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MODELING TRANSITIONAL BEHAVIOUR OF STATES IN MARRIAGE USING MARKOV CHAIN.

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ABSTRACT

In this paper, we used Markov chain Monte Carlo (MCMC) concepts and techniques in studying marriage transition behavior. The data was a primary data obtain through interview method, using simple random sample of size eighty one. The result of the analysis using MCMC show that two identify states (Divorce and Not Divorce) are recurrent state and with a

INTRODUCTION

Marriage socially recognized and approved union between individuals, who commit to one another with the expectation of a stable and lasting intimate relationship. It begins with a ceremony known as a wedding, which formally unites the marriage partners. A marital relationship usually involves some kind of contract, either written or specified by tradition, which defines the partners' rights and obligations to each other, to any children they may have, and to their relatives. In most contemporary industrialized societies, marriage is certified by the government.

In addition to being a personal relationship between two people, marriage is one of society's most important and basic institutions. Marriage and family serve as tools for ensuring social reproduction. Social reproduction includes providing food, clothing, and shelter for family members; raising and socializing children; and caring for the sick and elderly. In families and societies in which wealth, property, or a hereditary

limit transition probability values for the two state Divorce and Non Divorce equal 0.51 and 0.49 respectively. Furthermore, the result shows a high chance (51%) of a marriage transiting to divorce state. And the long- term behavior of the two states shows a probability (0.51, 0.49) of falling into any one of the state for any generation(s).

Keywords: *Markov Chain, Divorce, Transition, Family, state and Marriage*

title is to be passed on from one generation to the next, inheritance and the production of legitimate heirs are a prime concern in marriage. However, in contemporary industrialized societies, marriage functions less as a social institution and more as a source of intimacy for the individuals' involved. *Robert (2009)*

The outcome of marriage is the family. A family is a basic social group united through bonds of kinship or marriage, present in all societies. Ideally, the family provides its members with protection, companionship, security, and socialization. The structure of the family, and the needs that the family fulfills vary from society to society. The nuclear family—two adults and their children—is the main unit in some societies. In others, it is a subordinate part of an extended family, which also consists of grandparents and other relatives. A third family unit is the single-parent family, in which children live with an unmarried, divorced, or widowed mother or father.

Divorce

Divorce, or dissolution, as it is increasingly becoming known, a legislatively created, judicially administered process that legally terminates a marriage no longer considered viable by one or both of the spouses and that permits both to remarry. Until the divorce reform movement of the 1970s began to have an impact, the legal doctrines governing divorce could be understood only by reviewing the long history of English divorce law, which was dominated by concepts of canon law. The past few decades have witnessed dramatic changes in family life in all industrial countries. The increase in the divorce rate in the second half of the 20th century was striking; in fact, the divorce rate more than doubled in most Westernized countries from 1960 to 1980. The increase in divorces has been particularly consequential for children, as millions of them have experienced parental divorce. Moreover, recent increases in non-marital births, driven largely by rising rates of childbearing among cohabiting couples, have also resulted in a greater number of children experiencing the separation of their never-married parents. Because cohabiting relationships are less stable than marriages, many children who are born into these unions also will experience the dissolution of their parents' union when the cohabiting relationships end.

Toews et'al (2005) study was to assess predictors of women's use of verbal and physical aggression during marital separation among a sample of 147 divorced mothers. The predictor variables examined were women's self-esteem, mastery, attachment style, gender-role identity, and husband's verbal and physical aggression during separation. Hierarchical multiple regressions revealed that women's psychological characteristics and men's use of aggression toward their wives during separation were predictive of women's use of verbal aggression toward their husbands during marital separation. In addition, women's psychological characteristics and use of verbal aggression toward their husbands during separation and men's use of aggression toward their wives during separation predicted women's use of physical aggression toward their husbands during separation.

Amadi and Amadi (2014) study was informed by the rising profile of broken homes in the Nigerian society of contemporary times as many Nigerian homes today are riddled with marital crises. The investigation was designed as opinion survey using a structured questionnaire rated on a 4-point scale. Three research questions and four null hypotheses guided the investigation, and generated data was analyzed using descriptive statistics of the mean and standard deviation, while the hypotheses were subject to the t-test statistic. Findings indicated that emergence of crises in marital homes is occasioned by a lot of factors including incompatibility in social and sexual life, lack of marital confidence, third-party syndrome, economic disquiets, to mention a few. Consequences of marital crises were identified to include; poor mental, emotional and physical health of couples and their children, physical abuse and threat to life of partners, escalation of social vices and crimes such as drug abuse, kidnapping, prostitution, deschooling of children of crises-ridden and broken homes.

Gilman et'al(2005) study was to evaluate the effect of a 6-week child-oriented educational program on the adjustment of 7-9-year-old children from divorcing families. Using the Children's Divorce Adjustment

TIJSRAT
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Inventory (CDAI) and a series of vignettes the authors assessed the effect of Kids' Turn, a San Francisco Bay Area divorce education program. A matched sample T-test was completed on both measures. The study included 60, 7-9-year-old children who participated with their parents. Based on specific behavioral criteria, pre— and post testing revealed that children's adjustment significantly improved after completing Kids' Turn. Some of this criteria consisted of reports of less conflict between children and parents as well as children's ability to avoid participating in conflict-laden situations within the post-divorce family. In contrast, children appeared more emotionally activated at the culmination of the program. They had more reconciliation fantasies, greater awareness of distressing feelings regarding the divorce, and more sensitivity to being misunderstood by their parents.
In this paper, we used Markov chain Monte Carlo (MCMC) concepts and techniques in modeling marriage transition behavior which is the gap we intend to fill.

METHODOLOGY

MARKOV CHAIN

Markov chain is a sequence of random variables such that for any n, X_{n+1} is conditionally independent of $X_0, . \quad . . . . , X_{n-1}$ given X_n. That is, the "next" state X_{n+1} of the process is independent of the "past" states $X_0, . \quad . . . . , X_{n-1}$ provided that the "present" state X_n be known. It is required to possess a property that is usually characterized as "memoryless": the probability distribution of the next state depends only on the current state and not on the sequence of events that preceded it. This specific kind of "memorylessness" is called the Markov property. Markov chains have many applications as statistical models of real-world processes. The stochastic process $X=[X_n;\ n \epsilon N]$ is called a Markov chain provided that $P[X_{n+1} = j \mid X_0, ..., X_n] = P[X_{n+1} = j \mid X_n]$ for all j Ɛ E and nƐN. The link in the generations can be seen as a stochastic process $[X_n]$, which has S as state space. If the conditional probability of linking generation j together in the next step P_{ij}^m is dependent only on the last generation {m}, $[X_n]$ is called a m-order Markov chain.

$$P_{ij}^{\ m} = P[X_{n+m} = j \mid X_n = i] \quad \text{-----------1}$$

When m=1, X_{n+1} is dependent only on the current state X_n.

$$P_{ij} = P\{x_{n+1} = j \mid x_n = i\} \quad \text{---2}$$

TIJSRAT
ISSN: 2623-7861

$$P_{ij} = P_{ij}^{\ r} = P\{x_{r+1} = j \mid x_r = i\} \text{------------------------------------}3$$

is a one-order Markov chain, where P_{ij} is the probability that transition is made from i to state j in one step. The initial state Xo has an arbitrary probability distribution.
From the link structure above, Let $\mathbf{P_{ij}}$ be the transition probability matrix of Grandparent to Parent and also $\mathbf{C_{ij}}$ be the transition probability matrix of Parent to Children.
Generally,

Table 2

DEFINITIONS

1. Accessible state : A state j is said to be accessible from i if
2. $P_{ij}^{(n)} > 0$ for some $n \geq 0$, (i j)
3. Communicating state : A state i and j is said to communicate if each is accessible from each other (i j)
4. State is <u>recurrent</u> if $f_{ii} = 1$. When a state is recurrent, it indicates that the event/trait will continue to reappear with the assumption of no intervention.
5. Consider $f_{ii} = f_i =$ P(ever reenter i| X_o =i) P(never visiting i again)= 1- f_{ii} P(exactly n visits to i| X_o = i) = $f_i^{\ n-1}(1-fi)$ This says that the number of visits to i is a Geometric (1-f_i) random variables so its expectation equals E(number of visits to i|Xo =i)= $\dfrac{1}{1-fi}$
6. A state is <u>transient</u> if $f_{ii} < 1$. Transient states indicate that the event/trait will gradually die out.

Transition matrix method

Assumptions:
This topic related to mathematical topics known as finite Markov chains in stochastic processes. A Markov chain may be visualized as a process which moves from one state to another, as time progresses. We will develop this method with respect to two state this are present of trait (S_1) and Absent of trait (S_2) using 2 by 2 Markov chain .

TIJSRAT
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Let P_{ij} denote the probability of transition from state i in generation t – 1 to state j in generation t. Each transitional probability is a conditional probability which takes on the following values.

P_{11} = P (S_1 in generation t | S_1 in generation t – 1)
P_{12} = P (S_2 in generation t | S_1 in generation t – 1)
P_{21} = P (S_1 in generation t | S_2 in generation t – 1)

P_{22} = P (S_2 in generation t | S_2 in generation t – 1)

Where P_{ij} = transitional probability from state i in generation t – 1 to state j in generation t,

$$(0 \le P_{ij} \le 1)$$

These P_{ij} 's can be arranged in a matrix form

$$P = \begin{bmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{bmatrix}$$

Matrix P is known as a transition matrix or sometimes more specifically as a stochastic matrix. The transitional probabilities in each row sum to one, i.e. ,

$$\sum_{j=1}^{2} p_{ij} \text{ for } i=1,2 \text{ --4}$$

P_{PP} = P(P in generation t|P in generation t – 1)
P_{PA}= P(P in generation t|A in generation t -1)
P_{AP} = P(A in generation t|P in generation t– 1)
P_{AA} = P(A in generation t|A in generation t – 1)

generation t

$$P = \text{generation } t-1 \begin{bmatrix} P_{PP} & P_{PA} \\ P_{AP} & P_{AA} \end{bmatrix}$$

Where P is the probability of being in state j given that you are in state i with the following properties

$P_{ij} \ge 0$ for all i and j ≥ 0 and

$\sum_{j=0} P_{ij} = 1$ i= 0,1,2,………… r

P=(P_{ij}) i,j εS

$P_{ij}^{(n)}$ = Probability of going from i j in n steps

State Space

S = (Divorce (D), Not Divorce (ND))

The number of the occurrence of the event in the given state(s) i and j equal (n_{ij})

TIJSRAT
ISSN: 2623-7861

$$n_{ij} = \begin{bmatrix} n_{11} & n_{12} \\ n_{21} & n_{22} \end{bmatrix}$$

n_{11} = number of divorced family in generation t-1 and t (D,D)

n_{12} = number of divorced family in generation t-1and not divorced in generation t (D,ND)

n_{21} = number of not divorced family in generation t-1and divorced in generation t (ND, D)

n_{22} = number of not divorced family in generation t-1and not divorced in generation t (ND,ND)

And the transition probability matrix

$$p_{ij} = \begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix} \qquad \text{Where } P_{ij} = \frac{n_{ij}}{n_{i,}}$$

DATA PRESENTATION

The source of the data was primary source using interview method for the collection of the data. The sample size matrix (n_{ij}) represent the data collected for the two state. The sample size equal eighty one (81)

ANALYSIS

$n_{ij}= \begin{pmatrix} 37 & 11 \\ 8 & 25 \end{pmatrix}$ $P_{ij}= \begin{pmatrix} 0.77 & 0.23 \\ 0.24 & 0.76 \end{pmatrix}$ $P^2_{ij}=\begin{pmatrix} 0.65 & 0.35 \\ 0.37 & 0.63 \end{pmatrix}$

$P^4_{ij}=\begin{pmatrix} 0.55 & 0.45 \\ 0.47 & 0.53 \end{pmatrix}$ $P^8_{ij}=\begin{pmatrix} 0.51 & 0.49 \\ 0.51 & 0.49 \end{pmatrix}$ $P^{12}_{ij}= =\begin{pmatrix} 0.51 & 0.49 \\ 0.51 & 0.49 \end{pmatrix}$

$P^{16}_{ij}= =\begin{pmatrix} 0.51 & 0.49 \\ 0.51 & 0.49 \end{pmatrix}$

$P_{ij}= \begin{pmatrix} 0.77 & 0.23 \\ 0.24 & 0.76 \end{pmatrix}$

Applying the ergodicity theorem, we have the below equations

$$\begin{bmatrix} x_1 & x_2 \end{bmatrix} \begin{bmatrix} 0.77 & 0.23 \\ 0.24 & 0.76 \end{bmatrix} = \begin{bmatrix} x_1 & x_2 \end{bmatrix} \text{- - - - 1}$$

$x_1+x_2=1$ - - - - - - - - 2

then we have

$0.77x_1+0.24x_2=x_1$- - - - -1

$0.23x_1+0.76x_2=x_1$- - - - -2

$x_1+x_2=1$ - - - - -3

Solving the equation, $x_1=0.49$ and $x_2=0.51$ (49% and 51%)

Generation(n- steps)	DD	DN	ND	NN
1	0.77	0.23	0.24	0.76
2	0.64	0.36	0.37	0.63
3	0.55	0.45	0.47	0.53

TIJSRAT
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4	0.51	0.49	0.51	0.49
5	0.51	0.49	0.51	0.49
6	0.51	0.49	0.51	0.49
7	0.51	0.49	0.51	0.49
8	0.51	0.49	0.51	0.49
9	0.51	0.49	0.51	0.49

Where
DD= Divoced- Divoced DN=Divoced-Not Divoced ND=Not Divoced- Divoced
NN= Not Divoced – Not Divorced

Finding and Conclusion

In this analysis, we used Markov chain Monte Carlo (MCMC) concepts and techniques in studying family and divorce transition behaviors from generation the result of the analysis using MCMC show that the two given states are recurrent and the limit transition probability values for the two state Divorce and Non Divorce are 0.51 and 0.49 respectively. Furthermore, the result show a high chance (51%) of a family from divorce family of been divorce.
Conclusion, in other to avoid divorce in a family, it is advisable to married from a non-divorce/separated family due to the high chance of divorce case in any of the generations.

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