Sustainable engineering factors Affecting the generation of dwelling Solid Waste in some Residential neighborhoods in the Karkh district of Baghdad City in 2014

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Abstract. The world concern deeply in the creation of a healthy and happy environment for sustainable human living, to improve the human output in all activities of the life, so it is significantly concerned in finding the best procedure in the disposal of solid waste from the urban area. The recent improvements in economic, social and environment due to the national development and spatial analysis, led to increase in solid waste generated from different sources and to increase in the demands on this service, so it is necessary to study, and analysis quality and quantity of generated solid wastes effected on this problem. This study expresses the indicators in four selected neighborhoods of Baghdad residential areas in engineering and planning views by using quantitative approaches with the help of the different statistical methods. The researchers get off the effected of many variables; This discrepancy was due to a change in the behavior of the community and the diversity of the needs of its adult and child members as a result of the change in the general lifestyle. The problem of research is the environmental problems due to the accumulation of solid waste regarding health, environment aesthetic, and the lack of identification of indicators affecting them. Most urban areas suffered from increasing the volume of substantial waste dwelling from the residential area relative to the speed and convenience of dealing with techniques methods of modern planning ensure fair distribution of service based on updated planning indicators. Updating the spatial, temporal, engineering and economic indicators that have a limited impact on achieving the practical goal of this service and ensuring its continuity efficiently when dealing with the factors affecting the generation of household waste in residential areas. Identification and spatial analysis of factors affecting environmental pollution due to the generation of household waste using plastic bags in the study area by using quantitative and statistical methods. Several explanatory indicators can be used to estimate the number of plastic bags offered by dwelling units in the study area to decrease environmental pollution.

1. Introduction
Solid waste is any material resulting from human activity which is dispensed not benefiting from it or increasing need from the user which result in damage the environment directly or indirectly \cite{1}, if not disposed of sustainably and soundly. There are several classifications of solid waste by generation sources, such as residential, commercial, and industrial and construction waste. Solid waste is also classified by nature, such as organic and inorganic waste that can be rotten and non-corrosive. Burnable and non-combustible, ten thousand years ago, man defined the solid waste began to when it stabilizes in the form of human complexes \cite{2}, as these communities turned into the first cities, the problem of the accumulation of solid waste which was intended to through waste along the street emerged the pollution to the life and health of society \cite{3}. The steady increase rate in the population, the instability of the environment and change of urban lifestyle which was accompanied by the
accumulation of thousands of tons of municipal solid waste in the centers of cities cause pollution of the environment. Its beauty, the competent authorities have given this aspect of services great attention to achieving a safe and sustainable environment in addition to the adoption of some standards, planning, engineering, and environmental laws in accordance to the sustainable requirements environmental requirement: the low efficiency of the infrastructure due to available the comprehensive solid waste management system in Iraq in general, and the spatial study area indicators, especially the noticeable impact on the welfare level of the community. Despite the essential role of those responsible for providing the service generated by the activities of the community, its members are the shareholders and the actors at the same time, on the level of service efficiency. Parts of the Karkh Residential sector, selected from Baghdad city belonging to a quarter of different municipalities, which are different characters regarding economic, social and urban level. The time boundaries were field surveyed in July, September and October 2014.

The digital, descriptive and statistical methods used to collect dwelling solid waste data, processing, analyzing the data and showing the most critical sustainable indicators. The data obtained from the questionnaire were also field surveyed and the sample size selected was 5% of case study area dwelling, by means of the team plastic bags collection using a compact vehicle, and for representing the studied society and confirming its credibility with a statistically significant sample size, the following formula was used [4, and 5].

\[ N = \left( \frac{t \cdot s}{d} \right)^2 \]

Where:
N= sample size
t = limit of the confidence
s = standard deviation
d = level of significance

The value of( t) is 1.64 at a probability of 5%, and the value of d is equal t ( 0.1) of the mean of the variable when the permissible error is equal to 10% and the size of the sample to be used for the study area. For the five variables selected, The community represents a statistical and a permissible error of 5%, which enhances our confidence in the results.

2. Study area
Baghdad city is Iraq capital, the total area of Baghdad province of about (660) km 2 and the population about (7255278) persons, which is the largest city of Iraq regarding population, built in 762 AD and took the capital of the Abbasid state. The Tigris crosses through the city center to form two banks in Baghdad, where the west bank is called Karkh, and the east bank is called Rusafa.

Baghdad is located on latitude 33° and longitude 44° in central Iraq, which is 85 km north of the site of the ancient city of Babylon. A climate of desert and continental characterizes the climate of Baghdad. The summer of Baghdad is scorching and drought. The city has witnessed successive stages of responding to the geometric, urban, economic, social and environmental changes, which have been reflected in the urban texture and land uses from the beginning of the growth of Baghdad city in the 1920s. Namely design of streets and alleys with a harmonious texture and hierarchy that ends ways that do not reach the stage urban and planning maturity in the period from the beginning of the sixties until the late seventies, which had many reasons in the spread of modern planning of residential areas in terms of increasing the area of residential area and street view or cut its alleys. Table 1).

3. Selection of residential neighborhoods
In addition to the availability of some solid waste data, studies and research at the stage of collection, assembly and transfer to the transformational plant and hauling to the landfill areas. The researchers surveyed generation residential neighbourhoods site selected different spatial area to analyse, evaluate to get off recommendations that support the decision-making of this vital service the field survey included the researchers visit the selected neighborhood area number (604-817-430-421), and distribute questionnaire forms in months (7-8-9-10) in the year 2014, and site survey to temporary transfer stations. The first stage in the dwelling unit, the individual collects the waste in a specific
place or put it abroad for the capture, and then begin the second phase, disposed of it in the collection compact vehicles which depend on the technical and administrative style of the municipality in how to collect and transport it. Figure 1 illustrates the map of the study area and these neighborhoods are
- Neighborhood 421-Al-Kazemiyaa, of the holy municipality of Kazemiyaa.
- Neighborhood 430 – Al-Hurria, of the holy Municipality of Al-Hurria.
- Neighborhood 817-Al-Bayaa, of the holy Al-Rashid municipality
- Neighborhood 604, Al-Mansour of Al-Mansour municipality.

Figure 1. In this case simply justify the caption so that it is as the same width as the graphic.

Table 1 below shows the most important indicators of the reality for the study area. The residential dwelling 421-recorded the highest percentage of the number of children in the dwelling. While neighborhood 430 recorded the highest percentage of the number of adults and the amount of monthly expenditure. The residential neighborhood 604 registered on the percentage of the area of residential unit and garden area.
Table 1. The most important technical indicators and the general rate of study area neighborhoods [Ref.: Researcher based on 2014 questionnaire survey].

| Planning Indicators | General average for residential neighbourhood |
|---------------------|---------------------------------------------|
| Number of bags per week | 604  817  430  421 |
| Number of adults in the dwelling unit | 1.98  2  3.86  3.65 |
| Number of children in the dwelling unit | 2.12  4.50  5  3.1 |
| Amount of monthly expenditure (thousand Iraqi Dinars) | 1.9  1.44  3.42  3.66 |
| Area of residential dwelling in square meters | 558  610  613  520 |
| Area of the garden in square meters | 383  152  110.8  88.5 |
| Number of households per residential unit | 117.2  13.42  6.32  0.00 |
| The number of waste plastic bags generated by persons (X7) | 0.493  0.337  0.458  0.539 |

4. Factors affecting the number of disposable plastic bags

The use of plastic bags is the most important form for the citizen due to easy hauling from the dwelling and for the capturing from the waste staff collection, which provided by the municipalities. In order to study and analyze the factors affecting the environmental pollution of the household’s solid waste due to the number of generated plastic bags in the study area, multiple linear regression models will be used. The multiple regression interprets the dependent variable (Y) and the independent variables (X). The multiple regression model takes the following form [6]:

\[ Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + \ldots + B_kX_k \]

Where:

- \( K \) = no. of independent variables,
- \( B \) = parameters.

One of the problems facing regression models is the existence of a moral and robust correlation between two or more explanatory variables. The most significant adverse effects of double-linearity between explanatory variables are the instability of regression coefficients as well as the lack of reliability. The other problem is the multiplicity of linear relationships between two or more independent variables explained in the regression model [7]. The correlation analysis uses the correlation degree estimation and the extent of the linear relationship between two variables and the direction of this relationship, the relationship between \((-1 + 1)\) where the positive reference means that the relationship is a positive and negative signal means that the relationship between the two variables inverse.

4.1. Variables regression model for the study area

Most plastic bags are with uniform dimensions distributed from study areas municipalities are filled with the rate of 75% and their size is 0.063 m³. The volume is usually based on the method of packing dwelling solid waste inside the bag and its density. The preparation of waste bags that were taken from the collecting crew as the depended variable (Y) was studied and analyze its relationship with the independent variables influencing which were identified for the importance of its impact in the spatial dimension, namely:

\( X_1 = \) no. of adult persons
\( X_2 = \) no. of children
\( X_3 = \) amount of monthly expenditure
\( X_4 = \) dwelling area
\( X_5 = \) dwelling garden area
\( X_6 = \) no. of households
Y = f (X1, X2, X3, X4, X5, X6)

The researcher selected these explanatory variables according to the theoretical basis [8] because each of them household vital needs and depend in the interest of the occupancy, the area of the dwellings and the number of persons have the same task with the number of dwelling units independent family will use waste bags for their waste and the indicator of the area of the garden home importance for the trees and other branches of trees trash which collect some of which with domestic waste from the crew. Social factors, lifestyle and income levels affected on the quality and quantity of waste in modeling, as illustrated by modeling for each of the selected residential districts of the study area. The study variables find the best relationship between inputs and outputs data for the selected area as a whole, which amounted to (159) views [9] with statistical programs as follows:

1- Use the method of variance analysis for the number of single bags per week.

2 Using the distribution method of the mean and the standard deviation for the selected residential neighborhood by using statistical program SPSS.

3- We have tested whether there are significant differences between the studied dwelling units regarding the number of waste bags (Y) by applying the ANOVOAE WAY ANALYSIS OF (VARIANCE) method. It shows that the dependent variable number of bags raised from the dwelling unit per week affected by the change in the number of adults in the housing unit and the amount of monthly expenditure. Therefore, when estimating the number of plastic bags distributed by the municipality to the residential neighborhood in the study area, it is preferable to take into account, the number of individuals in the housing unit, (For the existence of significant differences at a significant level of 0.05 between residential neighborhoods).

4- To detect the sources of the significant differences, the method of multiple comparisons was applied according to the least significant difference method (LSD) to find significant differences between the average number of bags for the neighbourhood 817 and the other neighbourhoods where the average number of bags for the 817 is lower compared to the other neighborhoods (421, 430, 604) because the number of households per residential Unit is less than what was recorded in the 421 and 430 residential areas and the small area of the garden compared to the residential area 604. In addition to the existence of significant differences between the other residential neighbourhoods in terms of the average number of bags collected in a week except 421 and 430 (where there are no differences), morality between them is clear due to convergence of economic level and the nature of neighbourhoods among the population of the two localities.

The higher number of used bags per week was in neighborhood 430, with the number of children and adults higher than their percentage in the rest of the other neighborhoods, followed by 421, 604 and 817 respectively.

The number of waste plastic bags generated by persons (number of adults + number of children) is measured in the single dwelling unit represented by the variable X7 (X7 = the number of bags per person in the dwelling unit resulting from divided the number of plastic bags from the dwelling Y by the number of persons N p).

\[ X7 = \frac{Y}{Np} \]

The results show in table 1 above that 421 was the highest in terms of the number of bags generated by the X7 variable than for residential neighborhoods 604-430 and 817 respectively, where there is slight significant difference between neighborhoods 604 and 430 – 817 then this theoretical provided that X7 is high effected between depended and the number of persons in dwelling as un depended variable.

5. Models of regression and interpretation of the study area

By using the questionnaire distributed data survey, we obtained a set of regression models to predict the sustainable engineering scenarios. We obtained the best relation between the surveys data inputs for the research study, the stepwise method of multiple regression by depending on the results of the stepwise method for multiple regression as in Table 2, we obtained the following formula:

\[ Y = 1.249 + 0.527 \times X2 - 0.002 \times X3 \]
Table 2. Results of a stepwise method for multiple regression

| Model | Unstandardized Coefficients | Standardized Coefficient | t     | Sig.  |
|-------|----------------------------|--------------------------|-------|-------|
|       | B             | Std. Error | Beta |       |       |
| 1     | (Constant)    | 1.556       | 0.132 | -     | 11.833 | 0.000 |
|       | X2            | 0.532       | 0.041 | 0.719 | 12.958 | 0.000 |
| 2     | (Constant)    | 1.944       | 0.157 | -     | 12.356 | 0.000 |
|       | X2            | 0.526       | 0.039 | 0.712 | 13.442 | 0.000 |
|       | X4            | -0.002      | 0.000 | -0.216 | -4.082 | 0.000 |
| 3     | (Constant)    | 1.249       | 0.320 | -     | 3.904  | 0.000 |
|       | X2            | 0.527       | 0.039 | 0.713 | 13.688 | 0.000 |
|       | X4            | -0.002      | 0.000 | -0.264 | -4.751 | 0.000 |
|       | X3            | 0.001       | 0.000 | 0.138 | 2.482  | 0.014 |

a. Dependent Variable: y

The statistical tests using the selection coefficient of the function (0.880) showed that the explanatory strength of the equation is excellent as shown in Table 3. The model explains the deviations in the number of plastic bags generated by the dwellings due to variables number of children, income level and dwelling area (88%) so the model does not explain 12% of deviations in the number of bags. To achieve the correct interpretation of parameters of independent variables at the level of 5% and 1%, confirm the significance of the variables of indicators adopted in the interpretation of the number of bags generated during the week. The correlation between the explanatory variables leading to the phenomenon of multi-correlation, which results in the adverse effects related to the validity and accuracy of the results, is not apparent, so the selected model is statistically successful.

Table 3. The amount of explanatory power of the approved model [Ref.: the researcher depending on the program SPSS]

| Model | R   | R square | Adjusted R square | Std. The error of the Estimate |
|-------|-----|----------|------------------|-------------------------------|
| 1     | 0.719 a | 0.817    | 0.514            | 0.980                         |
| 2     | 0.751 b | 0.863    | 0.558            | 0.935                         |
| 3     | 0.762 c | 0.880    | 0.572            | 0.920                         |

a. Predictors: (Constant), X2
b. Predictors: (Constant), X2, X4

5.1 Models of neighborhood Regression 421

The best regression model that represents the relationship between neighborhood data 421 through the results is:

\[ Y = 0.711 + 0.534 \times X_2 + 0.320 \times X_1 \]

Table 4 below is shown the results of stepwise regression method:
Table 4. The results of the stepwise method for the multiple regression method

| Model | Unstandardized Coefficients | Unstandardized Coefficients | t    | Sig. |
|-------|-----------------------------|-----------------------------|------|------|
| 1     | Constant                    | 1.688                       | 0.325| -    | 5.189 | 0.000 |
|       | X₂                          | 0.538                       | 0.080| 0.844| 6.683 | 0.000 |
| 2     | Constant                    | 0.711                       | 0.469| -    | 1.516 | 0.148 |
|       | X₂                          | 0.534                       | 0.070| 0.838| 7.635 | 0.000 |
|       | X₁                          | 0.320                       | 0.122| 0.287| 2.613 | 0.018 |

a. Dependent variable: y
b. Predictors in the model: (constant), X₂
c. Predictors in the model: (constant), X₂, X₁

The explanatory variables of the variables: the number of children and the number of adults in a single dwelling unit has an effect on the number of plastic bags that are collected during the week. In comparison with the model of the neighborhoods together, we find that they are similar regarding the strength of the effect of the variable depended. Table 5 below shows the power of the model:

Table 5. The illustrative power of the model

| Model summary |
|---------------|
| Model | R | R Square | Adjusted R Square | Std. The error of the Estimate |
|-------|---|----------|-------------------|-------------------------------|
| 1     | 0.844<sup>a</sup> | 0.713     | 0.697             | 0.626                         |
| 2     | 0.892<sup>b</sup> | 0.795     | 0.771             | 0.544                         |

a. Predictors: (Constant), X₂
b. Predictors: (Constant), X₂, X₁

5.2 Models of neighborhood Regression 430
The best regression model extracted from Table 6, data represents the relationship between neighborhood specimens 430 is the following equation:

\[ Y = 2.931 + 0.683 X₂ - 0.130 X₄ \]

The analysis of the model shows that the increasing the number of adults in the dwelling unit will increase the number of bags collected per week by (0.680) for each waste bag per week and the area of the dwelling unit effects (0.13) for each waste bag per week. In comparison with the model of the neighborhoods together, we find that they are similar regarding the effect of the variable X2. Table 7 shows the results of stepwise multiple regression.
Table 6. Results method steps stepwise for the statistical method

| Model | Coefficients | Unstandardized Coefficients | Unstandardized Coefficients | t | Sig. |
|-------|--------------|-----------------------------|-----------------------------|---|-----|
|       | B            | Std. Error                  | Beta                        |   |     |
| 1     | Constant    | 1.474                       | 0.321                       | 4.597 | 0.000 |
|       | X₂          | 0.698                       | 0.083                       | 0.770 | 8.373 | 0.000 |
| 2     | Constant    | 2.931                       | 0.457                       | -   | 6.413 | 0.000 |
|       | X₂          | 0.683                       | 0.073                       | 0.755 | 9.399 | 0.000 |
|       | X₄          | -0.013                      | 0.003                       | 0.323 | 4.027 | 0.000 |

a. Dependent variable: y
b. Predictors in the model: (constant), X₂
c. Predictors in the model: (constant), X₂, X₁

Table 7. Stepwise results for multiple regression [Ref: the research depended on program SPSS]

| Model | R       | R Square | Adjusted R Square | Std. The error of the Estimate |
|-------|---------|----------|-------------------|-------------------------------|
| 1     | 0.770   | 0.594    | 0.585             | 1.041                         |
| 2     | 0.835   | 0.698    | 0.685             | 0.907                         |

a. Predictors: (Constant), X₂
b. Predictors: (Constant), X₂, X₄

5.3 Models of neighborhood Regression 817

The model explains the relationships between the data for neighbourhood 817 as shown in Table 8 which is in below equation:

\[ Y = 1.424 + 0.414 X₂ \]

The amount of explanatory power \( R = 0.623 \) shown in Table 9 shows that the increasing the number of children per unit will increase the number of bags per week by 0.414 per bag of waste per week. As
compared to the model of residential neighborhoods together, we find that they are similar in terms of the strength of the effect of the depended variable $X_2$.

**Table 8.** Stepwise results for multiple regression

| Model | Coefficients | Unstandardized | Unstandardized | t | Sig. |
|-------|--------------|----------------|----------------|---|------|
|      | B            | Std. Error     | Beta           |   |      |
| 1    | Constant     | 1.424          | 0.147          | 9.689 | 0.000 |
|      | $X_2$        | 0.414          | 0.075          | 0.623 | 5.519 | 0.000 |

a. Dependent variable: $y$

**Table 9.** The explanatory power of the model

| Model | R         | R Square | Adjusted R Square | Std. The error of the Estimate |
|-------|-----------|----------|------------------|-------------------------------|
| 1     | 0.623 a   | 0.388    | 0.376            | 0.705                         |

a. Predictors: (Constant), $X_2$

### 5.4 Models of neighborhood Regression 604

The below model explains the relationship between 604 data survey as below:

$$Y = 1 + 0.417X_1 + 0.167X_2$$

The explanatory power of the equation is $R = 0.661$, as shown in Table 10. From the model analysis, the increase in the number of adult individuals in the dwelling unit will increase the number of solid household waste bags per week by (0.167) for each waste bag per week. The increase in the number of children will result in an increase of (0.417) for each weekly waste bag and compared with the model of the neighborhoods together; we find that they are similar regarding the impact of the depended effect $X_2$.

**Table 10.** The explanatory power of the model

| Model | R         | R Square | Adjusted R Square | Std. The error of the Estimate |
|-------|-----------|----------|------------------|-------------------------------|
| 1     | 0.497 a   | 0.247    | 0.226            | 0.633                         |
| 2     | 0.661 b   | 0.437    | 0.406            | 0.555                         |

a. Predictors: (Constant), $X_1$
b. Predictors: (Constant), $X_1, X_2$

By studying the results of the statistical operations, we conclude that there are some engineering indicators that exceeded the importance of the rate of expenditure indicator or the level of income due to the change in the quality of life and consumption behavior of the individual in line with technological progress and changing social habits. One of the most useful indicators that would be preferred dependence on the provision of domestic solid waste service to the neighborhoods in terms of providing sufficient number of mechanisms and crew of dwelling waste collection. Consumption of plastic bags to serve and fit with the principle of preserving the environment and public health of the community as shown in Table 11, which illustrates the results of multiple linear regression equations and useful indicators.

Table 11. Results of multiple linear regression equations

| Regression model                     | Explanatory variable                                      | Neighborhood |
|--------------------------------------|-----------------------------------------------------------|---------------|
| $Y = 0.711 + 0.534 X_2 + 0.320 X_1$ | Adult no. $X_1$, Children no. $X_2$                       | 421           |
| $Y = 2.931 + 0.683 X_2 - 0.130 X_4$ | Children no. $X_2$, Dwelling area $X_4$                   | 430           |
| $Y = 1.424 + 0.414 X_2$             | Children no. $X_2$,                                       | 817           |
| $Y = 1 + 0.417 X_1 + 0.167 X_2$     | Adult no. $X_1$, Children no. $X_2$                       | 604           |
| $Y = 1.249 + 0.527 X_2 - 0.002 X_4$ | Children no. $X_2$, Dwelling area $X_4$, Monthly income $X_3$ | Study area    |

The indicator of the number of children $X_2$ between the selected residential neighborhoods recorded a positive relationship in the results of the statistical equations as a useful variable on the number of domestic waste bags. Followed by the number of adults $X_1$ and a direct relationship with the number of bags and then the area of the dwelling unit $X_4$ and a reverse relationship with the number of bags of residential waste, where the storage of bags of dwelling waste until the capture is available to provide space for it. The amount of monthly expenditure $X_3$ was positively correlated with the number of solid residential waste bags. This discrepancy was due to a change in the behavior of the community and the diversity of the needs of its adult and child members because of the change in the general lifestyle.

6. Conclusions
1. The effect and significance of the explanatory variables and indicators are different from one locality to another, since the variables number of adults, number of children and the amount of expenditure can explain the number of bags raised from the dwelling unit per week. A number of individuals a clear explanation of the residential neighborhoods in the study area all observed in the results of the equation. The impact of the selected explanatory variables on the residential neighborhoods as a single study area differs from their effect as a separate area. This emphasizes the importance of studying the spatial dimension of each residential locality as indicators of sustainable engineering.

2. The share of a collection of waste for the neighborhoods was not fair as the highest share of service was introduced to the neighborhood 604, and the lowest was to the neighborhood 421 and neighborhood 430.

3. The method used to collect dwelling solid waste within the residential unit for capture varies from one neighborhood to another according to the environmental level.

4. The use of plastic bags distributed by the municipal departments in the neighborhoods and collection of dwelling waste influential role in raising the level of service and was welcomed by the citizen and the persons responsible for lifting dwelling waste and thus reduce the visual pollution and environmental pollution.
5. Lack of justice in the level of service delivery to dwellings in the locality regarding type and quantity.
6. The importance of knowing the quantities required to be removed from solid dwelling waste in neighborhoods and residential areas will positively affect the achievement of the required goals and justice between all regions and thus their impact on the surrounding environment.
7. To commit to giving priority to the environmental dimension when signing the various land uses to ensure the sustainable engineering and to consider environmental planning as one of the planning pillars in the development of the basic design of cities.
8. To comply with the criteria, indicators of planning, environmental laws when dealing with solid waste by environmental requirements, update them in a format that enables the investment of solid waste and then safely.
9. The need to adhere to the time set for the date of passage of waste collection staff in the study area to reduce the accumulation of dwelling waste.
10. The need to update the data on the indicators of sustainable, environmental engineering spatially and temporally to increase the efficiency of the service provided by the competent authority.
11. Activation of the law on occupational safety measures in a broader scale and accounting for violators of workers in the service sector of solid waste disposal.

References
[1] Alwan, Kareem Hassn , 1987. A planning study for the disposal of the solid wastes generated from the residential dwellings, *a master thesis submitted to the college of urban and regional planning*, University of Baghdad, PPs.177-182.
[2] Purdom, P., Walton and Anderson, Stanley H. , 1980. Environmental science managing the environment, *Charles E. Merrill publishing company, A bell and Howell company*, P.318.
[3] Wilson, David Gordon, 1977. *Handbook of solid waste management*, Van Nostrand Reinhold Company, New York, P.1.
[4] Nouri, Walid Abdel Hamid, Nasser, Abdel Hamid Hamza, 1981. "Samples" Ministry of Higher Education and Research, *University of Mosul, Scientific, printed presses Dar books for printing and publishing, Iraq*, p: 81-86.
[5] Armore, Sidney J., 1973. Elementary statistics and decision making, *Charles E. Merrill publishing company, Abell & Howell company, Columbus, Ohio*, pps:168-170.
[6] Salman, Osama Rabea Amin, 2008. Statistical Analysis of Multiple Variables Using the SPSS Program, *Menoufia University, Commerce college, Egypt*, p: 143.
[7] Makridakis, Spyros, “Forecasting methods & application” 3rd. edition *John Wily & Sons Inc*. 199, p: 288.
[8] Grossman, Donald, Budson, James, F. and others, 1974. waste generation models for solid waste collection, *journal of the environmental engineering division, vol.100*, No. EE6, PP. 1220-1221.
[9] Hamdan, Maarib Yousif, 2015. The environment planning role in dealing with household solid waste, *master theses submitted to urban and regional planning for higher studies center, university of Baghdad*, PP. 92-102.