

QCM 27 sept 2020

Dans cet exercice il vous est demandé de donner la ou les bonnes réponses.

Question 1 We run an experiment where we measure how much time n different customers spend on a specific page of a website. Our observation $x_1, \dots, x_n$ are stored in a vector $\mathbf{x}$. We assume that the underlying statistical model is a gamma distribution with parameter (α, β) . Which one among the following command lines does return the empirical cumulative distribution function at a given point $\mathbf{t}$?

- ☐ `sum(x <= t)`
- ☐ `mean(x)`
- ☐ `pgamma(x)`
- ☒ `mean(x <= t)`
- ☐ `pgamma(t)`

Question 2 Consider X a random variable distributed according to the exponential distribution with parameter $\lambda = 0.5$. Which one among the following command lines does return the survival function $S(t) = \mathbb{P}[X > t]$ at point $t = 2$?

- ☐ `pexp(2, 2, lower.tail = FALSE)`
- ☐ `1 - pexp(2, 2)`
- ☐ `1 - dexp(2, 0.5)`
- ☐ `1 - qexp(2, 0.5)`
- ☒ `pexp(2, 0.5, lower.tail = FALSE)`

Question 3 Consider X a random variable distributed according to the exponential distribution with parameter $\lambda = 2$. Which one among the following command lines does return the survival function $S(t) = \mathbb{P}[X > t]$ at point $t = 0.5$?

- ☐ `1 - dexp(0.5, 2)`
- ☒ `1 - pexp(0.5, 2)`
- ☐ `pexp(0.5, 0.5, lower.tail = FALSE)`
- ☐ `1 - qexp(0.5, 2)`
- ☐ `1 - pexp(0.5, 0.5)`

Question 4 Let $\mathbf{x}$ be the realisation of an iid sample from a unknown continuous distribution. To check its closeness to the standard Normal distribution I *cannot*

- ☐ check that the points of `qqnorm(x)` are aligned on the identity line
- ☐ compare the result of `hist(x)` with the curve from `curve(dnorm, -10, 10)`
- ☒ compare the result of `barplot(table(x))` with the curve from `curve(dnorm, -10, 10)`

Question 5 Consider X a random variable distributed according to the exponential distribution with parameter $\lambda = 2$. Which one among the following command lines does return the survival function $S(t) = \mathbb{P}[X > t]$ at point $t = 0.5$?

- ☐ `pexp(0.5, 2, lower.tail = TRUE)`
- ☒ `1 - pexp(0.5, 2)`
- ☐ `1 - qexp(0.5, 0.5)`
- ☐ `1 - pexp(2, 0.5)`
- ☐ `1 - pexp(0.5, 0.5)`

Question 6 We run an experiment where we measure how much time n different customers spend on a specific page of a website. Our observations $x_1, \dots, x_n$ are stored in a vector $\mathbf{x}$. We assume that the underlying statistical model is a Gamma distribution with parameter (α, β) . Which one among the following command lines does return the first quartile of the Gamma model with parameter $(1, 2)$?

- ☐ `pgamma(0.25, 1, 2)`
- ☐ `rgamma(0.25, 1, 2)`
- ☒ `qgamma(0.25, 1, 2)`
- ☐ `quantile(0.25, 1, 2)`
- ☐ `quantile(x, 0.25, 1, 2)`

Question 7 Based on an iid sample $\mathbf{x}$, I plot `qqnorm(x)` : the points are mostly aligned on a straight line with equation $y = 2x + 1$. This brings support to the statement that

- ☐ $\mathbf{x}$ comes from a standard Normal distribution
- ☒ $\mathbf{x}$ comes from a non-standard Normal distribution
- ☐ $\mathbf{x}$ does not come from a Normal distribution

Question 8 Consider X a random variable distributed according to the gaussian distribution $\mathcal{N}(0, 4)$. Which one among the following command lines does return the density at point $t = 0.5$?

- ☐ `dnorm(0.5, 0, 4)`
- ☒ `dnorm(0.5, 0, 2)`
- ☐ `qnorm(0.5, 0, 4)`
- ☐ `pnorm(0.5, 0, 4)`
- ☐ `pnorm(0.5, 0, 2)`

Question 9 Which one among the following command lines does return a sample of size 10 according to the Uniform distribution on $[0, 1]$?

- ☐ `punif(10, 0, 1)`
- ☐ `qunif(10, 0, 1)`
- ☐ `dunif(10, 0, 1)`
- ☐ `dunif(0, 1, 10)`
- ☒ `runif(10, 0, 1)`

Question 10 An urn contains 10 balls numbered from 0 to 9. Which one among the following command lines is used to draw at random 4 balls without replacement, balls $\{0, 1, 2, 3\}$ being twice as likely to be drawn?

- ☐ `sample(0:9, 4, TRUE, c(rep(1/14, 4), rep(1/7, 7)))`
- ☐ `sample(0:9, 4, FALSE, c(rep(1/15, 5), rep(1/30, 5)))`
- ☒ `sample(0:9, 4, FALSE, c(rep(1/7, 4), rep(1/14, 7)))`
- ☐ `runif(4, 0, 9, c(rep(1/7, 4), rep(1/14, 7)))`
- ☐ `sample(0:9, 4)`

Question 11 An urn contains 10 balls numbered from 0 to 9. Which one among the following command lines is used to draw at random 4 balls with replacement, each ball having the same probability of being drawn?

- ☐ `random(0:9, 4)`
- ☐ `sample(0:9, 4, prob = rep(1/10, 10))`
- ☒ `sample(0:9, 4, TRUE)`
- ☐ `runif(4, 0, 9)`
- ☐ `sample(0:9, 4, FALSE)`

Question 12 Towards checking the a.s. convergence of the estimator $\hat{q} = (\sum_i \exp\{X_i\})^{1/2}$, based on a vector $\mathbf{x}$ of i.i.d. observations, which of the following command lines should I use?

- ☒ `cumsum(exp(x))**.5`
- ☐ `(exp(cumsum(x))**.5`
- ☐ `cumsum((exp(x))**.5)`

Question 13 We run an experiment where we measure how much time n different customers spend on a specific page of a website. Our observation $x_1, \dots, x_n$ are stored in a vector $\mathbf{x}$. We assume that the underlying statistical model is a gamma distribution with parameter (α, β) . Which one among the following command lines does return the quartiles of the sample?

- ☒ `quantile(x, probs = seq(0, 1, 0.25))`
- ☐ `quantile(x, 1, 2, probs = seq(0, 1, 0.25))`
- ☐ `pgamma(seq(0, 1, 0.25), 1, 2)`
- ☐ `qgamma(seq(0, 1, 0.25), 1, 2)`
- ☐ `qgamma(0.25, 1, 2)`

Question 14 An urn contains 10 balls numbered from 0 to 9. Which one among the following command lines is used to draw at random 4 balls without replacement, balls $\{0, 1, 2, 3\}$ being twice as likely to be drawn?

- ☐ `runif(4, 0, 9, c(rep(1/7, 4), rep(1/14, 7)))`
- ☐ `sample(0:9, 4)`
- ☐ `sample(0:9, 4, FALSE, c(rep(1/15, 5), rep(1/30, 5)))`
- ☒ `sample(0:9, 4, FALSE, c(rep(1/7, 4), rep(1/14, 7)))`
- ☐ `sample(0:9, 4, TRUE, c(rep(1/14, 4), rep(1/7, 7)))`

Question 15 Which one among the following command lines does return a sample of size 10 according to the Uniform distribution on $[0, 1]$?

- ☐ `qunif(10, 0, 1)`
- ☐ `dunif(0, 1, 10)`
- ☒ `runif(10, 0, 1)`
- ☐ `punif(10, 0, 1)`
- ☐ `dunif(10, 0, 1)`

Question 16 Towards checking the a.s. convergence of the estimator $\hat{q} = (\sum_i \exp\{X_i\})^{1/2}$, based on a vector `x` of i.i.d. observations, which of the following command lines should I use ?

- ☐ `(exp(cumsum(x)))**.5`
- ☒ `cumsum(exp(x))**.5`
- ☐ `cumsum((exp(x))**.5)`

Question 17 An urn contains 10 balls numbered from 0 to 9. Which one among the following command lines is used to draw at random 4 balls with replacement, each ball having the same probability of being drawn ?

- ☐ `runif(4, 0, 9)`
- ☒ `sample(0:9, 4, TRUE)`
- ☐ `sample(0:9, 4, FALSE)`
- ☐ `sample(0:9, 4, prob = rep(1/10, 10))`
- ☐ `random(0:9, 4)`

Question 18 Let `x` be the realisation of an iid sample from a unknown continuous distribution. To check its closeness to the standard Normal distribution I *cannot*

- ☐ check that the points of `qqnorm(x)` are aligned on the identity line
- ☒ compare the result of `barplot(table(x))` with the curve from `curve(dnorm, -10, 10)`
- ☐ compare the result of `hist(x)` with the curve from `curve(dnorm, -10, 10)`

Question 19 We run an experiment where we measure how much time n different customers spend on a specific page of a website. Our observation $x_1, \dots, x_n$ are stored in a vector `x`. We assume that the underlying statistical model is a gamma distribution with parameter (α, β) . Which one among the following command lines does return the quartiles of the sample ?

- ☐ `pgamma(seq(0, 1, 0.25), 1, 2)`
- ☐ `qgamma(0.25, 1, 2)`
- ☒ `quantile(x, probs = seq(0, 1, 0.25))`
- ☐ `qgamma(seq(0, 1, 0.25), 1, 2)`
- ☐ `quantile(x, 1, 2, probs = seq(0, 1, 0.25))`

Question 20 Consider X a random variable distributed according to the gaussian distribution $\mathcal{N}(0, 4)$. Which one among the following command lines does return the density at point $t = 0.5$?

- ☐ `pnorm(0.5, 0, 4)`
- ☐ `qnorm(0.5, 0, 4)`
- ☒ `dnorm(0.5, 0, 2)`
- ☐ `dnorm(0.5, 0, 4)`
- ☐ `pnorm(0.5, 0, 2)`

Question 21 Consider X a random variable distributed according to the exponential distribution with parameter $\lambda = 2$. Which one among the following command lines does return the survival function $S(t) = \mathbb{P}[X > t]$ at point $t = 0.5$?

- ☐ `1 - qexp(0.5, 2)`
- ☐ `pexp(0.5, 0.5, lower.tail = FALSE)`
- ☒ `1 - pexp(0.5, 2)`
- ☐ `1 - pexp(0.5, 0.5)`
- ☐ `1 - dexp(0.5, 2)`

Question 22 We run an experiment where we measure how much time n different customers spend on a specific page of a website. Our observation $x_1, \dots, x_n$ are stored in a vector $\mathbf{x}$. We assume that the underlying statistical model is a gamma distribution with parameter (α, β) . Which one among the following command lines does return the empirical cumulative distribution function at a given point t ?

- ☐ `mean(x)`
- ☐ `pgamma(x)`
- ☒ `mean(x <= t)`
- ☐ `pgamma(t)`
- ☐ `sum(x <= t)`

Question 23 Consider X a random variable distributed according to the exponential distribution with parameter $\lambda = 0.5$. Which one among the following command lines does return the survival function $S(t) = \mathbb{P}[X > t]$ at point $t = 2$?

- ☒ `pexp(2, 0.5, lower.tail = FALSE)`
- ☐ `1 - qexp(2, 0.5)`
- ☐ `1 - dexp(2, 0.5)`
- ☐ `pexp(2, 2, lower.tail = FALSE)`
- ☐ `1 - pexp(2, 2)`

Question 24 Based on an iid sample $\mathbf{x}$, I plot `qqnorm(x)` : the points are mostly aligned on a straight line with equation $y = 2x + 1$. This brings support to the statement that

- ☐ $\mathbf{x}$ comes from a standard Normal distribution
- ☒ $\mathbf{x}$ comes from a non-standard Normal distribution
- ☐ $\mathbf{x}$ does not come from a Normal distribution

Question 25 Consider X a random variable distributed according to the exponential distribution with parameter $\lambda = 2$. Which one among the following command lines does return the survival function $S(t) = \mathbb{P}[X > t]$ at point $t = 0.5$?

- ☐ `1 - pexp(0.5, 0.5)`
- ☐ `pexp(0.5, 2, lower.tail = TRUE)`
- ☐ `1 - qexp(0.5, 0.5)`
- ☒ `1 - pexp(0.5, 2)`
- ☐ `1 - pexp(2, 0.5)`

Question 26 We run an experiment where we measure how much time n different customers spend on a specific page of a website. Our observations $x_1, \dots, x_n$ are stored in a vector $\mathbf{x}$. We assume that the underlying statistical model is a Gamma distribution with parameter (α, β) . Which one among the following command lines does return the first quartile of the Gamma model with parameter $(1, 2)$?

- ☐ `pgamma(0.25, 1, 2)`
- ☐ `rgamma(0.25, 1, 2)`
- ☒ `qgamma(0.25, 1, 2)`
- ☐ `quantile(0.25, 1, 2)`
- ☐ `quantile(x, 0.25, 1, 2)`