Task 5: Gamma distribution

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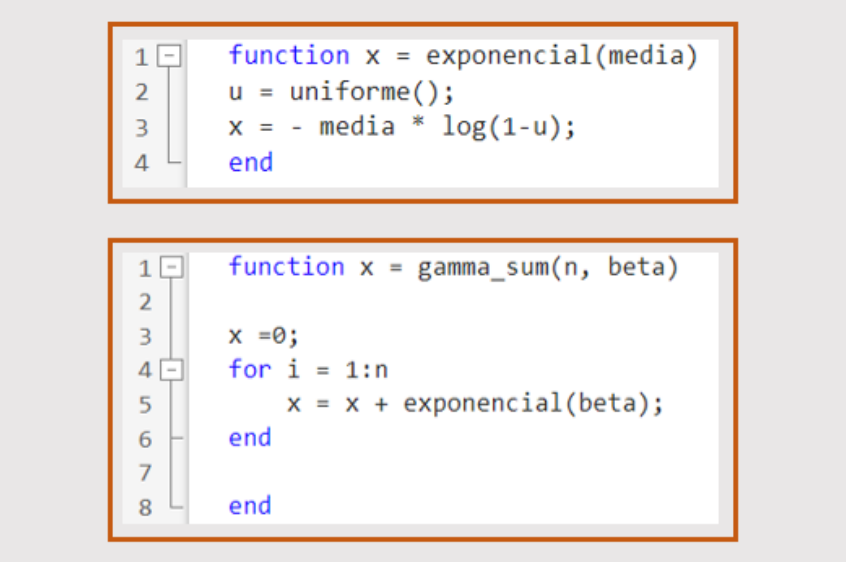
The objective of this practice is to obtain the gamma distribution as the sum of simpler distributions directly derived from the uniform one. In particular, the gamma distribution can be computed as the sum of n exponential distributions. The gamma distribution is characterized by two parameters: a shape parameter k and a scale parameter θ.

1 Function

In order to implement it in MATLAB a simple function has been written. The function features two parameters, n and beta (i.e. k and θ), and it is composed by a for loop that performs the sum of exponential distributions n times. The exponential distributions are obtained by calling the exponential function in the loop, see below Figure [1] (u is the uniform distribution).



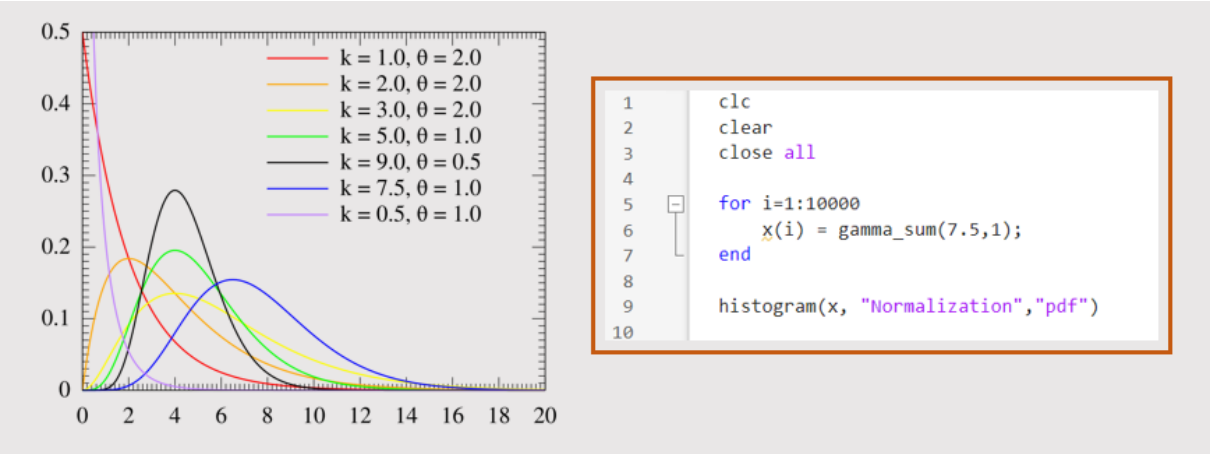
```
function x = exponencial(media)
u = uniforme();
x = - media * log(1-u);
end
```

```
function x = gamma_sum(n, beta)

x =0;
for i = 1:n
    x = x + exponencial(beta);
end

end
```

Figure 1: MATLAB script - gamma distribution summing exponential distributions.

2 Tests

To check if the function works correctly some simulations have been performed and the results have been compared with the literature (Wikipedia).




```
clc
clear
close all

for i=1:10000
    x(i) = gamma_sum(7.5,1);
end

histogram(x, "Normalization","pdf")
```

Figure 2: Left: Gamma distributions with different values of k and θ, source: Wikipedia. Right: MATLAB script used to plot results.

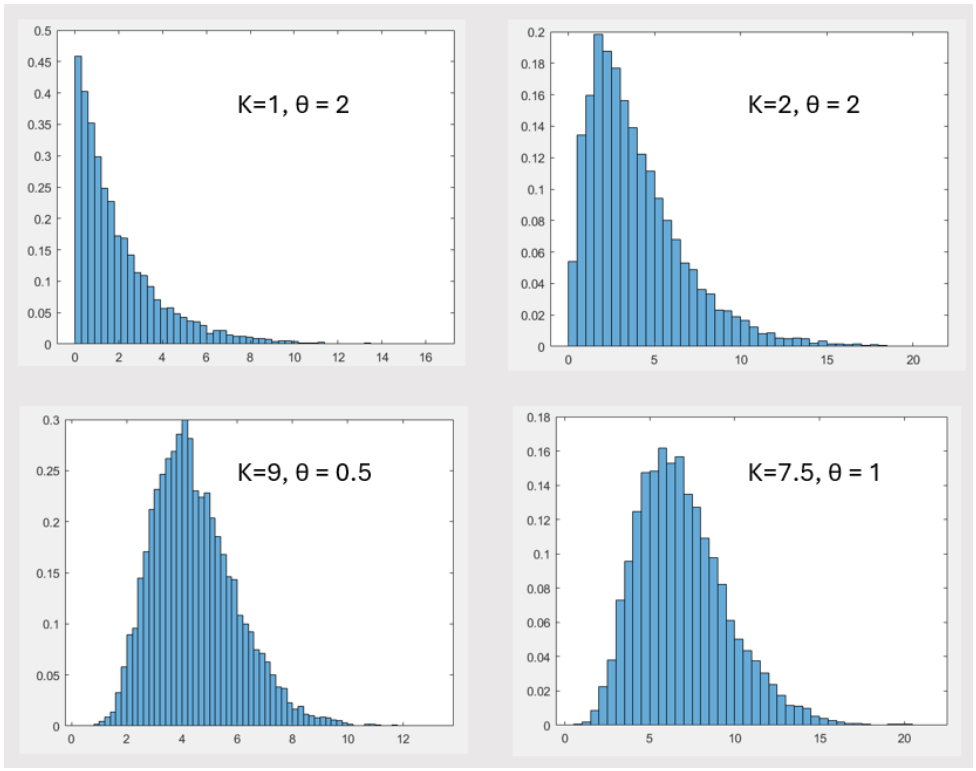


Figure 3: Results for different values of k and θ. Histograms have been normalized to be compared with the image above [2].