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# Creating continuous model review for material cement in Kirkuk plant when fuzzy and randomly demand with acceleration (speed up) waiting period by application.

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# أنشاء أنموذج مراجعة مستمرة لمخزون مادة السمنت في معمل كركوك عند ضبابية وعشوائية الطلب لتعجيل فترة الأنتظار مع تطبيق عملي .

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**Abstract:**

Many production companies suffering lot of problems concerning the management of inventory, especially in identify the amounts inventory should storage .In the actual market is very difficult to determine the precise value of the request for it to be random in most cases and that the adoption of these companies on the personal experiences and some of simple mathematical techniques leads to uncertainty determinant amounts of stock.

Where in this research create a model continuous for inventory due to demand is random fuzzy which has a fuzzy numbers for a following the trigonometric function for cement product which belong to cement plant Kirkuk at year 2015 and on a seasonal basis has been create a mathematical model after data distribution test which obtained upon request during the waiting period after removal of fuzzy where the test was using statistical program (spss) finding that distributed normally (normal distribution).

the research target to accelerate waiting period and identify the period which achieved highest economic typical quantitative by the lower expected cost with reduce the deficit and determine the best point to restore demand after conducting the required mathematical and statistical analyzes of the data by writing algorithm of proposed and It was using special mathematical criteria of quantitative methods in addition to the application importance and inventory effectiveness of the potential model in determining the economic quantities of production when the demand is random and fuzzy and reduced investment in inventories which leading to lower total costs of inventory to a minimum and so as to give solutions for research problem.

**Key words**: Continuous review of inventory, Fuzzy random demand Waiting time, Fuzzy trigonometric numbers.

**المستخلص :**

أن معظم الشركات الصناعيةوشركات الأنتاج تتعرض للكثير من المشاكل المتعلقة بأنتاج وخزن وتسويق المنتج وخاصة فيما يتعلق بتحديد كميات المخزون الواجب الأحتفاظ بها , لذلك من الصعب عمليا تحديد قيمة دقيقة للطلب لذلك يكون الطلب عشوائي في معظم الأحيان ومن ذلك فان أعتماد الشركات على الخبرات الشخصية وبعض الأساليب الرياضية التقليدية البسيطة ينتج عنه تحديد غير دقيق لكميات الخزين .

في هذا البحث تم أنشاء أنموذج مراجعة مستمرة للمخزون لكون الطلب عشوائي ضبابي ذو أرقام ضبابية تتبع الدالة المثلثية لمنتوج السمنت لمعمل سمنت كركوك لسنة (2015)م وعلى أساس فصلي ,وتم أنشاء الأنموذج بعد أختبار توزيع البيانات المستحصل عليها للطلب خلال فترة الأنتظار بعد أزالة الضبابية حيث تم الأختبار بأستخدام البرنامج الاحصائي (spss) وتبين أنها تتوزع توزيع طبيعيا (Normaldistribution).

ويهدف البحث الى تعجيل فترة الانتظار وتحديد الفترة التي تحقق اعلى كمية اقتصادية مثلى للانتاج باقل كلف كلية متوقعة وتقليل العجز المتوقع وكذلك تحديد افضل نقطة لاعادة الطلب وباجراء التحليلات الرياضية والاحصائية المطلوبة للبيانات لصياغة خوارزمية للانموذج المقترح واستعمالا لمعاير حسابية خاصة بالاساليب الكمية ولذلك اتضحت اهمية تطبيق هذا الانموذج وكفائتها في الحد من الاثار الناجمة عن التقلبات البيئية التي تواجهها الشركة من خلال السيطرة على مستوى الطلب وكلف الاحتفاظ بالخزين فضلا عن اهمية تطبيق انموذج الخزين وبيان فعاليته في تحديد الكميات الاقتصادية المثلى للانتاج عندما تكون كميات الطلب الضبابية عشوائية وبذلك سيتم تقليل الاحتفاظ في الخزين مما يؤدي انخفاض الكلف الاجمالية للخزين الى ادنى حد ممكن وبذلك ستوجد حلولا مقترحة لمشكلة البحث

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**الكلمات المفتاحية :**المراجعةالمستمرةللمخزون, الطلب الضبابي العشوائي, وقت الانتظار, الأعدادالضبابيةالمثلثية.

## 1 -Introduction:

Are important teaks management of store things that cannot be dispensed with in all companies and factories, the fact that the stock represents a portion of the capital of the company or factory value ranges between 15-25% of the invested capital. So that the storage is to keep a certain determinant quantities according to a scientific study of a commodity or raw material for a period of time to wait for the sale or used with storage costs. In practice, demand for goods is variable depending on consumer demand for the types of goods, as well as the waiting time. It is also variable depending on the circumstances that may be encountered by the external supplier. This leads to delaying the arrival of applications in a timely manner in some cases. The need for the consumer and the costs of storage because the increase in inventory generates a problem because it leads to idle capital and exploitation of storage space without interest and the lack of inventory generates another problem leading to loss which generated by the company because of the inability to meet the actual demand of the consumer so The company's management is facing the problem of determining the optimal value of inventory and timely supply for the issuance of an order to suppliers and optimal quantity for each supply order.

In this research, an optimal model will be constructed to control the storage of cement for the Kirkuk plant for the year 2015 by studying the continuous review system of the reservoirs under the alternative of the random demand with a deficit due to the instability of the demand quantities and the uncertainties that prevail. Fuzzy logic for handling data uncertainties this logic will provide an easy and simple way to obtain specific conclusions from inaccurate and ambiguous data, and then the waiting time will be increased production and reduce the expected deficit as well as to determine the optimal waiting period that achieves the highest optimal economic quantity. Production at the lowest total cost unexpected with lost fuzzy environment.

## 2 - The methodology:

### 1 -2 Model Assumptions:

We will use the following assumptions to development of a model for fuzzy probability storage with compression of waiting time components: (**5**)

A: The cost of preparing the order for each order.

$\hat{\hat{D}}$:The rate of demand during seasonal is random and fuzzy in nature.

$E[\tilde{x}_L]$:The expected demand rate during the waiting period is fuzzy.

h: The cost of storage per ton during the season.

L: Wait time (variable decition), consisting of several components (i ..... th) of the components of the minimum time () and the normal time of ($b_r$ ) with the cost of pressure per unit of time under the following assumption (C1≤ C2 ≤C3 ) The rang wait time is ().

Lr: Length of waiting time with its components (r ..... 1,2

The waiting period is compressed for the minimum duration as follows:

$L_n=\sum_{j=1}^{n} a_j$

$$Lr = L_n + \sum_{K=r+1}^{n} (b_k - a_k)$$

For $r = 0,1,\dots,n$

$b_r > a_r \ , L_{r-1} > L_r$

Q: The economic size of the production quantity.

$Q_r$:The economic size of the production quantity at the time of waiting (r).

$C_L$: The cost of compressing the waiting time for each cycle.

$B_r$: The amount of disability in each cycle.

B: The percentage of applications that are not executed due to depletion of deposits, which can be accepted by the plant management, and between ($0 \le B \le 1$)

π :Cost of disability per ton.

$\pi_0$ :Profit per ton.

$\bar{\pi}$:Total loss resulting from unsatisfied demand

$$\bar{\pi} = \pi + (1 - B)\pi_0$$

## 2 – 2 Mathematical formula:

From the assumptions above and given that a small portion of (B) during the period of entry into stock can be deferred requests so the total cost will be extracted through the following formula:

C(Q,R,L)= setup cost + holding cost + stock-out cost +lead-time crashing cost

$$= A\frac{D}{Q} + h\left[\frac{Q}{2} + R - E[x_L] + (1 - B)E[B_r]\right] + \frac{D}{Q}[\bar{\pi}E[B_r]] + \frac{D}{Q} \ldots\ldots(1)$$

$$= \frac{D}{Q}[A + \bar{\pi}E[B_r]] + h\left[\frac{Q}{2} + R - E[x_L] + (1 - B)E[Br]\right] \qquad \ldots\ldots(2)$$

Here the demand is considered as a random variable so the demand can be expressed vaguely and the total costs will be treated as a random variable so the cost function will be written as follows:

$$C(Q,R,L) = \frac{\hat{\tilde{D}}}{Q}[A + \bar{\pi}E[(\tilde{x}_L - R)^+]] + h\left[\frac{Q}{2} + R - E[\tilde{x}_L] + (1 - B)E[(\tilde{x}_L - R)^+]\right] \qquad \ldots\ldots.(3)$$

$$E[B_r] = E[(\tilde{x}_L - R)^+]$$

The demand during the waiting period is different depending on the length of the waiting period in the uncertain environment, so the estimation of the demand during the waiting period is based on the inaccurate perception, so the demand during the waiting period is fuzzy.

**Whereas:**

X: Demand weekly.

$x_L = x_2 L$

$0 \leq x_1 \leq x_2 \leq x_3$

Therefore, the expected value during the waiting period for the demand is fuzzy blurred and is extracted from the following equation:

$E[\tilde{x}_L]$= E$[\tilde{x}] * L$

$$\mathrm{E}[\tilde{x}_L] = \frac{x_1 + 2 * x_2 + x_3}{4} \ldots \ldots (4)$$

The model of continuous review of reservoirs under the fuzzy random cloud environment is as follows:

$$\tilde{C}(Q,R,L) = \frac{\hat{\tilde{D}}}{Q}[\mathrm{A} + \overline{\pi}\mathrm{E}[(\tilde{x}_L - \mathrm{R})^+] + \mathrm{C(L)}] + \mathrm{h}\left[\frac{\mathrm{Q}}{2} + \mathrm{R} - \mathrm{E}[\tilde{x}_L] + (1-\mathrm{B})\mathrm{E}[(\mathrm{xL} - \mathrm{R})^+]\right] \ldots\ldots(5)$$

There are two cases to calculate the expected deficit when the re-demand point is within range:

R in $(x_1 L, x_3 L)$

Provided that the re-order point is greater or equal to the expected demand during the waiting period

R ≥ E $[\tilde{x}_L]$

**Cas1: R $\epsilon$ $[x_1 \mathrm{L}, x_2 \mathrm{L}]$**

Re - order demand point as following figure:

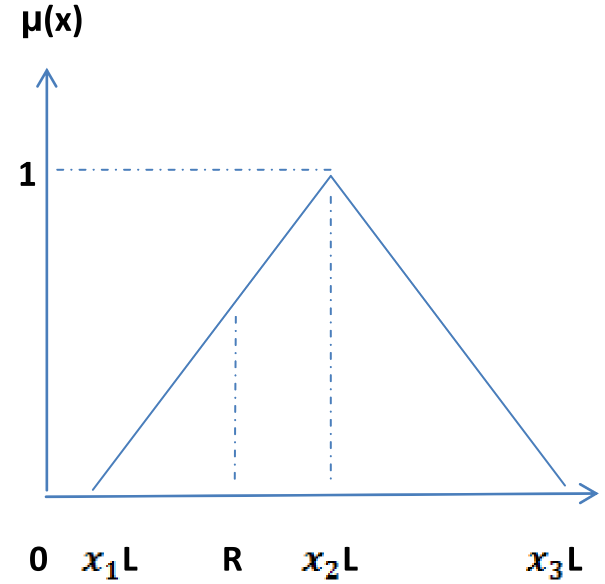


**Figure (1) when R ϵ ($x_1$L,$x_2$L)**

The expected disability in this case can be derived from the following:

$$E[(\tilde{x}_L - R)^+] = \int_R^{x_3L} (t-R)d\Phi(t) = \int_R^{x_2L} (t-R)d\Phi(t) + \int_{x_2L}^{x_3L} (t-R)d\Phi(t) \quad \ldots (6)$$

$$= \frac{2x_2L^2 - x_2L((x_1-x_3)L+4R)+2Rx_1L+R^2-x_1x_3L^2}{4(x_3-x_1)L} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots.(7)$$

Whereas:

$$\Phi(t)= )= \begin{cases} 0 & for \quad t \le x_1L \\ \left(\frac{t-x_1L}{2(x_2-x_1)L}\right) & for\ x_1L \le t \le x_2L \\ \left(\frac{t+x_3L-2x_2L}{2(x_3-x_2)L}\right) & for x_2L \le t \le x_3L \\ 1 & Otherwise \end{cases}$$

Assuming:

E[$\tilde{x}_L$]= t

Hanes the expected total cost for storage when R ϵ (Calculate by following formula When the total cost equation is derived for (Q):

$$E[\tilde{C}(Q,R,L)] = \frac{E[\tilde{d}]}{Q}\left[A + \bar{\pi}\left(\frac{2x_2L^2 - x_2L\big((x_1 - x_3)L + 4R\big) + 2Rx_1L + R^2 - x_1x_3L^2}{4(x_3 - x_1)L}\right) + C(L)\right]$$

$$h\left[\frac{Q}{2} + R - E[\tilde{x}_L] + (1 - B)\left(\frac{2x_2L^2 - x_2L\big((x_1 - x_3)L + 4R\big) + 2Rx_1L + R^2 - x_1x_3L^2}{4(x_3 - x_1)L}\right)\right] \ldots (8)$$

$$\frac{\partial}{\partial Q}E[\tilde{C}(Q,R,L)] = 0$$

We get the formula by calculate the optimal economic size.

$$Q^2 = \frac{2E[\tilde{d}]}{h}\left[\left[A + \bar{\pi}\left(\frac{2x_2L^2 - x_2L\big((x_1 - x_3)L + 4R\big) + 2Rx_1L + R^2 - x_1x_3L^2}{4(X_3 - X_1)L}\right)\right] + C(L)\right] \ldots\ldots\ldots (9)$$

$$Q. = \sqrt{\frac{2E[\tilde{d}]}{h}\left[\left[A + \bar{\pi}\left(\frac{2x_2L^2 - x_2L\big((x_1 - x_3)L + 4R\big) + 2Rx_1L + R^2 - x_1x_3L^2}{2(x_3 - x_1)L}\right)\right] + C(L)\right]} \ldots \quad \ldots (10)$$

**Case 2: Let R ϵ ($x_2$L,$x_3$ L)**

Therefore, the total expected cost of storage when R( ε )calculated from the following formula as shown figure :

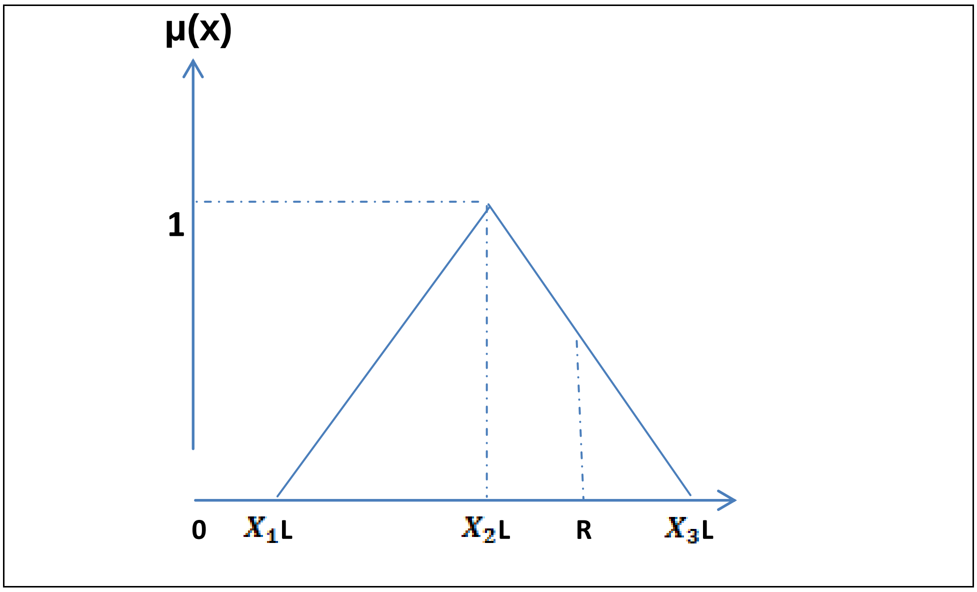


**Figure 2 when R ϵ [$X_2$L,$X_3$ L]**

The expected disability in this case can be derived from the following formula:

$$E[(\tilde{x}_L - \mathrm{R})^+] = \int_{\mathrm{R}}^{x_3\mathrm{L}} (\mathrm{t} - \mathrm{R})\, d\Phi(t) \qquad \ldots\ldots\ldots(11)$$

$$= \frac{(x_3L - R)^2}{4(x_3 - x_2)L} \qquad \ldots\ldots(12)$$

The expected total cost of storage when R( ε) is calculated from the following formula:

$$\mathrm{E}[\tilde{\mathrm{C}}(\mathrm{Q},\mathrm{R})] = \frac{\mathrm{E}[\tilde{d}]}{\mathrm{Q}}\left[\mathrm{A} + \overline{\pi}\left(\frac{(x_3\mathrm{L}-\mathrm{R})^2}{4(x_3-x_2)\mathrm{L}}\right) + \mathrm{C}(\mathrm{L})\right] + \mathrm{h}\left[\frac{\mathrm{Q}}{2} + \mathrm{R} - \mathrm{E}[\tilde{x}_L] + (1-\mathrm{B})\left[\frac{(x_3\mathrm{L}-\mathrm{R})^2}{4(x_3-x_2)\mathrm{L}}\right]\right] \ldots(13)$$

When we derivative the total cost equation for( Q) we get:

$$\frac{\partial}{\partial \mathrm{Q}} \mathrm{E}[\tilde{\mathrm{C}}(\mathrm{Q},\mathrm{R},\mathrm{L})] = 0$$

From this we get the formula by calculated the optimal economic size.

$$Q^2 = \frac{2E[\tilde{d}]}{h}\left[\left[A + \overline{\pi}\left(\frac{(x_3L - R)^2}{4(x_3 - x_2)L}\right)\right] + C(L)\right] \ldots (14)$$

$$Q = \sqrt{\frac{2E[\tilde{d}]}{h}\left[\left[A + \overline{\pi}\left(\frac{(x_3L - R)^2}{4(x_3 - x_2)L}\right)\right] + C(L)\right]} \ldots\ldots\ldots\ldots(15)$$

## 3 -Practical view:

### 1-3 Introduction:

For the purpose of applying the model of the problem in question has been relying on seasonal data for the year 2015, as the required data collected for the Cement Plant of Kirkuk - General Company for Iraqi Cement, for a period of one year and on a seasonal basis, which was obtained fuzzy quantity demand for the cement material where the first, third season data adoption for year (2015), as well as obtained the special costs of such material has been the cement industry relies on hageralklis, a raw material essential in the cement industry where interference by (75-80%) percent in the ton industry One of the cement and al trabalhudid, hageralgebs, white oil and will be the process of mixing materials involved measured ratios globally scientifically and practically passing through malty process to produce the cement material.

## 2- 3 The model data:

The formulation of data demand weekly for the first seasonal (January, February and March) , as indicated in the following table:

**Table (1 )** shows the weekly demand during the first seasonal

| Months | $X_1$ | $X_2$ | $X_3$ | E[x] |
|---|---|---|---|---|
| January | | | | |
| First week | 5209 | 5567 | 6144 | 5621.75 |
| Second week | 5114 | 5494 | 6038 | 5535 |
| Third week | 4928 | 5472 | 6006 | 5469.5 |
| Fourth week | 4833 | 5399 | 5904 | 5383.75 |
| February | | | | |
| First week | 4495 | 4769 | 5521 | 4888.5 |
| Second week | 4333 | 4536 | 5045 | 4612.5 |
| Third week | 4353 | 4719 | 5087 | 4719.5 |
| Fourth week | 4515 | 4952 | 5563 | 4995.5 |
| Marche | | | | |
| First week | 5764 | 6532 | 7035 | 6465.75 |
| Second week | 6168 | 6608 | 7003 | 6596.75 |
| Third week | 5657 | 6495 | 7145 | 6448 |
| Fourth week | 6275 | 6645 | 7177 | 6685.5 |

Source : Preparing the researcher based on the company records:

## 3-3 Distribution of the application during the waiting period:

When reviewing the statistical analysis of the demand during the waiting period for each chapter after removing the fuzzy using the following law $E[\tilde{x}]$ =It was found that the normal distribution is distributed where the data were tested by using the statistical program (SPSS).

**Table (2)** shows the normal distribution of the first chapter

| Descriptive Statistics | | | | | | |
|---|---|---|---|---|---|---|
| | N | Minimum | Maximum | Sum | Mean | Std. Deviation |
| | Statistic | Statistic | Statistic | Statistic | Statistic | Statistic |
| The First Season | 12 | 4612.50 | 6685.50 | 67422.0 | 5618.50 | 758.40276 |

A Test distribution is Normal

b. Calculated from data

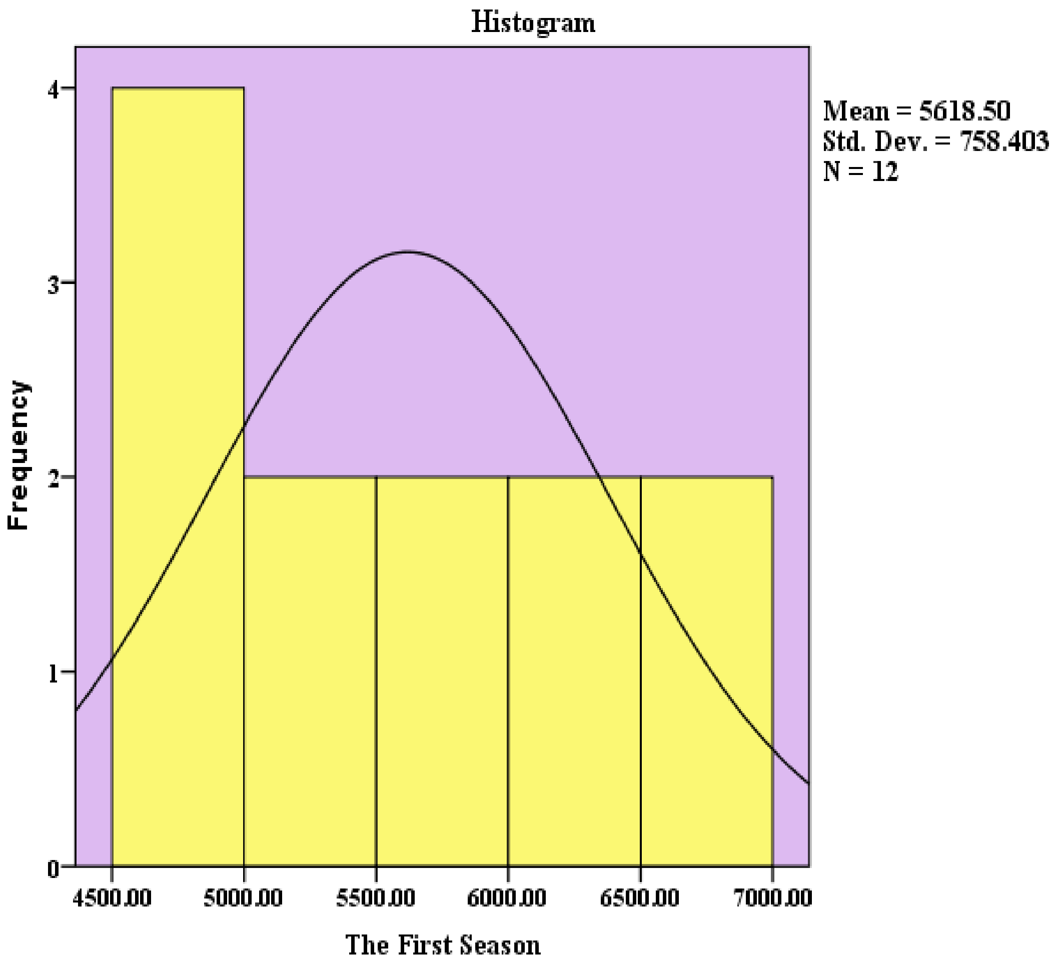


Figure (3) normal distribution of first seasonal

**Table (3**) shows the weekly demand rate during the first seasonal

| X1 | X2 | X3 |
|---|---|---|
| 5139 | 5599 | 6139 |

**Table (4)** shows the probability of fuzzy demand during the seasonal.

Probability Demand

| Demand | Probability |
|---|---|
| d1=(70024,70140,70370) | 0.15 |
| d2= | 0.18 |
| d3=(70070,70130,70221) | 0.20 |
| d4=(70105,70250,70320) | 0.22 |
| d5=(70150,70330,70400) | 0.25 |

Table) (5) shows the weekly demand during the second quarter (April, May, June)

| Months | $X_1$ | $X_2$ | $X_3$ | $E[X]$ |
|---|---|---|---|---|
| **April** | | | | |
| **First week** | **8566** | **8731** | **9544** | **8893** |
| **Second week** | **8433** | **8724** | **9540** | **8855.25** |
| **Third week** | **8280** | **8635** | **9216** | **8692.5** |
| **Fourth week** | **8413** | **8642** | **9220** | **8729.25** |
| **May** | | | | |
| **First week** | **8701** | **9217** | **9908** | **9260.75** |
| **Second week** | **8569** | **9276** | **10239** | **9340** |
| **Third week** | **:8357** | **9045** | **9423** | **8967.5** |
| **Fourth week** | **8913** | **8986** | **9754** | **9159.75** |
| **Jun** | | | | |
| **First week** | **6413** | **6743** | **7620** | **6879.75** |
| **Second week** | **6457** | **7003** | **7832** | **7073.75** |
| **Third week** | **6348** | **6796** | **7638** | **6943** |
| **Fourth week** | **6522** | **6950** | **7814** | **7059** |

Source: Preparing the researcher based on the company records

**Table (6)** shows the normal distribution ofsecond seasonal

| Descriptive Statistics | | | | | | |
|---|---|---|---|---|---|---|
| | N | Minimum | Maximum | Sum | Mean | Std. Deviation |
| | Statistic | Statistic | Statistic | Statistic | Statistic | Statistic |
| **The Second Season** | 12 | 6879.75 | 9340.00 | 99853.50 | 8321.1250 | 1003.83828 |

a. Test distribution is Normal.

b. Calculated from data

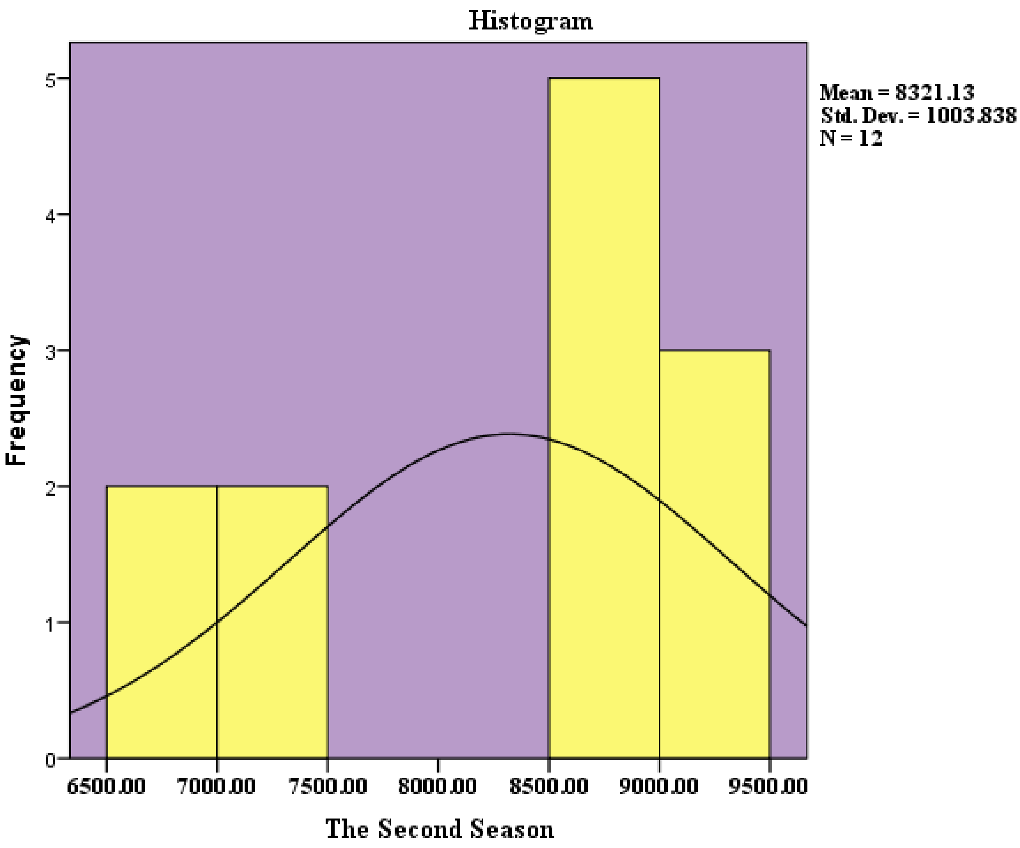


Figure (4) normal distribution of second seasonal

**Table (7**) shows the average weekly demand during the second seasonal

| X1 | X2 | X3 |
|---|---|---|
| **7831** | **8229** | **8979** |

Table (8) shows the probability fuzzy probability demand average during

| Demand | Probability |
|---|---|
| d1= | 0.27 |
| d2=(94010,96994,97530) | 0.24 |
| d3=(91989,92250,93122) | 0.19 |
| d4=(90928,92835,93202) | 0.16 |
| d5= | 0.14 |

**Source: Preparing the researcher based on the company records**

Table (9) shows the costs used in the model

| Season \ cost | α | H | ß | $\bar{\pi}$ | $\pi_0$ | π | A |
|---|---|---|---|---|---|---|---|
| First season | 0.35 | 4500 | 0.2 | 20100 | 20125 | 4000 | 16362192 |
| Second season | 0.4 | 4500 | 0.4 | 16075 | 20125 | 4000 | 21942309 |

Table (10) shows the components of the waiting time

| Contents waiting time | 1 | 2 | 3 |
|---|---|---|---|
| Normal time | 15 | 10 | 10 |
| Reduce time | 8 | 3 | 3 |
| Crash cost | 297000 | 300000 | 365000 |

**5-Model Algorithm:**

**First step:**

Calculate the length of the waiting period () with the compression of its components to the maximum of normal time by applying the following formula: (**5**)

$Ln = \sum_{j=1}^{n} aj$

$$Lr = L_n + \sum_{k=r+1}^{n} (b_{k-a_k})$$

$L_0$ = 35 days (5 weeks)

$L_1$= 35 - 7 = 28 days (4 weeks)

$L_2$ = 28 - 7= 21 days (3weeks)

$L_3$= 21 - 7 = 14 days (2weeks)

and

$$L_3 = \min_{0 \le r \le n} L_r = 2\ weeks$$

$$L_0 = \max_{0 \le r \le n} L_r = 5\ weeks$$

**4 - Application the model of fuzzy probability storage:**

This paragraph is devoted to the application of a model of fuzzy probability storage in the framework of the algorithm to be clarified based on the seasonal demand data of the product collected so that we can draw conclusions and discuss them.

Table (11) shows reduced waiting periods

| R | $L_r$ |
|---|---|
| 0 | 5 |
| 1 | 4 |
| 2 | 3 |
| 3 | 2 |

**Second step:**

Calculate expected demand during the waiting period through the following formula:

$$E[\tilde{x}_L] = E[\tilde{x}] * L_r$$

$$\mathrm{E}[\tilde{x}] = \frac{x_1 + 2 * x_2 + x_3}{4}$$

**Third step:**

Calculate the standard deviation of the demand during the waiting period by the following formula:

Whereas:

$$\overline{X} = \frac{\sum X_i}{n}$$

**Fourth step:**

Calculate the Redemption Point (R) through the following formula:

$$R = \mathrm{E}[\tilde{x}] * L_r + \sqrt{L_r} * Б * K_{\alpha i}$$

**Fifth Step:**

Calculate the degree of affiliation of the application during the waiting period through the following formula:

$$\mu(x) = \begin{cases} \dfrac{E(x)L - x_1 L}{x_2 L - x_1 L} & for\ x_1 L \leq E(x)L \leq x_2 L \\ \dfrac{E(x)L - x_3 L}{x_2 L - x_3 L} & for x_3 L \leq E(x)L \leq x_3 L \\ 0 & otherwise \end{cases}$$

**Sixth Step:**

Calculate expected **deficit** of demand during the waiting period.

**Case (1) if** $\mathrm{R} \epsilon (x_1 \mathrm{L}, x_2 \mathrm{L})$

The expected deficit is calculated by applying equation (7).

**Case (2) if** $\mathbf{R}\epsilon(x_2\mathbf{L}, x_3\mathbf{L})$

The expected deficit is calculated using the equation (12).

**Seventh step:**

Calculate expected demand during the quarter by the following formula:

$$\mathbf{E}[\tilde{d}] = \sum_{i=1}^{n} E[\tilde{d}i] * Pi$$

whereas:

$$E[di] = \frac{(di1+(di2*2)+di3)}{4}$$

**Eighth Step:**

Calculate the cost of pressure C (L) through the following law:

$$\text{C(L)=Cr}(L_{r-1} - L) + \sum_{K=1}^{r-1} C_K(b_k - c_k)$$

**Table (12)** shows the calculation of the cost of accelerating (speed up) the waiting time

| R | $C(L)$ | |
|---|---|---|
| 0 | 0 $for\ 35 \geq L$ | |
| 1 | $297000(35 - L) = 10395000 - 297000L$ | $for\ 35 \leq L \leq 28$ |
| 2 | $300000(28 - L) + 297000 * 7 = 8400000 - 300000L + 2079000$ | $for\ 28 \leq L \leq 21$ |
| 3 | 365000 | |

**Table (13)** shows the cost of accelerating the waiting time for each stag

| Crash lead –time | Lr | C(L) |
|---|---|---|
| 0 | 5 | 0 |
| 1 | 4 | 2079000 |
| 2 | 3 | 4179000 |
| 3 | 2 | 6734000 |

## Ninth Step:

The economic size of the production quantities is calculated by the following formula:

**CAS 1: IF R ϵ ($X_1$,$X_2$)** By applying equation (10) .

**CAS 2: IF R ϵ ($X_2$L,$X_3$L)** By applying equation (15) .

## Tenth Step:

Calculate the expected total cost of the storage through the following formula:

**CAS 1: IF R ϵ** By applying equation (8):

**CAS 2: IF R ϵ ($x_2 L$,$x_3$ L)** By applying equation (13):

**Table (14)** shows the optimal solution for third seasonal.

| Crash lead – time | L | MC | Q | R | SHORTS |
|---|---|---|---|---|---|
| 0 | 5 | 125969228.6 | 27080.8 | 28736.91 | 355 |
| 1 | 4 | 125934942.5 | 27205.51 | 23050.38 | 262.37 |
| 2 | 3 | 12461077805 | 27392.42 | 17354.66 | 174.16 |
| 3 | 2 | 127628443.6 | 27912.32 | 11644.56 | 92.88 |

**Table (15**) shows the best solution for fourth seasonal.

| Crash lead – time | L | MC | Q | R | SHORTS |
|---|---|---|---|---|---|
| 0 | 5 | 163412924.4 | 35425.56 | 42149 | 502 |
| 1 | 4 | 1631809618 | 35515.67 | 33772.5 | 382.88 |
| 2 | 3 | 163221426.9 | 35651.2 | 25387.9 | 266.6 |
| 3 | 2 | 164597679.6 | 36103.38 | 16990.7 | 155.94 |

## 6 - Results:

the table(14) show us that the best waiting period is when (L = 3) a week, (21 days), which is to accelerate the waiting period for two (14) days, meaning that we can only accelerate the components of the first and second waiting period. (27392.42) tons, or about (27392) tons during this period at the lowest total cost expected by (12461077805) dinars and the point of re-demand is when the stock reaches (17354.66) tons, or about (17355) tons with an attempt to reduce the amount The expected deficit to (174.16) tons or about (174) tons during this period of this seasonal ( third seasonal ) , while for the second seasonal , the economic quantity of the (35651.2) tons (35651) tons when the waiting period (L = 3) a week is the best waiting period because it achieves the highest quantity at the lowest total cost expected by (163221426.9) dinars and the point of re-demand is when the stock reaches (25387.9) ) And that the expected deficit during this period is (266.6) tons during the waiting period for this seasonal ( fourth seasonal ).

## 7 – Conclusions:

1-The company does not adopt the scientific methods in determining the actual quantities of demand for the cement product. An annual plan is drawn up based on personal estimates.

2-The use of fuzzy logic in inventory management is more effective and flexible for decision makers in determining the optimal quantities of traditional methods.

3-Through the study and analysis it became clear that the demand for the cement product is affected by the seasonal factors in its fluctuations due to the adoption of most companies on personal experience and some simple mathematical methods that lead to the identification of inaccurate amounts of storage, because in practice it is difficult to determine the exact value of the request, The demand is often vague.

## 8 - Recommendations:

1 -Conducting studies in the field of inventory management in the with a random and fuzzy environment and applying it to productive companies in Iraq because they lack inventory systems based on modern methods and methods of inventory management.

2- Adoption of modern scientific methods in determining the optimal economic volume of demand or production to develop a seasonally plan or annual study.

3 -Using the applications of the theory of aggregates fuzzy in various areas to remove the uncertainty and volatility that prevail in the Iraqi production environment.

4- Develop seasonally and annual plans using modern scientific methods in determining the economic quantities of production.

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