# Fuzzy sets and related topics

## Excersise 1. Answer to the question 4 of chapter 1 from the book Ross, 4th ed. 2017

The question asked us to find a membership function to terms “half-full”, “half-empty” and “full” while pointing to a glass of water.

**Answer:** The terms half-full or half-empy are ambiguous words. For example For the term “half-empty”:

* when our glass of water is full, we can assign zero value to half-empty meaning there is no have empty.
* Or if the glass is empty it’s possible to assign zero value to half-empy.

And for the term “half-full”:

* when our glass of water is full, we can assign zero value to “half-full”.
* Or if the glass is empty, again we can assign zero value to “half-full”.

With these assumptions above we can aswer the question “Does half-full and half-empty have identical membership function?” As below

Because both assumptions have same value assigned for an empty glass of water we can say that both have identical membership function. Below a triangular function is an example of membership function for these terms.

But for full we can assign another membership function such as S-type membership function.

And for conclusion it can be said that, the answer does not solve this ageless riddle.

## Excersise 2. Use a programming language to answer to the question 2 of the second chapter of Zimmermann, 4th ed, 2001 book.

**Answer:** The answer is in *main.ipynb* file or the exported form of it *main.pdf*

## Excersise 3. Which of the fuzzy sets in question 2 of the second chapter of Zimmermann, 4th ed, 2001 book, are Convex?

**Answer:** The answer is in *main.ipynb* file or the exported form of it *main.pdf*

## Excersise 4. Answer the question 2 of chapter 4 from the book Ross, 4th ed. 2017

**Answer:** The answer is in *main.ipynb* file or the exported form of it *main.pdf*

## Excersise 5. Answer Question 4 of the second chapter of Zimmermann, 4th ed, 2001 book

**Answer:** The answer is in *main.ipynb* file or the exported form of it *main.pdf*

# Fuzzy Operations

## Excersise 6. Answer to the question 8, chapter 2 from the book Ross, 4th ed. 2017

**Answer:** The answer is in *main.ipynb* file or the exported form of it *main.pdf*

## Excersise 7. Answer to the question 5, chapter 2 from the book Ross, 4th ed. 2017

**Answer:** To answer this question we must first analyse the chances of not having rainfall for each cities, then to evaluate the best week between cities, we would like to find the most value for the chance of not having rainfall.

So first we find the highest value of not having rain in each city.

then the set with maximum membership value is

then the set with maximum membership value is

then the set with maximum membership value is

And then we need to choose the highest between the highest membership values between cities. It’s obvious that both and have the highest values. So to hold the event we can either choose week4 in or week2 in .

# Fuzzy Numbers

## Excersise 8. Find the Answer to question 3, chapter five of Zimmermann, 4th ed, 2001 book

**Answer:**

**(a)** forthis part, it’s obvious that is similar to a LR type fuzzy number. First the parameters can be . And we can write the L and R functions as

And to prove that these L-R functions would produce the Left and right functions represented for , we can write them down.

Until here we defind the L and R functions but we didn’t actually prove that these functions are descending, symmetric and have the initial values as one. In order to prove these conditions we write the equations below

* **Initial Value is one**

Both conditions are correct, meaning the functions have initial value one. **✔**

* **Symetric**

Both Conditions are correct, meaning the functions are symmetric. **✔**

* **Descending for positive values**

So with the charts plotted, we can see that L and R functions are Descending for positive values. **✔**

And the answer to part (a) is correct!

**(b)** To answer this part we first plot the

Here to finding the LR functions and testing its conditions are not an easy task, so we will go through another way. Here we would like to test the conditions of a fuzzy number not conditions of LR functions. The condtions for a fuzzy number are to be convex and to be piecewise linear.

* **Convex**

It’s obvious from the plotted membership function that the membership function is convex on a sample data. **✔**

* **Have Unique Core**

As we can see from the equation in the question and also in the plotted membership function, the core have unique values. **✔**

So here we can conclude that is a set of fuzzy numbers.

**(c)** Here to check wether is a set of fuzzy numbers or not, we would go through the way we used in (b). We plot the set as below

It can be seen from this function that is convex and piecewise linear and So it’s fuzzy numbers set. Of course we could conclude this without plotting it but for better view we plotted it.

## Excersise 9. Find the Answer to question 4, chapter five of Zimmermann, 4th ed, 2001 book

**Answer:** To answer this question we must apply three conditions to each item to prove that they can be a reference function or not. Conditions are have initial value one, be a descending function in positive domain and be symmetric.

**(a)**

Checking the conditions:

* Initial value is one,

This condition is satisfied. **✔**

* Be a descending function in positive domain

So this condition is not satisfied and we cannot use as a reference function. **××**

**(b)**

Checking the conditions:

* Initial value is one,

So this condition is satisfied.

* Be a descending function in positive domain

This condition is satisfied too.

* Be a symmetric function

The last condition is satisfied and function in part (b) can be a reference function.

**(c)**

Applying the conditions would produce

* Have initial value one

This condition is satisfied. **✔**

* Be descending function for positive values

For this condition because we just have values from zero to half in positive values, we just evaluate this interval

And because of the negative sign we could conclude that this condition is satisfied too. **✔**

* Be a symmetric function

An example here shows that this function is not symmetric.

So here this function in part (c) cannot be a reference function. **××**

**(d)**

Checking the conditions:

* Have initial value one

This condition is satisfied. **✔**

* Be descending function for positive values

So this condition is satisfied too, because of the division. **✔**

* Be a symmetric function

This condition is satisfied because of absolute function surrounding . So the function in (d) can be a reference function. **✔**