New Trends in Fuzzy Sets, Intuitionistic Fuzzy Sets, Generalized Nets and Related Topics Volume II: Applications

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Generalized Net Model for Describing Some Banking Activities

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Abstract

A generalized net is used to construct a model which describes the typical banking activities. The model can be used to simulate some processes in the bank sector.

Keywords: Banking Activities, Generalized Net, Modelling.

1 Introduction

The purpose of the paper is to show how Generalized Nets (GNs for GN see [1], [2]) can be used to model the typical banking activities.
Undoubtedly the banks are the main participant in the financial intermediation process. Therefore, they are subject of strict control on the part of the state. Commonly the reasons for the regulatory regimes presence are the appearance of adverse external and/or internal shocks, information asymmetry, market failures or, most generally speaking, the regulations are a kind of prevention against the system risk in economy. In the bank sector case, three main motives are mentioned in the specialized literature, predetermining the necessity of regulatory framework construction:

- a significant share of the bank activity is actually inwardly vulnerable because the banks offer credits with terms longer than the terms of the deposits necessary to finance the offered credits;

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- even small and insignificant at first sight disturbances may threaten the financial stability because of the infection effect (for example see [5]); and
- the banks are the main source of specific for the society services – they keep substantial share of the population's wealth, secure and guarantee the payments between the economic agents in the country and abroad, credit the investment intents of the companies, etc.

In order to meet their current planned and incidental expenses, the credit institutions must maintain a certain level of liquidity. By definition liquidity is the capability of an asset to be transformed in money for maximum short period of time at minimum transaction costs. From this point of view, the liquidity is not only a necessary, but also an obligatory condition accompanying the banks' activity.

In Bulgaria, the management and the supervision of banks' liquidity is carried out by "Bank Supervision" Administration, which is a part of the BNB (Bulgarian National Bank) structure [3]. A liquidity management body is established within each commercial bank. Its main obligations are: drafting action plans in cases of unforeseen outflow of funds, periodical performance of stress test1, etc. Further, the body is maintaining an informational system of metrification and control of the liquidity, which is based on: creation and maintenance of a maturity structure table of the balance sheet and off-balance sheet positions; assessment of cash inflows and outflows and calculation of the necessary amount of liquidity assets and liquidity buffers.

The maturity table allocates the positions in the following categories:

- up to seven days;
- from eight days to one month;
- over one month up to three months;
- over three months up to six months;
- over six months up to a year;
- over a year.

Banks evaluate the cash inflows and outflows according to the maturity time of each balance sheet position individually. Where the cash inflows within one maturity interval exceed the cash outflows of the same maturity interval, the surplus is reviewed as an additional cash inflow for the next maturity interval, and in case of shortage – as an additional cash outflow for the next interval.

Pursuant to the regulatory requirements, banks' liquidity assets are: the moneys maintained in accounts with the central bank; assets in settlement accounts with

[1] Stress tests are a mandatory component of the risk management strategy. In their essence, they are various scenarios simulating certain adverse or positive shocks, aimed at "prognostication" of bank's stability. On the grounds of that preliminary data, the management can build a preventive actions strategy.

other credit institutions, as well as depositing funds with other banks with a term up to 7 days; the issued by central governments or central banks marketable debt securities, including bonds of the Bulgarian Government; marketable debt securities issued by international banks and organizations; investment gold.
The liquidity of the credit institutions is calculated on the grounds of the following two main ratios:
liquid asset ratio = amount of available liquid assets / the amount of deposits and other bank's liabilities
liquidity coefficient by maturity time bands – this represent the ratio of the amount of assets (cash inflow) for the relevant maturity time band plus the excess of the net cash flow from the preceding time band to deposits and other credit institution's liabilities (cash outflow) for the same maturity time band; where a shortage of the net cash flow from the preceding time band is established in calculating the ratio, the shortage should be added to deposits and other bank's liabilities (cash outflow).
According to Ordinance № 11 bank's liquidity is deemed acceptable if the liquidity ratio by maturity time bands is not under 1 at least for the first two maturity time bands. Central banks monitor bank's liquidity and if necessary it can intervene and impose minimum values of coefficients for each bank individually under which they may not go down.

2 A GN-model

The GN-model for this section (Figure 1) contains 7 transitions and 26 places, collected in four groups and related to the four types of the tokens that will enter respective types of places:
α - tokens and *a*-places represent the bank accountants and their activities,
β - tokens and *b*-places represent a data base with list of banking,
γ - tokens and *c*-places represent the clients and their activity,
φ - tokens and *d*-places represent the money and activities with them.

For brevity, we shall use the notation α-, β-, γ- and φ-tokens instead of α_s-, β_j-, γ_i-, and φ_l-tokens, where *s, j, i, l* are numerations of the respective tokens.

Initially the α-, β-, γ-, and φ-tokens remain, respectively, in places a_3, b_3, c_3, d_4 and d_7 with initial characteristics:

$$x_0^{\alpha} = \text{“name and activity of an accountant”},$$

$$x_0^{\beta} = \text{“banking services and criteria for offering credits”},$$

$$x_0^{\gamma} = \text{“name of a client”},$$

$$x_0^{\varphi 1} = \text{“current status of the pay-desk”}.$$

$x_0^{\varphi 2}$ = “current financial status of the Bulgarian National Bank”.

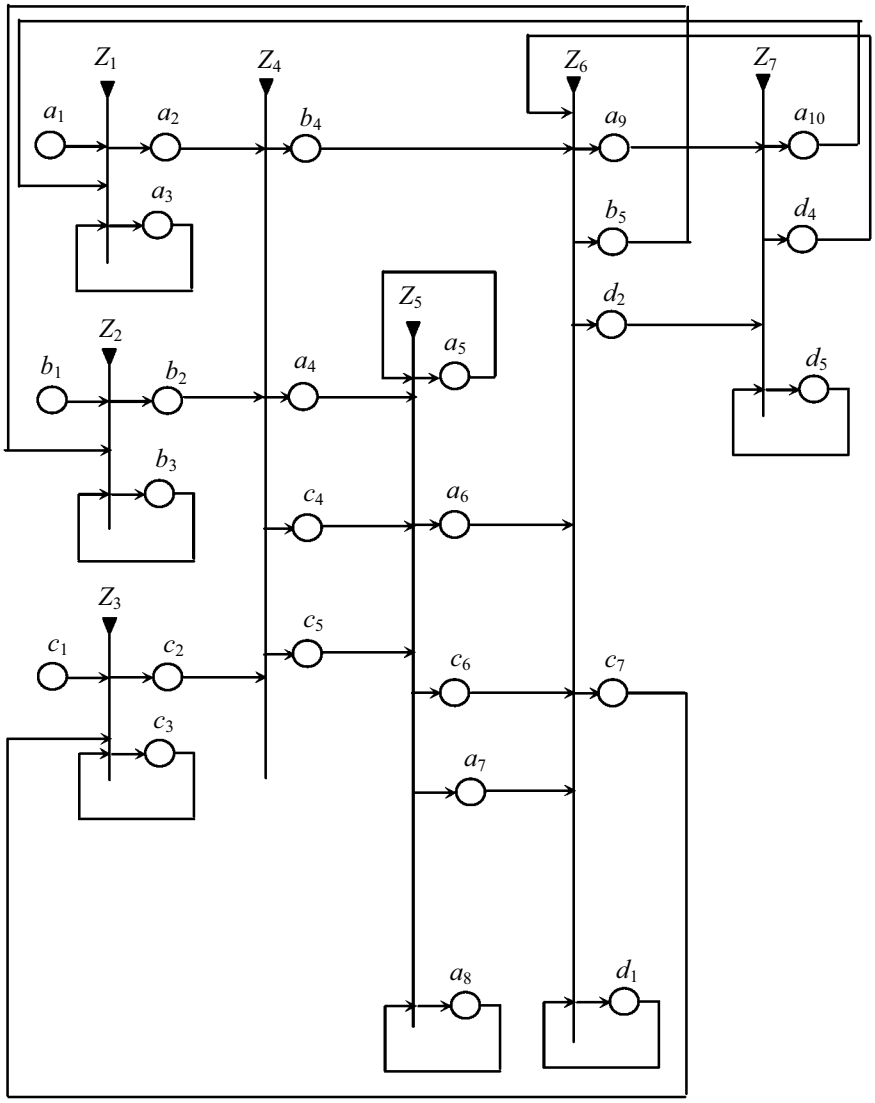

Figure 1: Generalized Net Model for describing typical banking activities

All α-tokens, all β-tokens, all γ-tokens, and all φ-tokens have equal priorities, but the priority of α-tokens is higher than the priority of β-tokens,

that is higher than the priority of γ-tokens, that is higher than the priority of φ-tokens.

Let x_{cu}^{α}, x_{cu}^{β}, x_{cu}^{γ} and x_{cu}^{φ} be the current characteristics of the α-, β-, γ- and φ- tokens' respectively. The forms of the transitions are the following.

$$Z_1 = <\{a_1, a_3, a_{10}\}, \{a_2, a_3\},$$

	a_2	a_3
a_1	*false*	*true*
a_3	$W_{3,2}^{a}$	$W_{3,3}^{a}$
a_{10}	*false*	*true*

$>$,

where:

$W_{3,2}^{a}$ = "The clerk has a client",

$W_{3,3}^{a} = \neg W_{3,2}^{a}$.

The α-tokens do not obtain new characteristic in place a_3 and they obtain the characteristic

$$x_{cu}^{\alpha} = \text{"Bank clerk, the requirements of banking service"}$$

in place a_2.

$$Z_2 = <\{b_1, b_3, b_5\}, \{b_2, b_3\},$$

	b_2	b_3
b_1	*false*	*true*
b_3	$W_{3,2}^{b}$	$W_{3,3}^{b}$
b_5	*false*	*true*

$>$,

where:

$W_{3,2}^{b}$ = "The banking service is included in x_{cu}^{α}",

$W_{3,3}^{b} = \neg W_{3,2}^{b}$.

The β-tokens do not have new characteristic in place b_3 and they take on the characteristic

$$x_{cu}^{\beta} = \text{"banking service"}$$

in place b_2.

$$Z_3 = <\{c_1, c_3, c_7\}, \{c_2, c_3\},$$

	c_2	c_3
c_1	*false*	*true*
c_3	$W_{3,2}^{c}$	$W_{3,3}^{c}$
c_7	*false*	*true*

$>$,

where:

$W_{3,2}^{c}$ = "The client has to complete documents for chosen banking service",

in place $W^c_{3,3} = \neg W^c_{3,2}$.

The γ-tokens do not obtain new characteristics in places c_3 and c_2.

$Z_4 = <\{a_2, b_2, c_2\}, \{a_4, b_4, c_4, c_5\},$

	a_4	b_4	c_4	c_5
a_2	*true*	*false*	*false*	*false*
b_2	*false*	*true*	*false*	*false*
c_2	*false*	*false*	$W^c_{2,4}$	$W^c_{2,5}$

$>$.

$W^c_{2,4}$ = "The client has chosen to make deposit",

$W^c_{2,5}$ = "The client has chosen to take credit",

The α- and β-tokens do not have new characteristic in places a_4 and b_4, respectively, while γ-tokens obtain characteristic

"Client, banking service: deposit"

in place c_4,

and "Client, banking service: credit"

in place c_5.

$Z_5 = <\{a_4, a_5, a_8, c_4, c_5\}, \{a_5, a_6, a_7, a_8, c_6\},$

$R_5 =$

	a_5	a_6	a_7	a_8	c_6
a_4	$W^a_{4,5}$	*false*	*false*	$W^a_{4,8}$	*false*
a_5	$W^a_{5,5}$	$W^a_{5,6}$	*false*	*false*	*false*
a_8	*false*	*false*	$W^a_{8,7}$	$W^a_{8,8}$	*false*
c_4	*false*	*false*	*false*	*false*	*true*
c_5	*false*	*false*	*false*	*false*	*true*

$>$,

where:

$W^a_{4,5} = W^a_{5,5}$ = "There are clients whose documents for a deposit must be processed by the clerk",

$W^a_{5,6} = \neg W^a_{4,5}$,

$W^a_{4,8} = W^a_{8,8}$ = "There are clients whose documents for a credit must be processed by the clerk",

$W^a_{8,7} = \neg W^a_{4,8}$.

The α- do not obtain new characteristic in places a_5 and a_8. The α-tokens that enter places a_6 and a_7 obtain characteristics respectively

"clerk, banking service, documents for a deposit"

in place a_6.

and “clerk, banking service, documents for a credit”

in place a_7.

The γ- do not obtain new characteristic in place c_6.

$Z_6 = <\{a_6, a_7, b_4, c_6, d_1, d_3\}, \{a_9, b_5, c_7, d_1, d_2\},$

	a_9	b_5	c_7	d_1	d_2
a_6	*true*	*false*	*false*	*false*	*false*
a_7	*true*	*false*	*false*	*false*	*false*
b_4	*false*	*true*	*false*	*false*	*false* >,
c_6	*false*	*false*	*true*	*false*	*false*
d_1	*false*	*false*	*false*	*true*	$W_{1,2}^d$
d_3	*false*	*false*	*false*	*false*	*true*

where:

$W_{1,2}^d$ = “There are financial resources for the Bulgarian National Bank”.

The α-, β- and γ-tokens do not obtain new characteristic in places a_9, b_5 and c_7.

The φ-tokens that enter place d_2 obtain characteristics

“clerk, client, banking service: credit, financial resource”.

$Z_7 = <\{a_9, d_2, d_4\}, \{a_{10}, d_3, d_4\},$

	a_{10}	d_3	d_4
a_1	*true*	*false*	*false*
d_2	*false*	*false*	*true* >,
d_4	*false*	$W_{4,3}^d$	*true*

where:

$W_{4,3}^d$ = “The clerk has a client”.

The α-tokens do not obtain new characteristic in places a_{10}.

The φ-tokens obtain the characteristic

x_{cu}^{φ} = “Financial resources for the commercial bank”

in place d_3.

Conclusions

The so-constructed GN-model gives possibility to simulate some processes, related with typical banking activities. The present model is an element of a more general model describing different processes, flowing in a bank. The

author, together with some colleagues has been preparing an extensive research on this theme.

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The papers presented in this Volume 2 constitute a collection of contributions, both of a foundational and applied type, by both well-known experts and young researchers in various fields of broadly perceived intelligent systems.
It may be viewed as a result of fruitful discussions held during the Eleventh International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2012) organized in Warsaw on October 12, 2012 by the Systems Research Institute, Polish Academy of Sciences, in Warsaw, Poland, Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences in Sofia, Bulgaria, and WIT - Warsaw School of Information Technology in Warsaw, Poland, and co-organized by: the Matej Bel University, Banska Bystrica, Slovakia, Universidad Publica de Navarra, Pamplona, Spain, Universidade de Tras-Os-Montes e Alto Douro, Vila Real, Portugal, Prof. Asen Zlatarov University, Burgas, Bulgaria, and the University of Westminster, Harrow, UK:

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The consecutive International Workshops on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGNs) have been meant to provide a forum for the presentation of new results and for scientific discussion on new developments in foundations and applications of intuitionistic fuzzy sets and generalized nets pioneered by Professor Krassimir T. Atanassov. Other topics related to broadly perceived representation and processing of uncertain and imprecise information and intelligent systems have also been included. The Eleventh International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2012) is a continuation of this undertaking, and provides many new ideas and results in the areas concerned.

We hope that a collection of main contributions presented at the Workshop, completed with many papers by leading experts who have not been able to participate, will provide a source of much needed information on recent trends in the topics considered.

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