A research project submitted to the school of mathematics in partial fulfillment of the requirements for the award of the degree of Master of Science in social statistics of the University of Nairobi.

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MSC SOCIAL STATISTICS
I56/74586/2014

Modeling teacher attrition using Univariate frailty model.
DECLARATION

This project is my original work and has not been presented for a degree in any other university

.................................................. ..................................................
Signature                                         Date

This project has been submitted for examination with my approval as University supervisor

.................................................. ..................................................
Signature                                         Date
DEDICATION

I dedicate this project to my beloved wife Lucinah Bosibori and my dear children June Ray and Jayd Ram for their prayers and infinite support all through my coursework.
ACKNOWLEDGEMENTS

I’m grateful to the almighty God for the gift of life and good health all through.

I would like to thank my able supervisor Dr. Nelson Owuor for his positive and charismatic guidance and support.

I also thank my colleagues for constant guidance and assistance especially Victor Ouma for his tireless support guidance and inspiration.

Lastly, thanks to everybody who prayed, encouraged and challenged me.

Thanks you all.
ABSTRACT

Researchers and policy developers have done a lot of studies on the reasons fueling teacher attrition in secondary schools. I contribute to these findings by evaluating the influence of gender, marital status, teaching subjects, age, education level and place of residence of a teacher on the teacher’s decision to transfer out of a sub county. Univariate frailty model with covariates was used to model teacher attrition using information from simulated data. The study objectives were to; develop a frailty model for teacher attrition, evaluate the factors influencing teacher attrition using frailty model and to determine the trend on teacher attrition rate. All the factors under investigation were found to have a significant influence on teacher transfer decision except the place of residence. The study as well found out that there were other unobserved factors which influence a teacher’s decision to transfer out of a given region. The data used in this study was randomly generated. Information investigation was done utilizing R-3.2.5 rendition.
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ABBREVIATIONS

Cdf  Cumulative density function
Pdf  Probability density function
Mgf  moment generating function
ICTs Information communication technologies
TSC Teachers service commission
AIC Akaike information criteria
BIC Bayesian information criteria
UNESCO United Nations education, science and cultural organization
KNUT Kenya national union of Teachers

SYMBOLS

E  expectation

\( f \) generic symbol for a probability density function

\( F \) generic symbol for a cumulative density function

\( \Gamma \) Gamma function

\( L \) Laplace transform

\( \lambda \) generic symbol for a (baseline) hazard function

\( P(A) \) probability of event A

\( S \) generic symbol for a survival function

\( V \) variance

\( X \sim \text{Exp}(\lambda) \) exponential distributed random variable with parameter \( \lambda \)

\( X \sim \text{Weibull}(a, b) \) Weibull distributed random variable with parameters \( a, b \)

\( X \sim \Gamma(k, \lambda) \) Gamma distributed random variable with parameters \( k, \lambda \)

\( \tau \) Kendall’s tau
CHAPTER 1

1.0 Introduction

1.1 Background

There is bottomless writing which has made an endeavor to diagnose the state of high teacher turnover in several developed nations like Herbert and Ramsay (2004) in United States, Finlayson (2003) in Scotland and Santiago (2001) in Britain with a portion of the studies reporting teacher attrition having reached national crisis. The teacher turnover situation in Sweden, Germany, New Zealand and some states in USA has been worsening.

In developing nations, the issue of educator turnover is relatively serious. A study by Xaba, (2003) in South and some countries in Africa like Zambia and Malawi pointed out that the issue of teacher attrition had almost reached a calamitous stage. Most African countries are faced with serious teacher deficiency due to high attrition rates especially in remote rural schools that cannot attract qualified instructors, a part from the head teacher. As a result, untrained teachers are over 33% of the schools’ staff. In Malawi according to Kadzamira (2005), there was a shocking urban bias in the distribution of educational resources. Low job satisfaction makes it difficult to properly staff rural schools. Remote rural schools are chronically understaffed due to high instructor turnover and the refusal of educators to be conveyed to schools in these areas. It is hard to staff remote institutions, once a teacher is lost; it is very difficult to find a replacement. These researchers all agree that there is a great problem of teacher turnover in developing countries, especially in rural remote areas.

The Kenyan government and UNESCO (2012) end of Decade assessment of instruction in Kenya bemoaned that in spite of the fact that the understudy educator proportion at the national level may demonstrate that the nation has accomplished the suggested proportion of 45:1, there are still local inconsistencies in the Coast and North Eastern areas, where the student instructor proportion can be as high as 63:1. Regardless of the endeavors of the administration to recruit educators, the instructor deficiency still continues. It is doubtful that the loss of qualified educators from the calling for any reason influences Kenya's monetary improvement, especially in the exploratory, mechanical, and professional divisions, and target which the Government of Kenya is endeavoring to accomplish through education. It is
against this foundation that this study set out to research the status of the teacher turnover and inspect a portion of the explanatory variables for the educator turnover in public high schools.

There is developing proof that have tried to investigate the difficulties defying teacher education, likely variables to explain the high teacher turnover as well as improvements of instructor training in Africa (Ondaro, 2004). A portion of the difficulties identify with: the increasing gap between the interest and supply of educators particularly in science and arithmetic; the expanding interest for better quality instructors and instructor education; the requirement for social and expert control in connection to quality confirmation; The difficulties of overseas training; improvements in Information Communication Technologies (ICTs) and the resultant requirement for utilizing present day ICTs in the preparation of teachers; weight for national aggressiveness in a globalized information based economy against a current supply of untrained and under prepared instructors in numerous African nations; and, the failure of the customary private college model of educator instruction and preparing to satisfactorily meet either present or anticipated interest for educator training. Among these difficulties, instructors' turnover has been given minimal consideration in the nation. Teaching is still the poorest paying employments in the nation, quality instructors cannot be held under the present terms and states of administration.

As indicated by Oplatka (2007) teaching was among the respected jobs for Africans before independence; it was a noble profession then in Kenya. A teacher was regarded highly as a source of knowledge therefore commanded respect, after freedom, teaching lost its glory and could not attract most gifted students. Factors influencing teacher attrition include gender, professional qualifications, job satisfaction, teaching experience, social-cultural factors, and career commitment. Educators stay on the job if physical, economic, social status and security needs related to their working conditions as well as adequate provision of salary, good supervision, teaching materials, small classes, timely and premium pay improve job satisfaction. These elements if not present in a working place brings down the assurance of the instructors, prompting the turnover.

1.2 Statement of the Problem
The Government of Kenya is aware of the magnitude of the issue of high teacher turnover, however just expresses that the present interest driven employment arrangement was set up to address the uneven distribution of educators and instructor deficiencies (Government of Kenya and UNESCO, 2012). Because of the stop on new employment, the commission has
just been replacing teachers who leave the profession through death. Reality on the ground is that there is an intense lack of educators to cater for higher demand after the introduction of essential and free day secondary education, where the administration accommodates free educational cost charges among different components. In 2010, with an aim of conquering lack of teachers, the government employed 18,060 instructors on contract terms as a makeshift measure to ease the instructor deficiency. There is an issue of work turnover among the educators in public secondary schools in Kenya, particularly those working in remote areas.

In spite of the fact that the Kenya government urges educators to stay in hardship regions by giving incidental advantages, most instructors working in such zones feel that what is offered is too little contrasted with what their partners in urban zones make as an afterthought by participating in businesses. These elements could prompt absence of dedication for instructors working in rural regions as is obvious in their unsteadiness in the teaching profession and low confidence in teaching and thus unsuitable execution of day by day school duties and activities. Instructors have been leaving teaching for better paying jobs despite the hardship stipend by the Teachers' Service Commission (TSC).

Generally, In Kenya, the number of teachers leaving the profession has tremendously increased in recent times. Likewise the rate of teacher transfer from specific areas has been generally high. It is not clear the reasons precipitating the high turnover of teacher and therefore the study seeks to evaluate how well certain factors contribute to the teacher attrition. Many studies have been using regression methods in determining the influence of factors on the teacher attrition but the risk of factors are rarely captured hence as they are not easily seen this study seek to include the frailty in modeling the risks of teacher attrition.

1.3 Main Objectives
To model teacher attrition using information from simulated data.

1.4 Specific objectives
1. Develop a frailty model for teacher attrition.
2. Evaluate factors influencing teacher attrition using frailty model.
3. Determine the trend on teacher attrition rate.
1.5 Justification /significance of the study
This study is of extraordinary significance as it can assist the administration and other education partners with knowing the state of teacher transfer and reasons they transfer from a given place and in extension the whole of Kenya. This information can help the government to know whether the teacher recruitment being done annually is sufficient in replacing the teachers who transfer, are fired, who die or dessert duty. The government as well can know the reasons for teacher attrition and address them to improve the retention of teachers in the profession.

1.6 Scope
The data used in this thesis was generated randomly using uniform distribution because of the inability to collect actual data due to time constraint. The data was analyzed using univariate frailty model with covariates to with the main aim of evaluating attrition (transfer) rate of secondary school teachers outside a school sub county.

1.7 Limitations
The main limitation was the inability to get actual data on teacher transfer due to bureaucracy and time constraints.
CHAPTER 2

2.0 Literature review
Linda Kuzan, M. (1988) investigated the factors influencing tutor attrition in Wisconsin's education system. Alpha factoring and Principal components analysis helped in reducing the variables from thirty seven to thirteen. On the basis of the stated factors, discriminant analysis came in handy in determining if precise predictions could be reached whether a teacher left or remained in teaching. The attrition rate in both general and special education was calculated. In general, the findings indicated significant higher attrition rates for special education teachers, teacher on emergency certification, teachers at secondary level, music, teacher with undergraduate training, foreign language teachers and teachers with less than six years experience in teaching.

John, Y. et al (2008), did a study in five vast metropolitan territories in upstate New York. The study concentrated on instructor's choice to leave a school locale or to leave instructing utilizing the prentice-Gloeckler Meyer method for unmeasured heterogeneity. The study included educator qualities like pay rates, training level, grade level, subjects taught and confirmation. These characteristics were found to contribute to teacher’s decision to quit teaching or transfer. The strength of this technique is that it uses random effects to incorporate unobserved heterogeneity. In conclusion, the study pointed out that the probability of a teacher transfer or quitting can be reduced by considerable salary increase.

Ghadimi et al, (2011) studied family history of the growth on the survival of the patients with gastrointestinal cancer in northern parts of Iran, using frailty models with an objective of determining the most common risk factors affecting the chance of surviving of the ailing people with GI tract cancer. Their approach was through a comparison of parametric models (Weibull, Exponential, Log-normal, and the Log-logistic) with frailty. The risk factors studied included; family history of cancer, age, sex, marital status, smoking status, engagement, tribe, state of taking medicine, education level, place of residence, cancer type, and migration status. Hazard ratio was used to interpret the death risk for the two models (fitted with and without frailty) and Akaike information criterion (AIC) compared to select the best model. The parametric models were compared, the log-logistic model with gamma frailty was better than the others and using that model, gender and the family history of the cancer were found to be significant predictors.
Hassan Aslami (2013), studied why secondary school teachers leave the profession in Afghanistan. The study used mixed approach in collection and analysis of data. The questionnaire captured information such as school type, gender, age, teaching subjects and years of service of teachers. Further, the study indicated that apart from salary, other factors influencing teacher attrition include; marital status, safety, low social status, school distance, ghost teachers and unfair transfers.

Sharon, J. et al, (2014) did a study on Institutional factors contributing to teacher attrition in public schools as well as examining the relationship between teachers’ individual factors and tutor turnover in Baringo. Qualitative data was analyzed with content analysis while quantitative data were analyzed using descriptive statistics, i.e. the mode, median, and the mean. In addition, the Pearson Moment correlation coefficient was used to ascertain the relationship between the independent factors and the dependent factor. The study considered a wide range of factors for accurate picture on factors influencing teacher turnover. The study pointed that the key factors influencing teacher attrition were present assignment, level of education, marital status and institutional factors like school category was also found to be an influential contributor to teacher attrition.

Khuda, B. M. (2016) evaluated the determinants of teacher attrition at secondary school level in Punjab with the aim of investigating factors influencing teacher attrition. Multiple regression was used in analyzing the data and the findings revealed that apart from the school climate, salary, principal behavior, work load and contractual employment, there are other factors influencing teacher attrition that were never studied since joint influence of the five determinants accounted for 65% of the attrition.
CHAPTER 3

3.0 Methodology

3.1 Data simulation
The data used in the study was generated for the variables of interest. The variables are as listed in the table below;

Table 1: variables of interest

<table>
<thead>
<tr>
<th>No.</th>
<th>Variable</th>
<th>Levels</th>
<th>Data type</th>
<th>Factor or integer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sub-County</td>
<td>10</td>
<td>Numeric</td>
<td>Integer</td>
</tr>
<tr>
<td>2</td>
<td>Teacher</td>
<td>3000</td>
<td>Numeric</td>
<td>Integer</td>
</tr>
<tr>
<td>3</td>
<td>Gender</td>
<td>0=Male, 1=Female</td>
<td>Categorical</td>
<td>Factor</td>
</tr>
<tr>
<td>4</td>
<td>Residence</td>
<td>0=Lari, 1=Nairobi, 2=Kikuyu, 3=Limuru</td>
<td>Categorical</td>
<td>Factor</td>
</tr>
<tr>
<td>5</td>
<td>Education levels</td>
<td>0=diploma, 1=Bed, 2=MSc, 3=PhD</td>
<td>Categorical</td>
<td>Factor</td>
</tr>
<tr>
<td>6</td>
<td>Teaching subject</td>
<td>0=Home_science, 1=Mathematics, 2=English, 3=Kiswahili, 4=CRE, 5=Geography, 6=Agriculture, 7=Business_studies, 8=History, 9=Physics, 10=Biology, 11=Chemistry, 12=Computer _studies</td>
<td>Categorical</td>
<td>Factor</td>
</tr>
<tr>
<td>7</td>
<td>Present Assignment</td>
<td>0= HoD, 1= Principal, 2=Deputy_head, 3= Teacher</td>
<td>Categorical</td>
<td>Factor</td>
</tr>
<tr>
<td>8</td>
<td>Age</td>
<td>Open</td>
<td>Numeric</td>
<td>Integer</td>
</tr>
<tr>
<td>9</td>
<td>Marital status</td>
<td>0=Single, 1=Married,</td>
<td>Categorical</td>
<td>Factor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2=Divorced</td>
<td>School category</td>
<td>0=National, 1=Extra-County, 3=County, 4=CDF</td>
<td>Categorical Factor</td>
<td></td>
</tr>
<tr>
<td>Duration of stay</td>
<td>0-20</td>
<td>Numeric (time to event)</td>
<td>Integer</td>
<td></td>
</tr>
<tr>
<td>Reason for leaving</td>
<td>0=Other (death, sacking, resignation, retirement.)</td>
<td>String</td>
<td>Censored</td>
<td></td>
</tr>
</tbody>
</table>

### 3.1.1 Frailty model

The frailty model for the study is a Univariate frailty model with covariates as shown

\[
\mu(t, Z, X) = Z\mu_0(t)\exp(\beta^T X)
\]  

[1]

Where;

- \(\mu_0(t)\) - Is the baseline hazard function,
- \(\beta\) - Is the vector of regression coefficients for the covariates
- \(X\) - Is the vector of observed covariates
- \(Z\) -is the frailty variable. (The frailty Z is a random variable changing over the population that reduces (Z<1) or adds (Z>1) the individual risk)

### 3.1.2 Assumptions for the model

Survival times should be positively associated

Homogeneity of the population

\(\mu_0(t)\)  Is the baseline hazard. Under the parametric approach, the baseline hazard is a parametric function and the vector of its parameters, say \(\psi\), is estimated in line with the coefficients of regression and the frailty (risk) parameter(s). Here the Weibull distribution of the hazard function is adopted.
3.1.3 Distribution for the frailty

The frailty is gamma distributed with a random variable $x \sim \Gamma(\gamma, \beta)$ with a standard probability density function given by

$$f(x) = \frac{x^{\gamma-1} \exp(-x)}{\Gamma(\gamma)}, \quad x \geq 0, \gamma > 0$$  \[2\]

Where $\gamma$ is the shape parameter while $\beta$ is scale parameter. $\Gamma$ is the gamma function which has the formula, $\Gamma(a) = \int_0^\infty t^{a-1} e^{-t} dt$. It corresponds to a gamma distribution $\Gamma(\gamma, \beta)$ with $\beta$ fixed to 1 for identifiability.

The hazard function of the gamma distribution is

$$h(x) = \frac{x^{\gamma-1} e^{-x}}{\Gamma(\gamma) - \Gamma_x(\gamma)} \quad x \geq 0, \gamma > 0$$  \[3\]

Where $\Gamma_x(\gamma)$ is the incomplete gamma function given by, $\Gamma_x(a) = \int_0^x t^{a-1} e^{-t} dt$. The cumulative hazard function is given by;

$$H(x) = -\log \left( 1 - \frac{\Gamma_x(\gamma)}{\Gamma(\gamma)} \right) \quad x \geq 0, \gamma > 0$$  \[4\]

The survival function, $S(t) = 1 - \frac{\Gamma_x(\gamma)}{\Gamma(\gamma)} \quad x \geq 0, \gamma > 0$  \[5\]

For the gamma distribution, the Kendall’s tau, which measures the association between two event times from the same group in the multivariate case, can be computed as

$$\tau = \frac{\theta}{\theta + 2} \in (0,1)$$  \[6\]

Where $\theta$ is the variance of the frailty term.

3.1.4 Distribution of the baseline hazard

In this study the distribution of the baseline hazard is weibull. The univariate frailty model is a generalization of the exponential model with non-negative parameters. The weibull model was chosen because of its great flexibility and the different forms of its hazard function
which makes it convenient to model empirical work and then again from the simplicity of the hazard and survival function. The equation for the standard two-parameter Weibull distribution with $\alpha = 1$ is;

$$f(x) = \gamma x^{(\gamma-1)}e^{-x^\gamma} \quad x \geq 0, \gamma > 0$$ \hspace{1cm} [7]

Where $\gamma$ is the shape parameter while $\alpha$ is the scale parameter.

The hazard function, $h(x)$ of the Weibull distribution, cumulative hazard function, $H(x)$, and the survival function, $S(x)$ are;

$$h(x) = \gamma x^{(\gamma-1)} \quad x \geq 0, \gamma > 0$$ \hspace{1cm} [8]

$$H(x) = x^\gamma \quad x \geq 0, \gamma > 0$$ \hspace{1cm} [9]

$$S(x) = \exp\left(-x^\gamma\right) \quad x \geq 0, \gamma > 0$$ \hspace{1cm} [10]

### 3.2 Likelihood approach to frailty model

#### 3.2.1 Survival likelihood

Survival data consists of event times and censored observations under random censoring. The likelihood function for survival data is given by

$$L = \prod_{j=1}^{n} \left(\left[1 - G_j(t)\right]f_j(t)\right)^{\delta_j} \left[\left[1 - F_j(t)\right]g_j(t)\right]^{-\delta_j} ,$$ \hspace{1cm} [11]

Where the censoring indicator is $\delta_j$, $g$ is the density function and $G$ is the cumulative distribution function of the censoring time, $f$ and $F$ are the density function and the cumulative distribution function of the event time, respectively. We can ignore the censoring time distribution in the likelihood function since it is independent of the required parameters of the survival function. With right censoring, the likelihood function for the $j_{th}$ subject is:
Following the idea above, the likelihood function for the $j_{th}$ subject in the $i_{th}$ subgroup is given by
\[ L_i = \prod_{j=1}^{n_i} \left( f_{ij}(t) \right)^{y_{ij}} \left( S_{ij}(t) \right)^{-y_{ij}} \]  

[12]

Since $h_y(t) = \frac{f_y(t)}{S_y(t)}$, then $f_y = h_y(t) S_y(t)t$. We can rewrite the conditional likelihood function in the form of
\[ L_i = \prod_{j=1}^{n_i} \left( h_{ij}(t) \right)^{y_{ij}} S_y(t) \]  

[13]

Following these ideas, we can easily derive the forms of the conditional and marginal likelihood functions of the frailty model.

Cox proportional hazards model for frailties is given by
\[ h_y(t) = h_0(t) u_i \text{exp}^{\beta Z_i} \]  

[15]

Where $u_i$'s are independent and identically distributed random sample from a distribution with mean of 1 and some unknown variance of $\theta$. The equation (15) be written as,
\[ \frac{f(t_y)}{S(t_y)} = h_0(t) u_i \text{exp}^{\beta Z_i}, \]  

[16]

Integrating both sides of the Eq. (16), we can get the expression for the survival function.
\[ -\ln(S_y(t)) = H_0(t) u_i \text{exp}^{\beta Z_i} \]  

[17]

Therefore,
\[ S_y(t) = \exp\left(-H_0(t) u_i \text{exp}^{\beta Z_i}\right) \]  

[18]

For the $i_{th}$ subgroup, its conditional likelihood function is ;
\[ L_i(\psi, \beta | u_i) = \prod_{j=1}^{n_i} \left( h_0(t_j) u_i e^{\beta_j Z_{i,j}} \right)^{\delta_j} e^{-H_i(t_j) u_i e^{\beta_j Z_{i,j}}} \]  \[ 19 \]

Where \( \psi \) is the baseline hazard’s vector of parameters i.e. \( \psi = (\lambda, \rho) \). Hence, the marginal likelihood function for the \( i_{th} \) subgroup is

\[ L_i(\psi, \theta, \beta) = \prod_{j=1}^{n_i} \int_0^\infty (h_0(t) u e^{\beta_j Z_{i,j}})^{\delta_j} e^{-H_i(t) u e^{\beta_j Z_{i,j}}} g(u) d(u) \]  \[ 20 \]

Where \( g(u) \) is the probability distribution function of frailties \( u_1, \ldots, u_G \).

To obtain the marginal log likelihood for the gamma frailty model, let \( u_1 \) be identical and independently distributed (iid) sample of gamma random variables with density function

\[ g(u) = \frac{u^{1/\theta-1} e^{-u/\theta}}{\Gamma(1/\theta)^{\theta/\sigma}} u > 0, \theta > 0 \]  \[ 21 \]

With \( E(U) = 1 \) and \( Var(U) = \theta \). Larger values of \( \theta \) indicate that there is a higher degree of heterogeneity among groups and strong association within groups.

First, we show that gamma frailties can be integrated out in the conditional survival likelihood. This would lead to explicit and simple marginal likelihood function which only contains the parameters of interest. The marginal likelihood function for the \( i_{th} \) group is given by

\[ L_i(\psi, \theta, \beta) = \prod_{j=1}^{n_i} \int_0^\infty (h_0(t) u e^{\beta_j Z_{i,j}})^{\delta_j} e^{-H_i(t) u e^{\beta_j Z_{i,j}}} \frac{u^{1/\theta-1} e^{-u/\theta}}{\Gamma(1/\theta)^{\theta/\sigma}} d(u) \]  \[ 22 \]

Rearranging the terms in Eq. (22), we obtain the following expression

\[ L_i(\psi, \theta, \beta) = \prod_{j=1}^{n_i} h_0(t_j)^{\delta_j} e^{\beta_j Z_{i,j}} \int_0^\infty \frac{u^{1/\theta-1} e^{-u/\theta} \exp \left( -\sum_{j=1}^{n_i} H_i(t_j) u e^{\beta_j Z_{i,j}} \right)}{\Gamma(1/\theta)^{\theta/\sigma}} du, \]

\[ = \prod_{j=1}^{n_i} h_0(t_j)^{\delta_j} e^{\beta_j Z_{i,j}} \frac{1}{\Gamma(1/\theta)^{\theta/\sigma}} \int_0^\infty \frac{u^{1/\theta-1} e^{-u/\theta} \exp \left( -\frac{\theta}{\sigma} \sum_{j=1}^{n_i} H_i(t_j) e^{\beta_j Z_{i,j}} \right)}{u^{1/\theta+\beta_j Z_{i,j}}} du, \]  \[ 23 \]
where \( d_i = \sum_{j=1}^{n_i} \delta_j \)

We integrate out the frailty term \( u \). The term under the integral is the moment generating function (mgf) of a gamma distribution with a pdf \( \Gamma\left(\frac{1}{\theta + d_i}, \frac{1}{\theta}\right) \) using this fact; we can derive the expression for marginal likelihood function as

\[
L_i(\nu, \theta, \beta) = \prod_{j=1}^{n_i} h_0(t)^{\delta_j} e^{\beta_i Z_{ij}} \cdot \frac{\Gamma\left(\frac{1}{\theta + d_i}\right)\left(\frac{1}{\theta}\right)^{d_i}}{\Gamma\left(\frac{1}{\theta} + \sum_{j=1}^{n_i} H_0(t) e^{\beta_i Z_{ij}}\right)^{\frac{1}{\theta + d_i}}} \cdot \int_0^\infty \frac{u^{\theta - 1}}{\Gamma\left(\frac{1}{\theta} + d_i\right)} du
\]

\[
= \prod_{j=1}^{n_i} h_0(t)^{\delta_j} e^{\beta_i Z_{ij}} \cdot \frac{\Gamma\left(\frac{1}{\theta + d_i}\right)}{\Gamma\left(\frac{1}{\theta} + \sum_{j=1}^{n_i} H_0(t) e^{\beta_i Z_{ij}}\right)^{\frac{1}{\theta + d_i}}} \cdot \int_0^\infty \frac{u^{\theta - 1}}{\Gamma\left(\frac{1}{\theta} + d_i\right)} du
\]

[24]

We can see that the term under the integral is the probability distribution function (pdf) of

\[
\Gamma\left(\frac{1}{\theta + d_i}, \frac{1}{\theta} + \sum_{j=1}^{n_i} H_0(t) e^{\beta_i Z_{ij}}\right), \text{ which integrates to 1}
\]

The final marginal likelihood function is
\[
L_i(\psi, \theta, \beta) = \frac{\Gamma\left(\frac{1}{\theta} + d_i\right) \prod_{j=1}^{n_i} h_0(t)^{\delta_i} \theta^{r_i Z_i \delta_i}}{\left(\frac{1}{\theta} + \sum_{j=1}^{\delta_i} H_0(t)^{\theta^{r_i Z_i}}\right) \frac{1}{\theta}} \Gamma\left(\frac{1}{\theta}\right) \theta^{r_i} \tag{25}
\]

Taking the logarithm of this expression and summing over the \( G \) clusters, we obtain the marginal likelihood function,

\[
 l(\psi, \theta, \beta) = \sum_{i=1}^{G} \left[ d_i \log(\theta) - \log\left(\frac{1}{\theta}\right) + \log\left(\Gamma\left(\frac{1}{\theta} + d_i\right)\right) - \log\left(\Gamma\left(\frac{1}{\theta}\right)\right) - \log\left(1 + \theta \sum_{j=1}^{\delta_i} H_0(t)^{\theta^{r_i Z_i}}\right)\right]
\]

\[
+ \sum_{j=1}^{\delta_i} \delta_j \left(\beta^r Z_j + \log(h_0(t))\right) \tag{26}
\]

Considering a gamma frailty with weibull baseline hazard rate, marginal log likelihood function is

\[
l(\psi, \theta, \beta) = \sum_{i=1}^{G} \left[ d_i \log(\theta) - \log\left(\frac{1}{\theta}\right) + \log\left(\Gamma\left(\frac{1}{\theta} + d_i\right)\right) - \log\left(\Gamma\left(\frac{1}{\theta}\right)\right) - \log\left(1 + \theta \sum_{j=1}^{\delta_i} \left(\frac{t}{\alpha}\right)^{\theta^{r_i Z_i}}\right)\right]
\]

\[
+ \sum_{j=1}^{\delta_i} \delta_j \left(\beta^r Z_j + \log\left(\frac{\eta \gamma^{\theta \gamma}}{\alpha^\gamma}\right)\right) \tag{27}
\]

Taking the first derivative of the gamma frailty model with weibull baseline hazard and one covariate

\[
\frac{\partial l(\eta, \alpha, \theta, \beta)}{\partial \alpha} = \sum_{i=1}^{G} \left[ \frac{(1 + \theta d_i)^{\frac{n_i}{\alpha}} \left(\frac{t}{\alpha}\right)^{\theta^{r_i Z_i}} Z_i}{\left(1 + \theta \sum_{j=1}^{\delta_i} \left(\frac{t}{\alpha}\right)^{\theta^{r_i Z_i}}\right)} - \frac{d_i \eta}{\alpha} \right] \tag{28}
\]
To obtain the maximum likelihood estimates equate the first order derivatives to 0 and solving for the required parameters. Since the equation is nonlinear, it can only be solved using algorithms such as Newton Raphson.

### 3.3 Model Selection

To compare the covariates that explain teacher attrition, 93 models were developed with varying covariates. I applied the information based criteria to select the best model. AIC is given by the expression:

\[
AIC = 2 \log (L) + 2k,
\]

Where \(L\) is the maximized likelihood value and \(k\) is the number of parameters in the model. BIC is given by the expression

\[
BIC = 2 \log (L) + k \ln (N),
\]

where \(N\) is the total sample size.

The model with the smallest AIC, BIC value is considered a better fit. Model 91 with AIC value of 5682.665 and BIC value of 5844.837 was chosen to be the best model.
CHAPTER 4

4.0 Data Analysis and Results

4.1 Exploratory analysis of the data

Box plot

Figure 1: Box Plot (Age, duration stay)
The cumulative hazard (H(t)) is the probability of failure at time t given survival up to time t. The cumulative hazard function indicates that the transfer rate increases with time, by the end of 20 years all teachers will have transferred.

**4.2 Univariate Frailty model analysis**

**4.2.1 Significant model**
Both AIC and BIC selected model 91 as the best model. (attrition.mod91)

Frailty distribution: gamma
Baseline hazard distribution: Weibull
Log likelihood: -2814.332

Table 2: Best Model/Model 91

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Estimate</th>
<th>Se</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>theta</td>
<td>0.22</td>
<td>0.105</td>
<td></td>
</tr>
<tr>
<td>rho</td>
<td>2.439</td>
<td>0.075</td>
<td></td>
</tr>
<tr>
<td>lambda</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Covariates</th>
<th>Estimates</th>
<th>se</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender male</td>
<td>0.458</td>
<td>0.093</td>
<td>***</td>
</tr>
<tr>
<td>Residence Lari</td>
<td>-0.25</td>
<td>0.152</td>
<td>.</td>
</tr>
<tr>
<td>Residence Limuru</td>
<td>0.258</td>
<td>0.124</td>
<td>0.037</td>
</tr>
<tr>
<td>Residence Nairobi</td>
<td>0.211</td>
<td>0.101</td>
<td>0.038</td>
</tr>
<tr>
<td>Education level Diploma</td>
<td>1.053</td>
<td>0.109</td>
<td>0</td>
</tr>
<tr>
<td>Education level MSc</td>
<td>0.027</td>
<td>0.115</td>
<td>0.816</td>
</tr>
<tr>
<td>Education level PhD</td>
<td>-0.045</td>
<td>0.143</td>
<td>0.753</td>
</tr>
<tr>
<td>Age</td>
<td>-0.032</td>
<td>0.004</td>
<td>0</td>
</tr>
<tr>
<td>Marital status Single</td>
<td>0.392</td>
<td>0.087</td>
<td>0</td>
</tr>
<tr>
<td>Teaching subjects Biology</td>
<td>1.458</td>
<td>0.276</td>
<td>0</td>
</tr>
<tr>
<td>Teaching subjects Business studies</td>
<td>1.081</td>
<td>0.271</td>
<td>0</td>
</tr>
<tr>
<td>Teaching subjects Chemistry</td>
<td>0.239</td>
<td>0.268</td>
<td>0.372</td>
</tr>
<tr>
<td>Teaching subjects Computer_Studies</td>
<td>1.136</td>
<td>0.221</td>
<td>0</td>
</tr>
<tr>
<td>Teaching subjects CRE</td>
<td>1.754</td>
<td>0.241</td>
<td>0</td>
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<tr>
<td>Teaching subjects English</td>
<td>0.607</td>
<td>0.23</td>
<td>0.008</td>
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<tr>
<td>Teaching subjects Geography</td>
<td>0.946</td>
<td>0.232</td>
<td>0</td>
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<tr>
<td>Teaching subjects History</td>
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<td>0.298</td>
<td>0.205</td>
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<tr>
<td>Teaching subjects Home_science</td>
<td>0.575</td>
<td>0.39</td>
<td>0.141</td>
</tr>
<tr>
<td>Teaching subjects Kiswahili</td>
<td>0.458</td>
<td>0.249</td>
<td>0.066</td>
</tr>
<tr>
<td>Teaching subjects Mathematics</td>
<td>0.745</td>
<td>0.227</td>
<td>0.001</td>
</tr>
<tr>
<td>Teaching subjects Physics</td>
<td>0.694</td>
<td>0.232</td>
<td>0.003</td>
</tr>
<tr>
<td>Present assignment HoD</td>
<td>0.627</td>
<td>0.14</td>
<td>0</td>
</tr>
<tr>
<td>PresentassignmentPrincipal</td>
<td>0.061</td>
<td>0.111</td>
<td>0.584</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>PresentassignmentTeacher</td>
<td>-0.149</td>
<td>0.13</td>
<td>0.252</td>
</tr>
</tbody>
</table>

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1  
Kendall's Tau: 0.099

### 4.3 Coefficients
When theta is significantly different from zero, it means that there exists heterogeneity between key subjects that is explained by non-observed covariates. Hypothesis of interest is

\[ H_0 : \theta = 0 \]
\[ H_1 : \theta \neq 0 \]

\[ Z = \frac{\theta}{\text{se}(\theta)} = \frac{0.22}{0.105} = 2.095 \]

\[ Z_{\left(\frac{\alpha}{2}\right)} = 1.96 \]

Since 2.095 > 1.96, we reject the null hypothesis and conclude that theta is significantly different from zero.

The positive value of the shape parameter, Rho = 2.439, in the joint model is indicating that the transfer rate is positively associated with time.

### 4.4 Covariates

#### 4.4.1 Gender
The estimate of male is 0.458, its hazard ratio is \( \exp(0.458) = 1.581 \). Holding other factors constant, males are \((1.581-1)*100\%\), that is 58.1% more likely to transfer than the female.

#### 4.4.2 Residence
The estimate for Lari was -0.25, \( \exp(-0.25) = 1.284 \). Adjusting for other factors, teachers staying in Lari are 28.4% less likely to transfer compared to those staying in Kikuyu. Limuru’s hazard ratio was \( \exp(0.258) = 1.294 \) this indicates that teachers staying in Limuru are 29.4% more likely to transfer than those residing in Kikuyu. Nairobi’s hazard ratio was \( \exp(0.211) = 1.235 \), indicating that teachers living in Nairobi are 23.5% more likely to transfer as opposed to those living in Kikuyu.
4.4.3 Education Level
Teachers with diploma qualification are \( \exp(1.053) = 2.866 \) times likely to transfer in comparison to the educators with Bachelor’s Degree. Teachers with master’s degree are \( \exp(0.027) = 1.027 \), 2.7% more likely to change working region compared to the ones with a bachelor’s degree in education. Teachers with a doctor’s degree are \( \exp(0.045) = 1.046 \), 4.6% less likely to transfer compared to those with a Bachelor’s Degree.

4.4.4 Age
With a unit increase in age, a teacher is \( \exp(0.032) = 1.0325 \), 3.25% less likely to transfer.

4.4.5 Marital Status
Single teachers are \( (\exp(0.392) - 1) \times 100 = 48\% \) more likely to transfer compared to the married ones.

4.4.6 Teaching Subjects
Biology teachers are \( \exp(1.458) = 4.3 \) times more likely to transfer compared to agriculture teachers. Business studies teachers are 2.95 times more likely to transfer than agriculture teachers. Chemistry teachers are \( (\exp(0.239) - 1) \times 100 = 27\% \) more likely to transfer compared to agriculture teachers. Computer studies teachers are 3.11 times more likely to transfer compared to agriculture teachers. Christian education teachers are 5.78 times more likely to transfer than their agriculture counterparts. English teachers are \( (\exp(0.608) - 1) \times 100 = 83.5\% \) more likely to transfer compared to agriculture teachers. Geography teachers have \( \exp(0.945) = 2.578 \) times more chances of transferring compared to their agriculture counterparts. Teachers teaching history are \( (\exp(0.378) - 1) \times 100 = 46\% \) less likely to transfer as opposed to those teaching agriculture. Home science teachers are \( (\exp(0.575) - 1) \times 100 = 77.8\% \) more likely to transfer compared to agriculture teachers. Kiswahili teachers are \( (\exp(0.458) - 1) \times 100 = 58.1\% \) more likely to transfer compared to agriculture teachers. Mathematics teachers have \( \exp(0.745) = 2.016 \) times more chances of transferring compared to their agriculture counterparts. Physics teachers have \( \exp(0.694) = 2.002 \) times chance to transfer compared to their agriculture counterparts.

4.4.7 Present Assignment
Heads of departments are \( (\exp(0.627) - 1) \times 100 = 87.2\% \) more likely to transfer in comparison to deputy head teachers. Principals are \( (\exp(0.061) - 1) \times 100 = 6.3\% \) more likely to transfer than the deputy heads. Ordinary teachers are \( (\exp(0.149) - 1) \times 100 = 16.07\% \) less likely to transfer in relation to the deputy head teachers.
CHAPTER 5

5.0 Conclusion and Recommendations.

This study focused on the importance of gender, marital status, teaching subjects, age, education level and place of residence on teachers’ decision to transfer out of a sub county. The main reasons for teacher turnover where gender, level of education, age, marital status, teaching subjects and the present assignment of a teacher. Place of residence of a teacher was not found to significantly contribute to the decision of a teacher to transfer out of a sub county. In relation to gender, male teachers were more likely to transfer in relation to the female teachers. On education level, the study concluded that teachers with diploma qualification had a higher chance of transferring while those with a doctoral degree had the least probability of transferring. For a unit increase in age, a teacher’s chances of transferring decreases by 3%. Also the study concluded that single teachers have a higher chance of transferring than the married. Teacher who teaches biology, computer studies, Christian religious education, business studies and geography have a higher chance of transferring. Lastly, heads of departments had a higher chance of transferring while the deputy head teachers are the least likely to transfer. The place of residence of a teacher was not found to influence a teacher’s decision to transfer. Generally the transfer rate is positively associated with the duration of stay.

In curbing teacher attrition by the government and stakeholders maneuver ways of enticing young teachers as well as providing conducive environment to encourage teacher’s advancement in their studies.
REFERENCES


**APPENDIX**

**R codes**

```r
setwd("C:/Users/ivan/Desktop/Data g Final") # data generation
set.seed(123)
subcounty <- rep(1:10, 300)
set.seed(89)
gend <- round(runif(300, 1, 2), 0)
gend[gend == 1] <- c("male")
gend[gend == 2] <- c("female")
gender <- gend
set.seed(904)
plac <- round(runif(300, 1, 4), 0)
plac[plac == 1] <- c("Lari")
plac[plac == 2] <- c("Nairobi")
plac[plac == 3] <- c("Kikuyu")
plac[plac == 4] <- c("Limuru")
residence <- plac
set.seed(670)
edc <- round(runif(300, 1, 4), 0)
edc[edc == 1] <- c("Diploma")
edc[edc == 2] <- c("Bed")
edc[edc == 3] <- c("MSc")
edc[edc == 4] <- c("PhD")
education_level <- edc
set.seed(594)
ts <- round(runif(300, 1, 13), 0)
ts[ts == 1] <- c("Home_science")
ts[ts == 2] <- c("Mathematics")
```
ts[ts==3]<-c("English")
ts[ts==4]<-c("Kiswahili")
ts[ts==5]<-c("CRE")
ts[ts==6]<-c("Geography")
ts[ts==7]<-c("Agriculture")
ts[ts==8]<-c("Business_studies")
ts[ts==9]<-c("History")
ts[ts==10]<-c("Physics")
ts[ts==11]<-c("Biology")
ts[ts==12]<-c("Chemistry")
ts[ts==13]<-c("Computer_Studies")
teaching_subjects<-ts
ten.set.seed(346)
pa<-round(runif(300, 1,4),0)
pa[pa==1]<-c("HoD")
pa[pa==2]<-c("Principal")
pa[pa==3]<-c("Deputy_head")
pa[pa==4]<-c("Teacher")
Present_Assignment<-pa
ten.set.seed(7893)
Age<-round(runif(300,24,60),0)
ten.set.seed(76609)
mar<-round(runif(300,1,2),0)
mar[mar==1]<-c("Married")
mar[mar==2]<-c("Single")
Marital_status<-mar
ten.set.seed(9547)
schcategory<-round(runif(300,1,4),0)
schcategory[schcategory==1]<-c("National")
schcategory[schcategory==2]<-c("County")
schcategory[schcategory==3]<-c("Extra_county")
schcategory[schcategory==4]<-c("CDF")
school_category<-schcategory

set.seed(76325)
duration_stay<-round(runif(300,1,20),0)
attri_data<-
as.data.frame(cbind(subcounty,gender,residence,education_level,teaching_subjects,Present_Assignment,Age,Marital_status,school_category,duration_stay))
View(attri_data)# to see the data
colnames(attri_data)<-
c("Subcounty","Gender","Residence","Educationlevel","Teachingsubject","Presentassignment","Age","Maritalstatus","Schoolcategory","Durationstay")
write.table(attri_data,file = "attri_data_2.csv",sep=" ",#writing the data
datacc<-
read.csv("attri_data_2.csv",sep=" ",header=TRUE) # to read the data before attaching
attach(datacc)
names(datacc)
datacc$sampledreasons<-
ifelse(Age<=50,sample(c("resignation","death","sacking","transfer"),300,replace=TRUE),sample(c("resignation","death","sacking","retirement","transfer"),300,replace=TRUE))
View(datacc)
write.table(datacc,file = "datacc1.csv",sep=" ",#writing the data
datacc1<-
read.csv("datacc1.csv",sep=" ",header=TRUE) # to read the data before attaching
attach(datacc1)
sampledreasons1<-ifelse(sampledreasons="transfer",1,0)
sampledreasons1
library(parfm)
Sv<-Surv(Durationstay,sampledreasons1)
Sv
plot(Sv, ylab = "H(t)") # plotting hazard fn

attrition.mod1 <- parfm(Surv(Durationstay, sampledreasons1) ~ 1,
                        cluster = "Subcounty",
                        dist = "weibull",
                        frailty = "gamma",
                        data = datacc1,
                        iniFpar = 0.001)

attrition.mod2 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender),
                        cluster = "Subcounty",
                        dist = "weibull",
                        frailty = "gamma",
                        data = datacc1,
                        iniFpar = 0.001)

attrition.mod3 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence),
                        cluster = "Subcounty",
                        dist = "weibull",
                        frailty = "gamma",
                        data = datacc1,
                        iniFpar = 0.001)

attrition.mod4 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel),
                        cluster = "Subcounty",
                        dist = "weibull",
                        frailty = "gamma",
                        data = datacc1,
                        iniFpar = 0.001)

attrition.mod5 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Age),
                        cluster = "Subcounty",
                        dist = "weibull",
                        frailty = "gamma",
                        data = datacc1,
                        iniFpar = 0.001)
attrition.mod6 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Maritalstatus),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod7 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Teachingsubjects),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod8 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod9 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod10 <- parfm(Surv(Durationstay, sampledreasons1) ~ (subcounty),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod11 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence),
cluster ="Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod12 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender+Educationlevel),
cluster ="Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod13 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender+ Age),
cluster ="Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod14 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender+Maritalstatus),
cluster ="Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod15 <- parfm(Surv(Durationstay, sampledreasons1) ~
(Gender+Teachingsubjects),
attrition.mod16 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender+Schoolcategory),
    cluster = "Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
    iniFpar=0.001)

attrition.mod17 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender+Presentassignment),
    cluster = "Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
    iniFpar=0.001)

attrition.mod18 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender+Presentassignment),
    cluster = "Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
    iniFpar=0.001)

attrition.mod19 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender+subcounty),
    cluster = "Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
\begin{verbatim}
attrition.mod20 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel),
  cluster = "Subcounty",
  dist = "weibull",
  frailty = "gamma",
  data = datacc1,
  iniFpar=0.001)

attrition.mod21 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Age),
  cluster = "Subcounty",
  dist = "weibull",
  frailty = "gamma",
  data = datacc1,
  iniFpar=0.001)

attrition.mod22 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Maritalstatus),
  cluster = "Subcounty",
  dist = "weibull",
  frailty = "gamma",
  data = datacc1,
  iniFpar=0.001)

attrition.mod23 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Teachingsubjects),
  cluster = "Subcounty",
  dist = "weibull",
  frailty = "gamma",
  data = datacc1,
  iniFpar=0.001)

attrition.mod24 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Schoolcategory),
  cluster = "Subcounty",
  dist = "weibull",
  frailty = "gamma",
  data = datacc1,
  iniFpar=0.001)
\end{verbatim}
attrition.mod25 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod26 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel + Age),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod27 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel+Maritalstatus),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod28 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel+Teachingsubjects),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
attrition.mod29 <- parfm(Surv(Duration, sampledreasons1) ~ (Educationlevel + Schoolcategory),
                   cluster = "Subcounty",
                   dist = "weibull",
                   frailty = "gamma",
                   data = datacc1,
                   iniFpar=0.001)

attrition.mod30 <- parfm(Surv(Duration, sampledreasons1) ~ ( Educationlevel + Presentassignment),
                   cluster = "Subcounty",
                   dist = "weibull",
                   frailty = "gamma",
                   data = datacc1,
                   iniFpar=0.001)

attrition.mod31 <- parfm(Surv(Duration, sampledreasons1) ~ (Age + Maritalstatus),
                   cluster = "Subcounty",
                   dist = "weibull",
                   frailty = "gamma",
                   data = datacc1,
                   iniFpar=0.001)

attrition.mod32 <- parfm(Surv(Duration, sampledreasons1) ~ (Age + Teachingsubjects),
                   cluster = "Subcounty",
                   dist = "weibull",
                   frailty = "gamma",
                   data = datacc1,
                   iniFpar=0.001)

attrition.mod33 <- parfm(Surv(Duration, sampledreasons1) ~ (Age + Schoolcategory),
                   cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001

attrition.mod34 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Age + Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod35 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Maritalstatus + Teachingsubjects),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod36 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Maritalstatus + Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod37 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Maritalstatus + Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod38 <- parfm(Surv(Durationstay, sampledreasons1) ~
(Teachingsubjects+Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod39 <- parfm(Surv(Durationstay, sampledreasons1) ~
(Teachingsubjects+Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod40 <- parfm(Surv(Durationstay, sampledreasons1) ~
(Teachingsubjects+Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod41 <- parfm(Surv(Durationstay, sampledreasons1) ~
(Teachingsubjects+Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod42 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Educationlevel),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod43 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Age),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod44 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Maritalstatus),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod45 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Teachingsubjects),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod46 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
iniFpar=0.001)
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod47 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Presentassignment),
cluster ="Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod48 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Age),
cluster ="Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod49 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Maritalstatus),
cluster ="Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod50 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Teachingsubjects),
cluster ="Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
attrition.mod51 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Schoolcategory),
  cluster = "Subcounty",
  dist = "weibull",
  frailty = "gamma",
  data = datacc1,
  iniFpar=0.001)

attrition.mod52 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Presentassignment),
  cluster = "Subcounty",
  dist = "weibull",
  frailty = "gamma",
  data = datacc1,
  iniFpar=0.001)

attrition.mod53 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel + Age + Maritalstatus),
  cluster = "Subcounty",
  dist = "weibull",
  frailty = "gamma",
  data = datacc1,
  iniFpar=0.001)

attrition.mod54 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel + Age + Teachingsubjects),
  cluster = "Subcounty",
  dist = "weibull",
  frailty = "gamma",
  data = datacc1,
  iniFpar=0.001)

attrition.mod55 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel + Age + Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar = 0.001)

attrition.mod56 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel + Age + Presentassignment),
                        cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar = 0.001)

attrition.mod57 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Age + Maritalstatus + Teachingsubjects),
                        cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar = 0.001)

attrition.mod58 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Age + Maritalstatus + Schoolcategory),
                        cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar = 0.001)

attrition.mod59 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Age + Maritalstatus + Presentassignment),
                        cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
inifpar=0.001)
attrition.mod60 <- parfm(Surv(Durationstay, sampledreasons1) ~
(Maritalstatus+Teachingsubjects+Schoolcategory),
    cluster ="Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
inifpar=0.001)
attrition.mod61 <- parfm(Surv(Durationstay, sampledreasons1) ~
(Maritalstatus+Teachingsubjects+Presentassignment),
    cluster ="Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
inifpar=0.001)
attrition.mod62 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence +
Educationlevel + Age),
    cluster ="Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
inifpar=0.001)
attrition.mod63 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence +
Educationlevel + Maritalstatus),
    cluster ="Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
attrition.mod64 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Educationlevel + Teachingsubjects),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod65 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Educationlevel + Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod66 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Educationlevel + Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod67 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Age + Maritalstatus),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod68 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Age + Teachingsubjects),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod69 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Age + Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod70 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Age + Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod71 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel + Age + Maritalstatus+Teachingsubjects),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod72 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel + Age + Maritalstatus+Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod73 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel + Age + Maritalstatus+Presentassignment),
    cluster ="Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
    iniFpar=0.001)

attrition.mod74 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Age + Maritalstatus+Teachingsubjects+Schoolcategory),
    cluster ="Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
    iniFpar=0.001)

attrition.mod75 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Age + Maritalstatus+Teachingsubjects+Presentassignment),
    cluster ="Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
    iniFpar=0.001)

attrition.mod76 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Educationlevel + Age + Maritalstatus),
    cluster ="Subcounty",
    dist = "weibull",
    frailty = "gamma",
    data = datacc1,
    iniFpar=0.001)
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod77 <- parfm(Surv(Durationstay, sampledreasons) ~ (Gender + Residence + Educationlevel + Age + Teachingsubjects),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod78 <- parfm(Surv(Durationstay, sampledreasons) ~ (Gender + Residence + Educationlevel + Age + Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod79 <- parfm(Surv(Durationstay, sampledreasons) ~ (Gender + Residence + Educationlevel + Age + Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod80 <- parfm(Surv(Durationstay, sampledreasons) ~ (Residence + Educationlevel + Age + Maritalstatus + Teachingsubjects),
cluster = "Subcounty",
dist = "weibull",
attrition.mod81 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Age + Maritalstatus+Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod82 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Age + Maritalstatus+Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod83 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel + Age + Maritalstatus+Teachingsubjects+Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)

attrition.mod84 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Educationlevel + Age + Maritalstatus+Teachingsubjects+Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
attrition.mod85 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Educationlevel + Age + Maritalstatus+Teachingsubjects),
   cluster = "Subcounty",
   dist = "weibull",
   frailty = "gamma",
   data = datacc1,
   iniFpar=0.001)
attrition.mod86 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Educationlevel + Age + Maritalstatus+Schoolcategory),
   cluster = "Subcounty",
   dist = "weibull",
   frailty = "gamma",
   data = datacc1,
   iniFpar=0.001)
attrition.mod87 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Educationlevel + Age + Maritalstatus+Presentassignment),
   cluster = "Subcounty",
   dist = "weibull",
   frailty = "gamma",
   data = datacc1,
   iniFpar=0.001)
attrition.mod88 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Age + Maritalstatus+Teachingsubjects+Schoolcategory),
   cluster = "Subcounty",
   dist = "weibull",
   frailty = "gamma",
   data = datacc1,
   iniFpar=0.001)
attrition.mod89 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Age + Maritalstatus+Teachingsubjects+Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod90 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Educationlevel + Age + Maritalstatus+Teachingsubjects+Schoolcategory),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod91 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Educationlevel + Age + Maritalstatus+Teachingsubjects+Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod92 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Residence + Educationlevel + Age + Maritalstatus+Teachingsubjects+Schoolcategory+Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar=0.001)
attrition.mod93 <- parfm(Surv(Durationstay, sampledreasons1) ~ (Gender + Residence + Educationlevel + Age + Maritalstatus+Teachingsubjects+Schoolcategory+Presentassignment),
cluster = "Subcounty",
dist = "weibull",
frailty = "gamma",
data = datacc1,
iniFpar = 0.001)

attrition.mod93
attrition.mod91
datag <- read.csv(file.choose(), header = TRUE)
attach(datag)
tapply(Age, residence, mean)# analysing age by residence
boxplot(Age, duration_stay)# checking if data is normally dist.
xtabs(~ Gender)# cross tabs
xtabs(~ Gender + Teachingsubjects)
xtabs(~ Gender + sampledreasons)
xtabs(~ Residence)
xtabs(~ Residence + sampledreasons)
xtabs(~ Educationlevel)
xtabs(~ Educationlevel + sampledreasons)
xtabs(~ Maritalstatus)
xtabs(~ Maritalstatus + sampledreasons)
xtabs(~ Presentassignment)
xtabs(~ Presentassignment + sampledreasons)
xtabs(~ Teachingsubjects)
xtabs(~ Teachingsubjects + sampledreasons)
xtabs(~ Age)
xtabs(~ Age + sampledreasons)
xtabs(~ Schoolcategory)
xtabs(~ Schoolcategory + sampledreasons)
Table 3: Cross Tabulations by Gender

<table>
<thead>
<tr>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>1450</td>
<td>1550</td>
</tr>
<tr>
<td>48</td>
<td>52</td>
</tr>
</tbody>
</table>

Table 4: Cross Tabulations by gender and teaching subjects

<table>
<thead>
<tr>
<th>Gender</th>
<th>Agriculture</th>
<th>Biology</th>
<th>Business studies</th>
<th>Chemistry</th>
<th>Computer Studies</th>
<th>CRE</th>
<th>English</th>
<th>Geography</th>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td>female</td>
<td>48</td>
<td>75</td>
<td>42</td>
<td>64</td>
<td>36</td>
<td>42</td>
<td>37</td>
<td>46</td>
<td>45</td>
</tr>
<tr>
<td>male</td>
<td>52</td>
<td>25</td>
<td>58</td>
<td>36</td>
<td>64</td>
<td>58</td>
<td>63</td>
<td>54</td>
<td>55</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Home science</th>
<th>Kiswahili</th>
<th>Mathematics</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>female</td>
<td>55</td>
<td>42</td>
<td>43</td>
<td>56</td>
</tr>
<tr>
<td>male</td>
<td>45</td>
<td>58</td>
<td>57</td>
<td>44</td>
</tr>
</tbody>
</table>

Table 5: Cross Tabulations by gender and sampled reasons

<table>
<thead>
<tr>
<th>Gender</th>
<th>Death</th>
<th>Resignation</th>
<th>Retirement</th>
<th>Sacking</th>
<th>Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>female</td>
<td>40</td>
<td>63</td>
<td>50</td>
<td>49</td>
<td>43</td>
</tr>
<tr>
<td>male</td>
<td>60</td>
<td>37</td>
<td>50</td>
<td>51</td>
<td>57</td>
</tr>
</tbody>
</table>

Table 6: Cross Tabulations by Residence and sampled reasons

<table>
<thead>
<tr>
<th>Residence</th>
<th>death</th>
<th>resignation</th>
<th>retirement</th>
<th>sacking</th>
<th>transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kikuyu</td>
<td>36</td>
<td>34</td>
<td>44</td>
<td>37</td>
<td>29</td>
</tr>
<tr>
<td>Lari</td>
<td>18</td>
<td>15</td>
<td>13</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>Limuru</td>
<td>14</td>
<td>14</td>
<td>13</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>Nairobi</td>
<td>33</td>
<td>37</td>
<td>31</td>
<td>29</td>
<td>39</td>
</tr>
</tbody>
</table>

Table 7: Cross Tabulations by Qualification

<table>
<thead>
<tr>
<th>Bed</th>
<th>Diploma</th>
<th>MSc</th>
<th>PhD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>520</td>
<td>1030</td>
<td>450</td>
</tr>
<tr>
<td>33</td>
<td>17</td>
<td>34</td>
<td>15</td>
</tr>
</tbody>
</table>
Table 8: Cross Tabulations by Qualification and sampled reasons

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Death</th>
<th>Resignation</th>
<th>Retirement</th>
<th>Sacking</th>
<th>Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed</td>
<td>33</td>
<td>35</td>
<td>56</td>
<td>31</td>
<td>29</td>
</tr>
<tr>
<td>Diploma</td>
<td>16</td>
<td>12</td>
<td>13</td>
<td>10</td>
<td>32</td>
</tr>
<tr>
<td>MSc</td>
<td>35</td>
<td>35</td>
<td>19</td>
<td>43</td>
<td>28</td>
</tr>
<tr>
<td>PhD</td>
<td>16</td>
<td>17</td>
<td>13</td>
<td>16</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 9: Cross Tabulations by marital status

<table>
<thead>
<tr>
<th>Marital Status</th>
<th>Married</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1480</td>
<td>1520</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>51</td>
</tr>
</tbody>
</table>

Table 10: Cross Tabulations by marital status and sampled reasons

<table>
<thead>
<tr>
<th>Marital Status</th>
<th>Death</th>
<th>Resignation</th>
<th>Retirement</th>
<th>Sacking</th>
<th>Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>43</td>
<td>55</td>
<td>38</td>
<td>63</td>
<td>41</td>
</tr>
<tr>
<td>Single</td>
<td>58</td>
<td>45</td>
<td>63</td>
<td>37</td>
<td>59</td>
</tr>
</tbody>
</table>

Table 11: Cross Tabulations by current assignment

<table>
<thead>
<tr>
<th>Current Assignment</th>
<th>Deputy_head</th>
<th>HoD</th>
<th>Principal</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>980</td>
<td>470</td>
<td>980</td>
<td>570</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>16</td>
<td>33</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 12: Cross Tabulations by present assignment and sampled reasons

<table>
<thead>
<tr>
<th>Present Assignment</th>
<th>Death</th>
<th>Resignation</th>
<th>Retirement</th>
<th>Sacking</th>
<th>Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deputy_head</td>
<td>38</td>
<td>31</td>
<td>31</td>
<td>33</td>
<td>29</td>
</tr>
<tr>
<td>HoD</td>
<td>16</td>
<td>18</td>
<td>13</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>Principal</td>
<td>29</td>
<td>34</td>
<td>38</td>
<td>34</td>
<td>33</td>
</tr>
<tr>
<td>Teacher</td>
<td>18</td>
<td>17</td>
<td>19</td>
<td>20</td>
<td>22</td>
</tr>
</tbody>
</table>
Table 13: Cross Tabulations by teaching subject

<table>
<thead>
<tr>
<th>Agric</th>
<th>Biology</th>
<th>Business studies</th>
<th>Chem</th>
<th>Computer Studies</th>
<th>CRE</th>
<th>English</th>
<th>Geog</th>
<th>History</th>
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Table 14: Cross Tabulations by teaching subject and sampled reasons

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Table 19: Model selection based on BIC
### Saturated

**attrition.mod93**

Frailty distribution: gamma  
Baseline hazard distribution: Weibull  
Loglikelihood: -2811.565

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Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Kendall's Tau: 0.097