Estimation Hazard Function of the Survival Function in Life Table for Kurdistan region by MICS4 Survey

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Abstract

In this paper we are estimating the Survival function and Hazard function of from the constructing life table of Kurdistan region by using the method empirical Survival function (ESF) and using the estimate Empirical Cumulative Hazard Function through analyses the data of Survey MICS4-kurdistan region-Iraq (2012) to find mortality statistics by population estimates based on the 1977 decennial census of Iraq, we depended on data prior of 1977 to reach abridged life table constructed by reference to standard table and for results from this Survey and found the overall expectancy of life for both sex (70.6) in ages (1-4) of Kurdistan region and Female(71) and Male(70.2), the high probability of surviving equal (0.99339) in ages (15-19), the variance in Survival function is less than from variance of hazard function in all ages, especial less variance in ages (15-19) and age(10-14) and note the variance of hazard function increasing at ages (less than one and +50)with mean of life time of hazard function λ(t) is high in ages (less than 5 and +50) exactly after the ages (+70) the mean of λ (t) is very high from analyses the data of Survey MICS4-Iraq (2012) .

this research is analyses by using SPSS Package v.22 and Excel Software.

Keywords: Life expectancy • survival • death rates• abridged life table• Hazard Function •product-limit(PL).

1. Introduction:

There are two types of life tables: the cohort (or generation) life table and the period (or current) life table. The cohort life table presents the mortality experience of a particular birth cohort—all persons born in the year 1900, from the moment of birth through consecutive ages in successive calendar years. Based on age-specific death rates observed through consecutive calendar years, the cohort life table reflects the mortality experience of an actual cohort from birth until no lives remain in the group, to prepare just a single complete cohort life table requires data over many years.

It is usually not feasible to construct cohort life tables entirely on the basis of observed data for real cohorts due to data unavailability or incompleteness .The period life table may thus be characterized as rendering a snapshot of current mortality experience and shows the long-range implications of a set of age-specific death rates that prevailed in a given year. In this report, the term “life table” refers only to the period life table and not to the cohort life table. Life tables can be classified in two ways, according to the length of the age interval in which data are presented. A complete life table contains data for every single year of age. An abridged life table typically contains data by 5- or 10-year age intervals. A complete life table can easily be aggregated into 5- or 10-year age groups.

The aim of the paper is using application to construction abridged life table and estimation Hazard Function of the Survival Function from the life table for Kurdistan region by MICS4 Survey and find the variance and mean for Hazard Function of Exponential distribution(Lawless, J.F.1982).

2: Methodology:

2.1: The abridged life table

Let us use the notation ${}_nD_x$ for deaths in a life table between the age of x and x+n. Then:

$${}_nl_{x+n} = l_x - {}_nD_x \qquad \ldots(1)$$

And $${}_nq_x = {}_nD_x / {}_nl_x \qquad \ldots(2)$$

(x, x+ n) : The number of years that the life table population lives between the ages of x and x+n is equal to the years lived by those that survive to the end of the interval .

${}_nl_x$: Of the starting number of new borns in the life table (called the radix of the life table, usually set at 100,000) the number living at the beginning of the age interval (or the number surviving to the beginning of the age interval).

${}_nD_x$:The number of persons in the cohort who die in the age interval (x, x+ n)

$n*l_{x+n}$: plus the years lived by those that die in the interval ${}_n\tau_x * n*{}_nD_x$, where ${}_n\tau_x$ is the proportion of the interval lived by those who die in it.

$${}_nL_x = n*l_{x+n} + {}_n\tau_x * n*{}_nD_x \qquad \ldots (3)$$

For all ages over 5, we can assume that the deaths are distributed evenly over the interval, so that (3) simplifies to

$${}_nL_x = n/2(l_x + l_{x+n}) \qquad \ldots (3a)$$

${}_nL_x$: Number of years of life lived by the cohort within the indicated age interval (x, x+ n) (or person-years of life in the age interval).

For ages at the beginning of the life table, it is not a realistic assumption that deaths are spread out evenly over the interval; they are concentrated at the beginning of the interval. For age 0 we frequently use ${}_1\tau_0$ =0.3 and ${}_4\tau_1 = .475$ which leads to:

$${}_1L_0 = {}_1\tau_0 * l_0 + (1 - {}_1\tau_0) * l_1 = 0.3* \ l_0 + 0.7 * \ l_1 \qquad \ldots (3b)$$ [1]

$${}_4L_1 = {}_4\tau_1 * n * l_1 + n*(1 - {}_4\tau_1) * l_5 = 1.9 * \ l_1 + 2.1 * l_5 \qquad \ldots (3c)$$

The exact values of ${}_n\tau_x$ for each individual age between 0 and 4, or for the interval from 1 to age 5, varies by sex and by pattern of mortality, for countries where the statistics are reliable these values have been calculated and are applied in a standard fashion. The same applies for T_x person years lived after the open age group, say person-years lived above the age of 85.

The mortality rate between x and x+n, is equal to:

$${}_nm_x = {}_nD_x / {}_nL_x \qquad \ldots (4)$$

Then T_x :All person-years lived after the age of x is equal to

$$T_x = \sum_x^{\varpi} {}_nL_x \qquad \ldots (5)$$

and the expectation of life after the age of x is:

$$e_x = T_x / l_x \qquad \ldots (6)$$

e_x: Average number of years of life remaining for a person alive at the beginning of age interval x.

2.2 The life table in single years

Imagine that we would have a birth cohort in single year of size 100,000, and that we would follow them through life. The number of Survivals at birth, or age 0, is l_0 =100,000. Before they reach their first birthday, some of them will die. If we refer to these deaths as ${}_1D_0$, we

[1] $${}_nL_x = n*l_{x+n} + {}_n\tau_x * n*{}_nD_x = n*l_{x+n} + {}_n\tau_x n(l_x - l_{x+n}) = {}_n\tau_x n * l_x + n(1 - {}_n\tau_x) * l_{x+n}$$

can say that at the age of 1 there will be 100,000 - ${}_1D_0$ Survivals, or $l_1 = l_0 - {}_1D_0$. Similarly $l_2 = l_1 - {}_1D_1$ or in general terms

$$l_{x+1} = l_x - {}_1D_x \qquad \dots (7)$$ [2]

This is the so called Survival ship function of the life table.

The probability that somebody of this hypothetical cohort dies between the age of o and the age of 1 is ${}_1q_0 = {}_1D_0 / l_0$. This is the infant mortality rate. The probability that a person in this cohort dies between the age of 1 and 2 is ${}_1q_1 = {}_1D_1 / l_1$ and in general terms

$${}_nq_x = {}_nD_x / l_x \qquad \dots (8)$$

${}_nq_x$: Proportion of persons alive at the beginning of the age interval who die during the age interval.

Let us assume that on average a person lives half a year after the birthday in his year of death. For example people who reach the age of 65 but die before their 66th birthday are assumed to live on average until age 65 ½. That implies that their deaths are distributed more or less evenly over the age interval. For most ages this is a fairly realistic assumption. Let us also assume that all people die before the age of 100.

The total number of years lived by this cohort from birth, is equal to the number that survived to the age of 1, plus the number that survived to age 2, plus the number that survived to age 3, all the way up until the number that survived to the age of 98, 99, and finally by the time we have reached the age of 100 all have died. We can then estimate the total number of person-years lived after the age of 0 (less than one year), T_0 by our hypothetical cohort as $T_0 = l_1 + l_2 + l_3 + \dots l_{98} + l_{99}$ and in general terms we can say by approximation that $T_x = \sum_{x+1}^{\omega} l_x$, where ω is the last age lived by the oldest person in the cohort. The life expectancy of a person that survives to age x, is equal to the person years lived after x, divided by the number of those that survive to age x. This number of person years is equal to those of the Survivals to each consecutive age x which is T_x plus the person years lived by those who die in each interval, for which we have to add ½ a year according to the assumption that we made.

$$e_x = 1/2 + T_x / l_x \qquad \dots (9)$$ [3]

The life expectancy at age 0 (less than one year) (e_0)for a given calendar year, is the average age a person can expect to reach if exposed to the mortality conditions in that year. Similarly e_1 is the number of years a person that reaches the age of 1 can expect to live after that age, e_2 is the number of years lived after the 2nd birthday, and in general terms e_x is the average number of years a person can expect to live after reaching his x-th birthday. Life expectancies at age x are calculated by diving person-years lived after age x, by the number of persons in the hypothetical cohort that reach this age.

We have now explained the meaning of four life table functions: the Survival function, deaths in the life table, probabilities of dying and the life expectancy. Next session we will continue with the subject of the life table, including the mortality rate ${}_1m_x$, giving the expressions used in the abridged life table that is in conventional five year age groups (Lee, Elisa, T. ,2003).

[2] or ${}_1D_x = l_x - l_{x+1}$

[3] The precise expression is $e_x = (T_x / l_x) + (\sum_{x}^{\omega} {}_1\tau_x * {}_1D_x) / l_x +$ where ${}_1\tau_x$ is the proportion of the year lived in each interval by those who die at age x.

3.2: Hazard function, h(t), through statistical lenses

Let F(t) denotes cumulative distribution function (c.d.f.),$0 \leq F(t) \leq 1$

In our case, *t* is time and F(t) is cumulative probability of an event up to time *t*, the longer the follow up time, the greater is the probability that the event will happen (Lawless, J.F.1982).

In other words, c.d.f. is simply the "cumulative incidence" (for incident events) or a proportion.

Let S(t) = 1 – F(t). Evidently, $S(t)$ is the survival probability.

The probability that the event will not happen until time *t*.

If we take the first derivative of a cumulative distribution function, we get the probability density function (p.d.f.), Let's call it f(t).

F'(t) = *d*F/*d*t = $f(t)$

Which is 1/time (or time-1).the hazard is not a probability, It is counts per time(which is rate).Some people call it "probability rate".

all of this was generic. We have nothing specific until we make an assumption about $F(t)$.

One possible function is exponential (known from draw the graphs.)

$$F(t)=1-\frac{1}{e^{\lambda t}} \quad \text{or} \quad 1-e^{-\lambda t} \qquad \ldots(11)$$

λ is a constant, but we don't know yet what it means. The function behaves reasonably, however: When t tends to 0, $F(t)$ tends to 0, as it should: the cumulative probability of the event is small. When t tends to infinity, F(t) tends to 1: the event will happen, "eventually

Now, derive $f(t)$, $S(t)$ and $h(t)$

$$f(t)=F'(t)=\lambda e^{-\lambda t} \qquad \ldots(12)$$

$$S(t)=e^{-\lambda t} \qquad \ldots(13)$$

$$h(t)=\frac{f(t)}{S(t)}=\frac{\lambda e^{-\lambda t}}{e^{-\lambda t}} \qquad \ldots(14)$$

So, we discovered that λ in $F(t)$, as defined above, is what we called the hazard. but he starts from the hazard and moves to the other functions. that the c.d.f. is the best starting point, pedagogically, from c.d.f. we get to p.d.f. and then to hazard.

There are other hazard functions that are not constant:

Exponential: $h(t) = \lambda$ (This is what we did above)

Gompertz: $h(t) = \exp(\lambda + \alpha t)$

Weibull: $h(t) = \lambda t^{\alpha}$

If we allow for predictors, and define log $h(t) = \mu$, then:

Exponential: log $h(t) = \mu + \beta_X$

Gompertz: log $h(t) = \mu + \alpha t + \beta_X$

Weibull: log $h(t) = \mu + \alpha \log(t) + \beta_X$

Maximum partial likelihood(Cox)makes no assumption about $h(t)$.

4.2: The Empirical Cumulative Hazard Function

The cumulative hazard function is defined as(Lawless, J.F.1982).

$$H(t)=-\log\hat{S}(t)$$

So a natural estimate of it is :

$$\hat{H}(t) = -\log \hat{S}(t) \quad \ldots(15)$$

Where $\hat{S}(t)$ is properties of the product- limit estimate (PL) to estimate of the Survival function for possesses several desirable large-sample properties, this also provides a nonparametric estimate of Survival or distribution function for the life distribution under study and the first discussed properties of product-limit by (Kaplan-Meier estimate,1958). An alternate estimate of H(t) is:

$$\tilde{H}(t) = \sum_{j:tj<t} \frac{d_j}{n_j} \quad \ldots(16)$$

Which is sometimes called the empirical(cumulative) hazard function. This estimate by several researches Crowley(1974),Nelson(1972),and Efron (1977) in the continuous case, and d_j/n_j as a contribution to the hazard function $h(t)$ at t_j for possibility of there being more than one death at t_j is allowed, and we let d_j represent the number of deaths at t_j .In addition to the lifetimes $t_1,\ldots,t_k$ the are also censoring time L_i for individuals whose lifetimes are not observed. The product- limit estimate of S(t) is defined as:

$$\hat{S}(t) = \prod_{j:tj<t} \frac{n_j - d_j}{n_j} \quad \ldots(17)$$

Where n_j is the number of individuals at risk at t_j

In the large samples the variance of $\hat{S}$ (t) can be approximated as:

$$Va\hat{r}\hat{S}(t) = \hat{S}(t)^2 \sum_{j:t\,j<t} \frac{d_j}{n_j(n_j - d_j)} \quad \ldots(18)$$

And to find sampling variation in $\hat{H}(t)$ or $\tilde{H}(t)$ the estimate equal:

$$Va\hat{r}[\hat{H}(t) or \tilde{H}(t)] = \frac{Va\hat{r}[\hat{S}(t)\ ]}{\hat{S}(t)^2} \quad \ldots(19)$$

The basic idea to make plots that should be roughly linear if the proposed family of models is appropriate, since departures from linearity can be readily appreciated by eye, the possibility of an underlying exponential distribution satisfies :

$$\log S(t) = -\lambda t \quad \ldots(20)$$

This is obtained by fitting a straight line to the plot and estimating λ as the slope of the line.

3: Practical Aspect:

By using the data of Survey MICS4 (Multiple Indicators Cluster Survey)-Iraq (2012)for the No. of observation (8024) women and mortality statistics with population estimates based on the 1977 decennial census of Iraq, and comparison with Iraq Census from life table based on data prior to 1977 and to find abridged life table constructed by reference to standard table In the analysis of census and survey data, however, one often only obtains mortality estimates for part of the age range.

For used mortality estimates made from birth history data and sibling history data provide no information on the mortality of older children or on adult mortality at age 50 and more. With estimates of this sort, model life tables can be used both to smooth the estimated death rates and to complete the life table by making plausible assumptions about the death rates that prevail at ages at which mortality has not been measured directly. and for results from this Survey and found the overall expectancy of life for both sex (70.6) in ages(1-4),Female(71) and Male(70.2) in Appendix and by using programs SPSS v.23 and Excel Software for analyses this data of MICS4 we find the fertility and mortality from file birth history and household and finding life table by sex both sex and in table (1),and Male and Female tables(3),(4) in Appendix .

Table (1) Abridged Life Table for Region Kurdistan by both Sex

Age (X)	Width(N)	nMx	nqx	lx	ndx	nLx	5Px	Tx	ex
<1	1	0.04899	0.047022	100000	4702.231	95983	0.947345	6820091	68.2
1-4	4	0.003379	0.013392	95297.77	1276.255	377690	0.989366	6724108	70.6
5-9	5	0.001256	0.006261	94021.51	588.67	468636	0.995023	6346418	67.5
10-14	5	0.000738	0.003685	93432.84	344.257	466304	0.996689	5877782	62.9
15-19	5	0.000588	0.002936	93088.59	273.3345	464760	0.996043	5411479	58.1
20-24	5	0.000999	0.004981	92815.25	462.3412	462920	0.993594	4946719	53.3
25-29	5	0.001574	0.007838	92352.91	723.879	459955	0.990981	4483799	48.6
30-34	5	0.002052	0.010208	91629.03	935.3779	455807	0.988351	4023844	43.9
35-39	5	0.002638	0.013104	90693.65	1188.408	450497	0.98481	3568037	39.3
40-44	5	0.003491	0.017305	89505.25	1548.878	443654	0.979565	3117540	34.8
45-49	5	0.004781	0.02362	87956.37	2077.572	434588	0.971551	2673886	30.4
50-54	5	0.006792	0.033395	85878.8	2867.889	422224	0.958881	2239298	26.1
55-59	5	0.010069	0.04911	83010.91	4076.685	404863	0.938083	1817074	21.9
60-64	5	0.015668	0.075386	78934.22	5950.51	379795	0.902649	1412211	17.9
65-69	5	0.025782	0.121106	72983.71	8838.778	342822	0.840282	1032416	14.1
70-74	5	0.045348	0.203651	64144.93	13063.2	288067	0.729989	689595	10.8
75-79	5	0.085832	0.353341	51081.74	18049.27	210285	0.476287	401528	7.9
80+		0.172726	1	33032.46	33032.46	191242		191242	5.8

From the above table we find estimation Hazard function of the Survival function by using Column (5) and(6) in table(1) and to estimate S(t),H(t) by the equation(15),(17) and calculate variance of Survival function and hazard function from equation(18),(19) with Estimate the parameter of **λ** (mean of life time of hazard function),its fitting to the exponential model to estimate λ(t),in exponential model. We summarized the results as in the following table(2):

Table(2): Estimation Survival Function& Hazard Function from the life table for Kurdistan region

Age	*S(t)*	*H(t)*	*V[S(t)]*	*V[H(t)]*	*h(t)*	*λ (t)*
<1	0.952978	0.020917	4481.1212	4934.251	0.047022	0.020917
1-4	0.940215	0.026773	1143.5297	2123.579	0.013392	0.026773
5-9	0.980431	0.008583	569.42069	592.3789	0.006261	0.008583
10-14	0.990578	0.004331	338.70710	345.5301	0.003685	0.004331
15-19	0.993390	0.002880	270.52730	274.1395	0.002936	0.002880
20-24	0.992097	0.003446	457.34050	464.6558	0.004981	0.003446
25-29	0.987220	0.005586	711.06773	729.5977	0.007838	0.005586
30-34	0.982034	0.007874	911.37251	945.0250	0.010208	0.007874
35-39	0.976822	0.010185	1149.0125	1204.187	0.013104	0.010185
40-44	0.969818	0.013310	1482.4470	1576.153	0.017305	0.013310
45-49	0.959483	0.017963	1958.9003	2127.832	0.023620	0.017963
50-54	0.943774	0.025132	2642.7061	2966.97	0.033395	0.025132

55-59	0.919135	0.036621	3621.8942	4287.232	0.049110	0.036621
60-64	0.879206	0.055909	4974.7946	6435.667	0.075386	0.055909
65-69	0.812638	0.090103	6641.2506	10056.71	0.121106	0.090103
70-74	0.699906	0.154960	8035.7361	16403.87	0.203651	0.154960
75-79	0.514966	0.288221	7401.8713	27911.57	0.353341	0.288221
+80	0	0.227207			1	

Through the above table(2) we note that the variance in Survival function is less than from variance of hazard function in all age and less variance especial in ages (15-19) and age(10-14),its appear from the same table the variance of hazard function increasing at ages (less than one and +50) .
And the value of hazard function increasing at ages (less than 5 and +30), and the mean of life time of hazard function **λ(t)** is high in ages (less than 5 and +50) exactly after the ages 70 the mean (**λ (t)**) is very high.
We see the Figure of fitted hazard function in figure (1) can suggest the possibility of an exponential lifetime distribution.

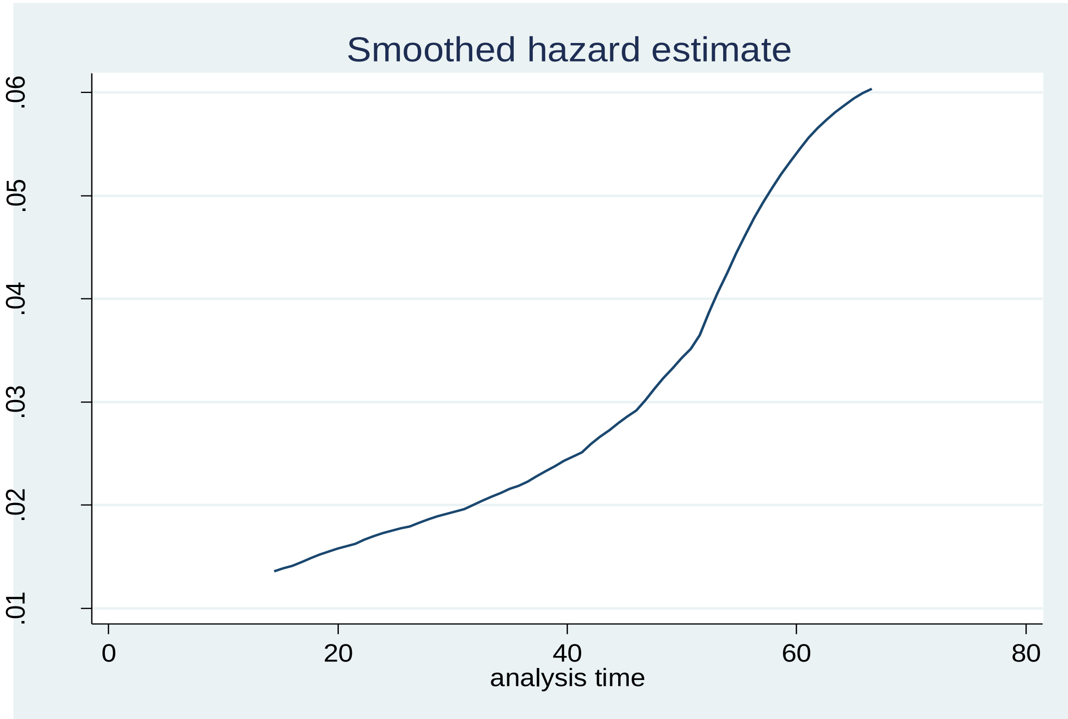

Figure (1):Analysis time of Hazard function estimates for data of MICS4

It's shown from Figure(1) the probability of hazard estimate decreasing at adult age, we can calculate hazard function estimation for all ages by crossing axes the ages and the probability of hazard from the curve of Figure (1) and equal Properties of exponential function.

4: Conclusions and Recommendation:

4.1: Conclusions

1.We found the overall expectancy life for person in life table for both sex (70.6) at ages (1-4),and is greater than last year(life table in Iraq1973-1974).
2.The probability of death(nq_x) at age less than one year is very high(0.047).
3.The variance of Survival function is less than hazard variance function in all ages, especially at ages group (15-19) and (10-14) years.
4.The variance of hazard function increasing at ages (less than one year and +50).

5.Mean of life time of hazard function **λ(t)** is higher at ages (less than 5 and +50) exactly after the ages 70 the mean (**λ (t)**) is very high.
6.Maximum probability of surviving is equal (0.99339)at ages(15-19).
7. The high value of life expectancy for the last period due to improved pension status and health conditions of the people.

4.2: Recommendation

1. Compute estimate of parameters in the weibull model to compare the estimated Survival function from (PL) with least square method.
2. Discuss the results with both health and education sectors in Kurdistan Region.
3. It's necessary interesting for health sector especially infant child(less than one year) because the mortality is increasing in this ages and compassion with our survey.
4. In general, the value of life expectancy in Kurdistan is less than the rest of the developed countries such as America, Japan, Germany and others and therefore must study this difference in mortality as a result of several economic and health factors.

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ملخص

تم في هذا البحث تقدير دالتي البقاء والمخاطرة من خلال إيجاد جداول الحياة المختصرة في إقليم كردستان العراق لكلا الجنسين وباستخدام في MICS4)) وتقدير الدالة التجميعية لدالة المخاطرة من خلال تحليل بيانات مسح متعدد المؤشرات(ESF2012الطريقة التجريبية لدالة البقاء (ومن إحصائيات الوفيات لتقديرات السكان على أساس تعداد كل عشر سنوات في العراق لعام 1977، ومقارنة مع تعداد اقليم كوردستان- العراق تم عمل جدول الحياة المختصر لكلا الجنسين واعطى اعلى توقع للحياة عند 1977من جدول الحياة المستند إلى قبل تعداد 17/1/1977العراق 70)سنة والاناث(71) سنة ووجد ان اعلى احتمال للبقاء الشخص هو 2. في إقليم كوردستان وبمعدل للذكور ((70.6)العمر (4-1) مساوياً) والعمر (10-14) وان تباين دالة المخاطرة يزداد عند 19-15 واقل تباين للدالة البقاء عند هذا العمر((19-15))عند العمر0.99339(الاعمارللاقل من سنة واحدة والاكثر من (50)سنة وكان متوسط اوقات الحياة للدالة الخطورة مرتفعا للاعمار الاقل من من (5) سنوات والاكثر من)سنة وان متوسط دالة الخطورة يكون مرتفعا جدا عند الاعمار الاكبر من (70)سنة واستخدم في هذا البحث برنامج الايكسل مع الحزمة 50(عند تحليل البيانات الخاصة بمسح متعدد الموشرات الخاص بالامومة والطفولة في كوردستان العراق SPSS v.22..2012 الاحصائية

Appendix

Table (3) Abridged Life Table for Kurdistan 2012 by Sex: Female

Age (X)	Width(N)	nMx	nqx	Lx	ndx	nLx	5Px	Tx	ex
0	1	0.043221	0.04 685	100000	4168.464	96399	0.953755	6888035	68.9
1	4	0.001888	0.007518	95702.88	72 .7573	380478	0.992428	6791619	71.0
5	5	0.000722	0.003606	94851.8	343.2678	473257	0.996448	6411110	67.6
10	5	0.000533	0.002661	94450.91	252.0658	471570	0.997124	5937848	62.9
15	5	0.000568	0.002837	94176.89	267.3043	470211	0.99586	5466295	58.0
20	5	0.001114	0.005555	93907.49	521.0205	468265	0.992704	4996110	53.2
25	5	0.001923	0.009573	93398.58	891.9694	464853	0.989859	4527872	48.5
30	5	0.002289	0.01138	92542.88	1052.008	460145	0.98758	4063034	43.9
35	5	0.002804	0.013924	91515.05	1273.561	454433	0.984389	3602885	39.4
40	5	0.003545	0.017567	90258.13	1585.413	447340	0.979694	3148431	34.9
45	5	0.004659	0.023024	88677.92	2042.092	438256	0.97249	2701056	30.5
50	5	0.00642	0.031587	86624.36	2737.402	426196	0.960952	2262759	26.1
55	5	0.009345	0.045644	83853.66	3830.047	409546	0.941534	1836537	21.9
60	5	0.014539	0.07012	79963.52	5611.883	385586	0.907031	1427013	17.8
65	5	0.024501	0.115387	74268.21	8576.379	349714	0.842349	1041553	14.0
70	5	0.045515	0.204338	65613.19	13406.27	294567	0.718136	692134	10.5
75	5	0.094348	0.382818	52214.38	19953.46	211613	0.469128	398019	7.6
80+		0.173895	1	32470.85	32470.85	186699		186699	5.8

* Source: the tables (3,4) prepare by researcher

Table (4) Abridged Life Table for Kurdistan 2012 by Sex: Male

Age (X)	Width(N)	nMx	nqx	Lx	ndx	nLx	5Px	Tx	ex
0	1	0.054485	0.052106	100000	5210.58	95587	0.941242	6755382	67.6
1	4	0.004799	0.018987	94911.95	1805.301	375034	0.98645	6659812	70.2
5	5	0.001764	0.00879	93230.76	822.3864	464235	0.993667	6284807	67.4
10	5	0.000934	0.004659	92463.25	432.0581	461288	0.996275	5820577	62.9
15	5	0.000607	0.003031	92052.1	279.0776	459568	0.996217	5359273	58.2
20	5	0.000889	0.004435	91775.03	406.4562	457830	0.994441	4899680	53.4
25	5	0.001241	0.006186	91357.03	563.7928	455290	0.99205	4441824	48.6
30	5	0.001827	0.009092	90758.7	824.3014	451675	0.989086	3986520	43.9
35	5	0.00248	0.012322	89911.37	1107.31	446749	0.985211	3534849	39.3
40	5	0.00344	0.017055	88788.22	1514.084	440144	0.979442	3088120	34.8
45	5	0.004897	0.024189	87269.18	2111.362	431095	0.970657	2648010	30.3
50	5	0.007147	0.035116	85168.74	2992.162	418442	0.956909	2216954	26.0
55	5	0.01076	0.052411	82208.29	4311.579	400403	0.934796	1798538	21.9
60	5	0.016743	0.080401	77953.94	6273.012	374280	0.898476	1398114	17.9
65	5	0.027003	0.126553	71760.38	9088.682	336258	0.838313	1023714	14.3
70	5	0.045188	0.202998	62746.6	12736.47	281876	0.741277	687176	10.9
75	5	0.077722	0.325268	50003.03	16235.76	209021	0.483105	404869	8.1
80+		0.171612	1	33567.33	33567.33	195570		195570	5.8

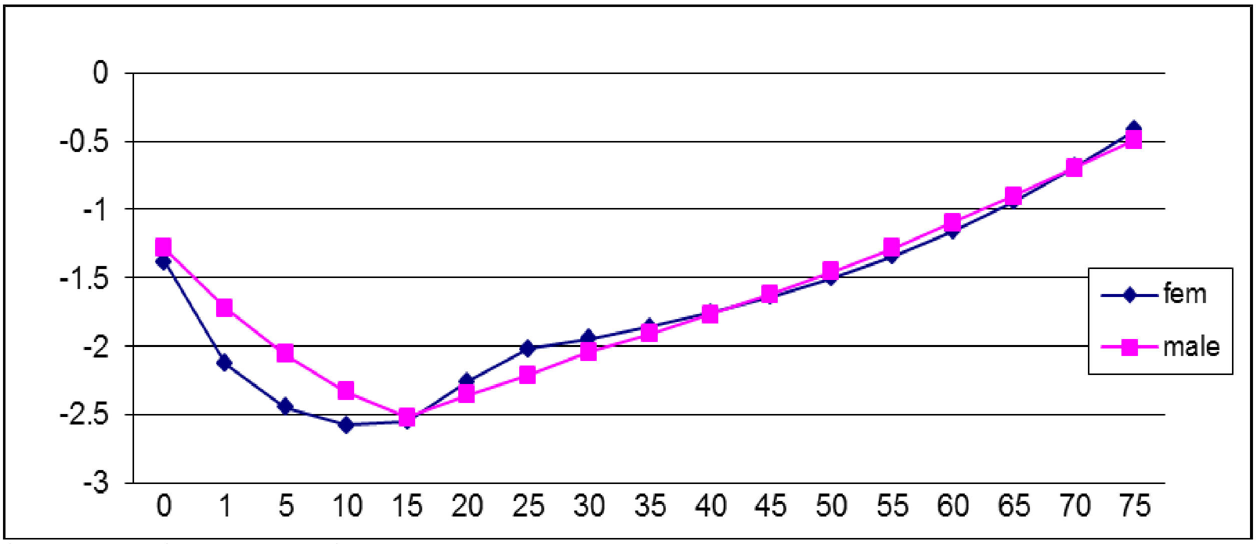

figure (2) log($_nq_x$) for both sex by Age for Kurdistan 2012 MICS4

Table (A) Estimates Of Iraqi Population By Age Group, Urban/Rural and Sex in 1991
Source: Iraqi Statistical Institute

Table (B) Distribution Of Population By Sex ,Age Groups (5-Year) and Urban /Rural -Total population 1977

Age Group	***Urban***			***Rural***			***Total***		
	Male	***Female***	***Total***	***Male***	***Female***	***Total***	***Male***	***Female***	***Total***
0-4	9703	9440	19143	5117	4670	9787	14820	14110	28930
5_9	9240	8873	18113	4390	4087	8477	13630	12960	26590
10-14	8503	8170	16673	3847	3590	7437	12350	11760	24110
15-19	7592	7256	14848	3218	3004	6222	10810	10260	21070
20-24	6504	6201	12705	2366	2349	4715	8870	8550	17420
25-29	5053	4978	10031	1527	1762	3289	6580	6740	13320
30-34	3683	3870	7553	1177	1450	2627	4860	5320	10180
35-39	2958	3129	6087	1022	1251	2273	3980	4380	8360
40-44	2492	2528	5020	828	972	1800	3320	3500	6820
45-49	2012	1950	3962	648	700	1348	2660	2650	5310
50-54	1575	1521	3096	545	559	1104	2120	2080	4200
55-59	1243	1272	2515	487	508	995	1730	1780	3510
60-64	966	1087	2053	444	473	917	1410	1560	2970
65-69	700	853	1553	370	397	767	1070	1250	2320
70-74	496	602	1098	274	278	552	770	880	1650
75+	669	838	1507	371	392	763	1040	1230	2270
Total	63389	62568	125957	26631	26442	53073	90020	89010	179030

Total population 1977

Age Group	*Urban*			*Rural*			*Total*		
	Male	*Female*	*Total*	*Male*	*Female*	*Total*	*Male*	*Female*	*Total*
0	159702	151078	310780	102042	88950	190992	261744	240028	501772
1_4	551919	524566	1076485	360395	344076	704471	912314	868642	1780956
5_9	635915	600350	1236265	427657	381037	808694	1063572	981387	2044959
10_14	524839	474242	999081	289365	251513	540878	814204	725755	1539959
15-19	368338	353270	721608	119968	168685	288653	488306	521955	1010261
20-24	410593	333182	743775	191769	180832	372601	602362	514014	1116376
25-29	287556	246457	534013	135237	141689	276926	422793	388146	810939
30-34	227273	185879	413152	90770	100162	190932	318043	286041	604084
35-39	183828	156176	340004	73879	81267	155146	257707	237443	495150
40-44	126787	119050	245837	59660	73540	133200	186447	192590	379037
45-49	132554	126758	259312	81510	77403	158913	214064	204161	418225

50-54	91714	100528	192242	61689	67192	128881	153403	167720	321123
55-59	69813	72222	142035	51789	50554	102343	121602	122776	244378
60-64	64801	65199	130000	48252	43175	91427	113053	108374	221427
65-69	49487	47190	96677	31517	27107	58624	81004	74297	155301
70-74	35537	40742	76279	24070	24294	48364	59607	65036	124643
75-79	23860	29902	53762	19662	23045	42707	43522	52947	96469
80-84	11102	13803	24905	8927	8665	17592	20029	22468	42497
85+	12589	17594	30183	14096	13866	27962	26685	31460	58145
Unknown.	11342	8317	19659	11095	4042	15137	22437	12359	34796
Total	3979549	3666505	7646054	2203349	2151094	4354443	6182898	5817599	12000497

Source: Census 17/1/1977

Table (C) Life Table Values, by Sex and Urban/Rural Residence Country or area/ Iraq Year/ 1973 – 1974(Source: U.S. Census Bureau, International Data Base)

Sex: Male

Age(x to x+n)	***qnx***	***dnx***	***mn x***	***Inx***	***Lnx***	***enx***
0- 1	96.43	9643	103.41	100,000	93,250	60
1- 5	36.87	3331	9.39	90.357	354.766	65.28
5-10	11.68	1016	2.35	87.026	432.590	63.7
10-15	7.32	630	1.47	86.010	428.475	59.42
15-20	5.14	439	1.03	85.380	425.802	54.88
20-25	9.01	765	1.81	84.941	422.792	50.11
25-30	11.58	975	2.33	84.176	418.442	45.55
30-35	15.18	1263	3.06	83.201	412.847	41.05
35-40	20.19	1654	4.08	81.938	405.555	36.64
40-45	27.27	2189	5.53	80.284	395.947	32.35
45-50	37.48	2927	7.64	78.095	383.157	28.19
50-55	52.29	3930	10.74	75.168	366.015	24.19
55-60	74.19	5285	15.41	71.238	342.977	20.38
60-65	106.87	7048	22.58	65.953	312.145	16.81
65-70	155.92	9184	33.82	58.905	271.565	13.53
70-75	229.62	11417	51.88	49.721	220.062	10.56
75-80	338.87	12980	81.6	38.304	159.070	7.97
80+	1.00000	25324	171.09	25.324	148.017	5.84

Sex: Female

Age(x to x+n)	***qnx***	***dnx***	***mnx***	***Inx***	***Lnx***	***enx***
0- 1	87.11	8711	92.77	100000	93902	59.85
1- 5	32.23	3663	10.24	91289	357830	64.54
5-10	10.2	894	2.05	87626	435895	63.15
10-15	6.28	545	1.26	86732	432297	58.78
15-20	5.34	460	107	86187	429785	53.13
20-25	14.2	1217	2.86	85727	425592	49.41
25-30	16.22	1371	3.27	84510	419122	45.08
30-35	18.92	1573	3.82	83139	411762	40.79
35-40	22.64	1847	4.58	81566	403212	36.52
40-45	27.85	2221	5.65	79719	393042	32.31
45-50	35.46	2748	7.22	77498	380620	28.17
50-55	46.97	3511	9.62	74750	364972	24.11
55-60	65.01	4631	13.44	71239	344617	20.18
60-65	94.56	6298	19.85	66608	317295	16.41
65-70	144.97	8743	31.26	60310	279692	12.86
70-75	234.38	12086	53.1	51567	227620	9.61
75-80	395.18	15602	9.85	39481	158400	6.79
80+	1000	23879	NA	23879	109760	4.6