Biometry, H25, Test 2

Name: _____   Student number_____

1. (3 marks) The axolotl (*Ambystoma mexicanum*) is a critically endangered salamander native to the ancient lake system of the Valley of Mexico. On average, adult axolotls measure $22cm$ in length. The standard deviation of their length is $3.3cm$, and the population lengths are assumed to be normally distributed.

   - Compute the probability that a randomly selected adult axolotl will measure more than $18cm$ but less than $25cm$.
   - Compute the bottom 20% and the top 10% of adult axolotl lengths.

2. (3.5 marks) The volcano rabbit (*Romerolagus diazi*), or teporingo, is endemic to the mountains surrounding the Valley of Mexico. A sample of 50 adult volcano rabbits had a mean weight of $500g$ with a standard deviation of $55g$.

- Construct a 95% and a 98% confidence interval for the population average weight of adult volcano rabbits.
- Write a sentence commenting on the tension between confidence level and the precision of the confidence interval estimate.

3. (3 marks) The coyote (*Canis latrans*) is highly adaptable and found in various habitats, including those adjacent to the Valley of Mexico. A study tracked the home ranges of six coyotes in the region, yielding the following values in km^2:

$$35.1 \quad 48.2 \quad 25.5 \quad 60.0 \quad 41.8 \quad 30.9$$

Assuming that the home range areas are normally distributed, compute a 99% confidence interval for the population mean home range area for coyotes in this region.

4. (3.5 marks) Two related species, the ringtail (*Bassariscus astutus*) and the cacomistle (*Bassariscus sumichrasti*), are members of the raccoon family and inhabit overlapping regions in Mexico. A sample of 40 ringtails had an average body length of $36cm$ with a standard deviation of $4cm$. A sample of 45 cacomistles had an average body length of $42cm$ with a standard deviation of $3.5cm$.

- Determine a 95% confidence interval for the difference in population mean body lengths (cacomistle mean length - ringtail mean length), assuming the population variances are equal.

- Based on this confidence interval, can you make a claim that the average body lengths of the two species differ? Explain briefly.

5. (3 marks) The Mexican prairie dog (*Cynomys mexicanus*) lives in colonies in specific grasslands of Mexico. Litter sizes vary. Mexican prairie dogs typically have litters ranging from 1 to 6 pups. A sample of 80 recorded litters showed that 25 litters consisted of 5 or 6 pups (considered 'large' litters).

- Construct a 98% confidence interval for the population proportion of large litters (5 or 6 pups) among Mexican prairie dogs.
- Based on this confidence interval, can you claim that more than 25% of all Mexican prairie dog litters are large? Explain briefly.

6. (3 marks) The axolotl (*Ambystoma mexicanum*) weight varies among individuals. An old study suggested the average weight of adult axolotls was $60g$. A recent sample of 40 adult axolotls showed a mean weight of $71g$ with a standard deviation of $12g$. Test the hypothesis $H_0 : \mu = 60$ versus $H_1 : \mu > 60$. Report a p-value and draw a conclusion in the context of the problem (Is there evidence the average weight is now greater than $60g$?).

7. (3.5 marks) The volcano rabbit (*Romerolagus diazi*) is known for its small, rounded ears. The ear length (in mm) was measured for six captured volcano rabbits:

37 32 36 31 38 33

Assuming the population ear length is normally distributed, test the hypothesis $H_0 : \mu = 35$ versus $H_1 : \mu < 35$. Report a range for the p-value (using t-tables or stating the exact value if calculated) and draw a conclusion in the context of the problem (Is there evidence the average ear length is less than $35mm$?).

8. (3.5 marks) Coyote (*Canis latrans*) movement patterns might differ between protected reserves and areas adjacent to urban development. The average daily travel distance (in km) was recorded for 8 individual coyotes tracked first within a protected reserve and later when their range included urban-adjacent areas:

Reserve Area	6.5	8.1	5.3	9.0	7.2	6.8	8.5	7.7
Urban-Adjacent Area	5.8	7.0	5.5	8.1	6.5	6.0	7.8	6.9

Let $d = \mu_{Reserve} - \mu_{UrbanAdj}$ be the mean difference in daily travel distance. Use this data to test $H_0 : d = 0$ against $H_1 : d > 0$. Assume the differences are normally distributed. Report a p-value for the test. Draw a conclusion in the context of the problem (Do coyotes tend to travel greater distances per day in the reserve compared to urban-adjacent areas?).

9. (3 marks) The number of costal grooves (grooves along the side of the body) in axolotls (Am-$bystoma$ $mexicanum$) is a characteristic feature. The number of costal grooves was counted for a sample of 10 axolotls:

   13   14   12   13   15   14   13   12   14   13

Previous studies suggested that the population standard deviation for the number of costal grooves was $\sigma = 1.0$. Assuming the number of grooves is normally distributed, test $H_0 : \sigma = 1.0$ versus $H_1 : \sigma \neq 1.0$. Report a range for the p-value and draw a conclusion in the context of the problem.

10. (3.5 marks) The white-nosed coati (*Nasua narica*) is found in various habitats, and its weight might differ between lowland and highland populations within the Valley of Mexico region. A sample of 30 coatis from lowland forests had an average weight of $4.5kg$ with a standard deviation of $1.1kg$. Another sample of 35 coatis from highland forests had an average weight of $5.1kg$ with a standard deviation of $1.5kg$. Without assuming the population standard deviations are equal, test $H_0 : \mu_{lowland} = \mu_{highland}$ versus $H_1 : \mu_{lowland} < \mu_{highland}$. Report a p-value and draw a conclusion in the context of the problem.