Project resource allocation in conditions of ambiguity

Martin Pelikán, Hana Štiková, Ivan Vrana
PEF ČZU Praha

Motivation

- Each project consists from a number of activities
- Project activities require certain resources, e.g. labour, equipment, rooms, etc.
- Reliable resource management can bring strategic competitive advantage
- Uncertainty and ambiguity accompany each project
- It is often impossible to use statistical methods to solve ambiguity
- Application of the fuzzy set theory.

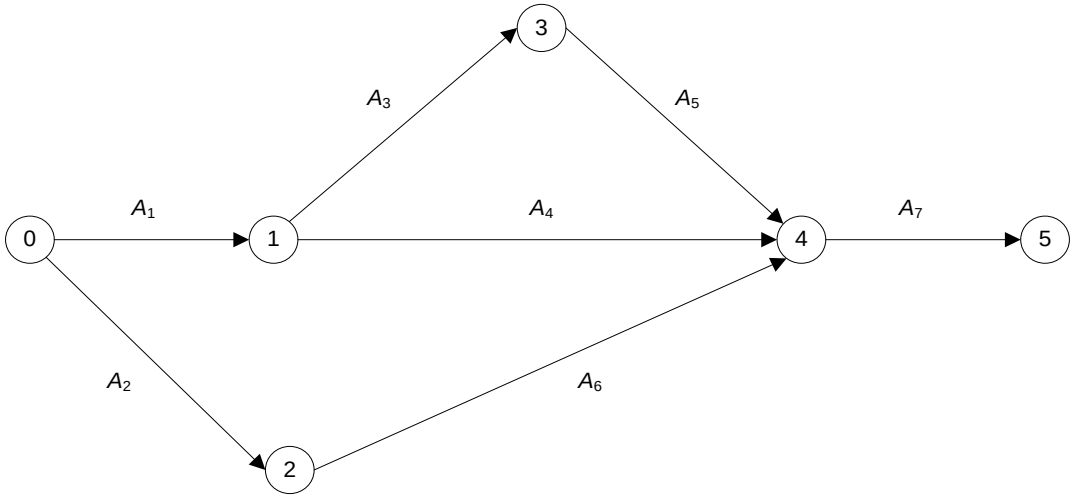
Project duration and timing

- Analysis begins by decomposing project into specific activities
- Activity may depend on other activities (e.g. should wait until finishing a preceding activity)
- The project duration is a sum of activities duration on the critical path
- The beginning time, ending time and duration of activity are generally real numbers
- We can substitute them by fuzzy quantities.

Resource planning

- Each activity can need several resources (e.g. equipment or labour)
- Each resource can be engaged in several activities
- Activities should share resources
- It is important to analyse workload of resources
- In case of no ambiguity, we can avoid overlapping of resources
- If timing is ambiguous, overlapping can occur
- We aim to minimize the risk of resource overloading.

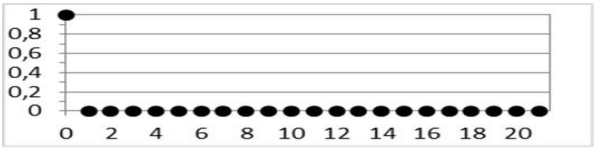
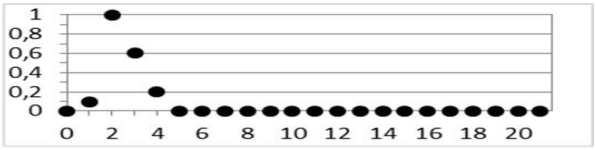
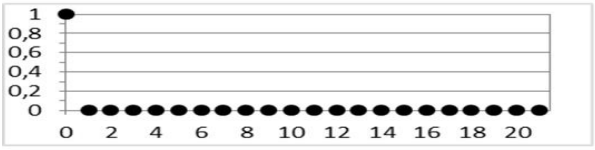
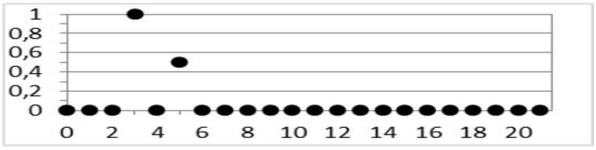
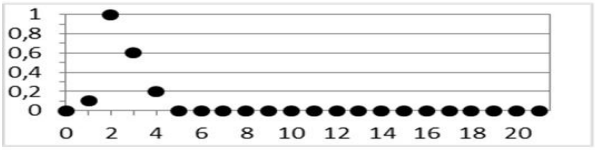
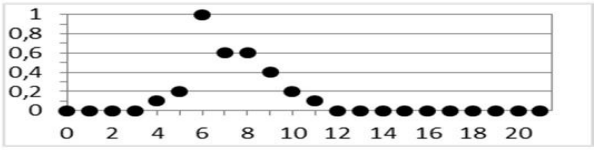
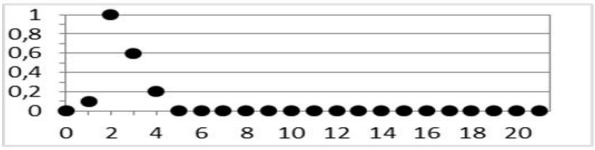
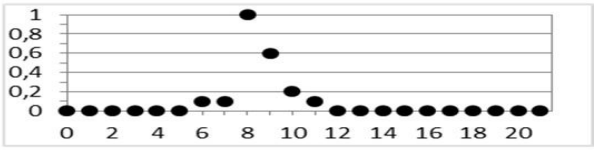
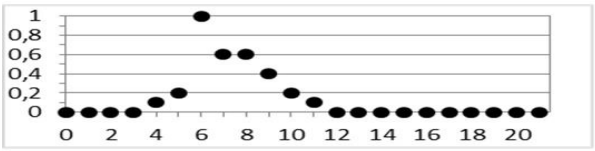
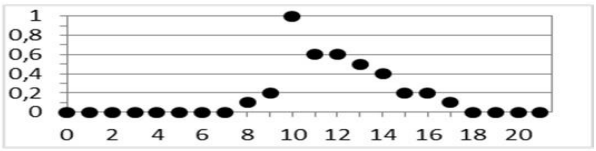
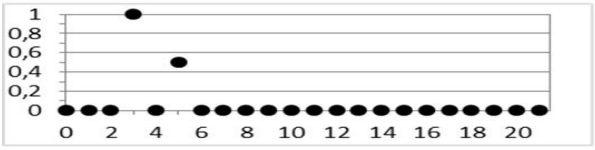
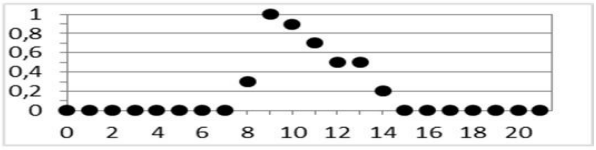
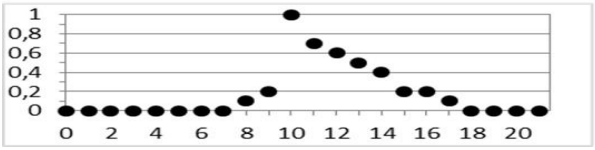
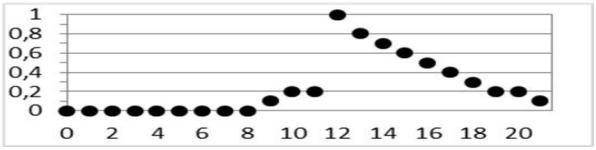
Example project



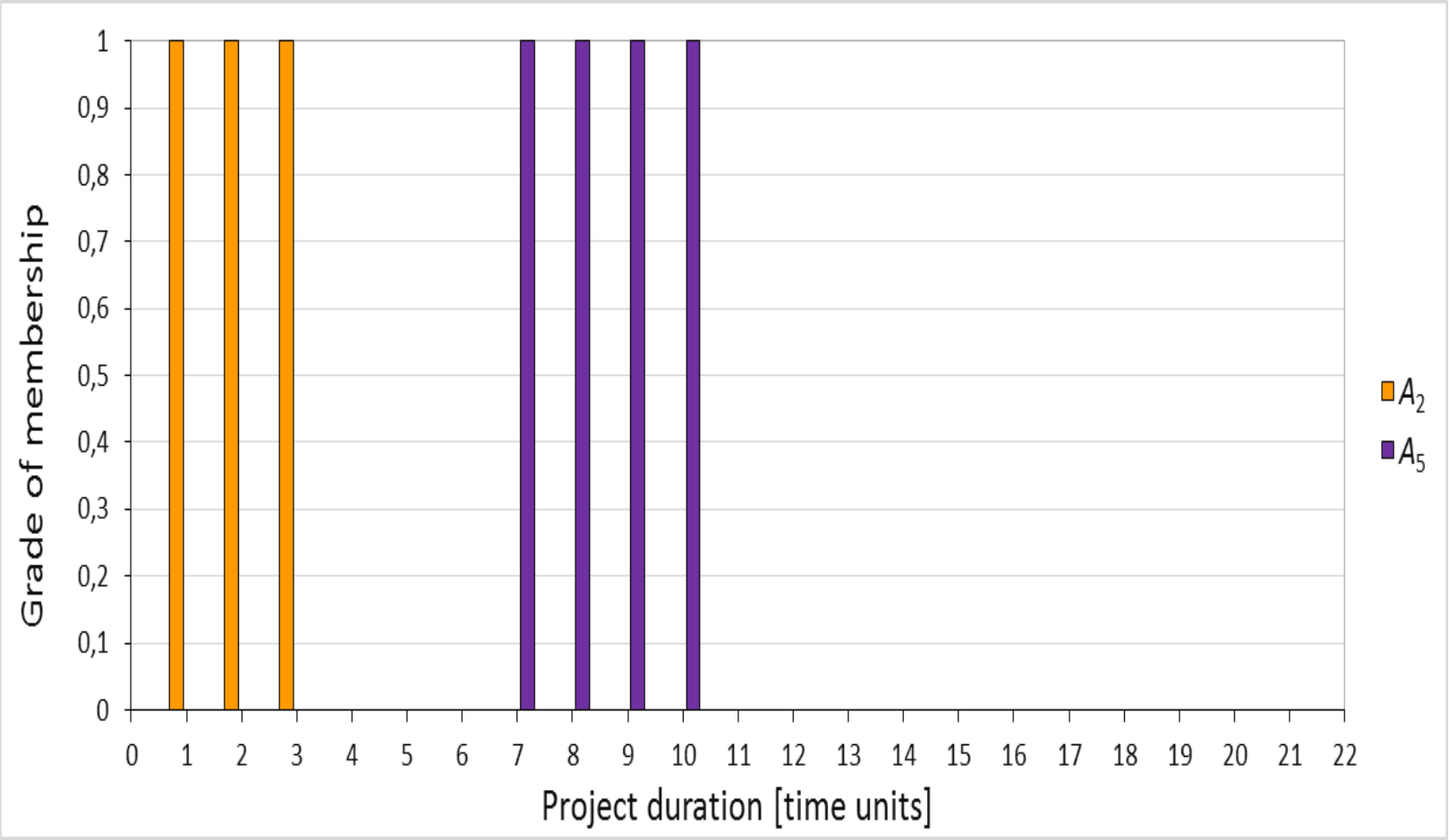
- We allocate resources to each activity

A1	A2	A3	A4	A5	A6	A7
S3	S1	S3	S2	S1	S3	S2

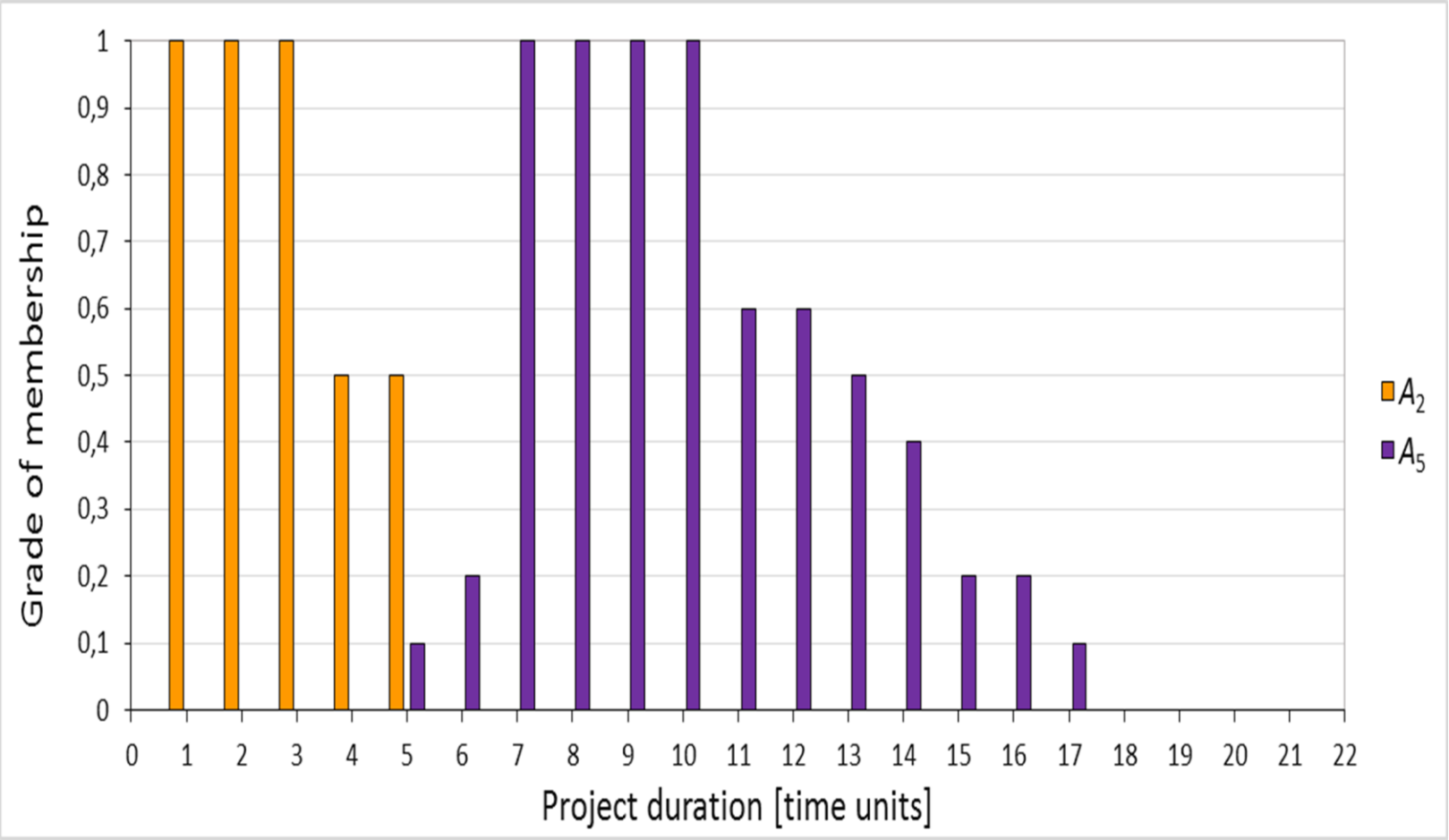
- In case of ambiguity, we assign membership function for duration of each activity.

	beginning	ending	
A1			S3
A2			S1
A3			S3
A4			S2
A5			S1
A6			S3
A7			S2

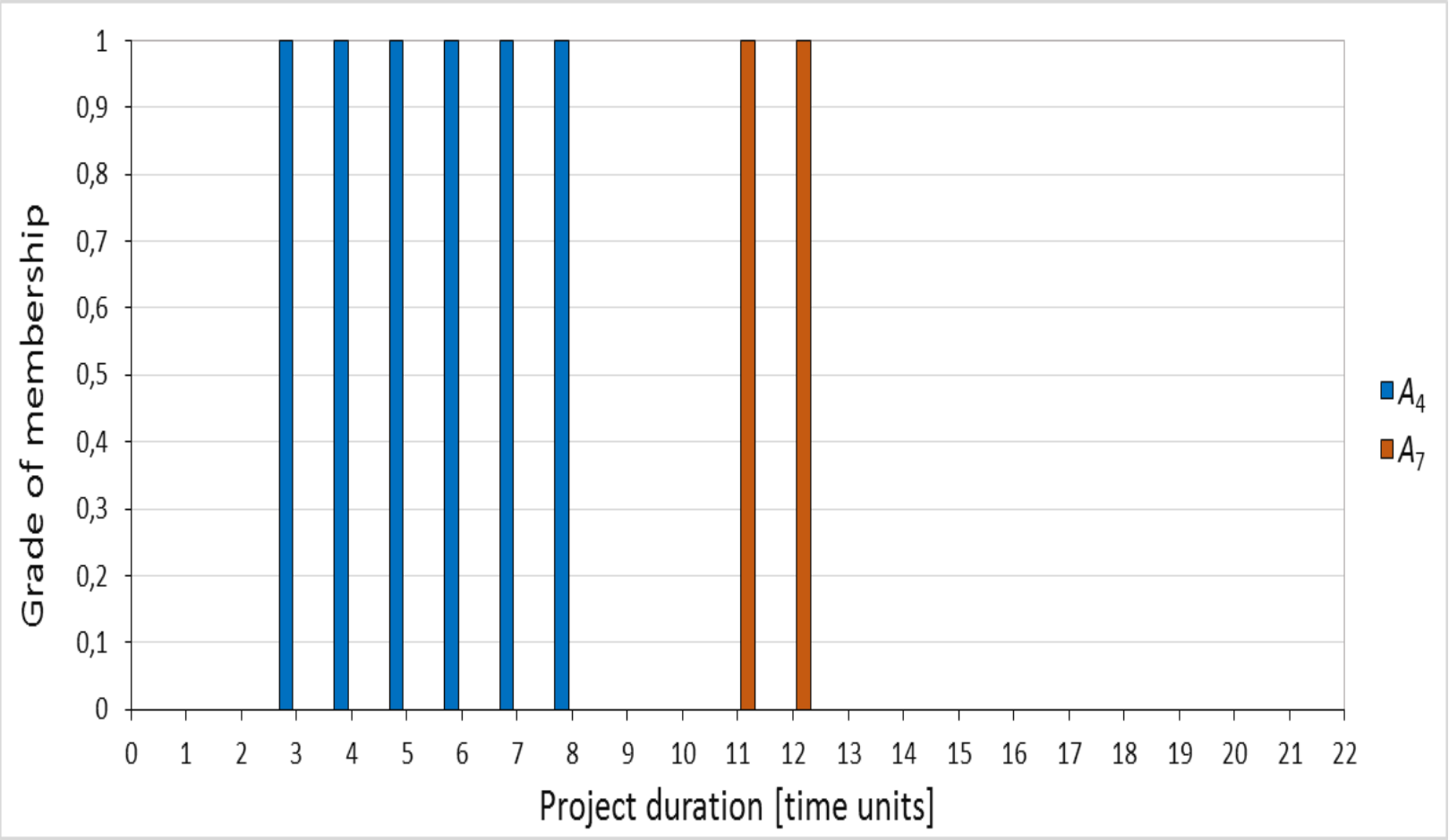
Membership function of the project workload of the resource S_1



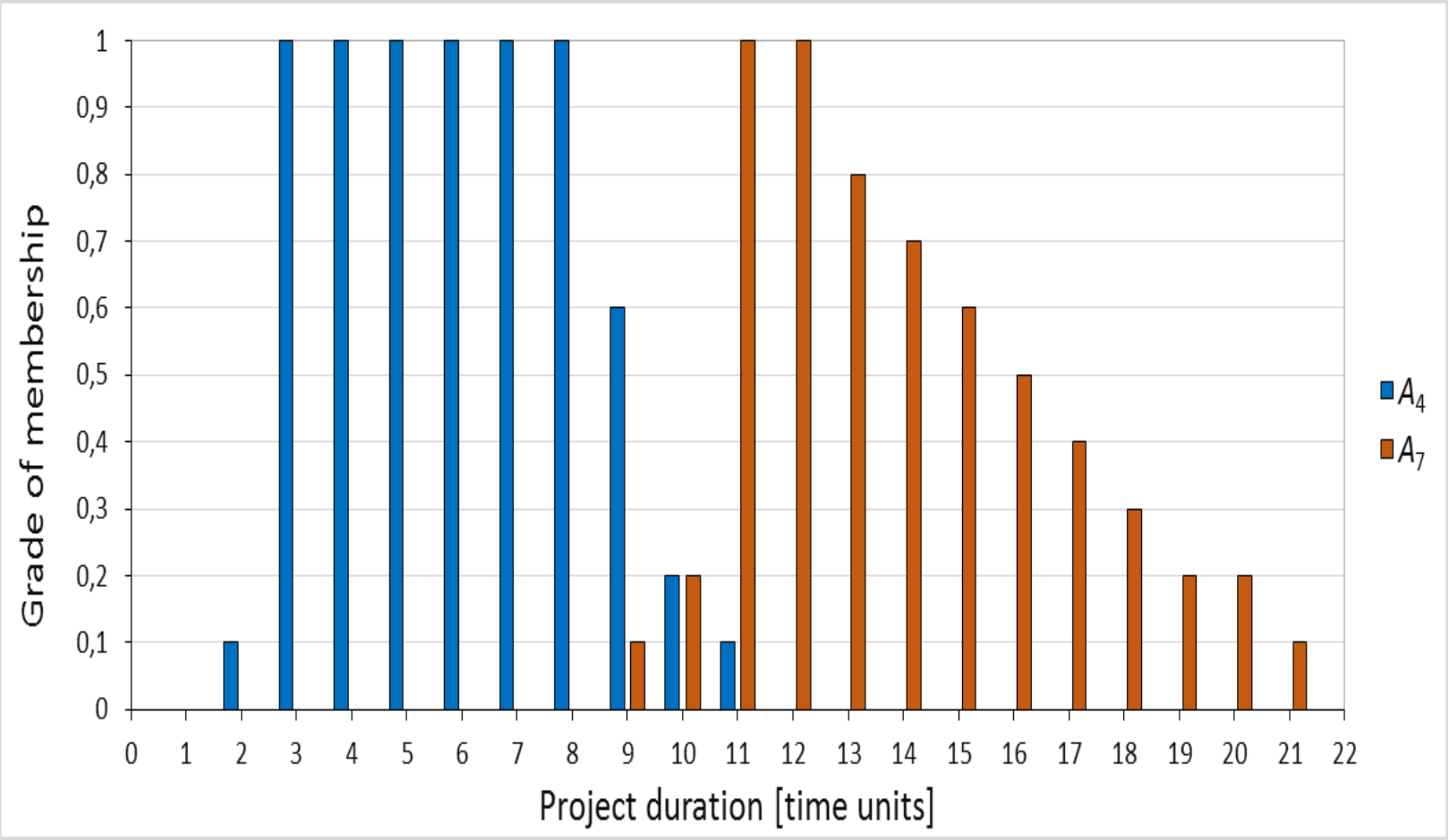
Membership function of the project workload of the resource S_1



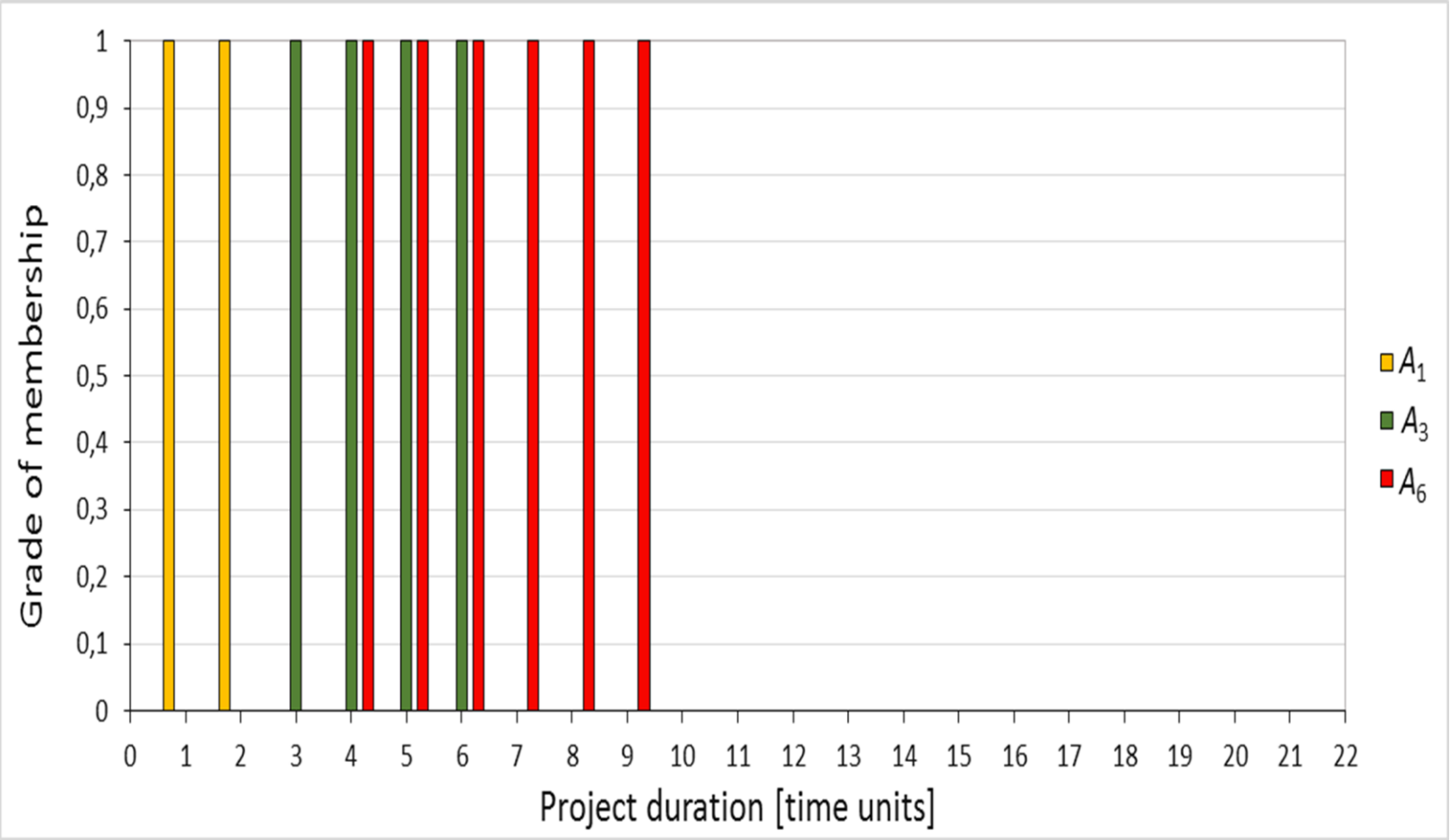
Membership function of the project workload of the resource S_2



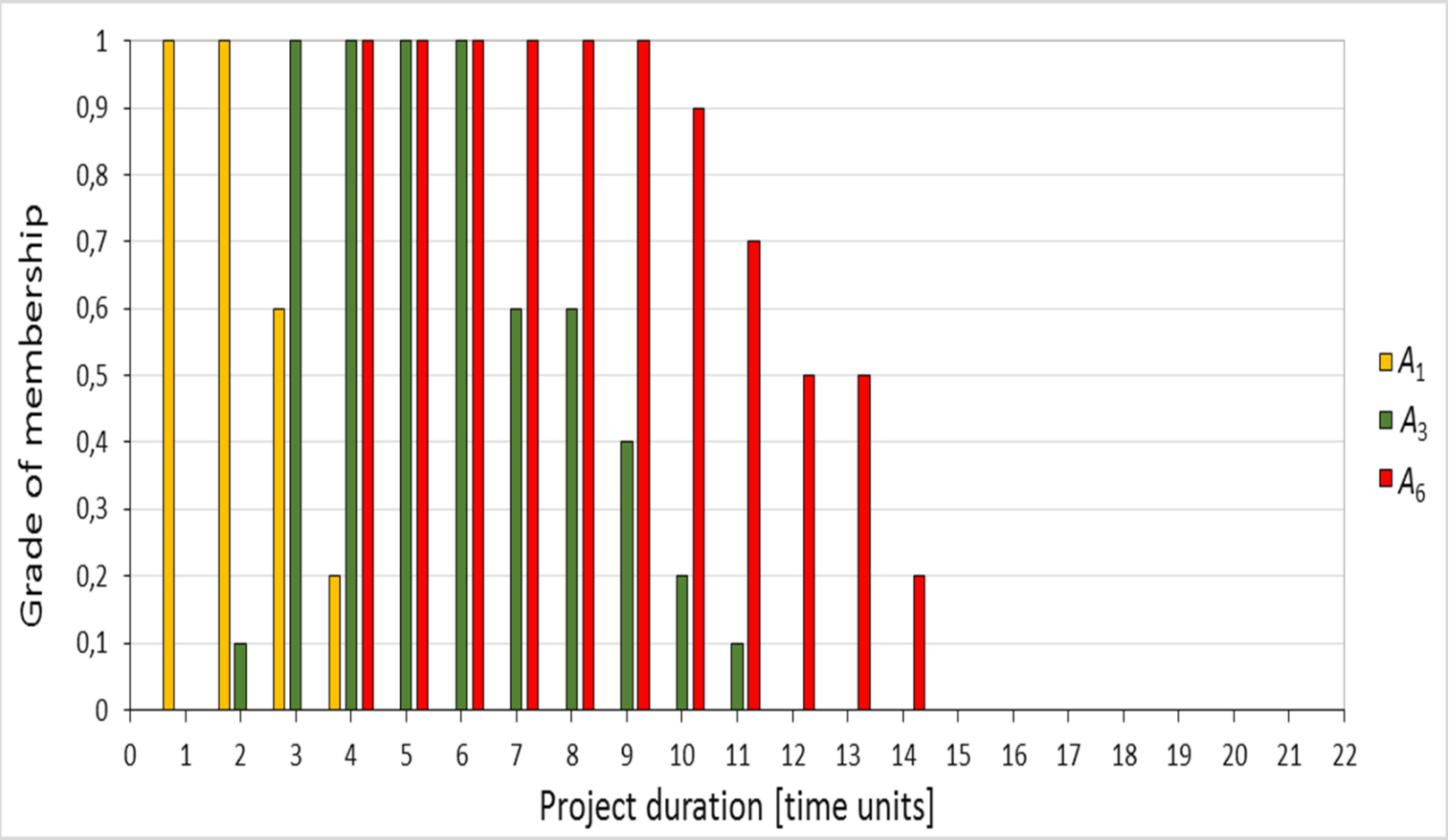
Membership function of the project workload of the resource S_2



Membership function of the project workload of the resource S_3



Membership function of the project workload of the resource S_3



Discussion

- In the deterministic approach, the overlap of activities can be invisible
- The fuzzy set approach can give a more realistic insight into project arrangement
- Fuzzy methods can detect potential problems of resource allocation
- Performance of the fuzzy approach is never poorer than in the deterministic approach
- The method was published in IEEE TFS (IF=6,7)
- We prepare a user-friendly SW for this method.