



Logistic growth for the Nuzi cuneiform tablets: Analyzing family networks in ancient Mesopotamia



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HIGHLIGHTS

- We reconstruct family trees and social networks from “Nuzi Personal Names”.
- We formulate the least squares problems with constraints of the trees and networks.
- We estimate the published years of cuneiform tablets for “Nuzi Personal Names”.
- It seems the published tablets increased by the logistic growth for about 60 years.

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ABSTRACT

We reconstruct the published year of each cuneiform tablet of the Nuzi society in ancient Mesopotamia. The tablets are on land transaction, marriage, loan, slavery contracts, etc. The number of tablets seems to increase by logistic growth. It may show the dynamics of concentration of lands or other properties into few powerful families in a period of about sixty years and most of them are in about thirty years. We reconstruct family trees and social networks of Nuzi and estimate the published years of cuneiform tablets consistently with the trees and networks, formulating least squares problems with linear inequality constraints.

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1. Introduction

We go back to ancient Mesopotamia, making an electronic version of the book Nuzi Personal Names (NPN) [1] as a database. NPN is an index of about ten thousands of individuals who appear in cuneiform tablets excavated from the site of Nuzi. By using NPN we reconstruct family trees and social networks of Nuzi, and estimate the published years of cuneiform tablets (contracts, documents) consistently with the trees and the networks. Making use of the kinships we make linear inequalities for example a father is at least 15 years older than his son, contractors were living at the time of the contract, etc. and formulate the least squares problems to estimate the published year of each document and the birth year and death year of each person in NPN, as shown in Sections 3, 4, and 5.

As in Ref. [2], “Ancient Nuzi, buried beneath modern Yorghan Tepe in northern Iraq, is a Late Bronze Age town belonging to the kingdom of Arrapa that has yielded between 6500 and 7000 legal, economic and administrative tablets, all belonging to a period of some five generations (1475–1350 B.C.E.) and almost all from known archeological contexts”, see also Refs. [3,4].

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It was destroyed by Assyrians [2]. As in NPN [1], “the name list, with its comprehensive data on genealogies and professions, will permit assignment of the documentary sources to successive generations concerned. With the attainment of this basic chronological perspective the progress of legal, economic, and social change will become traceable”. Also as in NPN [1] “the tablets discovered at Nuzi belong to private archives and official archives found in the houses of rich families or to official archives kept in the palace. There is a wealth of texts pertaining to land transactions (buying, renting, exchanging), there are family contracts in the form of marriage documents and wills, there are transcripts of litigations and of declarations in court, there are loan tablets, slavery contracts, lists and inventions of tablets, and many other varieties. All these texts enable us to reconstruct the social and economic life of Nuzi in the middle of the 2nd millennium B.C.E. The several thousand personal names mentioned in the texts furnish the main source for our evaluation of the ethnic background of Nuzi in this period”. Although published years of documents may be qualitatively studied by historians [2], here we introduce a quantitative base to estimate the published years of documents (cuneiform tablets) analyzing our database, electronic version of NPN. We observe a nonlinear dynamical system, logistic growth, on the accumulated number of published cuneiform tablets, which will help to convince our study. As given on line 12 of p. 9 in NPN, it is much more difficult to identify the persons than the names; that can be accomplished only after a careful study of the contexts in which they are mentioned. Here we suggest a method to identify the persons just from NPN [5] to study the published year of documents.

The observed phase changes of phenomena in human sciences are sometimes well explained by using the models developed in physics for example as the neolithic transition (i.e., the shift from hunter–gatherer to agricultural economies) [6], social change in Mediterranean prehistory [7], and many other problems as, word ordering rules in natural languages [8], election systems in the present society [9], stock price [10], etc. The time evolution of networks based on human interactions in economy, politics, transportation systems, Internet, family trees, etc. is drawing the attention to the present physicists [11,12]. Statistical methods [13] are useful to examine the archeological finds of a particular important individual.

To distinguish an author from every other author in our present scientific community, we use the information on education, employment, works, etc. For example ORCID provides a persistent digital author identifier for scientific papers. We reconstruct family trees identifying persons from the information in NPN. Formulating the least squares problem (Section 5) making use of the reconstructed family trees for each person with his (her) involved document identifiers (Section 4) in NPN, we estimate the published year of each of 1662 documents (cuneiform tablets) given in NPN. We find the number of tablets increases rapidly for about thirty years in a period of about sixty years, by the logistic growth until saturation [5], Fig. 2. A big portion of the documents is on land transaction, for example by the adoption given later in the tablet with the document identifier JEN 208 [14]. The logistic growth seems to show the dynamics of the concentration in landowning by a few powerful families as the Teḫiptilla family [15,2]. We see in the recent book (p. 9 [2]), “the stronger families at times exploit certain other families repeatedly, systematically, and extensively”. We remark that the logistic growth is the solution of the simplest prey predator system (the simplest Lotka–Volterra system) [16,17] in nonlinear dynamical system as we discuss in Section 3. Assuming that the property of the powerful family, as Teḫiptilla family, is proportional to the accumulated number of documents for the family, the logistic growth seems to be natural to understand the accumulation of cuneiform tablets in Nuzi and support to convince the success of our method. We believe that our computational method to get the published year of each cuneiform tablet will give a quantitative base to the studies of the daily life of Nuzi town in the 15th century B.C.E. and will reconstruct the life of Teḫiptilla and other persons in the town. Here we date the birth and death of three persons in Teḫiptilla family by our method in Section 3.3. To date the birth and death of persons is our next problem.

2. An example of the Nuzi documents

We have 4004 personal names included in 1832 tablets with the name of books or periodicals (i.e. AASOR, HSS, JEN, SMN, etc.) in NPN. As given on line 25 from the bottom in p. 8 of NPN, the Arabic number following an abbreviation of a book or periodical title with or without a Roman numeral designating the volume is regularly that of a tablet in the publication, as in HSS V 30:5 or JEN 100:5. For example JEN is abbreviation of the book title, Joint Expedition with the Iraq Museum at Nuzi. As given on line 22 from the bottom in p. 8 of NPN, Arabic number after a colon represents the line number. Our NPN electronic version is very carefully input (typed) NPN. For example the space, the comma, and the semicolon have very important meanings in NPN.

We consider a document with the document identified by JEN 208 to see how we use NPN for our computational studies [18,19,5] extending philological study [20]. Teḫiptilla’s family was involved in many contracts and transactions. The document JEN 208, referenced in Refs. [14,1], is the contract between Iluja, a son of Ḥamattar and Teḫiptilla a son of Puḫišenni, with the names of witnesses and scribes.

Example (JEN 208 [14]). Adoption tablet. Iluja, is a son of Ḥamattar. He made, Teḫiptilla son of Puḫišenni, for sonship. Iluja assigned Teḫiptilla to as (his) share 2 imer and 3 awehari of land in the large standard, west of the dimtu of Imbi-ili-su, east of the dimtu of enia. And Teḫiptilla [ga]ve Iluja as his gift 10 imer of barley. If the land ge[ts] a claimant, Iluja shall clear (it), to Te[h]ip-tilta he (shall) restore (it). The ilku service of the land only [I]luja [shall] bear/ [If Iluja infr]inges (the agreement), [he shall furnish 1 mina of silver (and) 1 mina of gold]. (Rest of the obverse destroyed) L1.17-20:4 seals; some seals destroyed.

[]: broken

(): added by original translator.

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