

# Biometry, H25, Test 1

Name: \_\_\_\_\_

Student number \_\_\_\_\_

El Silencio is a Nature Reserve in the middle Magdalena river valley in Columbia. The surrounding areas are subject to intense cattle farming and El Silencio offers the last remaining opportunity to preserve a slice of the local ecosystem and multiple threatened species.

1. (2.5 marks) The white-footed tamarin (*Saguinus leucopus*) is a tamarin species endemic to the area. It is a silvery brown colour with pale streaks and russet underparts. This species has a relatively small range and is under threat from destruction and fragmentation of the forest in which it lives and the IUCN has assessed its conservation status as "vulnerable". A study at El Silencio sampled 8 adult female white-footed tamarins produced the following measurements for their weights (in gram):

493 471 487 488 494 476 471 428

Compute the mean, the standard deviation and the coefficient of variation of the weights in this sample.

2. (2.5 marks) The black-headed spider monkey (*Ateles fusciceps*) also lives in El Silencio. The black-headed spider monkey is considered to be endangered by the IUCN due to an estimated population loss of more than 50% in the last 45 years. The prehensile tail of these monkeys is thought to be between 71.0 and 86.5 cm for adults. Observations from 24 adult black-headed spider monkeys in El Silencio show the following tail lengths (in cm)

73.4 73.6 76.5 84.4 78.9 71.1 80.7 79.5

82.5 76.1 71.9 84.9 83.9 72.2 80.0 82.3

81.4 82.2 74.4 75.0 73.0 82.7 80.6 72.1

Organize the data into a frequency table with five classes. Draw a histogram based on this frequency table. Comment on the shape of the distribution.

3. (2.5 marks) The Magdalena River turtle (*Podocnemis lewyana*) is a species of turtle in the family Podocnemididae. The species has been classified as "Critically Endangered" by the IUCN in 2015 and is considered the most threatened species of the family Podocnemididae. In less than 25 years, the species exhibited a population decline of over 80%. The decline is attributed to habitat destruction, pollution, over-harvest, hydrological changes due to electrical generation facilities, and climate change.

In the last five years the population of *Podocnemis lewyana* in a area of the El Silencio Nature Reserve has experienced changes of -8%, 4.3%, -16.7%, -12.5% and 5.7% respectively. If initially there were 50 of these turtles in this area of the Nature Reserve, how many *Podocnemis lewyana* were there after one year, after two years, after three years, after four years and after five years (round to integers)? What is the average yearly population growth or decline rate over the five years?

4. (2 marks) The West Indian manatee (*Trichechus manatus*) is a large, aquatic mammal native to warm areas from the Eastern United States to northern Brazil. Populations can be found in the swamps bordering the Magdalena River in Columbia. The manatees feed on underwater plants and use their whiskers to navigate. In breeding season, males form mating herds of up to two dozen males around an individual female. A study found the following for the sizes (number of males) of manatee mating herds in the Magdalena river:

Herd size	Frequency
[2, 5)	14
[5, 8)	24
[8, 11)	30
[11, 14)	12
[14, 17)	6
[17, 20)	2

Compute the average size of the manatee mating herds. If your result is not an integer is that a problem? Comment with a sentence or two.

5. (3.5 marks) The Colombian mahogany (*Cariniana pyriformis*) is a tree species found in Brazil, Colombia, and Venezuela. Despite its name, it's not a true mahogany. True mahoganies belong to the Meliaceae family, while *Cariniana pyriformis* is in the Lecythidaceae family. Overharvesting for its valuable timber is a significant threat. It is listed as near threatened on the IUCN red list. Colombian mahoganies can grow up to 50 meters tall. A study classified these trees based on their height: small if under 20m, medium if between 20m and 30m tall, large if between 30m and 40m tall and giant if more than 40m tall. A sample of trees measured in the three countries produced the following data:

Size	Small	Medium	Large	Giants
Brazil	41	79	22	11
Columbia	32	66	13	2
Venezuela	33	42	33	22

Consider selecting a random Colombian mahogany tree from one of these three areas. Consider the following events:  $Br = \{\text{Brazil}\}$ ,  $Columbia = \{Co\}$ ,  $Ve = \{\text{Venezuela}\}$ ,  $S = \{\text{Small}\}$ ,  $M = \{\text{Medium}\}$ ,  $L = \{\text{Large}\}$ ,  $G = \{\text{Giant}\}$ . Compute the following probabilities.

- a)  $p(Co)$ , b)  $p(M \cup Ve)$ , c)  $p(Br \cap G)$ , d)  $p(Co \cup S')$ , e)  $p(S|Co)$ , f)  $p(Co|M)$ .

By comparing unconditional with conditional probabilities decide if the size distribution of these trees depends on the location.

6. (2.5 marks) The jaguar (*Panthera onca*) is a large cat species and the only living member of the genus *Panthera* that is native to the Americas. In the Magdalena River Valley of Colombia, jaguars primarily hunt medium to large-sized mammals like deer, capybaras, and peccaries, as well as fish, turtles, and caimans found in the river and surrounding areas. Very rarely they attack livestock. Despite killing jaguars being illegal in Columbia, the jaguars are poached for their pelts and killed in retaliation for attacking livestock. In recent years 62% of the jaguar kills were by poachers and the remaining 38% in retaliation by ranchers. A poacher has a 79% chance of escaping justice after killing a jaguar. A retaliating rancher has a 46% chance of escaping justice after killing a jaguar. A jaguar killer has been found and convicted. What is the probability that this killer is a rancher?

7. (2 marks) *Micrurus ancoralis*, the regal coral snake, is a species of snake of the family Elapidae. This species has been documented in the Magdalena river valley. The venom of *M. ancoralis* is a highly potent neurotoxin. The Coral Snake Antivenin is a horse-derived immunoglobulin (Ig)G antibody. The treatment with this Antivenin is effective if administered without long delay (longer than 6 hours).

The coral snakes are shy and non-aggressive, still 6 people are bitten yearly (on average) by coral snakes in the middle Magdalena river valley area. If the probability of receiving the life-saving Antivenin on time is 75% compute the probabilities that anywhere from 0 to 6 people will die from the 6 bitten by coral snakes in a given year.

8. (3 marks) The blue-billed curassow (*Crax alberti*) is a species of bird in the family Cracidae. It is endemic to Columbia. The IUCN has assessed the blue-billed curassow as Critically Endangered. Its population is estimated to be fewer than 1,500 mature individuals and its population is fragmented and decreasing. Deforestation and hunting are the major threats. Male blue-billed curassows "boom" from the ground, "a few-syllable series of deep notes...repeated over and over, 'hmm...hmh...hmm...hmm...hmh'". Recordings of these booms produced the following data for the number of syllables in a boom:

count	1	2	3	4	5	6	7
frequency	2	9	10	10	8	7	4

- a) Compute the sample mean, the sample variance and the coefficient of dispersion. Does the Poisson distribution look like a good fit for this data?
- b) Implement a  $\chi^2$ -test for the goodness of fit of a Poisson model. Report a range for the  $p$ -value. Does the model fit well?