BIOMETRY, H20, TEST 2

Name: _____ Student number_____

The Pantanal is a natural region encompassing the world's largest tropical wetland area. It is located mostly within the Brazilian state of Mato Grosso do Sul, but it extends into Mato Grosso and portions of Bolivia and Paraguay. It sprawls over an area estimated at between 140,000 and 195,000 square kilometres. The Pantanal ecosystem is also thought to be home to 463 bird species, 269 fish species, more than 236 mammalian species, 141 reptile and amphibian species, and over 9,000 subspecies of invertebrates.

(**1**) (2 marks) One of the reptiles that inhabits the Pantanal is also one of the largest snakes in the world - the yellow anaconda. Females are generally larger than males, and grow up to $5m$ in length. Female Yellow Anacondas release a pheromone which entices the males to breed. In the wild, multiple male Anacondas are known to attempt to breed with a single female at the same time. This activity is known as a breeding ball. The average number of male yellow anacondas in a breeding ball is 6. Using the Poisson distribution compute the probabilities that a yellow anaconda breeding ball will have 4, 5, 6, 7, 8, 9, 10 males. Is a yellow anaconda breeding ball with 10 males a statistically significant observation?

(**2**) (3 marks) The southern crested caracara (Caracara plancus), also known as carancho or carcará, is a bird of prey in the family Falconidae and is found throughout the Pantanal. A study of 50 caracara nests with a clutch of four eggs found the following frequencies of survival of 0, 1, 2, 3, 4 chicks (out of four) after 6 months:

Survivors	0	1	2	3	4
Frequency	6	16	18	9	1

Determine if the binomial distribution is a good fit for this data with a χ^2-goodness of fit test. Make sure to report a p-value and draw a conclusion. What is the probability that a southern crested caracara chick will survive the first 6 months according to your model?

(**3**) (2.5 marks) Among the rarest animals to inhabit the wetlands of the Pantanal are the giant river otters (Pteronura brasiliensis). The giant otter is a highly social animal and lives in extended family groups. The giant otter feeds mainly on fish, including cichlids, characins (such as piranha), and catfish. The species can hunt singly and in groups. The table below gives the number of type of fish caught by the members of a giant otter family from the Pantanal depending on the type of hunt (single, group).

	Cichlid	Characin	Catfish
Single hunt	74	12	10
Group hunt	65	20	17

Use a χ^2 test for independence to test the hypothesis that type of fish caught and type of hunt are independent at the 5% level of significance. Make sure to report a p-value and draw a conclusion in the context of the problem.

(**4**) (2.5 marks) The hyacinth macaw (Anodorhynchus hyacinthinus) is a parrot inhabiting the Pantanal. With an average length (from the top of its head to the tip of its long pointed tail) of $98cm$ it is longer than any other species of parrot. The standard deviation of the length is $24cm$.

a) Determine the probability that a single hyacinth macaw will be longer than $110cm$.

b) Determine the probability that the average sample length of 12 hyacinth macaws will be more than $110cm$.

c) Determine the length of a hyacinth macaw which is at the top 5% of the length distribution.

(**5**) (2.5 marks) The giant anteater (Myrmecophaga trida) is listed as vulnerable by the IUCN. It has been extirpated from many parts of its former range. It has however a stable sub-population in the Pantanal.

The giant anteater has a low body temperature for a mammal. A sample of 43 giant anteaters had an average body temperature of $32.8°C$ with standard deviation of $1.1°C$. Construct a 95% and a 99% confidence intervals for the population average temperature of giant anteaters. Write a sentence commenting on the tension between confidence and precision when using confidence interval esimates.

(**6**) (2.5 marks) The marsh deer (Blastocerus dichotomus) is the largest deer species from South America. The marsh deer lives only in marsh areas, notably the Pantanal and Chaco, in which the level of water is less than 70 cm deep. Only the males possess antlers which are ramified. A sample of six male marsh deer gave the following length of their antlers (cm)

54 48 49 61 44 57

Assuming the length of the antlers of male marsh deer is normally distributed, compute a 99% confidence interval for the population mean length.

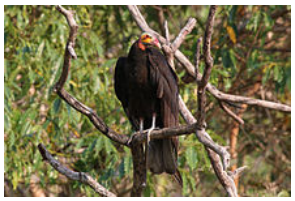
(**7**) (2.5 marks) The South American jaguar is a jaguar (Panthera onca) population in South America. Though a number of subspecies of jaguar have been proposed for South America, morphological and genetic research did not reveal any evidence for subspecific differentiation. A sample of 12 male jaguars from Northern Pantanal had average weight of $94.8kg$ with standard deviation of $20.8kg$. Another sample of 10 male jaguars from Guyana had average weight of $89.7kg$ with standard deviation of $20.6kg$. Assuming equal variances, compute a 95% confidence interval for the difference of population average weights of the male jaguars in the Northern Pantanal and the male jaguars in Guyana. Based on this confidence interval can you claim that the Pantanal male jaguars are heavier on average than the ones in Guyana?

(**8**) (2.5 marks) The capybara (Hydrochoerus hydrochaeris) is a giant cavy rodent native to South America. It is the largest living rodent in the world. While capybaras eat grass during the wet season, they have to switch to more abundant reeds during the dry season. The weights of seven adult capybaras in the Bolivian Pantanal were recorded towards the end of the wet season and also towards the end of the dry season. The results (kg) are given in the table below

Individual	1	2	3	4	5	6	7
Wet season	54	52	41	47	46	49	53
Dry season	52	51	44	46	45	42	50

Construct a 95% confidence interval for the difference of capybara weights in the wet season and in the dry season. Based on this analysis are the cabybaras heavier during the wet season?

(**9**) (2.5 marks) The black howler (Alouatta caraya) (also known as black-and-gold howler) is a species of howler monkey from northeastern Argentina, eastern Bolivia, eastern and southern Brazil, and Paraguay. They live in groups of three to twenty individuals. A study of large number of groups of black howlers from the Pantanal found that in the observed sample there were 74 males and 186 females. Construct a 95% confidence interval for the proportion of males in the population of black howlers.



(**10**) (2.5 marks) The lesser yellow-headed vulture (Cathartes burrovianus) also known as the savannah vulture, is a species of bird in the New World vulture family Cathartidae. It is found in Mexico, Central America, and South America in seasonally wet or flooded lowland grassland, swamps, and heavily degraded former forest. It is a large bird, with an estimated average wingspan of $158cm$. The capture and measurement of 52 adult yellow-headed vultures from Mato Grosso do Sul found an average sample wingspan of $151cm$ with sample standard deviation of $17cm$. At the 0.05 level of significance test $H_0 : \mu = 158$ against $H_1 : \mu < 158$. Report a p-value and make sure to draw a conlusion in the context of the problem.

(**11**) (2.5 marks) The southern tamandua (Tamandua tetradactyla) is a species of anteater from South America. It is a solitary animal, found in many habitats from mature to highly disturbed secondary forests and arid savannas. It feeds on ants, termites, and bees. The females are polyestrous. An article in "Mammalian Species" claims that gestation takes 160 days on average. The observation of seven female southern tamanduas in Southern Pantanal produced the following data for the length of their gestation period:

166 169 174 182 155 167 178

At the 0.05 level of significance test $H_0 : \mu = 160$ against $H_1 : \mu > 160$. Report a p-value and make sure to draw a conlusion in the context of the problem.

(**12**) (2.5 marks) The yacare caiman (Caiman yacare) is a crocodilian in the family Alligatoridae. The species is endemic to Argentina, Bolivia, Brazil, and Paraguay. In the 1980s, the species was "heading for oblivion" due to frequently being hunted for its skin; hunters often went to water holes containing many yacare caimans and shot large numbers of them. They utilized the skin for leather and left the other parts of the carcasses at the water holes. Trading restrictions placed since have caused its population to increase. Its population in the Pantanal is about 10 million, and it is listed as least concern on the IUCN Red List. The number of caiman in six Pantanal ponds were counted in 2013 and again in 2019. The results are given in the table below:

Pond	1	2	3	4	5	6
2013	47	123	52	29	97	64
2019	52	118	67	31	99	75

Let d be the mean difference of caiman numbers from 2019 minus the numbers from 2013. At the 0.05 level of significance test $H_0 : d = 0$ against $H_1 : d > 0$. Report a p-value and make sure to draw a conlusion in the context of the problem.