Chapter 2
Type-One and Interval Type-Two Fuzzy Logic for Quantitatively Defining Imprecise Linguistic Terms in Politics and Public Policy

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ABSTRACT

During a presidential forum in the 2008 U.S. presidential campaign, the moderator, Pastor Rick Warren, wanted Sen. John McCain and then-Sen. Barack Obama to define rich with a specific number. Warren wanted to know at what specific income level a person goes from being not rich to rich. The problem with this question is that there is no specific income at which a person makes the leap from being not rich to being rich. This is because rich is a fuzzy set, not a crisp set, with different incomes having different degrees of membership in the rich fuzzy set. Similarly, middle class and poor are fuzzy sets. Fuzzy logic is needed to properly ask and answer Warren's question about quantitatively defining rich. Similarly, fuzzy logic is needed to properly ask and answer queries about quantitatively defining imprecise linguistic terms in politics and public policy like middle class, poor, low inflation, medium inflation, and high inflation. Type-one or interval type-two fuzzy logic can be used for quantitatively defining imprecise linguistic terms. This chapter shows how to use type-one fuzzy logic and interval type-two fuzzy logic for this purpose, as well as the advantages and disadvantages of each. Imprecise terms in natural languages should be considered to have qualitative definitions, quantitative definitions, crisp quantitative definitions, fuzzy quantitative definitions, type-one fuzzy quantitative definitions, and interval type-two fuzzy quantitative definitions.

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1. INTRODUCTION

Certainty and precision are much too often used as an absolute standard in reasoning and decision making. Fuzzy logic (Kaufmann & Gupta, 1985; Kaufmann & Gupta, 1988; Gupta, Jin, & Homma, 2003; Solo & Gupta, 2007; Gupta & Solo, 2010; Solo, 2010; Gupta & Solo, 2015) can deal with information arising from computational perception and cognition that is uncertain, imprecise, vague, partially true, or without sharp boundaries. The theory of fuzzy logic was inspired by the processes of human perception and cognition. Lotfi Zadeh published his first famous paper on fuzzy sets in 1965 (Zadeh, 1965). Fuzzy logic allows for the inclusion of vague human assessments in computing problems. This mathematics of uncertainty is extremely useful in approximate reasoning and decision making. New computing methods based on fuzzy logic can be used in the development of intelligent systems for decision making, identification, recognition, optimization, and control.

Fuzzy logic is needed to properly quantitatively define many imprecise linguistic terms used in politics and public policy including income levels, unemployment levels, inflation, voter turnout levels, etc. Fuzzy logic is needed to quantitatively define imprecise linguistic terms used in politics like *poor, middle class, very poor, extremely poor, high inflation, medium inflation, low inflation, high unemployment, moderate unemployment, low unemployment, extremely high unemployment, extremely low inflation, high voter turnout, moderate voter turnout, low voter turnout,* etc. Type-one and interval type-two fuzzy sets in fuzzy logic have been used for imprecise linguistic terms in many intelligent systems applications, but this research paper proposes the use of type-one fuzzy sets or interval type-two fuzzy sets for the application of asking and answering queries about quantitatively defining imprecise linguistic terms in natural languages. This research paper describes how type-one fuzzy sets and interval type-two fuzzy sets can specifically be used in asking and answering queries about defining the imprecise linguistic terms *rich, middle class,* and *poor.*

First the use of type-one fuzzy logic for quantitatively defining imprecise linguistic terms in politics and public policy (Solo, 2009; Solo, 2012a; Solo, 2012b; Solo, 2014c) will be described. Then the use of interval type-two fuzzy logic for the same purpose (Solo, 2014d; Solo, 2016) will be described. Also, this chapter shows the advantages and disadvantages of using interval type-two fuzzy logic instead of type-one fuzzy logic for quantitatively defining imprecise linguistic terms in politics and public policy.

The use of fuzzy logic in quantitatively defining imprecise linguistic terms in politics is an example of political engineering and computational politics. The interdisciplinary fields of political engineering and computational politics were originated and defined by Ashu M. G. Solo (Solo, 2011; Solo, 2014a; Solo, 2017b). Political engineering and computational politics are described in the previous chapter (Solo, 2019).

The use of fuzzy logic in quantitatively defining imprecise linguistic terms in public policy is an example of public policy engineering and computational public policy. The interdisciplinary fields of public policy engineering and computational public policy were originated and defined by Ashu M. G. Solo (Solo, 2011; Solo, 2014b; Solo, 2017a). Public policy engineering and computational public policy are described in the previous chapter (Solo, 2019).