UPPSALA UNIVERSITET
Matematiska Institutionen
Statistics for biology. Spring semester 2015.
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Computer Lab 2.

1. In the previous Computer Lab we saw how to perform a binomial hypothesis test by means of the functions `pbinom`. There is also another function that can help us to perform the test. This function is `binom.test`.

   For example, if we have that out of 20 tossings we get 16 heads, and we want to test

   $$\begin{aligned} H_0: &\quad \mu = 0.5 \\ H_1: &\quad \mu > 0.5 \end{aligned}$$

   with $\alpha = 0.05$, we will type

   `binom.test(16, 20, 0.5, alternative="greater")$p.value>0.05`.

2. Could you explain the difference between the functions `dnorm` and `pnorm`? What is the value of `pnorm(0)`?

   (Hint) Use the help function.

3. With the help of the function `pnorm`, compute approximately the number c_α such that $P(X > c_\alpha) = 1 - \alpha$, for values of $\alpha = 0.05, 0.025$, where X is a normally distributed random variable with zero mean and variance equals to 1.

4. As we saw in the previous exercise, it is quite annoying to compute that values. For this purpose there exists a specific function: `qnorm`. Execute the following two commands: `qnorm(0.025)`, `qnorm(0.05)`. What do you get? Could you explain the outputs?

   (Hint) Use the help function.

5. If X is a normally distributed random variable with mean equals to 2 and standard deviation equals to 5, what is the probability that X is bigger that 3? And 4? And that X is between 1 and 3?

   (Remark) If we want to use, for example, the function `pnorm` for normally distributed random variables with mean equals to 2 and standard deviation equals to 5, then we should call them as `pnorm(1.1, mean=2, sd=5)`.

6. The IQ of the population is modelled by a normal distribution with mean equals to 100 and standard deviation equals to 15. Answer the following questions:

   - Between which two values lies the 95% of the population?
   - Between which two values lies the 99% of the population?

- It is said that Charles Darwin had 165 IQ score. Could we consider him a genius? (We define a genius as someone with an IQ in the top 1% of the population.)
- What is the probability that a random chosen person has an IQ higher than Charles Darwin? How many of them are in Sweden? (Roughly speaking).

7. The other day I sampled the grades that some of my students got in an exam. Out of 70 exams, I took 6 and obtained the following data:

$$20, 23, 12, 4, 36, 40.$$

My experience says that the grades follow a normal distribution with standard deviation equals to 10. Could you tell me the sample mean? And could you give me a confidence interval for it?

8. The other day a psychologist studied the IQ of 8 adult individuals and obtained the following data:

$$124, 94, 130, 82, 90, 103, 116, 151.$$

The psychologist affirms that this sample was obtained at random. What do you think? Should we believe him? To verify it, perform a two-tailed hypothesis test with $\alpha = 0.05$.

9. The next day, our friend the psychologist studied the IQ of another 8 adult individuals and obtained the following data:

$$124, 110, 130, 100, 105, 102, 120, 140.$$

The psychologist affirms again that this sample was also obtained at random, but it looks like that it was tuned. (All the values are above the mean!!!) What do you think? Should we believe him? To verify it, perform a one-tailed hypothesis test with $\alpha = 0.05$.