

Biometry, H22, Test 1

Name: _____

Student number _____

1. (2.5 marks) The Corsac fox (*Vulpes corsac*) is native to the steppes of Mongolia. The population numbers fluctuate significantly and can drop or increase tenfold in a single year. You are dispatched to the area of Tugrug in Western Mongolia to study a Corsac fox sub-population. The eight Corsac foxes you fitted with radio collars travelled the following distances (in km) in a week:

13 11 17 8 10 6 17 22

Compute the mean, the standard deviation and the coefficient of variation of Corsac fox weekly travelled distances.

2. (2.5 marks) Despite being very gorgeous Corsac foxes are formidable predators. Observations from 24 adult Corsac foxes show the following number of small rodents (voles, gerbils, jerboas, etc.) consumed in a week:

14 16 15 14 19 13 17 15

15 21 9 18 19 12 10 13

14 22 24 20 9 7 16 11

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

3. (2.5 marks) In the last five years the population of Corsac foxes in Tugrug has experienced growth of 28%, 60%, -16%, -20% and 40% respectively. If initially there were 90 Corsac foxes in the Tugrug area, how many Corsac foxes 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 growth rate over the five years?

4. (2 marks) Byaslag is a mild, unripened Mongolian cheese prepared from the milk of yak or cows. A rather dated survey has found that 85% of the Mongolian population prefers the yak byaslag with the remaining 15% preferring byaslag made from cow milk. You have decided to affirm these percentages and during your travels through Mongolia you have asked 10 randomly selected Mongols about their Bayslag preference. In your random sample of 10 only 5 Mongols preferred the yak byaslag. Compute the probability this will happen based on the probabilities from the survey. Do you have a statistically significant result?

5. (3.5 marks) The Przewalski's horse (*Equus ferus przewalskii*) was once extinct in the wild. It has now been reintroduced (starting in 1990) in its natural habitat in Mongolia at the Khustain Nuruu National Park, Takhin Tal Nature Reserve, and Khomiin Tal. There are two distinct coat colors, a lighter steppe variety and a darker mountain one. The table below gives the counts of coat colors present at the three reintroduction areas:

| Area | Lighter | Darker |
|----------------|---------|--------|
| Khustain Nuruu | 41 | 79 |
| Takhin Tal | 30 | 110 |
| Khomin Tal | 32 | 90 |

Consider selecting a random Przewalski horse from one of these three reintroduction areas. Consider the following events: $KN = \{\text{Khustain Nuruu}\}$, $TT = \{\text{Takhin Tal}\}$, $KT = \{\text{Khomin Tal}\}$, $L = \{\text{Lighter coat}\}$, $D = \{\text{Darker coat}\}$. Compute the following probabilities.

a) $p(KN)$, b) $p(L)$, c) $p(TT \cap L)$, d) $p(KT \cup D)$, e) $p(L|KN)$, f) $p(L|KN^c)$.

By comparing unconditional with conditional probabilities argue that the distributions of coat colors depends on the location.

6. (2.5 marks) Pallas' cats (*Otocolobus manul*) in Mongolia experience a high mortality rate from toxoplasmosis, a disease that results from infection with the *Toxoplasma gondii* parasite. A blood test for this parasite shows positive 92% of the time if the Pallas cat is infected. This test also shows positive 6% of the time for Pallas cats which are not infected with the parasite. 80% of Pallas kittens are known to be infected. A Pallas kitten is tested with this blood test and the result is negative. What is the probability the kitten infected with the parasite nevertheless?

7. (2.5 marks) The saker falcon (*Falco cherrug*) is the national bird of Mongolia. The saker falcon is a raptor of open grasslands preferably with some trees or cliffs. Sakers live at low densities across large ranges in remote regions, making distribution status difficult to assess. A study in Western Mongolia found the following counts of breeding pairs in seven areas of 900km^2

10 10 9 8 12 6 15

Compute the coefficient of dispersion. Is the population regularly spaced, randomly spaced or clumped?

8. (3 marks) The beech marten (*Martes foina*) is common in south-western Mongolia. A survey of 144 areas of 10km^2 found the following counts for the number of beech martens in each area

| | | | | | |
|-----------|----|----|----|----|----|
| count | 0 | 1 | 2 | 3 | 4 |
| frequency | 30 | 47 | 37 | 20 | 10 |

- 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 χ^2 -test for the goodness of fit of a Poisson model. Does the model fit?