# Extension of one of Baczynski-Jayaram's problems 

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#### Abstract

An extension of one of Baczynski-Jayaram's problems related to fuzzy implications and negations is formulated and some of its solutions in the form of pairs of intuitionistic fuzzy implications and negation are described.


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## 1 Introduction

In [4] Michal Baczynski and Balasubramaniam Jayaram formulated some problems related to fuzzy implications $I$ and negations $N$. In [1,2], Krassimir Atanassov and Dimitar Dimitrov gave a series of solutions to one of these problems:

Problem 1.7.1: Give examples of fuzzy implications I such that
(i) I satisfies only property

$$
\begin{equation*}
I(x, y)=I(N(y), N(x)) \tag{CP}
\end{equation*}
$$

(ii) I satisfies only property

$$
I(N(x), y)=I(N(y), x)
$$

$$
(L-C P)
$$

(iii) I satisfies both (CP) and (L-CP), but not

$$
I(x, N(y))=I(y, N(x))
$$

$$
(R-C P)
$$

with some fuzzy negation $N$, where $x, y \in[0,1]$.

Meantime, in [3], K. Atanassov, E. Szmidt and J. Kacprzyk published the full list of intuitionistic fuzzy implications and negations, existing by the end of October 2013. There is no information about publishing of new intuitionistic fuzzy implications and negations. By this reason, here, using this list, we check the above problem for all non-parametric operations, i.e., for 149 intuitionistic fuzzy implications and 41 intuitionistic fuzzy negations. Our research includes and extends the results from [1,2].

As it is mentioned in [3], the Intuitionistic Fuzzy Pair (IFP) is an object with the form $\langle a, b\rangle$, where $a, b \in[0,1]$ and $a+b \leq 1$, that is used as an evaluation of some object or process and which conponents ( $a$ and $b$ ) are interpreted as degrees of membership and non-membership, or degrees of validity and non-validity, or degree of correctness and non-correctness, etc. Here, we apply the implications and negations over IFPs.

## 2 Main results

Theorem 1. The pairs $(4,1),(5,1),(7,1),(12,1),(13,1),(15,1),(24,1),(25,1),(33,1),(34,1)$, $(35,1),(36,1),(37,1),(40,1),(43,1),(49,1),(50,1),(51,1),(52,1),(55,1),(58,1),(101,1)$, $(104,1),(107,1),(139,1),(140,1),(141,1),(142,1),(145,1),(146,1),(149,1),(20,2),(22,4)$, $(144,4),(148,4),(23,5),(27,6),(42,6),(57,6),(76,8),(143,8),(147,8),(20,9),(22,10)$, $(144,10),(148,10),(74,11),(77,13),(79,14),(88,14),(97,14),(20,16),(74,17),(101,18)$, $(76,23),(143,23),(147,23),(76,27),(143,27),(147,27)$, satisfy the three axioms.
Proof: The check of validity of all assertions in the paper is realized by the specialized software product, described in [5], but a part of these assertions are checked directly on the basis of the respective definitions. Here, we prove the validity of the Theorem for the case of implication $\rightarrow_{139}$ and negation $\neg_{1}$, as an exampe for the analytical way of the check.

Let $V(x)=\langle a, b\rangle, V(y)=\langle c, d\rangle$, where $a, b, c, d \in[0,1]$ and $a+b \leq 1, c+d \leq 1$.
Intuitionistic fuzzy implication $\rightarrow_{139}$ and intuitionistic fuzzy negation $\neg_{1}$ are defined by

$$
\begin{aligned}
\langle a, b\rangle \rightarrow_{139}\langle c, d\rangle & =\left\langle\frac{b+c}{2}, \frac{a+d}{2}\right\rangle \\
\neg_{1}\langle a, b\rangle & =\langle b, a\rangle .
\end{aligned}
$$

For (CP) we obtain sequentially:

$$
\begin{gathered}
\quad\langle a, b\rangle \rightarrow_{139}\langle c, d\rangle \\
=\left\langle\frac{b+c}{2}, \frac{a+d}{2}\right\rangle \\
= \\
=\left\langle\frac{c+b}{2}, \frac{d+a}{2}\right\rangle \\
= \\
\langle d, c\rangle \rightarrow_{139}\langle b, a\rangle \\
=\neg_{1}\langle c, d\rangle \rightarrow_{139} \neg_{1}\langle a, b\rangle .
\end{gathered}
$$

For (L-CP) we obtain sequentially:

$$
\neg_{1}\langle a, b\rangle \rightarrow_{139}\langle c, d\rangle
$$

$$
\begin{aligned}
= & \langle b, a\rangle \rightarrow_{139}\langle c, d\rangle \\
& =\left\langle\frac{a+c}{2}, \frac{b+d}{2}\right\rangle \\
& =\left\langle\frac{c+a}{2}, \frac{d+b}{2}\right\rangle \\
= & \langle d, c\rangle \rightarrow_{139}\langle a, b\rangle \\
= & \neg_{1}\langle c, d\rangle \rightarrow_{139}\langle a, b\rangle .
\end{aligned}
$$

For (R-CP) we obtain sequentially:

$$
\begin{gathered}
\langle a, b\rangle \rightarrow_{139} \neg_{1}\langle c, d\rangle \\
\langle a, b\rangle \rightarrow_{139}\langle d, c\rangle \\
=\left\langle\frac{b+d}{2}, \frac{a+c}{2}\right\rangle \\
=\left\langle\frac{d+b}{2}, \frac{c+a}{2}\right\rangle \\
\langle c, d\rangle \rightarrow_{139}\langle b, a\rangle \\
\langle c, d\rangle \rightarrow_{139} \neg_{1}\langle a, b\rangle
\end{gathered}
$$

This completes the proof.

Theorem 2. The pairs $(52,7),(55,7),(52,15),(55,15),(88,19),(33,20),(34,20),(35,20)$, $(37,20),(40,20),(43,20),(88,22),(88,25)$ satisfy two axioms and more exactly, they satisfy (L-CP) and (R-CP).

We had not found any couple of implication and negation that are solution of Problem 1.7.1 (iii).

Another result of our search is the following:

Theorem 3. The pairs $(2,2),(3,2),(8,2),(11,2),(16,2),(31,2),(32,2),(37,2),(40,2)$, $(41,2),(42,2),(12,3),(17,3),(49,3),(50,3),(51,3),(52,3),(55,3),(58,3),(107,3),(145,3)$, $(149,3),(12,4),(18,4),(49,4),(50,4),(51,4),(52,4),(55,4),(58,4),(107,4),(145,4)$, $(149,4),(14,5),(15,5),(19,5),(47,5),(48,5),(52,5),(55,5),(56,5),(57,5),(24,6),(26,6)$, $(31,6),(32,6),(37,6),(40,6),(41,6),(47,6),(48,6),(52,6),(55,6),(56,6),(25,7),(28,7)$, $(33,7),(34,7),(35,7),(36,7),(37,7),(40,7),(43,7),(47,7),(48,7),(56,7),(57,7),(104,7)$, $(142,7),(146,7),(33,8),(34,8),(35,8),(36,8),(37,8),(40,8),(43,8),(104,8),(142,8)$, $(146,8),(33,9),(34,9),(35,9),(36,9),(37,9),(40,9),(43,9),(104,9),(142,9),(146,9)$, $(47,10),(48,10),(52,10),(55,10),(56,10),(57,10),(97,11),(88,13),(47,15),(48,15)$, $(56,15),(57,15),(81,15),(88,15),(88,16),(47,17),(48,17),(52,17),(55,17),(56,17)$, $(57,17),(23,18),(42,18),(100,18),(22,19),(23,19),(31,19),(32,19),(33,19),(34,19)$,
$(35,19),(37,19),(39,19),(40,19),(41,19),(42,19),(43,19),(44,19),(45,19),(62,19)$, $(63,19),(65,19),(68,19),(70,19),(74,19),(82,19),(83,19),(84,19),(85,19),(86,19)$,
$(87,19),(89,19),(90,19),(100,19),(103,19),(115,19),(116,19),(117,19),(118,19)$, $(129,19),(130,19),(131,19),(132,19),(4,20),(5,20),(12,20),(13,20),(17,20),(18,20)$, $(22,20),(23,20),(25,20),(29,20),(31,20),(32,20),(39,20),(41,20),(42,20),(44,20)$, $(45,20),(49,20),(50,20),(51,20),(52,20),(55,20),(58,20),(62,20),(63,20),(65,20)$, $(68,20),(70,20),(71,20),(74,20),(81,20),(82,20),(83,20),(84,20),(85,20),(86,20)$, $(87,20),(88,20),(89,20),(90,20),(103,20),(107,20),(110,20),(112,20),(115,20),(116,20)$, $(117,20),(118,20),(125,20),(127,20),(129,20),(130,20),(131,20),(132,20),(145,20)$, $(149,20),(23,21),(42,21),(104,21),(22,22),(23,22),(31,22),(32,22),(33,22),(34,22)$, $(35,22),(37,22),(39,22),(40,22),(41,22),(42,22),(43,22),(44,22),(45,22),(62,22)$, $(63,22),(65,22),(68,22),(70,22),(74,22),(82,22),(83,22),(84,22),(85,22),(86,22)$, $(87,22),(89,22),(90,22),(103,22),(115,22),(116,22),(117,22),(118,22),(129,22)$, $(130,22),(131,22),(132,22),(2,23),(22,23),(23,23),(24,23),(31,23),(32,23),(33,23)$, $(34,23),(35,23),(37,23),(39,23),(40,23),(41,23),(42,23),(43,23),(44,23),(45,23)$, $(62,23),(63,23),(65,23),(68,23),(70,23),(74,23),(82,23),(83,23),(84,23),(85,23)$, $(86,23),(87,23),(88,23),(89,23),(90,23),(103,23),(115,23),(116,23),(117,23),(118,23)$, $(129,23),(130,23),(131,23),(132,23),(23,24),(42,24),(107,24),(22,25),(23,25),(31,25)$, $(32,25),(33,25),(34,25),(35,25),(37,25),(39,25),(40,25),(41,25),(42,25),(43,25)$, $(44,25),(45,25),(62,25),(63,25),(65,25),(68,25),(70,25),(74,25),(82,25),(83,25)$, $(84,25),(85,25),(86,25),(87,25),(89,25),(90,25),(103,25),(107,25),(115,25),(116,25)$, $(117,25),(118,25),(129,25),(130,25),(131,25),(132,25),(12,26),(107,25),(49,26)$, $(50,26),(51,26),(52,26),(55,26),(58,26),(107,26),(110,26),(112,26),(145,26),(149,26)$, $(12,28),(49,28),(50,28),(51,28),(52,28),(55,28),(58,28),(107,28),(145,28),(149,28)$ satisfy only the axiom (R-CP).

## The most interesting is the following

Theorem 4. The pairs $(57,2),(21,3),(25,3),(33,3),(34,3),(35,3),(36,3),(37,3),(40,3)$, $(43,3),(104,3),(142,3),(146,3),(33,4),(34,4),(35,4),(36,4),(37,4),(40,4),(43,4)$, $(104,4),(142,4),(146,4),(42,5),(12,7),(29,7),(42,7),(49,7),(50,7),(51,7),(58,7)$, $(107,7),(145,7),(149,7),(12,8),(49,8),(50,8),(51,8),(52,8),(55,8),(58,8),(72,8)$, $(107,8),(145,8),(149,8),(12,9),(49,9),(50,9),(51,9),(52,9),(55,9),(58,9),(107,9)$, $(145,9),(149,9),(42,10),(37,11),(40,11),(62,11),(63,11),(65,11),(68,11),(70,11)$, $(83,11),(84,11),(87,11),(88,11),(15,13),(52,13),(55,13),(69,13),(73,13),(92,13)$, $(93,13),(96,13),(97,13),(24,14),(37,14),(40,14),(52,14),(55,14),(78,14),(83,14)$, $(84,14),(87,14),(92,14),(93,14),(96,14),(29,15),(42,15),(92,15),(93,15),(96,15)$, $(97,15),(52,16),(55,16),(92,16),(93,16),(96,16),(97,16),(42,17),(77,18),(88,18)$, $(102,18), \quad(77,19), \quad(109,19), \quad(36,20),(104,20),(142,20),(146,20),(77,21),(88,21)$, $(107,21),(77,22), \quad(109,22),(77,24),(88,24),(104,24),(77,25),(104,25),(109,25)$, $(25,26),(33,26),(34,26),(35,26),(36,26),(37,26),(40,26),(43,26),(104,26),(111,26)$, $(142,26),(146,26),(33,28),(34,28),(35,28),(36,28),(37,28),(40,28),(43,28),(104,28)$, $(142,28),(146,28),(77,30),(81,30),(88,30),(77,32),(81,32),(88,32),(77,34),(88,34)$ $(13,35),(35,35),(50,35),(74,35),(77,35),(79,35),(81,35),(88,35),(90,35),(97,35)$,
$(99,35),(13,36),(35,36),(50,36),(74,36),(77,36),(79,36),(81,36),(88,36),(90,36)$, $(97,36),(99,36),(13,37),(35,37),(50,37),(74,37),(77,37),(79,37),(81,37),(88,37)$, $(90,37),(97,37),(99,37),(50,38),(74,38),(77,38),(79,38),(81,38),(88,38),(90,39)$, $(97,38),(99,38),(35,39),(74,39),(77,39),(79,39),(88,39),(97,39),(50,40),(74,40)$, $(77,40),(79,40),(81,40),(88,40),(97,40),(99,40),(35,41),(74,41),(77,41),(79,41)$, $(88,41),(90,41),(97,41)$ satisfy only Axiom (L-CP).

This theorem gives examples of couples "implication and negation" that are solutions of Problem 1.7.1 (ii).

In [2] the equalities $(C P),(L-C P)$ and $(R-C P)$ are changed to the equalities

$$
\begin{array}{lr}
I(N(N(x)), N(N(y)))=I(N(y), N(x)), & \left(C P^{\prime}\right) \\
I(N(x), N(N(y)))=I(N(y), N(N(x))), & \left(L-C P^{\prime}\right) \\
I(N(N(x)), N(y))=I(N(N(y)), N(x)) . & \left(R-C P^{\prime}\right)
\end{array}
$$

Here we shall give examples of pairs of implications and negations that satisfy an extended form of Problem 1.7.1 (ii), where the assertions are related to $\left(C P^{\prime}\right),\left(L-C P^{\prime}\right)$ and $\left(R-C P^{\prime}\right)$.

First, we shall note that there are 1481 pairs $(m, n)$ satisfying the three equalities.
Theorem 5. The pairs $(1,19),(6,19),(7,19),(9,19),(1,20),(6,20),(7,20),(9,20),(109,20)$, $(1,25),(6,25),(7,25),(9,25)$ satisfy two equalities and more exactly, they satisfy $\left(L-C P^{\prime}\right)$ and $\left(R-C P^{\prime}\right)$.

Another result of our research is the following:

Theorem 6. The pairs $(21,3),(25,3),(33,3),(34,3),(35,3),(36,3),(37,3),(40,3),(43,3)$, $(104,3),(146,3),(12,7),(46,7),(49,7),(50,7),(51,7),(53,7),(54,7),(58,7),(59,7),(60,7)$, $(91,7),(92,7),(93,7),(94,7),(95,7),(96,7),(97,7),(98,7),(99,7),(107,7),(111,7),(119,7)$, $(120,7),(121,7),(122,7),(125,7),(127,7),(134,7),(135,7),(136,7),(137,7),(145,7)$, $(149,7),(12,9),(15,9),(24,9),(46,9),(47,9),(48,9),(49,9),(50,9),(51,9),(52,9),(53,9)$, $(54,9),(55,9),(56,9),(57,9),(58,9),(59,9),(60,9),(62,9),(63,9),(65,9),(68,9),(69,9)$, $(70,9),(72,9),(73,9),(78,9),(91,9),(92,9),(93,9),(94,9),(95,9),(96,9),(98,9),(99,9)$, $(107,9),(119,9),(120,9),(121,9),(122,9),(134,9),(135,9),(136,9),(137,9),(145,9)$, $(149,9),(12,16),(15,16),(46,16),(47,16),(48,16),(49,16),(50,16),(51,16),(52,16)$, $(53,16),(54,16),(55,16),(56,16),(57,16),(58,16),(59,16),(60,16),(69,16),(72,16)$, $(73,16),(91,16),(92,16),(93,16),(94,16),(95,16),(96,16),(97,16),(98,16),(99,16)$, $(119,16),(120,16),(121,16),(122,16),(134,16),(135,16),(136,16),(137,16),(145,16)$, $(149,16)(30,17),(31,17),(32,17),(33,17),(34,17),(35,17),(36,17),(37,17),(38,17)$, $(39,17),(40,17),(41,17),(42,17),(43,17),(44,17),(45,17),(62,17),(63,17),(65,17)$, $(68,17),(70,17),(82,17),(83,17),(84,17),(85,17),(86,17),(87,17),(88,17),(89,17)$, $(90,17),(114,17),(115,17),(116,17),(117,17),(129,17),(130,17),(131,17),(132,17)$, $(142,17),(146,17),(2,19),(3,19),(8,19),(10,19),(11,19),(15,19),(16,19),(20,19)$,
$(24,19),(30,19),(36,19),(38,19),(69,19),(73,19),(76,19),(104,19),(105,19),(114,19)$, $(133,19),(142,19),(146,19),(2,20),(3,20),(8,20),(11,20),(14,20),(15,20),(16,20)$, $(20,20),(24,20),(30,20),(36,20),(38,20),(69,20),(76,20),(77,20),(104,20),(105,20)$, $(114,20),(133,20),(142,20),(146,20),(2,25),(3,25),(8,25),(10,25),(11,25),(14,25)$, $(15,25),(16,25),(20,25),(24,25),(30,25),(36,25),(38,25),(69,25),(73,25),(76,25)$, $(104,25),(105,25),(114,25),(133,25),(142,25),(146,25),(25,26),(33,26),(34,26)$, $(35,26),(36,26),(37,26),(40,26),(43,26),(104,26),(111,26),(142,26),(146,26),(25,28)$, $(33,28),(34,28),(35,28),(36,28),(37,28),(40,28),(43,28),(104,28),(142,28),(146,28)$, $(55,30),(81,30),(55,32),(81,32),(13,35),(35,35),(50,35),(81,35),(90,35),(99,35)$, $(141,35),(146,35),(149,35),(13,36),(35,36),(50,36),(81,36),(90,36),(99,36),(13,37)$, $(35,37),(50,37),(81,37),(90,37),(99,37),(6,38),(13,38),(35,38),(50,38),(64,38)$, $(81,38),(90,38),(99,38),(6,39),(13,39),(35,39),(50,39),(64,39),(81,39),(90,39)$, $(99,39),(6,40),(13,40),(35,40),(50,40),(64,40),(81,40),(81,40),(99,40),(6,41),(13,41)$, $(35,41),(50,41),(64,41),(81,41),(81,41),(99,41)$, satisfy only equality $\left(R-C P^{\prime}\right)$.

## The most interesting is the following:

Theorem 7. The pairs $(12,3),(17,3),(49,3),(50,3),(51,3),(52,3),(55,3),(58,3),(107,3)$, $(149,3),,(15,7),(24,7),(25,7),(26,7),(28,7),(30,7),(31,7),(32,7),(33,7),(34,7),(35,7)$, $(36,7),(37,7),(38,7),(39,7),(40,7),(41,7),(43,7),(44,7),(45,7),(81,7),(82,7),(83,7)$, $(84,7),(85,7),(86,7),(87,7),(88,7),(89,7),(90,7),(104,7),(114,7),(115,7),(116,7)$, $(117,7),(129,7),(130,7),(131,7),(132,7),(142,7),(146,7),(2,9),(3,9),(11,9),(16,9)$, $(30,9),(31,9),(32,9),(33,9),(34,9),(35,9),(36,9),(38,9),(39,9),(41,9),(42,9),(43,9)$, $(44,9),(45,9),(82,9),(85,9),(86,9),(89,9),(90,9),(104,9),(114,9),(115,9),(116,9)$, $(117,9),(129,9),(130,9),(131,9),(132,9),(142,9),(146,9),(2,16),(3,16),(8,16),(11,16)$, $(16,16),(30,16),(31,16),(32,16),(33,16),(34,16),(35,16),(36,16),(37,16),(38,16)$, $(39,16),(40,16),(41,16),(42,16),(43,16),(44,16),(45,16),(82,16),(83,16),(84,16)$, $(85,16),(86,16),(87,16),(88,16),(89,16),(90,16),(114,16),(115,16),(116,16),(117,16)$, $(129,16),(130,16),(131,16),(132,16),(142,16),(146,16),(12,17),(14,17),(15,17)$, $(18,17),(19,17),(46,17),(47,17),(48,17),(49,17),(50,17),(51,17),(52,17),(53,17)$, $(54,17),(55,17),(56,17),(57,17),(58,17),(59,17),(60,17),(91,17),(92,17),(93,17)$, $(94,17),(95,17),(96,17),(97,17),(98,17),(99,17),(119,17),(120,17),(121,17),(122,17)$, $(134,17),(135,17),(136,17),(137,17),(145,17),(149,17),(4,19),(5,19),(12,19),(13,19)$, $(17,19),(18,19),(19,19),(21,19),(26,19),(27,19),(28,19),(46,19),(47,19),(48,19)$, $(49,19),(50,19),(51,19),(53,19),(54,19),(56,19),(57,19),(58,19),(59,19),(60,19)$, $(61,19),(64,19),(66,19),(67,19),(71,19),(75,19),(91,19),(94,19),(95,19),(98,19)$, $(99,19),(100,19),(106,19),(107,19),(108,19),(110,19),(112,19),(119,19),(120,19)$, $(121,19),(122,19),(123,19),(124,19),(125,19),(126,19),(127,19),(128,19),(134,19)$, $(135,19),(136,19),(137,19),(138,19),(145,19),(149,19),(4,20),(5,20),(12,20),(13,20)$, $(17,20),(18,20),(19,20),(21,20),(25,20),(26,20),(27,20),(28,20),(29,20),(46,20)$, $(47,20),(48,20),(49,20),(50,20),(51,20),(52,20),(53,20),(54,20),(55,20),(56,20)$, $(57,20),(58,20),(59,20),(60,20),(61,20),(64,20),(66,20),(67,20),(71,20),(75,20)$,
$(78,20),(79,20),(80,20),(81,20),(91,20),(92,20),(93,20),(94,20),(95,20),(96,20)$, $(97,20),(98,20),(99,20),(100,20),(106,20),(107,20),(108,20),(110,20),(111,20)$, $(112,20),(119,20),(120,20),(121,20),(122,20),(123,20),(124,20),(125,20),(126,20)$, $(127,20),(128,20),(134,20),(135,20),(136,20),(137,20),(138,20),(145,20),(149,20)$, $(4,25),(5,25),(12,25),(13,25),(17,25),(18,25),(19,25),(21,25),(26,25),(27,25),(28,25)$, $(46,25),(47,25),(48,25),(49,25),(50,25),(51,25),(53,25),(54,25),(56,25),(57,25)$, $(58,25),(59,25),(60,25),(61,25),(64,25),(66,25),(67,25),(71,25),(75,25),(91,25)$, $(94,25),(95,25),(98,25),(99,25),(100,25),(106,25),(107,25),(108,25),(110,25)$, $(112,25),(119,25),(120,25),(121,25),(122,25),(123,25),(124,25),(125,25),(126,25)$, $(127,25),(128,25),(134,25),(135,25),(136,25),(137,25),(138,25),(145,25),(149,25)$, $(12,26),(49,26),(50,26),(51,26),(52,26),(55,26),(58,26),(107,26),(110,26),(112,26)$, $(145,26),(149,26),(12,28),(49,28),(50,28),(51,28),(52,28),(55,28),(58,28),(107,28)$, $(145,28),(149,28),(23,30),(31,30),(32,30),(34,30),(37,30),(40,30),(42,30),(45,30)$, $(83,30),(84,30),(90,30),(23,32),(31,32),(32,32),(34,32),(37,32),(40,32),(42,32)$, $(45,32),(83,32),(84,32),(90,32),(20,35),(23,35),(27,35),(42,35),(57,35),(140,35)$, $(142,35),(145,35)(20,36),(23,36),(27,36),(42,36),(57,36),(20,37),(23,37),(27,37)$, $(42,37),(57,37),(20,38),(23,38),(27,38),(42,38),(57,38),(20,39),(23,39),(27,39)$, $(42,39),(57,39),(20,40),(23,40),(27,40),(42,40),(57,40),(20,41),(23,41),(27,41)$, $(42,41),(57,41)$, satisfy only equality $\left(L-C P^{\prime}\right)$.

Theorem 7 gives examples of pairs of implications and negations that are solutions to Problem 1.7.1 (ii).

## References

[1] Atanassov K., D. Dimitrov, On one of Baczyncki-Jayaram's problems. Cybernetics and Information Technologies, Vol. 9, 2009, No. 2, 14-20.
[2] Atanassov, K., D. Dimitrov, Extension of one of Baczyncki-Jayaram's problems. Comptes Rendus de l'Academie bulgare des Sciences, Vol. 62, 2009, No. 11, 1377-1386.
[3] Atanassov, K., E. Szmidt, J. Kacprzyk, On intuitionistic fuzzy pairs, Notes on Intuitionistic Fuzzy Sets, Vol. 19, 2013, No. 3, 1-13.
[4] Baczynski M., B. Jayaram, Fuzzy Implications, Berlin, Springer, 2008.
[5] Dimitrov, D., IFSTool - software for intuitionistic fuzzy sets. Issues in intuitionistic fuzzy sets and generalized nets, Vol. 9, 2011, 61-69.

