

# Simulation exercise

## 1. Show where the distribution is centered at and compare it to the theoretical center of the distribution

The following code simulates the distribution of averages of 40 exponential(0.2)s. This distribution is called mexp.

```
set.seed(200)
lambda <- 2
mexp <- NULL
for (i in 1 : 1000) (mexp = c(mexp, mean(rexp(40,lambda))))
```

The following code computes the theoretical center of the distribution.

```
1/lambda
```

```
## [1] 0.5
```

The following code computes the center of the simulated distribution of averages of 40 exponential(0.2)s.

```
espsim <- mean(mexp)
espsim
```

```
## [1] 0.4984
```

The distribution center is very close to its theoretical value.

## 2. Show how variable it is and compare it to the theoretical variance of the distribution.

The following code computes the theoretical variance of the distribution.

```
varsim <- (1/lambda)^2/40
varsim
```

```
## [1] 0.00625
```

The following code computes the variance of the simulated distribution of averages of 40 exponential(0.2)s.

```
var(mexp)
```

```
## [1] 0.006581
```

The variance of the distribution is very close to its theoretical value.

### 3. Show that the distribution is approximately normal.

The 40 exponential(0.2)s. are iid variables.

The Central Limit Theorem states that the distribution of averages of iid variables becomes that of a standard normal as the sample size increases.

So we can say that mexp is approximately a normal density with an expectancy of epsim and a variance of varsim.

The following codes will illustrate this by a plot.

This codes simulate the normal density with an expectancy of epsim and a variance of varsim.

```
norm <- rnorm(1000, mean = epsim, sd = sqrt(varsim))
```

The following codes shows with a plot the similarity between the distribution of the mean of 40 exponential(0.2)s (mexp) and the distribution of the normal density with an expectancy of epsim and a variance of varsim(norm).

```
par(mfrow = c(1,2))
hist(mexp, breaks = 24,xlab = "",ylab = "", prob=TRUE,main = "40 Exponential(0,2)s")
lines(density(mexp),col = "red")
lines(density(norm), col = "blue")
legend("topright", legend = c("density of mexp","density of norm"), col = c("red","blue"), lwd = 1)
hist(norm,breaks = 24,xlab = "",ylab = "", prob=TRUE,main = "Norm(epsim,varsim)")
lines(density(mexp),col = "red")
lines(density(norm), col = "blue")
legend("topright", legend = c("density of mexp","density of norm"), col = c("red","blue"), lwd = 1)
```

