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Determinants of the Age at First Marriage among the University Teachers in Algeria: a mixed Methodology Approach

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Abstract

This study examines the determinants of age at first marriage among the university teachers in Algeria. A Weibull proportional hazard and multivariable logistic regressions models were used on data set from a survey covering a sample of 682 teachers. The findings revealed that: The median ages at first marriage are: 36 and 39.4 years for men and women, respectively, with a gap of 3.1 and 8 years from the general population. For: birth order, teacher specialty, study place and working before joining the academic staff all together explain a very small percent of the variation of the age at marriage; in contrast, Housing, salaries' level, and a suitable partner were the hidden factors determining the age at marriage. As policy implications, policy-makers have to focus on these factors in order to help teachers to satisfy this biological and sociological need.

Keywords: Age at Marriage, University Teacher, socio-economic factors, Algeria

***JEL Classification*:** C4; J12

1. Introduction

The engine of the academic systems is teachers, and the challenges face by the academic professions are mainly concentrated on working conditions and social aspects of the academic staff (Sanders & Rivers, 1996; Fan, 2012; Altbach, et al., 2013). Marriage as a socio-demographic phenomenon is among the most significant events in every person's life including university teachers. Demographers and

sociologists make more attention to the age at first marriage for aims to analyze the determinants of this variable, (Jones & Gubhaju, 2009; Manning et al., 2014; Schumm et al., 2016) and many others. Age at first marriage is an important indicator for governments to control the population growth because it affects the age at first birth and the fertility rate over the childbearing period of women. First, the work of (Bitter, 1986) tried to put a linkage between late marriage and marital instability, where (Lesthaeghe, 2010) considers the delaying of age at marriage as a factor of the second demographic transition.

All previous studies carried out in this subject confirmed that the most educated persons have the longest age at first marriage compared to other persons, which become a universal fact; see the studies of: (Islam & Ahmed, 1998; Aryal, 2007; Jones, & Gubhaju, 2009; Aktar et al., 2017). Taking the heterogeneity in family and community, (Manda & Meyer, 2005) conducted a multilevel analysis to confirm the birth cohort and education's level effects on rising age at first marriage among women in Malawi. This role of education has been diagnosed in the developing world by (Bongaarts et al., 2017), where (Hamideh et al., 2018) were interested in the trend and social determinants of age at first marriage in Iran. Under the conclusions of these studies, we focalized directly on this high educated category, represented by the university's professors in Algeria to analyze their patterns of age at first marriage. No objective studies have been made on this socio-professional category, this study came to fill the gap.

The datasets used in the analysis are from a survey conducted during the period (January to Feb 2020) in Algeria, with an effective sample of 682 university teachers. Lacking previous work on this socio-professional category, difficulties were encountered when it came to choosing the explanatory variables. For the modeling process, particular attention was focused to the following factors: *Teacher's birth order* which was grouped into three categories: (1) first birth, (2): second & third and (3): fourth or more. *Teacher's specialty*, categorized into two: Social and human sciences (e.g. sociology, economics…), and technical sciences (e.g. Physics, Mathematics…). *The place of post-graduate* studies; we asked teachers where they accomplished the graduate cycle in the native state or out of it. Another factor is the status of *being working* or not before joining the academic staff. Rest some factors have been included (not adjusted for modeling

step) through the qualitative analysis. However, the main question arises through this analysis is: *what are the effects of these factors on the age at first marriage among the university teachers?* As hypotheses under this question; *first:* we predict a difference of age at the first marriage between men and women, *second:* teachers worked before joining the academic staff get married earlier than others, *third*: no difference of age at the marriage between teachers studied social and human sciences and those in technical sciences, *fourth:* teacher firstborn have married before others.

To develop the lines of this study and respond to these questions and verified the hypothesis, we follow a mixed methodology approach, (i.e.) quantitative and qualitative methods to analyze the pattern and dynamic of age at first marriage. Regarding quantitative methods, *firstly*, survival models have been applied to estimate the mean and median age at first marriage by the nonparametric model (Kaplan & Meier, 1956), to estimate the effect of covariates on the age at marriage, a survival Weibull regression model has been fitted, noted that the majority of the previous studies in this topic have used the Cox proportional hazard model, (Cox, 1972,1975) for which the Weibull model is a competitive (sometimes an alternative), (Carroll, 2003). *Secondly*, a multivariable logistic regression model was carried out to ascertain the factors affecting the odd ratios of marriage events among the surveyed teachers; an abundant literature relative of marriage dynamics had applied such method, e.g. (Roseboom et al., 1995) performed a study to estimate the probability of pregnancy; (Tomlinson et al., 1996) applied this approach to analyze the infertility dynamic. (Hogan & Furst, 2010) they focalized on marriage in the military core, by using a logistic regression; they concluded that those who serve in military were get married earlier and divorce earlier. (Choe et al., 2005) applied such a method to analyze the delaying marriage and early motherhood in Nepal. Rest for qualitative methods was used to analyze the text data provided through the analysis of the open questions asked in the survey, where we follow a simple text-mining approach to summarize the main features of the teachers' responses. We think that the qualitative approach (like: focus groups, interviews) would be a great step to overcome and fill the gap of the quantitative methods. However, qualitative techniques, from focus groups to cognitive and

in-depth interviews (IDIs), can improve survey efforts and provide unique data unobtainable through quantitative methods.

The rest of the article is organized as follows; section 2 is an overview of the age at first marriage in Algeria, section 3: outlines the statistical methods: Logistics regression and Weibull regressive models, section 4: describes the dataset and highlights the selected variables for the modeling process, section 5: reports the estimation results and the full discussion, finally the last section summarizes the findings of this work and draws conclusions and perspectives.

2. An overview of the age at first marriage in Algeria

Marriage in Algeria is a consensual contract between a man and a woman in accordance with Algerian law, based on the Muslim rite. The minimum legal age for marriage for both men and women is the age of legal majority, i.e. 19 years. However, the judge may grant an age exemption if necessary, provided that the capacity for marriage is established. As depicted by (Heaton, 1996), Islamic beliefs do not detail the ideal ages to inter in a union and Muslims including the Algerian population have shown high flexibility in family structure.

During the latter half of the 20th century, huge changes in the age at first marriage patterns in all societies of the World have been noticed. Algeria is no longer an exception as regards the decline in the average age of marriage. Precisely, in the aftermath of independence - which was in July 1962- Algeria recorded a maximum fertility rate, particularly in the early 1970s. A proportion is explained by the new population policies and other social and economical factors. For example, at the end of the 1970s, when the government embarked on a policy of limiting births, Algerian fertility experienced a free fall, (Ouadah-Bedidi & Vallin, 2013).

Table 1 outlines the mean age of first marriage from 1948 to 2015 in Algeria, according to their gender. We find that women tended to marry at a younger age than men. in 2008, Algerian women remain single on average 11 years older than forty years ago: after the drop observed between 1966 and 1970, the average age at first marriage has steadily increased to 29, 9 years in 2006 against 18.3 years in 1966 and this, according to the results of a study carried out by the Ministry of Health with the support of Unicef. The Age gap between spouses was

nearly 6 years in the 1960s, after we record a decline since the decade 1977s, after stability is maintained around 4 years.

Table 1 trend of the age at first marriage in the general population

Sex	1948	1954	1966	1970	1977	1987	1998	2002	2008
Men	25.8	25.2	23.8	24.4	25.3	27.7	31.3	33.7	33.5
Women	20	19.6	18.31	19.3	20.9	23.7	27.6	29.6	29.5
Gap	5.8	5.6	5.49	5.1	4.4	4	3.7	4.1	4

Source: ONS (Nationale Office of Statistics) demographic reports from different national survey and census. (*e.g*). ***RGPH:*** *Recensement général de la population et de l'habitat : (1977,1987,1998,2008) ;* ***EASF*** *2002 : Enquête Algérienne sur la Santé de la Famille ; Mulitple Indicators Creterion Survey : MICS3, MICS4. Algeria.*

In comparison between the Arab countries, the age at first marriage is nearly the same in Egypt as reported by (Yount et al., 2018), and Morocco. This evolution of the age of marriage in Algeria is not due to that of the legislation which very often only accompanies the real changes in progress. It is much more closely linked on the one hand, to the expansion of schooling which is taken place in Algeria since the impendence in 1962, which prolongs, in particular among girls, the duration of studies and delays marriage, and on the other hand, the access of women to the labor market which offers them an alternative to early entry into married life and procreation. Other factors are a cruel lack of housing, unemployment and difficulties of all kinds made the marital union an illusion, and marriage in Algeria has more and more to justify its delay.

3. Statistical Methods

This study is based on both quantitative and qualitative statistical approaches; for the first method, a multivariable logistic and Weibull survival models have been applied and, hereafter, we display briefly these quantitative models.

In general, the linear regression model is used when the dependent variable or outcome variable of interest is a continuous variable, such as birth intervals or age at marriage. Given a sample $(y_1, y_2, ..., y_n)$ of age at first marriage, we seek to explain, with as much precision as possible, the values taken by y_t, called the endogenous variable, from a series of explanatory variables $(x_1, x_2, ..., x_k)$.

The theoretical model, formulated in terms of random variables, takes the form

$$y_t = \beta_0 + \beta_1 x_1 + \beta_1 x_2 + \cdots + \beta_k x_k + \varepsilon_t \quad (1)$$

Where $\varepsilon_t$is the error of the model which expresses, or summarizes, the information missing in the linear explanation of the values of y_t from $(x_1,\ x_2,\ ...,\ x_k)$; (specification problem, variables not taken into account, etc.). The coefficients$\beta_0, \beta_1, \dots, \beta_k$, are the parameters to be estimated. For estimation, we used the ordinary least square (OLS) and maximum likelihood methods (MLE). However, in several fields of research, many outcome variables of interest cannot be conceptualized as continuous. In some cases, the outcome variable can be categorical (for example, a dichotomous or binary variable, as if a person has a disease or not), while in many other situations, the outcome variable can be time to an event to occur and it is possible that the researcher may not know when (or if) the event occurs for everyone in the study.

The purpose of this section is to discuss two regression analysis methods that are suitable for such situations. The chapter begins with a discussion of the methodology and appropriate use of logistic regression for the analysis of a result variable which is binary (or dichotomous). The second part of the chapter gives an overview of two different techniques that fall under the general analysis of survival, the Kaplan-Meier procedure and the Weibull regression model; Both are widely used in the clinical literature when the outcome variable is the time until the occurrence of an event. For model selection, and to choose the optimal model, w can use the information criterion like: *Akaike information criterion* (AIC), (Akaike, 1974) and Bayesian information criterion, (Schwarz, 1978).

3.1. Logistic Regression models

If we want to analyze the status of being married or not married, we can construct a binary outcome variable:

$$\begin{cases} \delta_i = 1\,, if\ the\ i^{th}\ is\ married \\ \delta_i = 0\,, if\ the\ \ i^{th}\ never\ married \end{cases}$$

where the appropriate statistical method would be the logistic regression models (**Hilbe, 2009**). Indeed, this coding allows to estimate the probability of the event as: $E(\delta_i) = P(\delta_i = 1) \times 1 +$

$P(\delta_i = 0) \times 0 = P(\delta_i = 1) = p_i$; the logistic models provide the possibility to estimate the effect of explanatory variables x_k on these probabilities $p_i, (i: 1,2, \dots, n)$. the logit is the log of the odds: $\log\left(\frac{p}{(1-p)}\right)$; where the logistic regression model is given by this relation:

$$\log\left(\frac{p_i}{(1-p_i)}\right) = \beta_0 + \beta_1 x_1 + \beta_1 x_2 + \cdots + \beta_k x_k + \boldsymbol{\varepsilon_i} \qquad (2)$$

Maximum Likelihood Estimation

To build the Maximum Likelihood Estimation (MLE) for the logistic model, we start by equation (2) to formulate the likelihood function, we assume that ε_i follow a logistic distribution,

$$P(\delta_i = 1 \backslash\, x_i) = p_i = \frac{1}{1 + exp^{(\underline{\beta} X)}}$$

With: X and $\underline{\beta}$, are explanatory variables and their corresponding coefficients to be estimated by MLE. For that purpose, firstly, we need to fit the probability p_i as a binomial distribution; which gives

$$P(\delta_i) = {p_i}^{\delta_i}(1 - p_i)^{1-\delta_i}$$

Generalizing this probability for a n observations, and under the independence condition of probability distribution for each observation I, the likelihood function is given as,

$$\mathcal{L}\left(\underline{\beta}; X, \delta_i\right) = \prod_{i=1}^{n} {p_i}^{\delta_i}(1 - p_i)^{1-\delta_i}$$

$$= \prod_{i=1}^{n} \left(\frac{1}{1 + exp^{(\underline{\beta} X)}}\right)^{\delta_i} \left(\frac{exp^{(\underline{\beta} X)}}{1 + exp^{(\underline{\beta} X)}}\right)^{1-\delta_i}$$

$$= \prod_{i=1}^{n} \frac{\delta_i exp^{(\underline{\beta} X)}}{1 + exp^{(\underline{\beta} X)}}$$

Dealing with log-likelihood give the same estimation for the parameters, so

$$\log \mathcal{L}\left(\underline{\beta}; X, \delta_i\right) = \sum_{i=1}^{n} \delta_i \left(\underline{\beta} X\right) - \sum_{i=1}^{n} log\left(1 + exp^{(\underline{\beta} X)}\right)$$

To find the value of $\underline{\beta}$ that maximizes $\log \mathcal{L}\left(\underline{\beta}; X, \delta_i\right)$, we differentiate *this function* with respect to *the coumponants* $\underline{\beta}$ and set the resulting expressions equal to zero. A most detailed work on MLE estimation of logistic model is done by (Czepiel, 2002). The main assumptions to build a logistic regression models are: observation independences (without repeated measures), absence of multicollinearity among the explanatory variables, another assumption is the linearity of log odds and explanatory variables, *eq. (2),* more details see the

The exponential of the coefficients ($exp\ (\beta)$) measures by how much the dimension of the explained variable is multiplied when the corresponding factor x increases by one. This is called an odds ratio. As a technical point, if we work on covariates dependent of time, the intercept coefficient β_0 has two extensions: (1) if $\beta_0 = \beta_0 t$, so we have a Gompertz form (2) if $\beta_0 = \beta_0 \ln\ (t)$, we found a weibull distribution form

3.2. Survival analysis approach

The survival data analysis (or time to event data, or history data…) is a branch of statistics, where the variable of interest is the time to occur a specific event (success, failure, death, accident, success, marriage …). Survival time can be defined as the time until the occurrence of an event of interest. (e.g.): the event - in biostatistics - usually takes three types: the first is the emergence of a disease, the second is the development of this disease and the last is death. *So we can say that the survival time is the time between two different states.* One of the characteristics of survival data (time to event data) is the existence of incomplete observations. Indeed, the data is often collected partially, particularly because of the process of censorship and truncation.

It is assumed in this study that the data are right censored, and we note:

$\begin{cases} X_i: age\ of\ teacher \\ C_i: Censored\ time \\ T_i: age\ at\ marriage \end{cases}$,With $\delta_i = \begin{cases} 0\ ,if\ X_i \geq C_i \\ 1\ ,if\ X_i < C_i \end{cases}$

Therefore, the data associated with a sample$(X_1, \dots, X_k), k = 1, \dots, n$Are presented by a couple observations ,with $(T_i\ , \delta_i)\ ,\ T_i = min(X_i, C_i)$**.**

Survival Function $S(t)$ and Cumulative density$F(t)$

The survival function $\boldsymbol{S(t)}$, is the probability of surviving beyond the time $\boldsymbol{t}$, it is defined as,

$$S(t) = P(X > t) = \int_t^{\infty} f(x)dx\ , \quad t \geq 0. \tag{3}$$

$\boldsymbol{S(t)}$, is a decreasing function, and the average survival time is expressed simply using it follows from this function, distribution function$\boldsymbol{F(t)}$, which is complementary to$\boldsymbol{S(t)}$,.$\boldsymbol{F(t) = 1 - S(t)}$**:**

$$F(t) = P(X \leq t) = \int_0^t f(x)dx \tag{4}$$

Risk function $h(t)$

This function characterizes the probability of dying in a small time interval after $\boldsymbol{t}$, conditional on having survived up to time t (that is to say the risk of instant death to those who survived) .$\boldsymbol{t}$

$$h(t) = \lim_{h \to 0} \frac{P(t \leq X \leq t+h/\ X \geq t)}{h} = \frac{f(t)}{S(t)} = -\frac{S(t)'}{S(t)} = -[linS(t)] \tag{5}$$

Weibull survival models

The Weibull distribution has been developed by **Wallodi Weibull (1887-1979)** in 1951. For a real random variable$T \in [0, +\infty[$ follows a Weibull distribution, its survival functions:$\boldsymbol{S(t), f(t), h(t)}$are given by:

$$\begin{cases} \boldsymbol{S(t/\alpha,\beta,\kappa)} = exp^{-(\alpha(t-\kappa))^{\beta}}, \forall\, t \geq \kappa \\ \boldsymbol{f(t/\alpha,\beta,\kappa)} = \beta\ \alpha(\alpha(t-\kappa))^{\beta-1} exp^{-(\alpha(t-\kappa))^{\beta}}, \quad \forall\, t \geq \kappa \\ \boldsymbol{h(t/\alpha,\beta)} = \beta\alpha\ (t\alpha)^{\beta-1} \end{cases} \tag{6}$$

with:

- $\boldsymbol{\kappa}$ is a location parameter having the same dimension of $\boldsymbol{T}$, (it is assumed $\kappa = 0$).
- $\boldsymbol{\alpha}$ is a scale parameter of life- model.
- $\boldsymbol{\beta}$ is a shape parameter

To generalize the Weibull model, we include the covariates vector $\underline{\boldsymbol{x}}$ through an exponential function as:

$$h\big(t/\alpha,\beta,\theta,\underline{x}\big) = h_0(t)\ exp(\underline{x'\theta}) \tag{7}$$

The effects of the covariates $\underline{\boldsymbol{x}}$ act multiplicatively on the hazard function $\boldsymbol{h\big(t/\alpha,\beta,\theta,\underline{x}\big)}$ which is clear from the Equation (7). The expected value of the Weibull distribution is.$\boldsymbol{E(T) = \alpha\Gamma(1+\frac{1}{\beta})}$, the Weibull distribution is the most flexible among all parametric densities family, several generalizations of this distribution were developed, see for instance, (Lai, 2014).

Likelihood Estimation

The usual method for estimating regression parameters,$\boldsymbol{\theta_0 \ldots \theta_m}$ is the Maximum Likelihood method, (**Molinares, 2011**). When estimating the likelihood function, each non-censored data ($\boldsymbol{\delta_i = 1}$), contributes to the likelihood via the probability density$\boldsymbol{f(t)}$, and each censored data ($\boldsymbol{\delta_i = 0}$), contributes to the likelihood via the survival function $\boldsymbol{S(t)}$. With, normalization factor$\boldsymbol{K}$, the standard form of the likelihood is given by,

$$l(t_i;\ \beta_i;\ \delta_i) = K \prod_{i=1}^{n} f(t_i;\ \theta_i)^{\ \delta_i} S(c_i;\ \theta_i)^{1-\ \delta_i} \tag{8}$$

We work generally on the log-likelihood function, to facilitate the estimation of parameters, $\boldsymbol{\theta_k}$, $\boldsymbol{k}$: $\mathbf{0}, \dots, \boldsymbol{m}$. Therefore, equation **(8)** becomes,

$$ll(t_i;\ \theta_i;\ \delta_i) \propto \sum_{i=1}^{n} \delta_i ln\, f(t_i;\ \theta_i) + (1 - \delta_i) \ln S(c_i;\ \theta_i)$$

To build the likelihoods of the two models discussed above, we just replace their probability densities $\boldsymbol{f(t_i)}$ and survival functions $\boldsymbol{S(t_i)}$in equation **(8).**The parameters$\boldsymbol{\beta_i}$ of two models will be estimated, .by setting the first derivatives of the log-likelihood function:

$$\frac{\partial (ll(t_i;\, \beta_i;\, \delta_i))}{\partial\, \beta_i} = 0 \qquad (9)$$

Weibull regression model can be written in both accelerated and proportional forms, allowing for simultaneous description of treatment effect in terms of HR and relative change in survival time [event time ratio (ETR)] (2).

For a detailed reading of modeling and estimation of survival analysis, see**:** (Jong & Mara, 2004; Olga, 2008; David, 2011).

As we analyzed in previous sections, each statistical technique provides (exploits) a part of data information; among these three methods, the survival models exploit the max of information, we decided to use both of them in this work.

4. Data Descriptive Analysis

4.1. Measure of variables

When it comes to choosing potential variables to explain age at first marriage for the university teachers, a big difficulty has been arisen, because we focalized on a specific sub-category of the population where the background in this subject (age at first marriage) have carried out in a general population. Underneath, we briefly indicated the outcome and explanatory variables.

Dependent variable: the outcome variable is university teacher's age at first marriage, where we put two scales of measures, *the first* is for survival analysis we work on the age at first marriage with the presence of censored observations, *the second* is for logistic regression models, we work on the status of being married or not.

Explanatory variables: For the modeling process, particular attention was paid to the following factors: Teacher's birth order, was grouped into three categories: (1) first birth, (2): second & third and (3): fourth or more. Teacher's graduate and post-graduate sciences filed, was categorized on two: Social and human sciences (e.g. sociology, economics…) and technical sciences (e.g. Physics, Mathematics…). The graduate area study, we asked teachers where they accomplished the graduate cycle in the original state or out of the native state. Another factor is the status of being working or not before joining the academic staff. Rest some factors have been added (not adjusted for modeling step), for example, we asked the never married teachers (both sex) what are the main barriers to get married? And what is your opinion about living with parent after marriage?

In the absence of vital statistics, there are two main methods for measuring the age at marriage in a population: from retrospective statements by respondents (age or date of marriage), or from proportions singles by age registered at a given time. Retrospective data have the double advantage of being provided by most demographic surveys and of allowing direct estimation of trends. The data collection has been oriented by author, because we study a social category for which the variables used in previous studies are neither adequate nor relevant (e.g. *occupation status, education levels* ...), a big difficulty was the selection of pertinent covariates that can explain the dynamic of age at first marriage for the University teacher in Algeria, this difficulty is further aggravated by the lack of previous studies on this social class. Hence, we mainly targeted: the age at first marriage, current age, sex of teacher, birth order, the status of being married before or after academic position, the science field of the teacher (we divided it into two main categories: social sciences and technical sciences), and other questions about teacher's opinions about marriage.

Inclusion criterion: We select teachers from different Algerian universities, they represent 682 teachers; 64% of the total surveyed teachers, the rest have been drop out of analysis. The age of marriage taking in consideration is (15-49) years interval.

4.2. Data Survey Description

According to statistics provided by the Ministry; the Algerian university network comprises one hundred and six (106) institutions of

higher education, spread over forty-eight (48) states across the national territory. Fifty (50) universities, thirteen (13) university centers, twenty (20) national higher schools, ten (10) high schools, eleven (11) high schools for professors, and two (2) Institutes. The total number of teachers (different grades) is about 70 .000, (MESRS, 2020).

Table 1 Summary statistics for the baseline characteristics of the sample

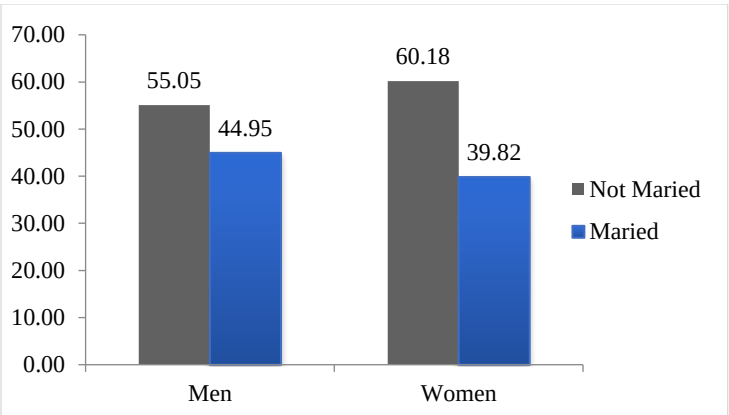
		(N)	(%)
Marriage status	Single	401	58,8
	Married	281	41,2
Sex	Men	373	54,7
	Women	309	45,3
Birth order	First	192	28,2
	Second	117	17,2
	Third	96	14,1
	Fourth	93	13,6
	>Five	184	27,0
Specialty	Social Sciences	425	62,3
	Technical Sciences	257	37,7
Study place	Out of original state	350	51,3
	In original state	332	48,7
House Type	Parent's House	406	59,5
	Private House	120	17,6
	Rented House	156	22,9
Working before	No	277	40,6
	Yes	405	59,4
Age	Range	27-59	__
	Mean∓ SD	36.7 ∓ 6.22	__

Source: baseline characteristics of the sample.

Table 1 summarizes the survey characteristics, the celibacy rate among the university teachers is 58.8% with a slightly higher rate for women compared to men (see Figure 1), 39.82% of women are married and 44.95 % of men. For gender axis, and in the general population, we stated that out of nearly 60,000 university teachers of all grades, according to the Ministry statistics, nearly 47% are women which is,

approximately the same estimated percentage in this study; these statistics shows a nearly equal distribution in the academic staff by gender, which reject the differences in terms of access to full-time positions in Algerian universities.

Figure 1 celibacy rate by teachers' sex.



The mean age of participants is 36.7 with a variation of 6.22 years (estimated by the standard deviation) the age range of teachers is (27-59). According to birth order, 28.28% of surveyed teachers are first born, 17.2 % second birth order, and the rest are third born or more. The sample has been divided in term of teachers' specialty, 62.3% are in social sciences disciplines (Economic, Sociology, History…) and 37.7% of teachers in technical and natural sciences (Mathematics, Biology, Physics…), such statistics are proportionally with the number of students in each science domain in Algeria. Relative to the place (state) where the teacher had his graduation studies, 51.3 % of them had continued in their native state and others (48.7%) out of the native state. At the economic level, 59.4% of teachers already worked in other sectors before joining the academic profession; by this factor when we ruled a bivariate analysis, there no difference between teachers' specialty, the same result when we compare it (working before) and graduation studies place.

For the house type, the contingency table below shows the interaction among the house's type, the professor sex, and status of being married or not. We see that the single professors both women and men are living with parents, 85 % and 80%, respectively, while for the married professors, we note that the women tend to live in private house 47.3%

of them, 36 % lived in a rented house and just 16.5% are living in parents house (the parents of their husband).

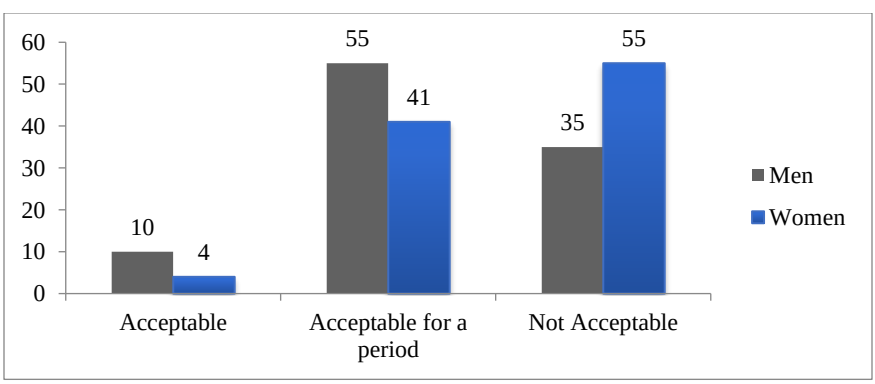
Table2 Housing type of university teachers by sex and marital status (married vs single)

	Married	Parent's House	Private House	Rented House	Total
Women	No	0.8557	0.0746	0.0697	1.000
	Yes	0.1654	0.4737	0.3609	1.000
Men	No	0.8019	0.0725	0.1256	1.000
	Yes	0.3136	0.2485	0.4379	1.000

Source: Estimated from the survey database. Note: a high statistically-significant difference ($p < 0.05$ for a Chi-squared test) has been confirmed between these dimensions (Teacher's sex, marital status) and housing type.

For married men professors, 43.7% lived in rented houses, 24.8% have their private houses, and 31.3% with parents. Under this axis, we asked professors for their opinion on a married person who lived with parents, the responses are surprising; 7.7% of them think it acceptable, 44.2% think it not acceptable at all, and 48.2% say that is acceptable for a well determinate period.

Figure 2 Teaches' opinion to co-reside with the parents versus sex.



Note: there no statistically-significant difference ($p < 0.05$ for a Chi-squared test) between women's and men's opinions for this question.

These percentages are not the same for women and men; the histogram below shows that just 4% of women think that it's acceptable to live with parents (here, husband's parents) after marriage, 55% of them think it is not acceptable at all to live in parent's house while 35% of men professors think so ; this result confirms (partially) that women professors think living a private house or rented house) it is a necessary condition for marriage; a condition that can explain a part of delaying their age at first marriage seeing the housing problem in Algeria .

5. Modeling Results and Discussion

The estimation results for Weibull models are depicted in table 4 and those of the multivariable logistic regression model in Table 5. We start this section by diagnosed the mean and median age at first marriage, displaying the survival functions for both sexes. After we discussed the estimation results and lastly, we recapitulated the main results taken off from the qualitative analysis.

5.1. Mean and Median age at first marriage

To select the best statistics indicator to measure the age at first marriage for the whole sample, we confront a big challenge between the mean and median age; after investigation of the dataset, the former (mean) is highly affected by the outliers (because the range of survival time is upper bounded by the longest censored age, the same problem have been reported by (Barker, 2009).

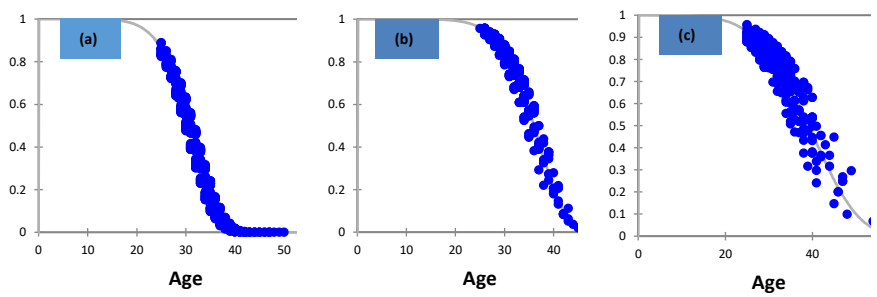
This is so confirmed also in this study where a clear difference between the mean and median age at marriage is displayed in the table above; which depicts the estimation of the means and medians of age at first marriage for the university teachers in Algeria; the gap median age of marriage between men and women is 4 years, but this finding was quite unexpected, because the natural gap in the general population is that women have married earlier than men, as reported in Table 1, here men (teachers men) married earlier than women. Comparing with the mean age at marriage, we think that the estimated means for the university teachers are broadly consistent with the previous works indicating that persons whose educational levels are secondary or more have nearly 3 years as age over 33 years which is the mean age at first marriage in the general population. (Ouadah-Bedidi & Vallin, 2013).

Table 3 Means and Medians for age at first marriage of university teachers

	Mean age at first marriage				Median age at first marriage			
	Estimate	SD	95% Confidence Interval		Estimate	SD	95% Confidence Interval	
			LB	UB			LB	UP
Men	**37,15**	,676	35,822	38,473	**36,00**	,636	34,753	37,247
Women	**42,49**	1,043	40,450	44,538	**39,40**	2,444	35,210	44,790
Overall	**40,38**	,728	38,957	41,812	**37,00**	,685	35,658	38,342

Source: estimation from the survey's dataset**.** SD: standard error. LB, UP: lower and upper bounds of the 95% confidence interval.

Figure3. Survival distribution functions for the age at first marriage. (a) is for both Sex, (b) for Men and (c) is for Women.



This difference of age at first marriage patterns between men and women have been also confirmed through the Weibull survival models and logistic regression, see Tables (5, 6). Before that, Figure 3 depicts well the differences between the survival functions of men ages at first marriage Sub-Figure (b) and ages of women in sub-Figure (c); the

survivor function (Equation 3), describes the probability of marriage past a specific time duration; it appears this probability of marriage before the age 25 years is null, in contrast, the probability is higher in the sub-ages interval $[26 - 38]$ for both sexes. An important remark is the homogeneity of the probability of marriage among men along with the age range (X axis in Figure 3), this homogeneity is well showed by the estimated standard deviation of this function (SD= 0.636 years), in dissimilarity for women, probability heterogeneity for marriage is bigger than men, with an estimated standard deviation (SD=2.44 years).

We select the Weibull model to avoid the problem of restrictive assumptions of the Cox ph models (Cox, 1972), especially the proportional hazards assumptions. Firstly, we applied the Cox model, but the effects of the whole covariates on the hazard rate to get married were not constant over time, which means a violation of these assumptions; technically, we use graphing of Kaplan-Meir to assess this assumption for categorical covariates and scaled Schoenfeld residuals for continuous covariates. Furthermore, and as an alternative, the Weibull model fits well the dataset (see Table 4) and this for Women sub-dataset, men sub-dataset and both of them; theoretically, researchers saw that parametric models in survival models are more robust than semi-parametric ones. To read more about the comparison between parametric and semi-parametric survival models see (Couallier, 2004; Reza et al., 2018).

5.2. Discussion of Weibull and logistic estimation results

Noting hereafter, we can employ the stepwise iteration techniques to assess the adequacy of fitted models (used mainly in the context of model selection). For our cases, as it's the first study on university teachers, we have no a priori reasons to believe that the selected explanatory variables are indeed relevant to our model; for that reason, we kept all selected covariates across the estimation process.

Table 4 Weibull model fitting for the age at first marriage for Men, Women and both sex

	Coefficient	*Value*	*SE*	*Pr > Chi²*	*LB(95%)*	*UB(95%)*	*-2 LL*	*AICc*
Overall	*Intercept*	3,6893	0,0109	< 0,0001	3,6679	3,7107	406.24	1549.45
	Scale	0,1737	0,0074	< 0,0001	0,1598	0,1889		
Men	*Intercept*	3.6403	0.0109	< 0,0001	3.6189	3.6617	122.11	676.1
	Scale	0.1372	0.0075	< 0,0001	0.1232	0.1527		
Women	*Intercept*	3.7488	0.0220	< 0,0001	3.7488	3.7488	247.88	792.7
	Scale	0.2112	0.0148	< 0,0001	0.2112	0.2112		

Source: Fitting results. *Notes*: ***SE***: standard error relative of each coefficient. ***LB, UB****:* are lower and upper bounds of the confidence intervals for the estimated coefficients*. -2LL:* is log-likelihood functions associated with the fitted models. ***AICc****:* corrected Akaike Information Criterion.

Table 5 Weibull regression estimation results

Variable	Both Sex			Men			Women		
	Coef	SE	P.value	Coef	SE	P.value	Coef	SE	P.value
Intercept	3,434	0,022	< 0,0001	3,664	0,055	< 0,0001	3,602	0,095	< 0,0001
Sex	0,000	0,009	1,000	-	-	-	-	-	-
Specialty	0,005	0,008	0,548	-0,004	0,021	0,842	0,007	0,040	0,864
Study place	0,003	0,008	0,722	-0,037	0,022	**0,088**	0,058	0,039	0,135
Work before	0,029	0,008	**0,000**	0,002	0,022	0,933	0,062	0,038	0,107
Birthord-Third	0,029	0,010	**0,004**	0,041	0,026	0,106	0,057	0,048	0,229
Birthord-Second	0,008	0,011	0,477	0,034	0,026	0,196	-0,033	0,048	0,500
Scale	0,135	0,004	< 0,0001	0,128	0,007	< 0,0001	0,204	0,015	< 0,0001

Source: estimation from dataset, N.B: note here for the birth order that we recoding it into three categories 1: first birth, 2 for second and third and 3 for fourth or plus.

Is working before joining the academic staff a factor that accelerates the age at marriage (or the probability to get married) for the university teachers? We work on this covariate by an a priori hypothesis that teachers who worked before can accumulate financial resources helping them to get married earlier than don't work at all before, the estimation results for both Weibul and logistic regression models were:$\left(\hat{\beta}_{\text{Workin before}} = 0.02\right)$ and $\left(\hat{\beta}_{\text{study place}} = 0.08\right)$, respectively, they don't show any pattern or effect of this variable on the age at marriage neither on the probability of marriage.

Relative to *the post-graduate study place*, we starting from an assumption that teachers studied out of their native states have a higher hazard rate (*so lower age*) to married compared to those who followed the post-graduate study in their native state; this hypothesis is supported by the fact that teachers studied out have more opportunities to meet suitable partner, because he knows (be known) by people in and out of his native state. The second possible fact that can support this hypothesis is a psychical one, teachers moving to study out of their native states, they feel alone, so they try to fill this inner void feeling to enter into relation with others; the fact that could speed up her marriage.

We integrate the place of graduate and post-graduate of teachers to test if it would be a discriminate factor between teachers studied in their native states and those studied out of their original sates in term of age at first marriage, For the modeling process, both Weibull and logistic models reject such hypothesis, see Tables(5, 6), the relative estimated coefficients were statistically non –significant, except for the logistic models applied on the men data, where we reveal a positive effect on the marriage probability (on logit-function) , nearly no effect of this variable with an estimated coefficient$\left(\hat{\beta}_{study\ place} = 0.003\right)$, the same results have been found in the logistic regression model.

Is there a difference in age at first marriage among professors in the Technical fields and Human Sciences? Through this question, precisely, we want to know if teachers in the social and human sciences (Economics, Sociology ...) have the same age at first marriage compared to the teachers in the technical sciences (mathematics, physics…). The estimated coefficient for this variable was found to be

non-significant, which indicates no difference in the age at first marriage between specialties.

Table 6 Multivariable logistic regression estimation results

Variables	Both Sex		Men		Women	
	Coef	Exp(B)	Coef	Exp(B)	Coef	Exp(B)
Sex	-,29 (0.15)**	,743	-	-	-	-
Specialty	,141 (0.16)	1,152	,022 (0.21)	1,022	,339 (0.25)	1,403
Study place	,195 (0.16)	1,215	,458 (0.22)	1,582**	-,166 (0.24)	,847
Work before	,080 (0.15)	1,084	,286 (0.22)	1,330	-,188 (0.23)	,828
Birthord-Third	-,061 (0.20)	,940	-,030 (0.27)	,971	-,140 (0.30)	,870
Birthord-Second	-,142 (0.19)	,868	-,077 (0.26)	,926	-,238 (0.28)	,788
Constant	-,383 (0.48)	,682	-1,08 (0.54)**	,338	-,519 (0.57)	,595
-2-Log likelihood	914.41		506.22		402.62	
Cox & Snell R^2	0.014		0.018		0.014	
Nagelkerke R^2	0.019		0.024		0.019	

Source: *Estimating output using survey data.*

5.3. Birth order and Age at married

For this variable, it was supposed that first birth would tend to marry earlier than later birth. According to survival estimation taking the birth order of teacher as a factor, we found that the mean and the median age at marriage of the first-born (both sex) is 37.19 and 35 years (respectively) which was lower than that of the second and third (40.7 and 37 years) and fourth born (40.5 and 39 years), see Table below. When we split the dataset by sex, there was no significant relationship between birth order and marriage-age for females.

Table7 Means and Medians for age at first marriage

Birth order	Mean age at first marriage		Median Age at first marriage	
	Estimation	Confidence interval (95%)	Estimation	Confidence interval (95%)
1st	37,19	(35,51 - 38,88)	35,000	(33,43 - 36,57)
2-3th	40,68	(38,33 - 43,03)	37,000	(34,79 - 39,20)
4th and >	40,50	(38,68 - 42,32)	39,000	(36,75 - 41,24)
Global	40,38	(38,96 - 41,81)	37,000	(35,66 - 38,34)

Source: Estimation from data set.

For the multivariable analysis (both for Weibull regression and logistic models), the birth order covariate was statistically not significant. We note here the partial failure of the quantitative methods to answer the main questions of this study. In the context of a quantitative approach, teachers are easily categorized—for example, 39.8% of women university teachers are married, and 60.2% are not. A teacher is either married or not; there are only two possibilities. In contrast, with a qualitative method, we try to explore why university teachers didn't get married? As an axis of this study, we asked this question for the never-married teachers.

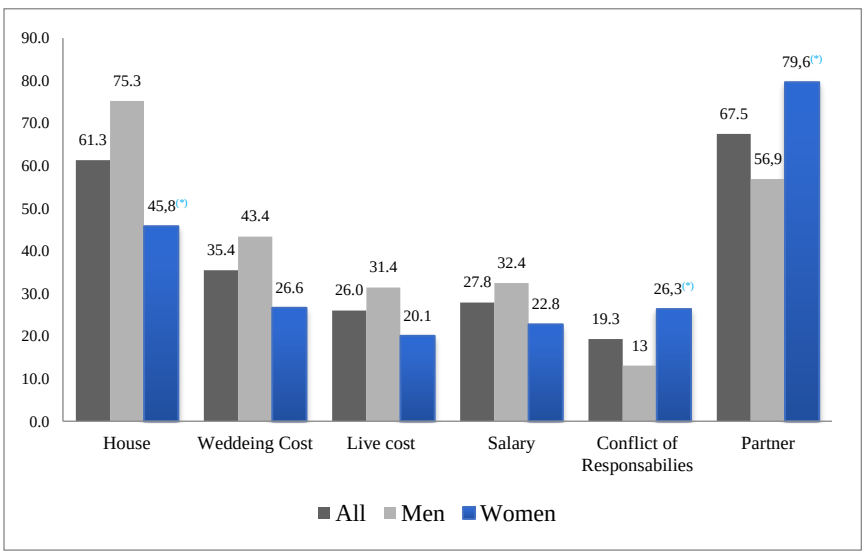
5.4. Qualitative approach: What prevents university teachers to get married?

Responses to this question are recapitulated in Figure 4. From the percentage over the bars, we see clearly that men are worried about: housing (75 % of men teachers), marriage costs (43 % of them) which covers the Islamic system dowry, post-marriage costs (with 31 %), insufficient of wages to cover these costs (32 % of men); the responses are highly adequate with the real because in the Algerian society all of these factors are the men duties toward his family.

5.4.1. Housing Problem

Furthermore, for the housing problem, and when looking at the whole picture of the economic reality of the housing market in Algeria, the cost of an apartment across all 48 states in Algeria compared with the income of University teachers, we found that the teacher has to work 10 years without spending no dollar to buy such an apartment, (Zitoun, 2012). In Algeria, the mean cost for rent a bedroom is 23,000 DZ (200 dollars) per month which represents 50% of the monthly salary for an assistant teacher (B), see Table (7).

Figure 4 The main obstacles (in percentage) for marriage stated by gender of the selected sample.



Note: The asterisk (*) above the bar indicates a statistically-significant difference ($p < 0.05$ for a Chi-squared test) between women's and men's responses.

5.4.2. Salaries levels

The salaries indicated in Table(8) below have been provided from the recent nomenclatures of the ministry of higher education and scientific research (MHESR) of Algeria, the median salary for an assistant professor in category B is 61900 DZ, an equivalent of $304 per month, for assistant professor in A category, the median salary is 72844 DZ nearly $479 per month, while a lecturer professor makes a median of 87671.4 DZ ($572) per month, rest for senior lecturer and full professor

they touch (respectively) 98179.3 DZ and 124371.5 DZ as median salary.

Table 8 Monthly salaries for the university teachers in Algeria

Career rank	Monthly salary Bottom of scale	Monthly salary Middle of scale	Monthly salary Top of scale (*)
Assistant professor (B)	46310,91	61900,3875	109410,87
Assistant professor (A)	55446,28	72844,0935	122361,5
Lecturer	68965,81	87671,4034	142101,73
Senior lecturer	77334,4	98179,3733	156024,59
Full professor	100751,8	124371,501	199260,68

Source: Data from information provided by the MSER of Algeria, 2019. We have: 1 US$=152 DAZ, in June 2020. (*) the top of the scale in table are all for the professors working in the south of Algeria.

The heterogeneity of the monthly salary scales is affected by the area premium; because the MHESR allowed different levels of area premium across the country, for example, a professor who works in the university in North cannot benefit from such a premium, which increases as we head south, which is the region which receives the max area premium, due to the climate difficulties and educational conditions in the desert. In comparison with the university salaries in MENA zone, they have been ranked in bottom rank; in fact, we just compare well-known universities in this region, we lack for that a scientific tool for comparison, in literature, the unique work carried out for professoriate salaries comparison was realized by (Klemenčič, 2013).

In relation with marriage status, from the survey results 100% of no married teachers are either: assistant professor (A, B) or lecturer, in the context of the current economical crisis in the country in general and regarding the inflation rate in particular, we think that such salary levels can delay more the age of marriage for this sub-category of the academic staff in Algeria. This situation would be more complicated

when we know that a teacher occupying a permanent position in a public-funded university or college cannot take up supplementary employment. Furthermore, we note here spectacular changes in the governing economic model during the last several decades (especially post-civil war in the 1990s) have left the higher education system somewhat adrift.

5.4.3. Conflict of Responsibilities

19% of surveyed teachers think that the conflict of responsibilities of academic work and the future family building is among the main barrier to get married, the percentage is higher for women (26.3%) than men (13%); in other words, the balance between the academic tasks, on the one hand, and union duties on the other remains a dilemma for women; this dilemma has been revealed as a source of occupational stress of married teachers through the survey. According to the study findings' of (Pu et al, 2017), work–family conflict and psychological capital were both significantly correlated with job burnout of the university teachers. In a general topic of the occupational stress of academic staff see (Barkhuizen & Rothmann, 2008). The implications of marriage for women teachers pushed the ban of it in the Irish primary schools, see the study of (Redmond & Harford, 2010). This worry of responsibility conflict is a subjective factor; for some teachers is considered as a motivation but for other, it is certainly a demotivation factor, a study carried out by (Kızıltepe, 2008) on a public university in Turkey don't list the marriage (or family) neither as a source of motivation or demotivation.

5.4.4. Conditions of partner

A final factor under this axis is the difficulties encountered by the teacher to meet a suitable partner; 65.6 % of respondents say the partner (future wife and husband) that meets the conditions for marriage is a real barrier to get married; it's so difficult to summaries what should be these features or these ideal standards; we think it would be a nonfactual question in which the respondents (teachers) explain their opinions; for best understanding the pattern of the answers we can work with the theory of online processing model developed by (Lodge et al., 1995). However, some researchers have positioned this problem in a purely material (financial) context, especially for women teachers, e.g. (Becker, 1973,1974) think that for women having higher

wage rates relative to their males, so the gains generated from the marriage with such males are minimal, the fact that delaying the age at marriage till to find the suitable partner.

As limitations of this study, we think that the sample size needs enlargement, another limitation is no-response problems for surveyed teachers especially for relevant questions, consequently, findings and relative hypothesis still needs more analysis and investigation.

6. Conclusions

This study investigated the age at first marriage among university teachers in Algeria, using Weibull survival and multivariable logistic models to estimate the effects of different socio-economic and academic factors on this variable; these two approaches have been supported by a qualitative analysis to perform more the analysis. The findings revealed that: The median ages at first marriage are: 36 years with CI (34.7-37.2), and 39.4 years with CI (35.2 – 44.7), respectively, for men and women, with a gap of 3.1 and 8 years in the general population. For: birth order, teacher specialty, study place and working before joining the academic staff all together explain a very small part of variations of the age at marriage; in contrast, Housing, salaries' level and looking for a suitable partner were the hidden factors that determine the transition to marriage among the University teachers in Algeria.

We stated also that late marriage and celibacy has become a big challenge and a real problem for the Algerian University teachers; based on qualitative analysis, we found that men did not worry too much to delay marriage, but for the women, on the other hand, it is a real problem. Age at marriage is particularly important for women in cultural contexts that define their primary role as wives and mothers. In such contexts, marriage simultaneously ushers women into the responsibilities of homemaking and limits their potential roles in nonfamilial contexts. As policy implications, we think that the main solutions to satisfy this biological and sociological need for the university teachers in Algeria are: 1) through the increase of salaries, when we consider the increase in cost living 2) and accommodate the procedures for housing.

As a prospective note, the methodology of this study can be applied in other higher educational persons like doctors, lawyers. Further works will be needed to validate the results of the current study, where we intend to the extent and increase the sample to cover all university teachers taking a form of a census. The next study will be addressed on the psychological and cultural axes, where the Structural Equations models should be carried out.

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