Probability – Lab Assignment **IMPORTANT:** See further instructions regarding the report and work structure from the R lecture slides. In particular, you should work individually.

Anton Kalén

anton.kalen@his.se

September 16, 2022

1. Calculate the probability that $x \in [0,3]$ for a standard normal distribution ($\mu = 1$, $\sigma = 2$).

2. Draw different number of observations from the standard normal distribution ($\mathcal{N}(0,1)$), e.g., 10, 30, 50 and 100, and calculate the mean value. What happens as the number of observations increases?

3. For a random variable $X \sim \text{Binom}(0.7, 10)$, plot its probability mass function.

4. For the above distribution, calculate central tendencies (mean, median, mode). Are they similiar? Discuss why/why not.

5. In what is known as hierarchical models or multi-level models, one assumes distributions over parameters in other distributions, i.e., a hierarchy. Assume that there is a standard normal distribution over μ in another standard normal distribution and generate observations x based on these assumptions.

$$
\begin{aligned}
x &\sim N(\mu, \sigma = 1) \\
\mu &\sim N(0, 1)
\end{aligned}
\tag{1}
$$

Plot the drawn samples in a histogram.

6. Read up on the exponential distribution. Explain what an exponential random variable likely represent (what is it used for). Plot its probability density function.

7. You work for an amusement park that wants to decisde how many people they have one person selling tickets in the entrance. On average, they

sell 4 tickets per minute, but it varies from minute to minute. What is a reasonable distribution to assume for the random variable X indicating the amount of tickets per minute? Plot its probability mass/density function, as well as its cumulative distribution function.

8. What is the probability of the above amusement park selling more than 8 tickets one minute?