Evaluating the Efficiency of Spatial Distribution of ATM Machines in Abha City using Geographical Information Systems

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Abstracts

This study aims to use geographic information systems to analyze the spatial distribution of ATMs in Abha city. This is based on the most important applied aspects of geographic information systems, namely spatial analysis, to reveal the characteristics of the spatial distribution of ATMs and their distribution pattern, and to evaluate the efficiency of their distribution according to spatial variables. The study came out with a number of results and recommendations, the most important of which is increasing the number of ATMs in high-density neighborhoods that are deprived of service, which reduces the pressure on them, in a way that ensures their sustainability, and in a manner that is proportional to both the area and the number of residents in the city's neighborhoods.

Keywords: ATM machines; Spatial distribution; Applied Geography; Geographic information systems.

Introduction

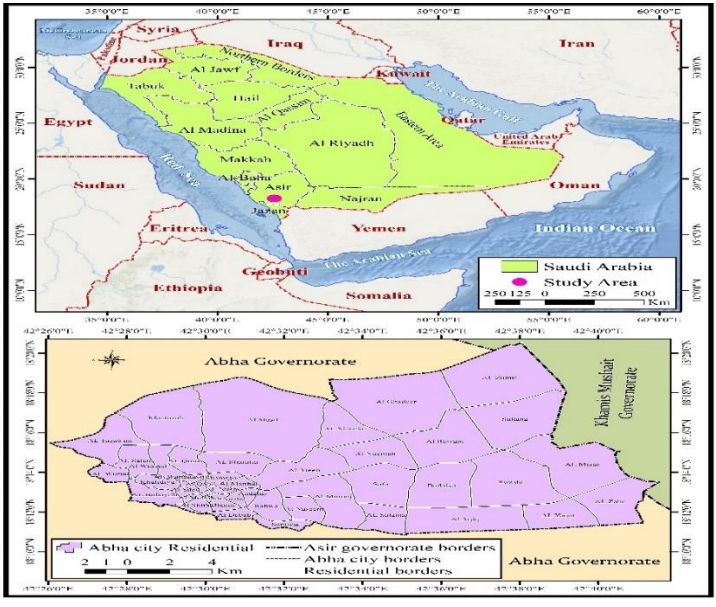
Banking services are vital services in the country, as they play an effective role in implementing the objectives of monetary policies to achieve comprehensive development projects. This requires providing banking services and increasing their efficiency to keep pace with rapid technological developments and the increase in e-commerce operations, which requires providing a type of non-traditional banking services (Al-Deeb, 2006, p. 125). All types of banking services have witnessed rapid development in quantity and quality, and banks are now facing great competition to gain more customers and increase their cash share; therefore, they have provided more ATMs.

ATMs represent one of the types of electronic banking services that have provided customers with more services, including saving time and effort and reducing frequency of visits to different banks, as ATMs are a means of communication between customers and banks, and through them the customer obtains many different cash services; hence, banking services have become a major requirement in contemporary societies (STUTZ & WARF, 2005, p. 279). The city of Abha has witnessed a clear increase in the number of ATMs, in light of the state's encouragement to use electronic payment methods to reduce the number of customers visiting banks. In 2023, their

number reached 109 machines, after it was only 47 machines in 2000, with an increase of 62 machines in a period not exceeding twenty-three years.

Study area:

Abha city is located between latitudes ˚18 ´10 ˝52 and ˚18 ´20 ˝31 north, and between longitudes ˚42 ´25 ˝59 and ˚42 ´41 ˝30 east in the southwest of the Kingdom of Saudi Arabia within the Asir administrative region, and is bordered to the east and northeast by Khamis Mushait Governorate, to the northwest by Tanuma Governorate, and to the west and southwest by Muhayil Governorate. Abha city is the capital of the Asir administrative region, and the region's emirate and most government interests and institutions are located there, and it is connected by a network of main roads with the cities of: Al Khamis, Al Namas, Ahad Rafidah, and Jazan. Abha city consists of forty-five residential neighborhoods, according to the classification of the Asir Region Municipality, and occupies an area estimated at about 300.44 km2 according to the official map approved by the Asir Region Municipality as shown in Figure.(1)



Source: Digital maps of Abha city, Asir Region Municipality, 2023.

Figure (1) the geographical location and administrative division Abha city 2023.

Research question:

- Is there a fundamental difference in the distribution of ATMs at the level of Abha city's neighborhoods?

- Research hypothesis: There is no fundamental difference in the distribution of ATMs at the level of the city's neighborhoods, meaning that they are distributed efficiently in the study area.

-Alternative hypothesis: There are fundamental differences in the distribution of ATMs at the level of the city's neighborhoods. Meaning that they are not distributed efficiently at the level of the neighborhoods of the study area.

Previous studies:

Previous studies are divided into two sections:

First - Studies related to the analysis of some services using geographic information systems:

There are a number of studies that dealt with some services in terms of analyzing the distribution pattern and efficiency of services at the level of some regions of the Kingdom, including: The study (Al-Rahili, 1427 AH) aimed to use geographic information systems to evaluate the current status of the sites of government girls' schools in the city of Makkah Al-Mukarramah at all its stages, according to a set of natural, human and social criteria. The study (Al-Sheikh, 1429 AH) focused on studying the geographical pattern of the distribution of public and model parks in the city of Jeddah using cartographic analysis in geographic information systems (GIS). Al-Duwaikat and Al-Faisal studied the analysis of the distribution pattern of theft crimes in the Saudi city of Hail using geographic information systems. The study showed a strong relationship between theft sites and the perpetrators' residential locations, and that the general trend of thefts in the city of Hail is towards the northwest with new urban trends. The study showed the hotspot areas for theft crimes in the city, in addition to the study (Shawish, 2014) on some aspects of the spatial analysis of the main road network in Taif Governorate in the Kingdom of Saudi Arabia in terms of analyzing the network pattern and using information systems in analyzing it and treating its problems. The study (Abdul Karim, 2014) on the spatial analysis of public services and determining planning needs with application to the city of Hafar Al-Batin, where he focused on monitoring the geographical distribution of public services and evaluating them in the city of Hafar Al-Batin according to the standards of the foundations of urban planning in the Kingdom of Saudi Arabia...while (Al-Huwaish, 2014) dealt with the analysis of spatial variation of health services in the Kingdom of Saudi Arabia in the period from 1413-1431 AH with the aim of analyzing the components of the health service to know its components and spatial variation between the regions of the Kingdom of Saudi Arabia. (Mansour, 2014) focused on spatial modeling of quality of life indicators at the governorate level in the Kingdom of Saudi Arabia, through the geographical distribution of quality of life indicators using a spatial analysis model to assist decision makers in making development policies in the Kingdom of Saudi Arabia. (Al-Qahtani, 2018) addressed the spatial analysis of primary schools in the city of Abha in the Asir region, where he focused on the geographical distribution of primary schools and processing them using geographic information systems.

Second - Applied studies on ATMs:

The most important of which are: - Al-Sawy's study (2018) The spatial distribution of ATMs of government banks in the city of Alexandria, applied to the East District, and addressed the geographical distribution of ATMs in the city of Alexandria, focusing on the East District as a model for the study. It also highlighted the characteristics of the beneficiaries of this service, their levels of satisfaction, and then the problems of the service and their proposed solutions.

- Ismail's study (2018) Spatial analysis of banking services in the city of Port Said - a study in the geography of communications, and presented banking services and their geographical distribution in the city, and the characteristics of their beneficiaries.

- Sharif's study (2019) Spatial analysis of banking services in the city of Dammam - a study in the geography of communications, and addressed the development of banking services in their patterns and geographical distribution, and also addressed the positives and negatives of the service and its future planning.

- Mohamed Nainaa's study (2020) A geographical analysis of banking services in Kafr El-Dawar city, and presented the geographical distribution of banks and ATMs, customer characteristics and satisfaction levels, then the problems of banks and their proposed solutions.

- Ahmed Habib's study (2021) entitled: Spatial analysis of ATM service in Tanta city, and presented the distribution of ATMs in the city and analyzing their efficiency indicators, then their problems and proposed solutions.

- Atlam's study (2021) A geographical analysis of ATM service in Shibin El-Kom city, and dealt with the distribution of ATMs in the city, and a geographical analysis of this distribution, then customer characteristics and their degree of satisfaction, and finally service problems and their proposed solutions.

-Ali's study (2022) ATM locations and their banking services in Assiut city, and dealt with the spatial analysis of banks and ATMs in Assiut city, and evaluating the efficiency of distribution and spatial modeling of ATM locations in the city.

Study objectives:

This applied study is a contribution from the researcher to shed light on the reasons for the spatial variation in the level of ATM distribution efficiency in one of the cities of the Kingdom, to achieve several objectives, the most prominent of which are the following:

1. Revealing the characteristics of the spatial distribution of ATMs and their distribution pattern.
2. Identifying the scope of the spatial concentration of ATMs in the city of Abha.
3. Determining the spatial distribution pattern of ATMs in the study area.
4. Future planning for ATM services by proposing appropriate numbers for the service and determining their optimal locations.

Study Methods and Approaches:

The study relied on the descriptive analytical inductive approach linked to the spatial analysis of the study phenomenon, in addition to using geographic information systems programs to analyze the spatial distribution of restaurants in the study area. The methodology is linked to the spatial analysis methods of geographic information systems programs through which raw data is converted into data of great benefit by relying on analytical methods and processes specific to collecting, measuring and classifying spatial data, the most prominent of which are matching, spatial and cartographic modeling, distance analysis, and others, in order to understand spatial patterns and variations.

The logical sequence for studying the topic is through addressing the following points:

First: The geographical distribution of ATMs and their spatial relationships:

Distribution is the necessary starting point for any geographical study, and a step towards a crisis in understanding the behavior of any geographical phenomenon. Distribution means the arrangement or organization resulting from the distribution of phenomena in place according to a special pattern. This means that distribution represents the current image or the final result of a set of relationships that result in the location of the phenomenon. Its size, and its distance from other phenomena (Khair, 2000: 240).

1. Distribution of banks:

By analyzing Table (1) and Figure (2), it becomes clear that there are about 27 branches of different banks spread throughout the neighborhoods of Abha city. The branches of the Saudi National Bank account for more than 33% of the total banks in the city, followed by the branches of Al Rajhi Bank, with a percentage of 29.6% for each of them. Then came the branches of SABB, Al Arabi and Al Riyad banks in third place with a rate of 7.4% for each of them, then came the branches of Saudi Fransi, Al Jazira, Al Bilad and Anma in the last places with a rate of 3.7% for each of them.

Table (1) Numerical and relative distribution of banks in Abha city in 2023

%	number	Bank	N
33.3	9	Al Ahli Saudi	1
29.6	8	Al Rajhi	2
7.4	2	SABB	3
7.4	2	Al Arabi	4
7.4	2	Riyad	5
3.7	1	Saudi Fransi	6
3.7	1	Al Jazira	7
3.7	1	Al Bilad	8
3.7	1	Alinma	9
100	27	Total	

Source: Prepared by researchers based on (Google Earth 2023), and the field study in 2023.

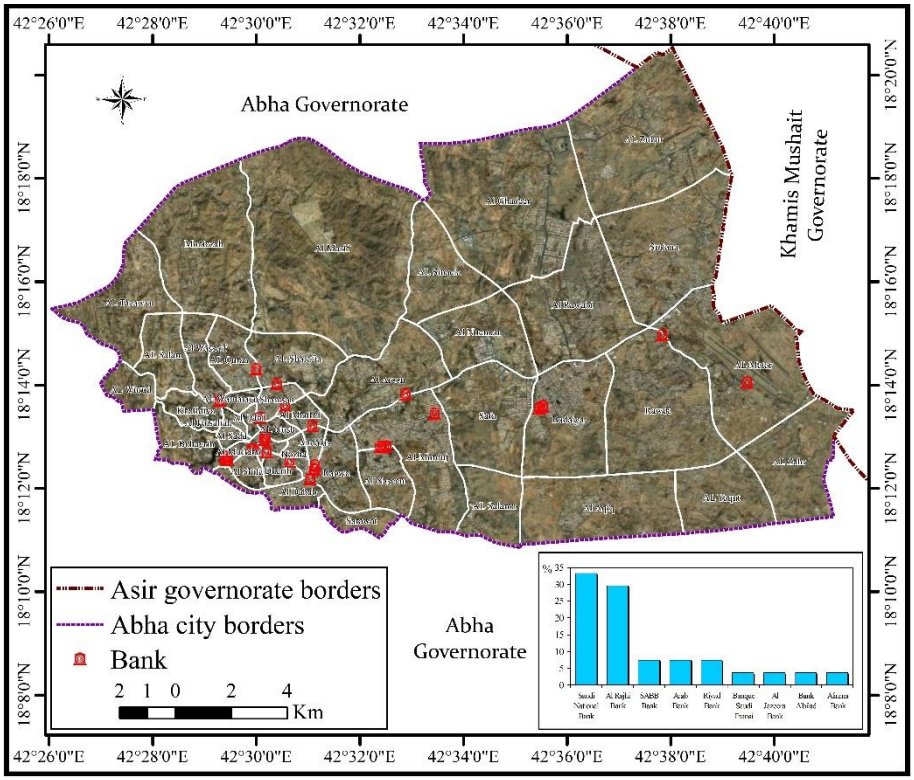
To understand the nature of the spatial distribution indicators of services, we must focus on the locations of services and the places of residence of individuals, and thus the kilometre distance, as the variation and difference in the distribution of bank branches at the level of the city's neighbourhoods is evident in the following table:

Table (2) Numerical and relative distribution of banks in residential neighborhoods of Abha city in 2023 AD

Total		Alinma	Al Bilad	Al Jazira	Saudi Fransi	Riyad	Al Arabi	SABB	Al Rajhi	Al Ahli Saudi	Residential neighborhood	N
%	number											
14.8	4	-	1	-	-	-	1	-	1	1	Al Murooj	1
7.4	2	-	-	1	-	-	-	-	-	1	Downtown	2
7.4	2	-	-	-	-	-	-	-	1	1	Shamsan	3
7.4	2	-	-	-	-	-	-	-	1	1	Al Muftaha	4
7.4	2	-	-	-	-	-	-	-	1	1	Al Badi	5
7.4	2	1	-	-	-	-	-	-	-	1	Al Buhaira	6
3.7	1	-	-	-	1	-	-	-	-	-	Dhra	7
3.7	1	-	-	-	-	-	1	-	-	-	Al Wasayef	8
3.7	1	-	-	-	-	-	-	-	1	-	Al Nahda	9
3.7	1	-	-	-	-	-	-	1	-	-	Al Manhal	10
3.7	1	-	-	-	-	-	-	-	-	1	Al Matar	11
3.7	1	-	-	-	-	-	-	-	1	-	Al Qarya	12
3.7	1	-	-	-	-	1	-	-	-	-	Al Azizia	13
3.7	1	-	-	-	-	0	-	-	-	1	Al Areen	14
3.7	1	-	-	-	-	1	-	-	-	-	Al Dhabab	15
3.7	1	-	-	-	-	0	-	-	-	1	Al Sharafiya	16
3.7	1	-	-	-	-	-	-	-	1	-	Al Rawda	17
3.7	1	-	-	-	-	-	-	1	-	-	Al Rabwa	18
3.7	1	-	-	-	-	-	-	-	1	-	Al Andalus	19
100	27	1	1	1	1	2	2	2	8	9	number	Total
	100	3.7	3.7	3.7	3.7	7.4	7.4	7.4	29.6	33.3	%	

Source: Prepared by researchers based on (Google Earth 2023), and the field study in 2023 AD.

The previous table and map show the clear concentration of banks in the southwest of Abha city, where Al Morouj district accounted for about 15% of the total banks in the city, followed by the Downtown, Al Badi, Al Safwa, and Al Buhaira districts with about 10 bank branches at a general rate of 7.4% for each district, then came the districts of Dhra, Al Wasayef, Al Nuzha, Al Manhal, Al Matar, Al Aziziyah, Al Areen, Al Dhabab, Al Sharqiyah, Al Rawdah, Al Rabwa, Al Andalus, with an average of one bank branch in each neighborhood.



Source: Google Earth 2023, and the field study 2023.

Fig (2) Geographical distribution of banks in Abha city 2023

2. ATM:

Today, ATMs represent one of the requirements of modern life in any society, due to the assistance in the facilities provided to citizens with the high demand for them and the increase in their use. Table (3) and Figures (3) and (4) show the numerical and relative distribution of ATMs in the city of Abha.

Table (3) Numerical and relative distribution of ATM machines in Abha city in 2023.

%	number	Bank ATM
23.9	26	Al Rajhi
18.3	20	Al Ahli Saudi
13.8	15	Arabi

10.1	11	Riyad
9.2	10	SABB
7.3	8	Alinma
7.3	8	Al Bilad
3.7	4	Saudi Fransi
2.8	3	Saudi Investment
2.8	3	Al Jazira
0.9	1	Saudi Hollandi
100	109	Total

Source: Prepared by researchers based on (Google Earth 2023), and the field study in 2023.

The table shows that the number of ATMs in Abha city reaches 109 ATMs, varying according to the type of bank, as Al Rajhi Bank ranked first in the rate of owning ATMs, equivalent to 23.9% of the total ATMs in the city, followed by the National Commercial Bank of Saudi Arabia, which owns 20 ATMs in the city, representing 18.3% of the total ATMs in Abha city, and the two banks together own more than 42% of the total ATMs in Abha city, due to the antiquity of the two banks in the study area, in addition to the spatial spread of these two banks in the city.

- Arab Bank came in third place, equivalent to 13.8% of the total ATMs in the study area, then SABB Bank came in fourth place, equivalent to 9.2% of the total ATMs in Abha city, then Alinma and Albilad Bank came in fifth place, representing 7.3% each, then in sixth place, Saudi Fransi Bank, then Saudi Investment Bank, and Saudi Hollandi Bank came in last place in the rate of owning ATMs in the study area.

The distribution of ATMs in Abha city also varies across the city's different neighborhoods. Abha city can be divided according to the degree of ATM settlement in the city, as shown in Maps 3 and 4, into the following categories:

- Neighborhoods in which more than 8% of ATMs in Abha city are concentrated, including the neighborhoods (Al Areen- Al Morouj – Al Nusub), and this category includes about 29 ATMs, equivalent to 26.6% of the total ATMs in Abha city.

- Neighborhoods in which 6- to less than 8% of the total ATMs in Abha city are concentrated, including the neighborhoods (Al Qarya - Shamsan), and this category includes about 12 ATMs, equivalent to 11% of the total ATMs in Abha city.

- Neighborhoods in which 4 to less than 6% of the total ATMs in Abha are concentrated, including the neighborhoods of (Al Rabwa – Al Manhal – Al Safa - Downtown – Al Sharfiya), and this category includes about 20 ATMs, equivalent to 18.4% of the total ATMs in Abha.

- Neighborhoods in which 2 to less than 4% of the ATMs in Abha are concentrated, including the neighborhoods of Al Rawabi – Al Dhabab – Al Numan – Al Badi – Al Nuzha – Al Wardatayn - Dhra – Al Matar - Al Andalus) and this category includes about 27 ATMs, equivalent to 24.8% of the total ATMs in Abha.

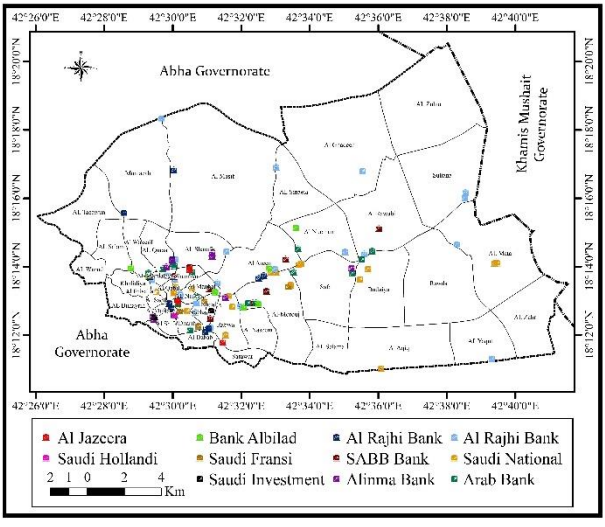
Neighborhoods where less than 2% of ATMs are concentrated in Abha city, including the - neighborhoods of (Al Masif - Sultana – Al Buhaira – Al Muntazah – Al Aziziyah – Al Wasayef – Al Khasha – Al Muftaha – Al Ghadeer – Al Faisaliah – Al Salam – Al Aqeeq – Al Yaqoot – Al Shifa). This category includes about 21 ATMs, equivalent to 19.3% of the total ATMs in Abha city. - Neighborhoods deprived of ATM services in Abha city, including the neighborhoods of (Al Naseem – Al Sinaiyah – Al Zahour – Al Rawdah- Al Sarawat – Al Salama – Al Qabil – .Al Wurood – Al Taawun – Al Zahr – Al Khalidiyah – Al Sadd)

Table (4) Numerical and relative distribution of ATM machines in residential neighborhoods of Abha city in 2023.

%	Total	Saudi Hollandi	Al Jazira	Saudi Investment	Saudi Fransi	Al Bilad	Alinma	SABB	Riyad	Arabi	Al Ahli Saudi	Al Rajhi	Residential neighbourhood
10.1	11	0	0	0	0	1	1	1	2	0	4	2	Al Areen
9.2	10	0	0	0	1	2	0	2	0	2	2	1	Al Morouj
7.3	8	0	0	0	0	0	0	0	0	1	2	5	Al Nusub
5.5	6	0	0	0	0	0	2	0	1	3	0	0	Al Qarya
5.5	6	0	1	0	0	0	0	2	0	1	1	1	Shamsan
3.7	4	0	1	0	0	0	0	0	0	0	2	1	A -Rabwa
3.7	4	0	0	0	0	2	0	1	0	0	1	0	Al Manhal
3.7	4	0	0	0	0	0	1	0	0	2	1	0	Al Safa
3.7	4	0	1	0	0	0	0	2	1	0	0	0	Downtown
3.7	4	0	0	0	0	0	2	0	0	0	0	2	Al Sharfiya
2.8	3	0	0	0	0	0	0	1	0	1	0	1	Al Rawabi
2.8	3	0	0	0	0	0	0	0	3	0	0	0	Al Dhabab
2.8	3	0	0	0	0	1	0	0	0	1	0	1	Al Numan
2.8	3	0	0	0	0	0	0	0	0	1	2	0	Al Badi
2.8	3	0	0	0	0	0	0	0	0	0	0	3	Al Nuzha
2.8	3	0	0	1	0	0	0	0	0	0	0	2	Al Wardatayn
2.8	3	0	0	0	2	0	0	0	0	1	0	0	Dhra
2.8	3	0	0	0	0	0	0	0	0	0	2	1	Al Matar
2.8	3	0	0	1	1	0	0	1	0	0	0	0	Al Andalus
1.8	2	0	0	0	0	0	0	0	1	0	0	1	Al Masif
1.8	2	0	0	0	0	0	0	0	0	0	0	2	Sultana
1.8	2	0	0	0	0	0	2	0	0	0	0	0	Al Buhaira
1.8	2	0	0	0	0	0	0	0	1	0	0	1	Al Muntazah
1.8	2	1	0	0	0	0	0	0	1	0	0	0	Al Azizia
1.8	2	0	0	0	0	1	0	0	0	1	0	0	Al Waseef
1.8	2	0	0	0	0	0	0	0	0	1	1	0	Al Khasha
0.9	1	0	0	1	0	0	0	0	0	0	0	0	Al Maftaha
0.9	1	0	0	0	0	0	0	0	0	0	0	1	Al Ghadeer
0.9	1	0	0	0	0	0	0	0	0	0	1	0	Al Faisaliah
0.9	1	0	0	0	0	1	0	0	0	0	0	0	Al Salam
0.9	1	0	0	0	0	0	0	0	0	0	1	0	Al Aqeeq
0.9	1	0	0	0	0	0	0	0	0	0	0	1	Al Yaqoot

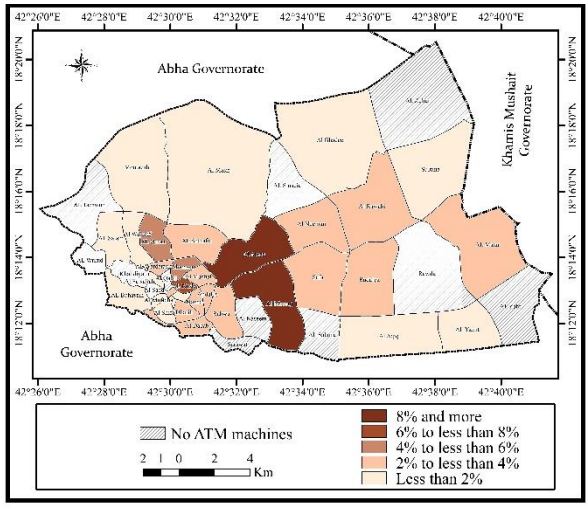
0.9	1	0	0	0	0	0	0	0	1	0	0	0	A -Shifa
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Naseem
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Sinaiya
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Zahour
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Sarawat
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Salama
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Rawdah
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Qabil
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Ward
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Taawun
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Zahr
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Khalidiya
-	-	-	-	-	-	-	-	-	-	-	-	-	Al Sadd
100	109	1	3	3	4	8	8	10	11	15	20	26	Total

Source: Prepared by researchers based on (Google Earth 2023), and the field study in 2023.



Source: Google Earth 2023, and the field study 2023.

Fig (3) Geographical distribution of ATM machines in Abha city 2023.



Source: table (4).

Fig (4) The Relative distribution of ATM machines in Abha city 2023

- The relationship between the distribution of ATMs and population density:

Population density is one of the important variables that affect the geographical distribution of ATMs, as spatial differences and areas that need ATMs, or have reached the stage of sufficiency, are evident in what appears in the following table:

Table (5) Population categories and ATMs in residential neighborhoods of Abha city in 2023.

Population		Residential neighborhoods		ATM machines		Population size categories (thousand people)
%	person	%	Residential neighborhood	%	number	
10.2	23999	2.2	1	9.2	10	20 or more
7.8	18494	2.2	1	2.8	3	15 to less than 20
21.8	51488	8.9	4	11.9	13	10 to less than 15
34.2	80666	26.7	12	38.5	42	5 to less than 10
24.3	57458	42.2	19	34.9	38	1 to less than 5
1.7	4052	17.8	8	2.8	3	less than 1
100	236157	100	45	100	109	Total

Source: Prepared by researchers.

− The category of more than 5-10 thousand people came as the highest rate, representing 34.2% of the total population of the study area, distributed over 12 neighborhoods, representing 26.7% of the neighborhoods of Abha city, where the land is used for educational, health, sports and entertainment services, and where the commercial heart of the city is, which led to these neighborhoods containing about 42 ATMs, equivalent to 38.5% of the total ATMs in Abha city.

- The second classification came for the category of residential neighborhoods with a population density of 1- to less than 5 thousand people, distributed over 19 residential neighborhoods of Abha city, where these residential neighborhoods contain 38 ATMs, equivalent to 34.9% of the total.

- The third category was less than 10 to less than 15 thousand people, representing 21.8% of the total population of the study area, which included 4 residential neighborhoods, while the number of ATMs was about 13 ATMs. The category of 20 thousand people and more came in fourth place, as it included 10 ATMs, which represents 9.2% of the total ATMs in the city. Then came the category of 15 to less than 20 thousand people in fifth place, as it included one residential neighborhood and included three ATMs. The category of less than 1000 people came in last place, representing 1.7% of the population of the study area, to include 17.8% residential neighborhoods, and about 2.8% of the ATMs in the study area.

From the above, we conclude that the number of residents in a single neighborhood and its total area affect the necessity of having or not having an ATM, as the ATM is one of the daily and necessary needs for residents to meet their cash needs. If the population concentration is linked to the large area of the neighborhood, then there must be more than one ATM in a single neighborhood, and the ATM may serve residents of neighboring neighborhoods.

- The relationship between the distribution of ATMs and the area of the city

The following table shows the relationship between the distribution of ATMs and the areas of the neighborhoods of Abha city.

Table (6) Categories of residential neighborhoods and ATMs in Abha City in 2023.

Area		Residential neighborhoods		ATM machines		Area categories (km^2)
%	km^2	%	Residential neighborhood	%	number	
11.6	34.93	2.2	1	1.8	2	25 or more
14.8	44.43	4.4	2	0.9	1	20 to less than 25
16.3	48.96	6.7	3	4.6	5	15 to less than 20
20.7	62.33	11.1	5	17.4	19	10 to less than 15
21.4	64.31	17.8	8	21.1	23	5 to less than 10
13.1	39.46	33.3	15	29.4	32	1 to less than 5
2.0	6.02	24.4	11	24.8	27	less than 1
100	300.44	100	45	100	109	Total

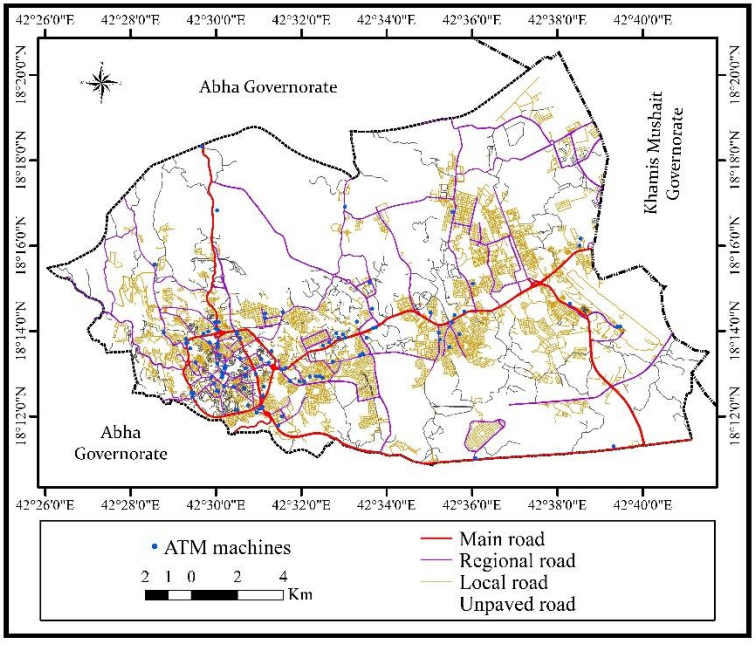
Source: Prepared by researchers.

The table shows that the neighborhood category (from 1 to less than 15 km2), which has a high share of ATMs, represents 75.5% of the city's neighborhoods, serving 109.79 km2 and including about 50.5% of the total number of ATMs in the city, while the number of neighborhoods with an average share reached about 6.7% of the city's neighborhoods, serving about 48.96 km2 of the city's area, with a number of ATMs reaching 5 ATMs, which represents 4.6% of the total ATMs in the city. The neighborhoods with low and very low service came to represent more than 6.6% of the city's total neighborhoods. Therefore, the relationship is not parallel between the distribution of ATMs in Abha neighborhoods and the area of the neighborhoods. Therefore,

the city needs to redistribute and establish this type of ATM services in the deprived and low-service neighborhoods in order to balance the degree of service. The evidence for this is the negative correlation coefficient between the area of the city's neighborhoods and the number of ATMs and the number of residential neighborhoods, reaching a degree of about (-0.06), which is a negative correlation that reaches the stage of perfection, while the correlation was average between the number of ATMs and the population and the number of the city's neighborhoods, representing(0.56) .

-Spatial organization of ATM locations and its relationship to the main road network in Abha city.

The spatial organization of ATM locations plays a major role in determining the efficiency of that ATM and its readiness to perform the tasks assigned to it in the required manner. The efficiency of the spatial organization of ATM locations is linked to several factors and considerations, including: Reducing the travel time to the ATM locations. This requires that the location be selected in a medium area of the assumed service range and on main or arterial road axes with ease of entry and exit from that location, and covering the service area with the required level and quality of service, i.e. in a manner consistent with the size and nature of land uses and population density in the area. Figure (5) shows the main road network and ATM locations in Abha city.



Source: table (6).

Fig (5) geographical distribution of ATM machines

And the road in Abha city 2023

From the analysis of Figure (5), it is clear that there is a strong and positive correlation between the spatial organization of ATM locations and the road network (main, arterial and regional) in Abha city, which reflects the efficiency of the locations of most ATM machines in relation to the main road network in Abha city. This helped to maximize the great role of transportation methods and their role in maximizing the economic importance of the concentration and spread of ATM services in Abha city.

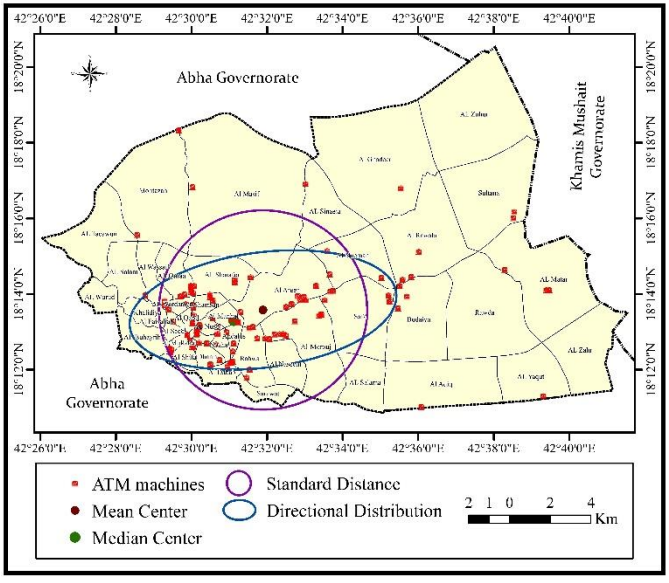
Second: Spatial analysis of the distribution of ATMs.

1- Geographic distribution measurement analyses:

(a) The mean geographical center or spatial average.

It is used to calculate the arithmetic mean of non-spatial data to determine where the spatial average of the phenomenon under study is located. It is called the simple spatial average, which is the simplest of the ideal point distributions. It is an average of the values of a single digital data set. It is used for any phenomenon that can be represented by a point on the map. It represents the point around which the distribution of the phenomenon's components is equal or the location of a sample taken spatially, and its description and spatial distribution are prepared in preparation for analysis and interpretation.

A grid of squares is drawn covering the study area to measure the locations of points according to their distribution on the x-y axes, which is called the ideal virtual pivot point, considering that this center represents the point around which the distribution of the phenomenon's components is equal. The spatial average tool is the counterpart to calculating the arithmetic mean value of the spatial data, i.e. it determines where the location is located, which is a geographical average for the locations of the components of the phenomenon under study (Dawoud, 2012, p. 162). The geographical center of the ATM locations in Abha city is determined, and the space separating it from other locations is less than the distance separating the locations and any other location. From the analysis of Figure (6), the average geographical center of ATM machines in the residential neighborhoods of Abha city in 2023 AD can be identified as follows- :



Source: Arc map 10.7

Fig (6) Mean Center, Standard Distance, and Direction Distribution of ATM machines in Abha city 2023.

The median geographical center of ATMs in the residential neighborhoods of Abha city is located in the southwest of the city in Al Areen neighborhood, at the intersection of latitude 34 °18 ´ 13 ˝, with longitude ˚42 ´31 ˝ 53; this explains the concentration of the majority of ATMs in the old residential neighborhoods west of the city.

(A) The Median Geographical Center.

The median geographical center of ATMs in the residential neighborhoods of Abha city is located in the southwest of the city in Al Manhal neighborhood, at the intersection of latitude 17 ˚18 ´ 13 ˝, with longitude ˚42 ´31 ˝ 07 this explains the concentration of the majority of ATMs in the old residential neighborhoods west of the city.

(B) Standard Distance.

It is one of the most important measures of spatial dispersion of spatial distributions, and is similar in concept to the standard deviation in calculating the distance between the adjusted center and each point representing a mobile station in the study area; where the standard distance is split by squaring the values of the standard deviation on the x- and y-axes from their average, and is used to measure the extent of the phenomenon's spread around its average geographical center, and is also an indicator to know the extent of the divergence or convergence of the phenomenon's components, as it is the deviation of values from their arithmetic mean, which is

a description of the dispersion of points around the adjusted center; where the adjusted center is not sufficient to complete the picture, and the comparison is clearer.

The value of the standard distance is represented by a circle whose center is the adjusted geographical location and is called the standard circle, so that the center of the circle is the location of the coordinates of the actual average center of the phenomenon, and the more the circle shrinks, this indicates spatial concentration, and the wider the circle, this indicates the spatial dispersion of the phenomenon. The standard distance is one of the measures of dispersion and spatial concentration that is similar in its structure to the standard deviation, and it is the most used to distribute sites around their average center. This method is one of the most prominent measures of spatial distributions, and it is used to measure the extent of the phenomenon's spread from its center (Al-Otaibi and Al-Taie, 2013, p. 138).

Figure (6) can determine the standard distance for ATM machines in residential neighborhoods of Abha as follows:

-The area of the standard circle of ATMs in the residential neighborhoods of Abha city occupied about 74.3 km2, which constitutes 24.7% of the total area of the city, which amounts to 300.44 km2.

The basic model assumes that the standard circle contains 68% of the total points, but the reality indicated that the standard distance circle for the ATMs included 78 machines, representing 71.6% of the total ATMs in the residential neighborhoods of the city of Abha, which indicates that the geographical distribution pattern The ATM machines in the residential neighborhoods of the city of Abha have a regular distribution pattern, as the higher the percentage, the more the distribution pattern tends towards a regular shape, while a lower percentage indicates their random distribution.

(C) Directional Distribution.

This tool is used to determine the general direction of the distribution of the spatial phenomenon components, by drawing an oval shape, drawn at an angle of inclination that determines the direction of distribution of the majority of the phenomenon components in the study area to determine the extent of the spatial concentration of the phenomenon or its spread, so that its center is the location of the coordinates of the actual average center of the phenomenon, where the north direction is represented by an angle of (zero), the east direction by an angle of (90 degrees), the south direction by an angle of (180 degrees), and the west direction by an angle of (270 degrees); the more the shape shrinks, the more the phenomenon is spatially concentrated, and the wider the shape, the higher the value of the standard distance, and this indicates the spread of the phenomenon's distribution and its spatial dispersion, i.e. the distance of the circle is directly proportional to the degree of spread and spatial distribution.

The idea of the distribution direction is very close to the standard distance, and differs from it in that it is concerned with the concentration of the elements of the phenomenon and the direction of the distribution of the phenomenon, while the second is based on the degree of dispersion and the concentration of the phenomenon, and the eastern standard deviation and the northern standard deviation are calculated from the average center, and then the shape of the distribution

direction of the phenomenon is determined in the study area, and the average center is the center of the oval shape for all points and each oval shape has two axes (X-Y).

From the analysis of Figure (6), the distribution trend of ATM machines in residential neighborhoods of Abha can be identified as follows: -

- The center of the oval shape coincides with the middle center point, and its largest axis measures the value of the direction taken by most of the elements of the phenomenon, as the length of its largest axis is 6.3 km, and the length of its minor axis is 2.8 km.

- The angle of distribution direction was 81°

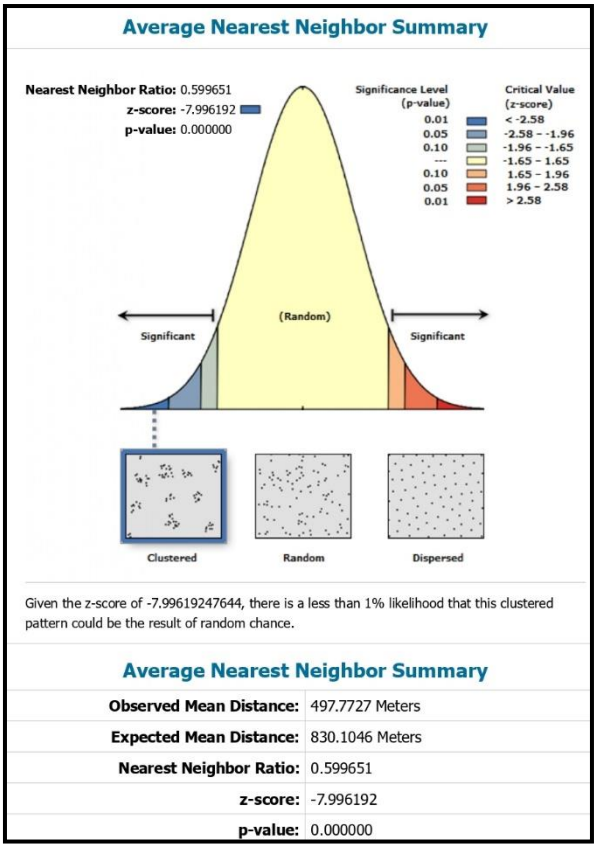
- The general direction of the distribution of ATMs in the residential neighborhoods of Abha city indicates from west-southwest to east-northeast in the west of Abha city.

- The area of the oval shape was 55.4 km2, or 18.4% of the total area of the city.

It is concluded from the results of the indicators revealing the nature of trends in the spatial distribution of ATM machines in the residential neighborhoods of the city of Abha, that there is a clear concentration of these machines in the southwest of the city, such that they converge to each other to a clear degree, and the general prevailing trend in the distribution of these types of machines extends from the west to the east. The opposite is true in the trends of the city's expansion, both spatially and demographically.

2- Nearest Neighbor Analysis:

The study of the spatial pattern of the distribution of geographical phenomena aims to reveal the method of distribution of these phenomena and the nature of their spread and arrangement on the surface of the Earth, whether they take a specific distribution pattern that tends toward regularity and symmetry or concentration and clustering or randomness that is due to the factor of chance or prior planning by the authorities responsible for the method. Distributing them in a specific way also aims to achieve the justice that residents aspire to, and meet their needs in a way that reduces the time and effort expended in accessing them, especially with regard to services of all kinds, which must be distributed in a specific manner that is appropriate to the nature of the area.



Source: Arc map 10.7

Fig (7) Results of the neighborhood relationship analysis for ATM machines in Abha city 2023.

The spatial distribution pattern of ATMs in different areas is affected by the residential area, the shape of the area and the widespread topographic phenomena, its population size, the street network plan, its distribution pattern, the historical development of the area, and the neighborhood relationship between different areas, thus contributing to the emergence of some patterns of service institution clusters.

This method is one of the most appropriate methods for analyzing the spatial patterns of the phenomenon, as it enters into the analysis of all sites in the studied area and their relationship with each other, and on the other hand, it depends on the distances between the site and other sites closer to it, which contributes to identifying the distances traveled to reach the service, which in turn helps to accurately determine the characteristics of the distribution that is close (clustered), distant, or random. The Clustered pattern represented the geographical distribution

of ATMs in the city of Abha, where the value of the nearest neighbor for the total stations in the city was 0.599651, which indicates the convergence of the distribution, albeit in an irregular shape.

3- Kernel densitometric analysis of kernel:

Kernel analysis aims to estimate the density of the geographical distribution of a particular phenomenon over a specific area, and to identify the areas in which the phenomenon is concentrated. It was developed to obtain an estimate of the single or multiple analysis of the expected probabilities of the distribution of a particular phenomenon. By studying Table (7) and Figure (8), the results of the kernel analysis to measure the density of the distribution of ATMs in the neighborhoods of Abha City in 2023, can be divided as follows:

Table (7) Kernel analysis categories to measure the concentration of ATMs in residential neighborhoods of Abha city in 2023.

Area	ATM machines	Machine/km^2
0.2	7.3	8 or more
1.7	23.9	6 to less than 8
2.3	26.6	4 to less than 6
11.8	34.9	2 to less than 4
84.0	7.3	less than 2
100	100	Total

Source: Prepared by the researchers based on Figure No. (8) using the program (Arc map 10.7).

The previous table and Figure 8 show the following- :

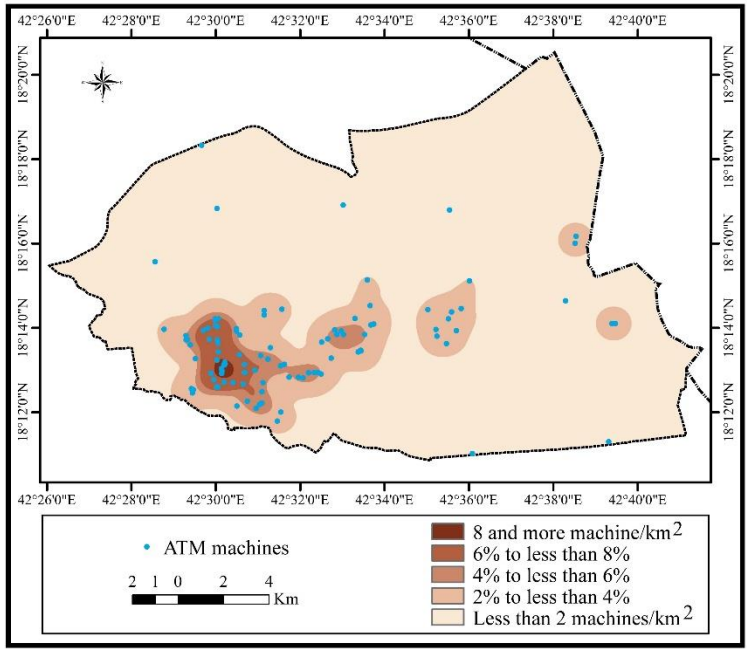
− Very high density (8 ATMs or more / km2), occupying 0.20% of the total area of the city, and appears in the southwestern neighborhoods where most of the ATMs are concentrated, including the neighborhoods (Al Areen – Al Morouj – Al Nasb).

− High density (6 ATMs for less than 8 / km2), occupying 1.7% of the total area of the city, and appears in the southwestern neighborhoods adjacent to the first category where most of the ATMs are concentrated.

− Medium density (4 ATMs for less than 6 / km2), occupying 2.3% of the total area of the city, and appears in the south and southwest adjacent to the first and second categories, in addition to some neighborhoods in the east of the city.

− Low density (4 ATMs for less than 6 / km2), occupying 23.386 km2, representing 11.8% of the total area of the city, and appears in the eastern and central neighborhoods of the city.

− Very low density (4 ATM for less than 4/km2), it occupies 292,809 km2, or 84% of the total area of the city, and appears in all residential neighborhoods of the city, especially on the northern and western edges and the city center.



Source: Arc map 10.7

Fig (8) Kernel analysis to measure the concentration of ATM machines in Abha city 2023

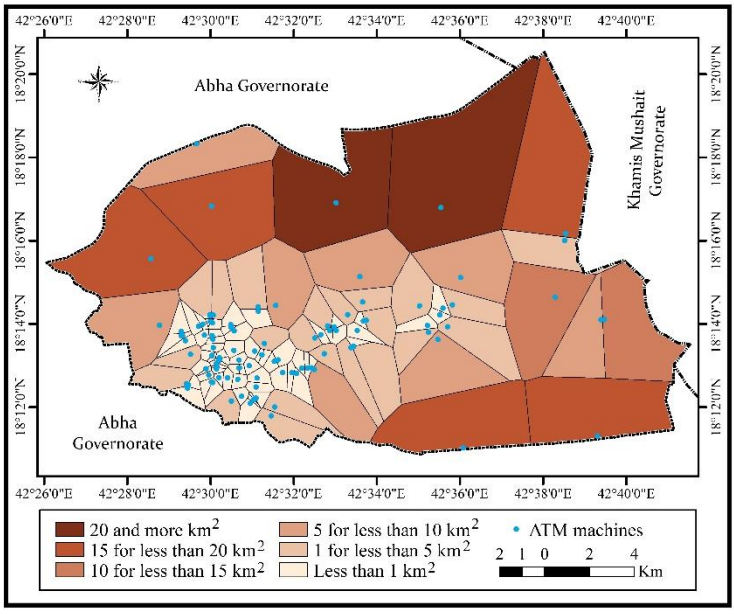
4-Geographical allocation range (Thiessen polygon) for ATMs in Abha City:

The Thiessen polygon is used as a tool to determine the spatial allocation areas. This tool deals with point-type layers, as it studies large areas through points only, and creates polygons, each polygon containing one point. The boundaries of this polygon depend on the points surrounding the point, as the distances between the point inside the polygon and the rest of the points closest to it are classified. This process is applied to all points in the layer (Al-Tayeb, 2017, p. 129).

Table (8) Geographical allocation (Thiessen polygon) of ATMs in Abha city in 2023.

Area		Polygons		Category (km^2)
%	km^2	%	number	
18.0	53.9	1.8	2	20 or more
28.1	84.5	4.6	5	15 for less than 20
8.2	24.5	1.8	2	10 for under 15
22.1	66.3	8.3	9	5 for less than 10
16.0	47.9	19.3	21	1 for less than 5
7.7	23.3	64.2	70	Less than 1
100	300.44	100	109	Total

Source: Prepared by researchers using the computer program (Arc map 10.7).



Source: Arc map 10.7

Fig (9) Allocation range (Thyssen polygon) for ATM machines

in Abha 2023.

From Table (8) and Figure (8), the following is clear:

- The number of polygons reached 109 polygons covering the city area of 300.44 km2
- The areas shrink in the southwest of the city, where the majority of ATMs are concentrated, which account for more than three-quarters of the city's ATMs, then the area of the polygons expands in the east, north, and south of the city.

5- Average spacing between ATM machines in Abha:

It should be noted that there are many factors and motives that prevent the equitable distribution of ATM machines in the neighborhoods of Abha. Where the space "area" plays an important role, and is a balance between need and availability, and Table and Figure (9) show the average spacing between ATMs in Abha City in 2023.

Table (9) Average spacing of ATMs in residential neighborhoods of Abha city in 2023.

Average divergence (km)	Area (km^2)	ATM machines	Residential neighborhood	N
2.3	13.62	3	Al Rawabi	1
1.1	3.87	4	Al Rabwah	2

0.6	1.30	4	Al Manhal	3
0.9	2.09	3	Al Dhabab	4
0.0	3.50	0	Al Naseem	5
1.7	7.51	3	Al Numan	6
0.0	7.28	0	Al Sanaiyah	7
4.5	34.93	2	Al Masyaf	8
0.8	3.29	6	Al Qarya	9
2.1	11.00	3	Al Badi	10
0.0	20.35	0	Al Zahour	11
0.7	0.43	1	Al Muftaha	12
0.4	0.85	8	Al Nasb	13
5.3	24.08	1	Al Ghadeer	14
0.6	0.91	3	Al Nuzha	15
0.7	0.42	1	Al Faisaliah	16
0.5	0.78	3	Al Wardatain	17
0.0	1.89	0	Al Sarawat	18
0.0	4.95	0	Al Salamah	19
1.7	9.93	4	Al Safa	20
0.0	16.42	0	Al Rawdah	21
2.9	14.90	2	Sultana	22
1.0	9.00	11	Al Areen	23
1.4	3.50	2	Al Buhaira	24
0.7	1.18	3	Dhara	25
0.2	0.19	4	Downtown	26
0.0	0.48	0	Al Qabil	27
3.0	15.86	2	Al Muntazah	28
0.3	0.15	2	Al Aziziyah	29
0.5	1.35	6	Shamsan	30
1.3	2.91	2	Al Wasayef	31
1.1	10.51	10	Al Murooj	32
0.0	2.25	0	Al Warood	33
1.3	5.55	4	Al Sharafiyah	34
2.2	4.10	1	Al Salam	35
0.0	8.25	0	Al Taawun	36
2.5	16.67	3	Al Matar	37
0.5	0.37	2	Al Khasha	38
0.0	9.66	0	Al Zaher	39
3.8	12.29	1	Al Aqeeq	40
2.9	7.14	1	Al Yaqoob	41
0.0	2.13	0	Al Khalidiyah	42
1.2	1.15	1	Al Shifa	43
0.0	0.65	0	Al Sadd	44
0.5	0.78	3	Al Andalus	45
1.8	300.44	109		Total

The average spacing between ATMs indicates their distribution pattern according to the factors affecting the distribution. The previous table and Figure (9) show the disparity and spacing between ATMs in Abha city in 2023 as follows:

- Very large spacing (4 km or more) in which ATMs are spaced about 4 km or more apart, and include two residential neighborhoods in Abha city (Al Ghadeer – Al Masif), and are distributed in the west of the city, and occupy an area estimated at about 59.01 km2, at a rate of 6.19%; The increase in spacing between these neighborhoods is attributed to the large area and the small number of ATMs.

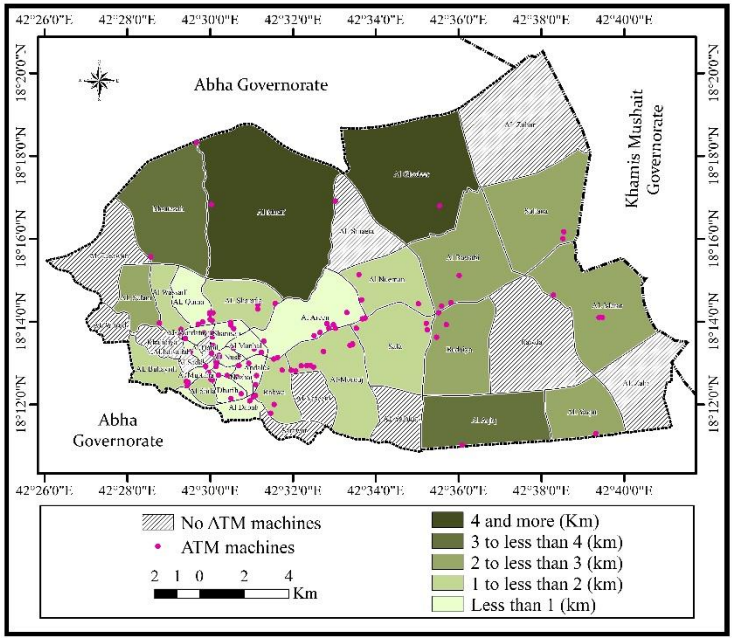
- Large spacing (3 km to less than 4 km): It includes two residential neighborhoods of the city, equivalent to 4.4% of the total neighborhoods of the city, to serve an area estimated at about 28.15 km2, equivalent to 9.4% of the total area of the city, and includes the neighborhoods (Al Aqeeq – Al Muntazah), and this category includes about 3 ATMs, which represents 2.8 of the total ATMs in Abha city.

- Medium spacing (2 km to less than 3 km): It includes 6 residential neighborhoods, equivalent to 13.3% of the total neighborhoods of the city, to serve an area estimated at about 67.43 km2, equivalent to 22.4% of the total area of the city, and includes the neighborhoods (Al Rawabi – Al Badi – Al Salam – Al Matar - Sultana – Al Yaqout), and this category includes about 13 ATMs, which represents 11.9% of the total ATMs in the city.

- Small spacing (1 km to less than 2 km) and includes 9 residential neighborhoods equivalent to 20% of the total city neighborhoods to serve an area estimated at about 53.94 km2, equivalent to 18% of the total city area, and includes the neighborhoods (Al Rabwa – Al Numan – Al Safa – Al Areen – Al Buhaira – Al Wasayef – Al Morouj – Al Sharqiya – Al Shifa) and this category includes about 41 ATMs, which represents 37.6.9% of the total ATMs in the city.

- Very small spacing (less than 1 km) and includes 14 residential neighborhoods equivalent to 31.1% of the total city neighborhoods to serve an area estimated at about 23.01 km2, equivalent to 7.7% of the total city area, and includes the neighborhoods (Al Manhal – Al Dhabab – Al Naseem – Al Qura – Al Muftaha - Al Nasb – Al Faisaliah – Al Wardatayn - Dhra - Downtown – Al Aziziyah - Shamsan – Al Khasha - Al Andalus) and this category includes about 49 ATMs, which represents 45% of the total ATMs in the city.

- Neighborhoods deprived of ATM services in Abha city include the neighborhoods of (Al Naseem - Al Sanaiyah - Al Zahour - Al Rawdah- Al Sarawat - Al Salamah - Al Qabil - Al Wurood - Al Taawun - Al Zaher - Al Khalidiyah - Al Sadd).



Source: table (9).

Fig (10) Average spacing of ATM machines in Abha city 2023

From the above, we conclude the close relationship between the distribution of ATMs and the central area in the southwest of the city, such that the spacing rate decreases to increase the level of service in the west of the city, and the quality decreases and the distance increases the further we move towards the northern and eastern outskirts, where the area of the neighborhoods increases the further we move away from the center, and most of them are newly established neighborhoods, which led to an increase in the spacing rates towards the outskirts, so the relationship is inverse here between the distribution of ATMs and the spacing rate from the center to the outskirts of the city. This is in addition to the neighborhoods deprived of ATM service in Abha city, which suggests the need to increase ATMs in the northern, eastern and southeastern neighborhoods of Abha city to increase the level of service in the future.

Third - Future expectations for ATMs in Abha City

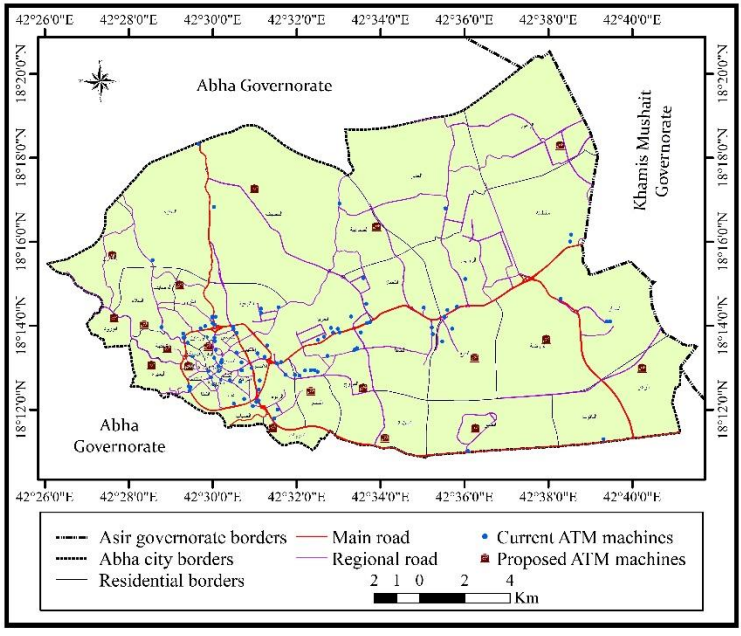
Planning or evaluation means appropriate distribution and highly efficient relationship, both of which result from choosing the appropriate location; the goal is to reach the best in distributing the elements of the place, whether in terms of location, sizes, or dimensions. In other words, it is the search for the optimal location, the most appropriate size, and the closest path that includes the shortest path in the transportation network. (Khair, 2000, p. 403). The study proposes establishing a group of ATMs spread in residential neighborhoods that lack ATMs, as well as in neighborhoods with high population density. It is taken into account when localizing them that

they are within the residential block and near the main and regional road networks for easy access to them. As a result of the above and the field study and Fig. (10), 16 sites were proposed as follows:

-Residential neighborhoods without ATMs, numbering 12 residential neighborhoods (Al Naseem – Al Sinaiyah – Al Zahour – Al Sarawat – Al Salama – Al Rawdah – Al Qabil – Al Wurood – Al Taawun – Al Zahr – Al Khalidiya – Al Sadd).

-Neighborhoods with high population density, which occupied the neighborhood (Al Morouj – Al Badi).

-Residential neighborhoods that witnessed modern urban projects, which occupied the neighborhood (Al Masif – Al Salam).



Source: table (9).

Fig (11) geographical distribution of the proposed ATM machines in Abha city 2023

The study proposes the establishment of a group of ATMs spread in residential neighborhoods that lack ATMs, as well as in neighborhoods with high population density. When localizing them, it is taken into account that they are located within the residential block and near the main and regional road networks for easy access.

The proposed ATMs were located in 16 locations as follows:

-Residential neighborhoods that lack ATMs, and their number is 12 residential neighborhoods (Al Naseem – Al Sinaiyah – Al Zahour – Al Sarawat – Al Salama – Al Rawdah – Al Qabil – Al Wurood – Al Taawon – Al Zahr – Al Khalidiya – Al Sadd).

-Neighborhoods with high population density, which occupied the neighborhood (Al Morouj – Al Badi).

-Residential neighborhoods that witnessed modern construction projects, which occupied the neighborhood (Al Masif – Al Salam).

Results and Recommendations:

First: Results.

Finally, the study concluded some results, the most important of which are:

- The multiplicity of banking services in the city of Abha, as the city includes about 20 banks and 109 ATMs.

- The clear disparity in the distribution of ATMs in the city's neighborhoods, as the southwestern neighborhoods account for most of the ATMs in the study area.

- The map of the distribution of ATMs in the city of Abha does not match the population density and area maps, which requires increasing their numbers in neighborhoods and places with high residential and population densities in the city.

-Spatial analyses showed that the average geographical center of ATMs in the residential neighborhoods of the city of Abha is located in the southwest of the city in the Al-Arin neighborhood, which explains the concentration of the majority of ATMs in the old residential neighborhoods west of the city. The standard distance circle for ATMs included 78 machines, representing 71.6% of the total number of ATMs in the residential neighborhoods of Abha city, which indicates that the geographical distribution pattern of ATMs in the residential neighborhoods of Abha city is a regular distribution pattern, as the higher the percentage, the more the distribution pattern tends to be regular, while the lower the percentage indicates its random spread. - The general trend of the distribution of ATMs in the residential neighborhoods of Abha city indicates from the west of the southwest to the east of the northeast in the west of Abha city. It is concluded from the results of the indicators of the nature of the spatial distribution trends of ATMs in the residential neighborhoods of Abha city, that there is a clear concentration of these machines in the southwest of the city such that they are clearly close to each other, and the general prevailing trend of the distribution of these machines of all types extends from west to east and vice versa in the directions of the city's expansion in terms of area and population. - The clustered pattern represented the geographical distribution of ATMs in Abha city, where the value of the nearest neighbor for all stations in the city was recorded at 0.599651, which indicates the closeness of the distribution, albeit in an irregular form.

- The number of polygons reached 109 polygons covering the city area of 300.44 km2, where the areas shrink in the southwest of the city, where the majority of ATMs are concentrated, which

account for more than three-quarters of the city's ATMs, then the area of the polygons expands in the east, north, south, and city. - The study of the spacing rate showed a close relationship between the distribution of ATMs and the central area in the southwest of the city, such that the spacing rate decreases to increase the degree of service in the west of the city, and the quality decreases and the distance increases the further we move towards the northern, northwestern, and eastern outskirts, where the area of the neighborhoods increases the further we move away from the center, most of which are newly established neighborhoods, which led to an increase in spacing rates towards the outskirts, so the relationship is inverse here between the distribution of ATMs and the spacing rate from the center to the outskirts of the city. This is in addition to the neighborhoods deprived of ATM service in Abha city, which suggests the need to increase ATMs in the northern, eastern, and southeastern neighborhoods of Abha city to raise the degree of service in the future.

Finally, the study concluded with its most important recommendations, which are the establishment of 16 ATM machines spread in residential neighborhoods that lack ATMs, as well as in neighborhoods with high population density. When localizing them, they should be located within residential blocks and near the main and regional road networks for easy access. They are concentrated in the neighborhoods of (Al Naseem – Al Sinaiyah – Al Zahour – Al Sarawat – Al Salama – Al Rawdah – Al Qabil – Al Wurood – Al Taawun – Al Zahr – Al Khalidiyah – Al Sadd – Al Morouj – Al Badi – Al Masif – Al Salam), which represents 35.6% of the total neighborhoods of Abha city.

- The study recommends supplying shopping areas and commercial centers with ATM machines in various bank branches, especially the central market in Abha city, due to the large number of times they are used by the city's residents.

- ATM machines should be continuously supplied with cash to ensure the convenience of customers.

- Providing continuous maintenance operations for ATM machines to increase customer satisfaction with the service provided.

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WORKS CITED

1. General Administration of Cultural and Media Affairs, (1419 AH): Civil Defense and a 74-Year Journey, General Directorate of Civil Defense, Ministry of Interior, Kingdom of Saudi Arabia.
2. Habib, Ahmed Abu Al-Yazid (2021), Spatial Analysis of ATM Service in Tanta City Using Geographic Information Systems, Annals of the Faculty of Arts, Beni Suef University, Special Issue (7), May.
3. Ali, Ahmed Ahmed (2022), Geographical Study of ATM Locations and Their Banking Services in Assiut City, Journal of the Faculty of Arts, Beni Suef University, Vol. 14, No. (1) Humanities and Social Sciences, January.
4. Bishr, Mahmoud Mohamed Gamal, (2010), Spatial Analysis of the Distribution of Civil Defense Service in Muscat Governorate Using Geographic Information Systems, Geographical Letters Journal, Letter No. 356, Kuwait Geographical Society, Kuwait.

5. Al-Khalifa, et al., (1413 AH - 1993 AD), Factors for Benefiting from the Services of Private Treatment Institutions, "A Field Study," Journal of Humanities and Social Sciences, No. 37, Deanship of Scientific Research, Imam Muhammad bin Saud Islamic University.
6. Al-Baghdadi, Mustafa Mohamed (1994): A systematic study on the relationship between geography and services, Girls College Annual, Ain Shams University, Issue 17.
7. Al-Ghamdi, Abdul Aziz bin Saqr (1986), A study of the locations of mosques in the city of Mecca, Mecca Cultural and Literary Club, Mecca.
8. Abdul Karim, Ashraf Ahmed Ali, (2014): Spatial analysis of the distribution of public services and identification of planning needs, an applied study on the city of Hafar Al-Batin, Saudi Geographical Society, King Saud University.
9. Al-Rabdi, Mohamed Salih, (1419 AH), Riyadh Region, a historical, geographical and social study, Services in the Riyadh Region, Vol. (7), edited by Abdullah Al-Wali'i, Emirate of Riyadh Region.
10. Al-Rabiah, Badr Abdul Aziz, (2007), The Development of Bakeries in the Kingdom of Saudi Arabia over a Hundred Years, King Abdul Aziz House, Riyadh.
11. Al-Rahili, Basma bint Salamah (1427 AH): Using Geographic Information Systems to Evaluate the Current Status of Government Girls Schools in Makkah Al-Mukarramah, Unpublished Master's Thesis, Umm Al-Qura University, Makkah.
12. Al-Zahrani, Ramzi Ahmed, (1424 AH - 2003 AD) Geographical Distribution of Health Services in Makkah Al-Mukarramah Region, Geographical Research, No. (55), Saudi Geographical Society.
13. Al-Zahrani, Ramzi Ahmed, (2006 AD) Spatial autocorrelation of bakery distribution, Journal of Gulf and Arabian Peninsula Studies, No. (123), Kuwait University.
14. Al-Zahrani, Ramzi Ahmed, (2000 AD), Living standards in the Kingdom of Saudi Arabia, a study in residential characteristics, No. 241, Kuwait Geographical Society, Kuwait.
15. Sharif, Abdul Salam Sharif (2019), Spatial analysis of banking services in Dammam City - a study in communications geography, Journal of the Faculty of Arts, Port Said University, No. 14, July.
16. Shawish, Adel Mohammed, (2014): Some aspects of spatial analysis of the main road network in Taif Governorate in the Kingdom of Saudi Arabia, a study in transportation geography.
17. Al-Qahtani, Hassan bin Mohamed Misfer, (2018): Spatial analysis of primary schools in the city of Abha, Asir Region, Vol. 18, No. 127, Culture and Development Association, Kingdom of Saudi Arabia.
18. Al-Huwaish, Abdul Karim bin Khalaf, (2014 AD): Analysis of spatial variation in health services in the Kingdom of Saudi Arabia for the period (1413-1431 AH), Journal of Gulf and Arabian Peninsula Studies, Year 40, Issue 153, Scientific Publication Council, Kuwait University.
19. Al-Habishi, Sanaa bint Saleh (2011): Bread Industry in the City of Makkah Al-Mukarramah, A Study in Economic Geography, Umm Al-Qura Journal of Social Sciences, Umm Al-Qura University.
20. Al-Duwaikat, Qasim and Al-Faisal, Khalid bin Hamad (2010): Analysis of the Distribution Pattern of Theft Crimes in the Saudi City of Hail Using Geographic Information Systems, Journal of the Association of Arab Universities for Literature, Volume 4, Issue 3.
21. Al-Sheikh, Amal bint Yahya (1429 AH): Analysis of the Distribution Pattern of Model Public Parks in the City of Jeddah Using Geographic Information Systems Technology, a working paper at the Third National Conference on Geographic Information Systems in the Kingdom of Saudi Arabia, Al-Khobar.
22. Al-Asiri, Fayez bin Mohamed Mushabbab (1422 AH): Awareness of the Importance of Geographic Information Systems in Civil Defense Work, a working paper at the Nineteenth Civil Defense Conference, King Fahd Coastal City, Jeddah.
23. Al-Asiri, Fayez bin Mohamed Mishbab (1424 AH): A model for rapid response in determining the location of an accident using geographic information systems for bakeries in the city of Riyadh, PhD thesis, King Saud University, Riyadh.
1. Ismail, Abdul Salam Abdul Sattar (2018), Spatial analysis of banking services in the city of Port Said, a study in the geography of communications, Arab Geographical Journal, Issue 71, Egyptian Geographical Society.
2. Otero, X., Santos-Estevez, M., Yousif, E., & Abadía, M. F. (2023). Images on stone in sharjah emirate and reverse engineering technologies. Rock Art Research: The Journal of the Australian Rock Art Research Association (AURA), 40(1), 45-56.
3. Nguyen Thanh Hai, & Nguyen Thuy Duong. (2024). An Improved Environmental Management Model for Assuring Energy and Economic Prosperity. Acta Innovations, 52, 9–18. https://doi.org/10.62441/ActaInnovations.52.2
4. Girish N. Desai, Jagadish H. Patil, Umesh B. Deshannavar, & Prasad G. Hegde. (2024). Production of Fuel Oil from Waste Low Density Polyethylene and its Blends on Engine Performance Characteristics . Metallurgical and Materials Engineering, 30(2), 57–70. https://doi.org/10.56801/MME1067
5. Shakhobiddin M. Turdimetov, Mokhinur M. Musurmanova, Maftuna D. Urazalieva, Zarina A. Khudayberdieva, Nasiba Y. Esanbayeva, & Dildora E Xo'jabekova. (2024). MORPHOLOGICAL FEATURES OF MIRZACHOL OASIS SOILS AND THEIR CHANGES. ACTA INNOVATIONS, 52, 1–8. https://doi.org/10.62441/ActaInnovations.52.1
6. Yuliya Lakew, & Ulrika Olausson. (2023). When We Don't Want to Know More: Information Sufficiency and the Case of Swedish Flood Risks. Journal of International Crisis and Risk Communication Research , 6(1), 65–90. Retrieved from https://jicrcr.com/index.php/jicrcr/article/view/73

7. Szykulski, J., Miazga, B., & Wanot, J. (2024). Rock Painting Within Southern Peru in The Context of Physicochemical Analysis of Pigments. Rock Art Research: The Journal of the Australian Rock Art Research Association (AURA), 41(1), 5-27.
8. Mashael Nasser Ayed Al-Dosari, & Mohamed Sayed Abdellatif. (2024). The Environmental Awareness Level Among Saudi Women And Its Relationship To Sustainable Thinking. Acta Innovations, 52, 28–42. https://doi.org/10.62441/ActaInnovations.52.4
9. Kehinde, S. I., Moses, C., Borishade, T., Busola, S. I., Adubor, N., Obembe, N., & Asemota, F. (2023). Evolution and innovation of hedge fund strategies: a systematic review of literature and framework for future research. Acta Innovations, 50,3, pp.29-40. https://doi.org/10.62441/ActaInnovations.52.4
10. Andreas Schwarz, Deanna D. Sellnow, Timothy D. Sellnow, & Lakelyn E. Taylor. (2024). Instructional Risk and Crisis Communication at Higher Education Institutions during COVID-19: Insights from Practitioners in the Global South and North. Journal of International Crisis and Risk Communication Research , 7(1), 1–47. https://doi.org/10.56801/jicrcr.V7.i1.1
11. Sosa-Alonso, P. J. (2023). Image analysis and treatment for the detection of petroglyphs and their superimpositions: Rediscovering rock art in the Balos Ravine, Gran Canaria Island. Rock Art Research: The Journal of the Australian Rock Art Research Association (AURA), 40(2), 121-130.
12. Tyler G. Page, & David E. Clementson. (2023). The Power of Style: Sincerity's influence on Reputation. Journal of International Crisis and Risk Communication Research , 6(2), 4–29. Retrieved from https://jicrcr.com/index.php/jicrcr/article/view/98
13. 25 Bin Salma, Nasser bin Mohammed (1422 AH): The importance of geographic information systems in planning the redistribution of bakery units in Riyadh, Kuwait Geographical Society, Geographical Letters, No. (262), Kuwait.
14. Sami Aziz Abbas Al-Otaibi, and Iyad Ashour Al-Taie, (2013), Modeling and Statistics in Geography, Al-Amara Press, Baghdad - Iraq, 1st ed., p. 138.
15. Khair, Safouh (2000): Geography, its subject, methods and objectives, Dar Al-Fikr, Damascus, Syria.
16. Othman, Badr Al-Din Taha (1424 AH): Supporting decision-making and spatial analysis in geographic information systems, Kuwait Geographical Society, Geographical Letters, No. (277), Kuwait.
17. Al-Sawy, Jihan Abu Bakr (2018), Spatial distribution of ATMs of government banks in Alexandria city with application to the East District, Journal of the Faculty of Arts, Alexandria University, No. 88.
18. Masilhi, Fathi Muhammad (2007): Geography of Services Theoretical Framework and Arab Traders, Dar Al-Majid for Publishing and Distribution, 2nd ed.
19. Nainaa, Muhammad Ahmad (2020), Geographical Analysis of Banking Services in Kafr El-Dawar City, Journal of the Faculty of Arts for Humanities and Social Sciences, Damanhour, Volume 12, Issue 2, July.
20. Atlam, Musa Fathi (2021), Geographical Analysis of ATM Service in Shibin El-Kom City, Arab Geographical Journal, Egyptian Geographical Society, Issue 156, May.
21. Ministry of Economy and Planning, General Statistics Authority, Preliminary Results of the General Population and Housing Census: (1431 AH).
22. Ministry of Municipal and Rural Affairs (1426 AH): Guide to Planning Standards for Services, Riyadh, First Edition.
23. Ministry of Municipal and Rural Affairs, Eastern Province Municipality, Geographical Information Systems Department, (1428 AH), Map of Dammam City (Neighborhood Boundaries, Cities, Land Uses), Dammam.

English references:

24. Adam. T, (2002). Geography of Service: Progress in the Geography of Service, Progress Report, School of Geographical Sciences. University of Bristol. Bristol. U.K.
25. Berry. B, (1972). Classification Handbook Methods and Application, New York.
26. Hagget. P, (1965). Location Analysis in Human Geography, London.
27. Jakle.D, (1999). The Strategy of Equality, Allen and Unwin, London.
28. Rubenstein. J, (2003). An Introduction to Human Geography, the Cultural Landscape. New Jersey, Pearson Education, Inc.
29. Sarmistha. B, & Helen. L, (2006). Economic Geography: Past, Present, and Future, Route Ledge, U. S. A, New York.