<tr>
<th>Services</th>
<th>Convenience</th>
<th>Transportation</th>
<th>Beautification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Playground</td>
<td>Chairs/ Benches</td>
<td>Bicycle Track</td>
<td>Lake</td>
</tr>
<tr>
<td>Cafe</td>
<td>Toilets</td>
<td></td>
<td>Greenery</td>
</tr>
<tr>
<td></td>
<td>Water cooler</td>
<td></td>
<td>Artificial hill</td>
</tr>
<tr>
<td></td>
<td>Garage</td>
<td></td>
<td>Statue</td>
</tr>
<tr>
<td></td>
<td>Dog poo bags</td>
<td></td>
<td>Sculpture</td>
</tr>
</tbody>
</table>

Site 2: Minute Maid Park

<table>
<thead>
<tr>
<th>Services</th>
<th>Convenience</th>
<th>Transportation</th>
<th>Beautification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benches</td>
<td>Bins</td>
<td>Bus Stop</td>
<td>Greenery</td>
</tr>
<tr>
<td>Cafe</td>
<td>Shade</td>
<td></td>
<td>Statue</td>
</tr>
<tr>
<td></td>
<td>Lights</td>
<td></td>
<td>Sculpture</td>
</tr>
<tr>
<td></td>
<td>Disabled Parking</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ATM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Map</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Donut diagrams allow you to compare two different sets of data with very effective colour representation which shows clear change in values.

Nature of amenities

Figure 4.1

Site 1: Discovery Green
Site 2: Minute Maid Park
Site 5: Main St. at Gray

<table>
<thead>
<tr>
<th>Services</th>
<th>Convenience</th>
<th>Transportation</th>
<th>Beautification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mac Donald’s</td>
<td>Bin</td>
<td>Bus stop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pay Parking</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Site 6: Main St. at Elgin

<table>
<thead>
<tr>
<th>Services</th>
<th>Convenience</th>
<th>Transportation</th>
<th>Beautification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop</td>
<td>Bench</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petrol Station</td>
<td>Lights</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Nature of amenities**

Figure 4.2

**Amenities Count data**

This data can be cross referenced with many other data types to prove a point. The data shown is represented in 4 categories and it is drawn on a donut graph. As we can see, as we move away from the CBD, the numbers of amenities decrease and less and less of them are related to beautification. This in turn causes a decrease in the environmental quality. Also, with poor amenities, litter count increase as shown by Fig 5.2
Presentation of litter count data

Number of litter found

Litter Count Data
The litter count data shows that there is a clear trend in the litter count. It can be easily seen that as distance from CBD increases, the amount of litter at the sampling point increases (with an anomaly at site 2: Minute Maid park). Fig 5.2 shows a cross referenced data graph, comparing amenities with litter count. It clearly shows a decreasing trend with the line of best fit was plotted.

Graph of litter against number of amenities:

Amenities against Litter count

Figure 5.1

Figure 5.2
Hotel prices near the CBD

**Hotel Tariff Data**

The hotel tariff data’s trend line shows a very interesting pattern which confines to geographical theory. The trend line shows the price decreasing as we move away from the CBD but then slowly starts to increase as we hit the inner suburban areas which houses “pockets” of development such as the presence of a Medical Center.

Graphs the like these are very useful because they allow us to make sense of scattered data plots by adding a trend line. These help us to see co relations very effectively (e.g. tariffs drop and then increase as we get to inner suburbs.)
Data Analysis

The various data collected show many patterns and trends which need to be spotted and explained. First I will need to describe the data which has been presented in the previous section and identify the basic trends.

Environmental Quality Data (not shown in data presentation section)
The graph (Fig 3.1) shows the changing environmental quality of the Houston Downtown area. A sharp decreasing trend is shown by the graph with a spike in certain areas (areas with urban regeneration). The graph follows the trends of geographical theory which mentions decreasing environmental quality from the CBD with spikes at regenerated or developed areas. The pictures provide pictographic evidence to support points made in the later section.

Statistical Analysis

Spearmen’s Rank Correlation Coefficient
This can be used to whether a link is present between two variables. (In my case, Hotel tariff and environmental quality)

The formula:
\[ \rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)} \]

Null Hypothesis: There is no significant correlation between environmental quality and hotel rates.

Research Hypothesis: There is a significant correlation between environmental quality and hotel rates.

<table>
<thead>
<tr>
<th>Variable x: Environmental Quality</th>
<th>Variable y: Hotel Tariff rates based on distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable x</td>
<td>Rank x</td>
</tr>
<tr>
<td>46.5</td>
<td>1</td>
</tr>
<tr>
<td>39.5</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>-16.5</td>
<td>6</td>
</tr>
<tr>
<td>-22.5</td>
<td>7</td>
</tr>
<tr>
<td>-4.5</td>
<td>5</td>
</tr>
<tr>
<td>-35.5</td>
<td>8</td>
</tr>
<tr>
<td>42</td>
<td>3</td>
</tr>
</tbody>
</table>

Total \( d^2 = 19 \)

Using the formula, SRCC= 0.77381

From my SRCC, we can clearly see that there is a strong positive correlation between hotel tariff and environmental quality. When working with a sample size of 8, a 95% significance needs a value of 0.64 and above while a 99% correlation needs a value of 0.83 or above.

Final Statement: I can reject my null hypothesis and therefore accept the research hypothesis. I can be 95% confident that there is a positive correlation between environmental quality and hotel tariff.
How does demand change as we move away from the CBD?
From the patterns established from the above and the graphs produced in the data presentation section, we can say that demand decreases with increasing distance from the CBD, until it hits the suburbs. Referring to geographical theory, the land use of areas near the CBD greatly influences the demand. Posh areas like the CBD have high end offices, brand name shops, etc. which attract the people (mainly the richer crowd). In Fig. 1.1, we can see that there is a very large spread with vehicles from 7 different counties. Some vehicles were even from Oklahoma. This shows that Discovery green has a high demand which attracts people from a large range. Fig 1.2 also has very similar characteristics with vehicles from 8 different counties. Fig. 2.2 backs up this theory as shown by the high pedestrian count in the CBD. Referring to data for the environmental survey, we can see that the government/private organizations have maintained the standard of the area with sufficient investment in beautification and convenience (Fig. 4.1). As the environmental increases, offices and other businesses want to invest in the CBD. Referring to my statistical analysis, we can conclude that this causes an increased demand for hotels in the area, resulting in higher tariffs per night, which prove that demand is very high in the CBD. This demand is created by an influx of high skilled labor in the area who patronizes hotels for business purposes. Litter count in the area is also the lowest suggesting good maintenance of the premises due to the presence of a large amount of amenities (Fig. 5.1 and 5.2). An important link in the relation between amenities and litter count is shown in the graph (Fig 5.2). The graph shows a negative correlation with litter count decreasing with increasing amenities. Increased amenities mean that more rubbish bins and poo collectors thus people are more likely to put the rubbish in the right place (bin). This means in the CBD, the litter count is low due to the presence of a large amount of amenities. Linking this to my hypothesis, I can say that the CBD has the maximum demand in the area when compared to the other areas which I am going to study. Its demand is very much economical as it acts as the business hub of the city. The demand is more for the services (shops, restaurants, offices) rather than the land, but this demand for services spurs a massive increase in demand for land due to the location and its convenience. The characteristics of the CBD as shown by my data make it a part of both the settlement models (Burgess and Hoyt) as their specifications are very similar.

The more derelict areas of town are less developed with the presence of derelict industry, poor quality housing and rising social tensions. These theories are greatly reflected in the data which I have collected. As we start to move towards the inner city areas, the sphere of influence is greatly decreased. In Fig. 1.3 and 1.4, the case is very different. The vehicles are mainly from Harris County with a minor number from surrounding counties such as Fort Bend and Galveston. In site 6, vehicles were present from 4 counties which were near the Inner city areas. This represents low demand and the area lacks the ability to attract people from a wide range. Here, as we moved away from the CBD, the demand decreases. Fig. 2.2 reflects a difference too, in terms of pedestrian count and shows low levels of pedestrian activity which suggest poor amenities and attractions. Environmental quality also drops drastically with values in the
negative axis, suggesting poor landscaping and beautification as shown in Fig 3.1. The amount of amenities for beautification also drops suggesting that only the bare minimum is present for the residents to use. Poor amenities and environmental quality show a lack of investment in the area which equates to a low demand. This low demand is represents due to the absence of offices and shops in the inner city areas. Photographs in Fig 3.3 provide evidence regarding the poor maintenance of amenities which may be the root cause for the high litter count from Sites 4 to 6 (referring to Fig. 5.1). Hotel Tariff rates have also dropped near the inner city areas, going as low as $89 per night (Fig 6.1). This shows a major drop in demands as we near the inner city areas. Prices have dropped here due to the absence of a business oriented crowd which reside in the CBD hotels. Their absence has caused a lack of demand for hotels which have to settle for lower prices. Considering my hypothesis, we can see a sharp decrease in demand for this area (Inner City) due to the evidence stated above. This follows my hypothesis statement and conforms more to the Burgess City model due to the presence of derelict land and low class housing which are arranged more in rings than in sectors. We saw major changes in land use in the same major road which suggests the presence of a circular arrangement. However, in a Hoyt model, similar characteristics would have been seen along that transport route as Hoyt suggested that development of certain zones occur only along a major road.

The above patterns start to change again as we move into the suburban areas. Suburban areas are characterized with improving living conditions and richer residents. Semi-detached housing and private estates are abundant in these areas with better amenities and facilities. These differences are clearly represented in my data. Fig 2.1 shows that traffic activity is highest, furthest from the CBD, suggesting high demand and good transport routes. As mentioned in geographical theory, people move to such areas due to the presence of good transport routes and traffic count data clearly shows this. Environmental quality improves drastically, reaching as high as the CBD itself suggesting state of the art landscaping and high government/private organization investment (Fig 3.1). As there are Medical Centers and research institutes in these areas, the demand is high, urging the authorities to maintain the landscape and clear any litter which is present. Litter counts also decrease drastically suggesting presence of adequate amenities which are well maintained. Hotel tariff also starts to increase as we move into the suburbs with pockets of development present (Fig 6.1). Referencing this with my statistical analysis, we can say that Hotel tariff rates go up due to good environmental quality. This environmental quality is caused by the government adding more in investment to the inner suburban areas which includes adding more amenities. As we know, an increase in amenities is followed by a decrease in litter count. Decreasing litter count helps to increase the environmental quality of the area and these events continue in a cycle to form the basic stages of development. An interesting correlation to note is the one between pedestrian activity and traffic activity. Near the CBD, where pedestrian count is at its highest, traffic activity is at its lowest. Slowly, as we move away, pedestrian count decreases, while traffic count starts building up. As facilities are near by in the CBD, people can commute by walking and they prefer it, resulting in a high
pedestrian rate (Thus a low traffic count). Further away from the CBD, the amenities are further away from each other, resulting in more people using cars. So, as pedestrian count increases, traffic count decreases. Linking this to my hypothesis, I can say that the decreasing trend shown by data from the inner city is not present anymore and the demand begins to rise, this time for the land. The inner suburbs which house the high class is located very close to the CBD and as land is cheaper here, the demand shoots up for people who cannot afford housing in the CBD. When trying to link this all into a settlement model, all three areas of my study clearly fit into the Burgess model as all the changes have occurred along one transport route, highlighting the presence of an annular arrangement. Also, in Houston all the roads are criss cross and mostly perpendicular to each other which results in a simple annular arrangement. Cities with complicated road directions generally fall into the Hoyt model as it is based around sectors which form along roads going in various directions.

Limitations/ Anomalies in data
One easily identifiable anomaly in the data is the litter count for Site 2: Minute Maid Park. It shows an unusually high litter count for its location, which is in the heart of the CBD. This could be because of the fact that it is near a stadium which accommodates a large number of people who produce a large amount of litter. If this anomaly was not present, my graph for litter count would show a smooth and clear pattern.

A limitation to the study was the presence of a metro rail public transport system which tampered with the data for pedestrian count because many of the pedestrians may have chosen to use the rail in the edges of the CBD. This may make many of my conclusions incomplete.

Another limitation to the study was time. Different characteristics of areas are revealed with changing time for example during lunch time, an unusually large amount of pedestrians are present. In my study, data is taken at different times for each site which may give me inaccurate results. The above limitations may endanger the accuracy of my study but even with possibly inaccurate results, my data shows a strong correlation that demand decreases as we move away from the CBD, until the suburbs are reached where demand starts to increase again.

Conclusion of investigation
• We can clearly conclude that demand is the highest in the CBD and lowest in the inner city, with a reasonably large demand for the inner suburban areas.
• The demand in the CBD is created by the existence of high class shopping, offices, posh restaurants, etc. which creates an influx of wealthier consumers and businessmen into the area.
• The Inner city is home to the least demand and is inhabited by the poorest people of the city (minorities). It consists of derelict industry and low class housing with reduced environmental quality which is a deterrent for consumer influx.
• The inner city also has a high demand due to its proximity to the CBD of Houston. It consists of semi-detached housing and high-class residential areas which attracts a large amount of wealthy residents working in the CBD. It has high environmental quality and good transport links with the CBD which aid in escalating the demand of the area.

• The demand not only changes in its magnitude but also in its type. The CBD, the demand is linked to the services such as shops and offices not much to the land. This can be proved by the fact that during night, the CBD is almost empty which shows that it only houses a business crowd.

• In the inner suburbs, the demand is much more due to the location of the land which has spurred an increase in the services of the area. The location of the land is vital in providing it with the high demand which it has attained.

• Lastly, I believe that Houston conforms to the Burgess Settlement Model due to the fact that all changes that were seen occurred on a single transport route. This proves the existence of circular settlement arrangements.

**Evaluation**

The field study went pretty well, with which I could draw sound conclusions. The question was answered very clearly, with clear representation of the data collected. It clearly showed that with increasing distance from the CBD, the demand for the area decreased, until it hit the inner suburbs. However, the key set of data which showed demand, mainly the tax disc data, was incomplete as there was no data for areas in the inner suburbs. To improve this study, I would need to use major car parks as my secondary sampling points to get a complete set of data. My investigation functioned well with each data linking with the other. Patterns were seen in every data set apart from traffic count. The data which was least useful was the traffic count data as it did not help me to spot any patterns or explain other patterns. The other data sets were enough to prove a point and the traffic activity data was not every effective. A piece of data that would be effective is the crime rate within the areas in the CBD. We could count the number of robberies and murders in the area and compare it to the data got for the CBD itself. Another alternative to using hotel tariff, is to use apartment rents of the apartments on Main St. As an extension to my study, I could have more sampling points past Herman Park and into the Outer Suburban areas. This would help me get a more rounded graph which covers all the important sectors of a settlement. The accuracy of my data is questionable due to the fact the data for each sampling point was collected at different times. This could influence things like pedestrian count, the traffic count and even the sphere of influence. However, my data is valid due to the fact that it conforms to most geographic models brought about by Burgess and Hoyt. The geographical theory explains similar patterns to that of my data which proves that my data is reliable.
Bibliography

The following references were used:

- www.juicygeography.com
- http://www.geography.learnontheinternet.co.uk/topics/landusemodels.html
- Google Earth (for aerial shots)
- Wikipedia- Spearman’s Rank Coefficient Constant