Fitting

To have this assignment evaluated for the in-class exam, please upload on WeBeep a ZIP file including:

- the source code used to solve this assignment
- this file, with the table below properly filled

Name (Family + given)		Giovanni Demasi
Student ID (codice persona)		10656704
QR-code ID (8 digits of the QR that was given you)		71847928
`Traces.csv, column A`	1^{st} Moment of the trace	4,9630
	2^{nd} Moment of the trace	48,6574
	3^{rd} Moment of the trace	719,0993
	Uniform Left bound *a* [Method of moments]	-3,5268
	Uniform Right bound *b* [Method of moments]	13,4529
	Exponential rate λ [Method of moments]	0,2015
	λ_1 HyperExponential [Method of moments]	0,1732
	λ_2 HyperExponential [Method of moments]	0,1932
	p_1 HyperExponential [Method of moments]	-0,3583
	λ_1 HypoExponential [Method of moments]	16,1851
	λ_2 HypoExponential [Method of moments]	0,2040
	Exponential rate λ [Maximum likelihood]	0,2015
	λ_1 HyperExponential [Maximum likelihood]	0,2015
	λ_2 HyperExponential [Maximum likelihood]	0,2015
	p_1 HyperExponential [Maximum likelihood]	0,3495
	λ_1 HypoExponential [Maximum likelihood]	1230,7447
	λ_2 HypoExponential [Maximum likelihood]	0,2015
	Figure for the [Method of moments]	

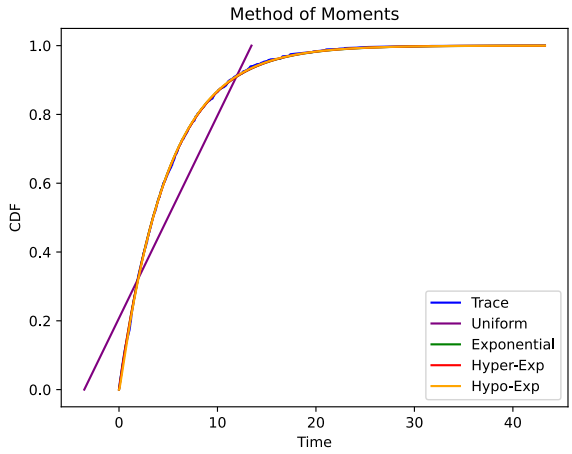
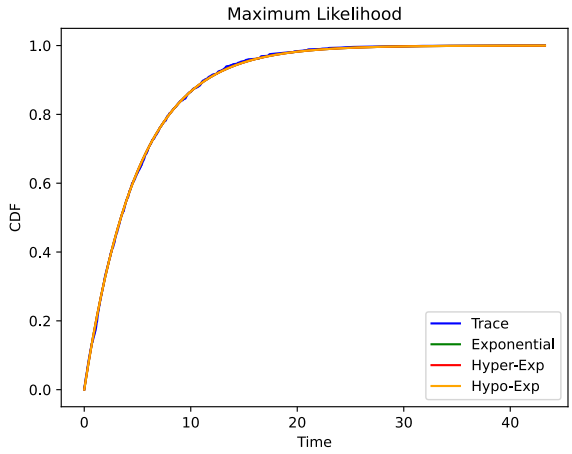
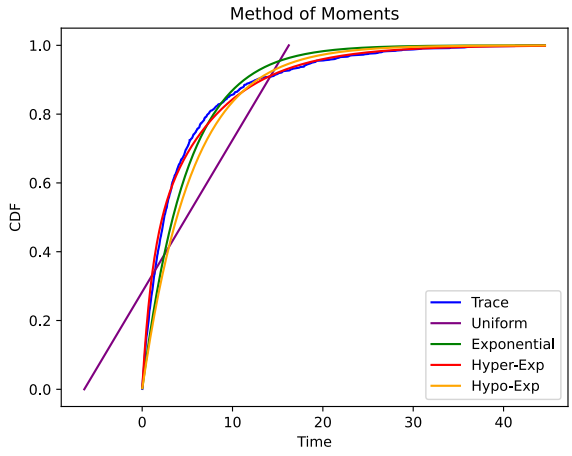
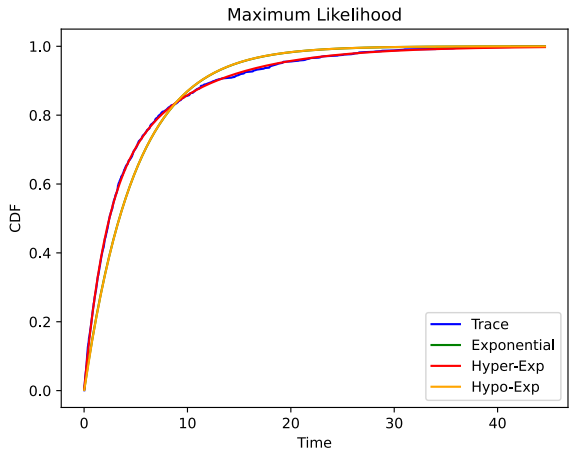


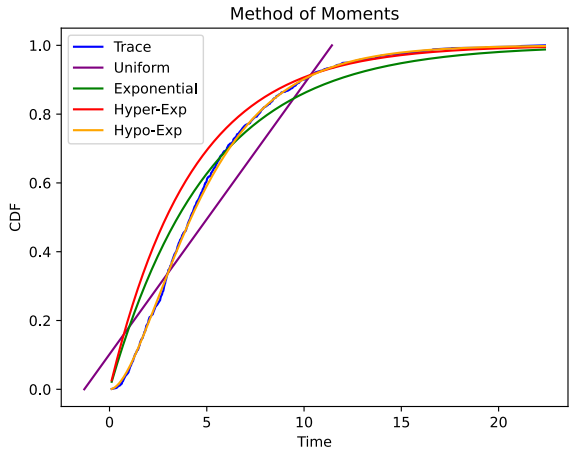
	Figure for the [Maximum likelihood] 

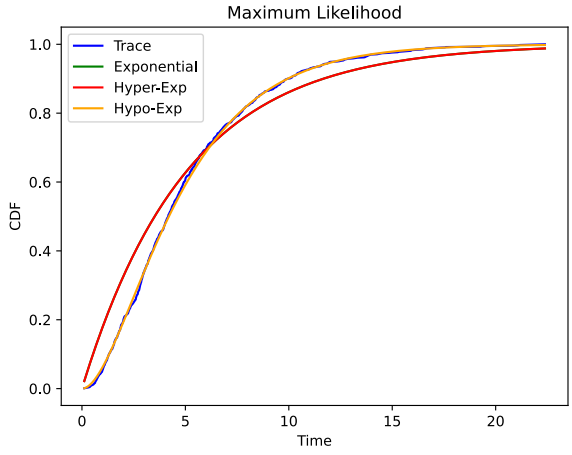
Traces.csv, column B		
	1st Moment of the trace	4,9112
	2nd Moment of the trace	66,8283
	3rd Moment of the trace	1452,3913
	Uniform Left bound *a* [Method of moments]	-6,4081
	Uniform Right bound *b* [Method of moments]	16,2305
	Exponential rate λ [Method of moments]	0,2036
	λ_1 HyperExponential [Method of moments]	0,1365
	λ_2 HyperExponential [Method of moments]	0,9416
	p_1 HyperExponential [Method of moments]	0,6145
	λ_1 HypoExponential [Method of moments]	17416,9605
	λ_2 HypoExponential [Method of moments]	0,1805
	Exponential rate λ [Maximum likelihood]	0,2036
	λ_1 HyperExponential [Maximum likelihood]	0,1179
	λ_2 HyperExponential [Maximum likelihood]	0,4971
	p_1 HyperExponential [Maximum likelihood]	0,4479
	λ_1 HypoExponential [Maximum likelihood]	86,9042
	λ_2 HypoExponential [Maximum likelihood]	0,2041
	Figure for the [Method of moments]	
	Figure for the [Maximum likelihood]	





Traces.csv, column C		
	1st Moment of the trace	5,0681
	2nd Moment of the trace	39,1922
	3rd Moment of the trace	408,2968
	Uniform Left bound *a* [Method of moments]	-1,2974
	Uniform Right bound *b* [Method of moments]	11,4336
	Exponential rate λ [Method of moments]	0,1973
	λ_1 HyperExponential [Method of moments]	0,2296
	λ_2 HyperExponential [Method of moments]	0,2367
	p_1 HyperExponential [Method of moments]	-0,1214
	λ_1 HypoExponential [Method of moments]	0,5107
	λ_2 HypoExponential [Method of moments]	0,3215
	Exponential rate λ [Maximum likelihood]	0,1973
	λ_1 HyperExponential [Maximum likelihood]	0,1973
	λ_2 HyperExponential [Maximum likelihood]	0,1973
	p_1 HyperExponential [Maximum likelihood]	0,4021
	λ_1 HypoExponential [Maximum likelihood]	0,5161
	λ_2 HypoExponential [Maximum likelihood]	0,3194
	Figure for the [Method of moments]	
	Figure for the [Maximum likelihood]	





Clarifications about hyper-exp and hypo-exp multiple solution

The assignment has been solved using Python. As it can be seen by the script file, there is a section which reports some methods (*3*) for completeness purposes, which have been used to verify some solutions.

In particular: there are two methods - *hyperExponentialMM2* and *hypoExponentialMM2* - which estimate the hyper exponential and hypo exponential parameters using *Sympy* package.
This package aims to find the most correct mathematical solution of the non-linear system, in fact all the solution coincides with the ones of the method *hypoMM* which implements the analytical formulas for the parameters estimation of the hypo exponential. Anyway, these formulas return significant solution only when $cv < 1$.

The differences with the proposed solution affect only the cases in which the fitting shouldn't be possible, so when the coefficient of variation is greater than one for the hypo exponential and less than one for the hyper exponential.

In conclusion, for coherence reasons, it has been decided to use the *Scipy* package with *fsolve* function, because it returns solution more like the function of MATLAB presented during the course and allows to plot more significant distribution.