

MATH 338

MIDTERM 1 - LAB PORTION

THURSDAY, OCTOBER 4, 2018

Your name: _____

Your scores (to be filled in by Dr. Wynne):

Problem 1: ____/5

Problem 2: ____/8.5

Problem 3: ____/3.5

Total: ____/17

You have 50 minutes to complete this exam and an extra 10 minutes to save (as a .docx or .pdf file) and upload it to Titanium.

You may refer to your notes, your textbook, and any pre-existing online reference (eBook, R/Rguroo help, anything on Titanium).

You may search for help online, but you must cite any source found through the search. You may ask Dr. Wynne to clarify what a question is asking for. You may not ask other people for help or use any other resources.

For full credit, show all work except for final numerical calculations (which can be done using a scientific/graphing calculator or R).

1. The cats.csv file on Titanium contains values of the following variables measured on 144 cats:

- Sex (M – Male, F – Female)
- Body_Weight: weight of the cat, in kilograms
- Heart_Weight: weight of the cat's heart, in grams

Important Note: If you are having trouble importing the data for any reason, this dataset is also found in the **MASS** package as the **cats** data set. You can access it in Rguroo by importing it from the Rguroo Data Repository (MASS repository), or in R/R Studio by running the command to load the package, **library(MASS)**.

A) [1.5 pts] Find the mean and median of the variable Body_Weight, rounded to two decimal places. Interpret each value.

Numerical Variables

Variable	No. read	No. observed	No. missing	Min	Q1	Q2	Q3	Max	Mean	Std. deviation	Variance	SE of mean
Body_Weight	144	144	0	2	2.30000	2.70000	3.05000	3.90000	2.72361	0.485307	0.235523	0.0404422
Heart_Weight	144	144	0	6.30000	8.90000	10.1000	12.1500	20.5000	10.6306	2.43464	5.92745	0.202886

0.5 pts: The mean is 2.72 and the median is 2.70.

0.5 pts: The average body weight of the 144 cats is 2.72 kg.

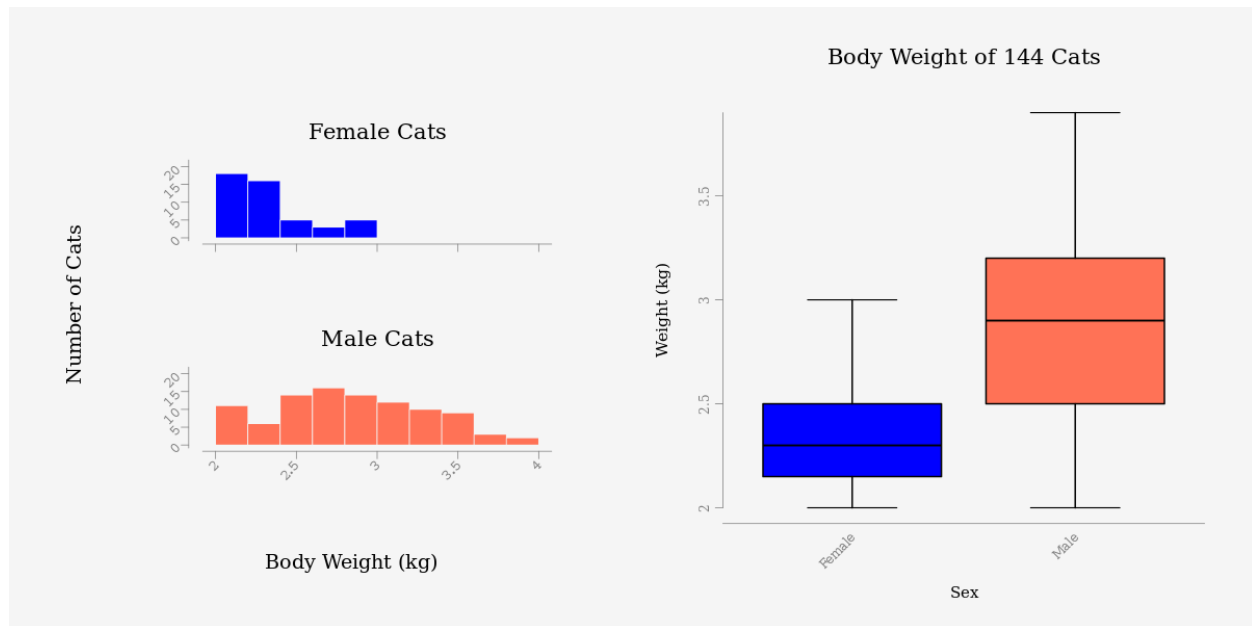
0.5 pts: The average cat in the dataset weighs 2.70 kg.

Points awarded for equivalent, sensible interpretations of mean and median.

B) [0.5 pts] Compute the interquartile range of the variable Body_Weight, rounded to 2 decimal places.

0.5 pts: $IQR = Q3 - Q1 = 3.05 - 2.30 = 0.75$ kg

C) [2 pts] Create a set of graphs that shows how the distribution of body weights differs in Male vs. Female cats. Make sure your axis labels are well-defined!



1 pt for either the set of histograms or the set of boxplots above

1 pt for appropriate x-axis and y-axis labels, such as those shown above

D) [1 pt] Briefly explain what your figure in part (C) indicates about how Body_Weight is affected by Sex.

The graphs clearly show that male cats weigh more than female cats, on average, and that the variability in male cat weights is greater. 1 pt for any reasonable comparison of body weight between male and female cats.

2. Suppose that the heart weight of all female cats in a population is approximately $N(9, 1.5)$ and the heart weight of all male cats in a population is approximately $N(12, 2.5)$. Round all probabilities below to three decimal places (tenth of a percent).

Note: for this problem, I am including the screenshot of the dialog with the answer. You could have included the graph instead.

A) [1.5 pts] What is the probability that a randomly selected female cat has a heart weight above 11 g?

Values \Rightarrow Probability ☒ Probability \Rightarrow Values ☐ ?

0.091211

Distribution : Normal ?

Mean (μ) : 9 SD (σ) : 1.5

Above 11 ?

The probability that a randomly selected female cat has a heart weight above 11 g is 0.091.

0.5 pts for the correct distribution, 1 pt for the correct probability statement

B) [2 pts] What is the probability that a randomly selected male cat has a heart weight between 11.5 and 12.5 g?

Values \Rightarrow Probability ☒ Probability \Rightarrow Values ☐ ?

0.15852

Distribution : Normal ?

Mean (μ) : 12 SD (σ) : 2.5

Between 11.5 and 12.5 ?

The probability that a randomly selected male cat has a heart weight between 11.5 and 12.5 g is 0.159.

0.5 pts for the correct distribution, 1.5 pts for the correct probability statement

C) [2 pts] What is the probability that a simple random sample of 47 female cats has a sample mean heart weight below 8.8 g?

The screenshot shows a statistical calculator interface. At the top, there are two radio buttons: "Values \Rightarrow Probability" (selected) and "Probability \Rightarrow Values". Below these is a large display area showing the result "0.18034". Underneath the display, there is a "Distribution:" dropdown menu set to "Normal". Below that, there are input fields for "Mean (μ):" set to "9" and "SD (σ):" set to "0.2188". At the bottom, there is a dropdown menu for the tail type set to "Below" and an input field for the value set to "8.8".

The probability that a simple random sample of 47 female cats has a sample mean heart weight below 8.8 g is 0.180 (I'll accept anything between 0.179 and 0.182, depending on how you round your standard deviation)

1 pt for the correct distribution - sampling distribution of the sample mean is $N(9, 1.5/\sqrt{47})$ or approximately $N(9, 0.2188)$

1 pt for the correct probability statement

D) [3 pts] Suppose we obtain a simple random sample of 5 female cats and, independently, a simple random sample of 5 male cats. What is the probability that the sample of female cats has a higher mean heart weight?

☒ Values \Rightarrow Probability
 ☐ Probability \Rightarrow Values
 ?

0.010697

Distribution : Normal ?

Mean (μ) : 3 SD (σ) : 1.3038

Below ?

0 ?

☒ Values \Rightarrow Probability
 ☐ Probability \Rightarrow Values
 ?

0.010697

Distribution : Normal ?

Mean (μ) : -3 SD (σ) : 1.3038

Above ?

0 ?

The probability that the sample of female cats has a higher mean heart weight is 0.011.

1.5 pts The sample mean for female cats is distributed $N\left(9, \sqrt{\frac{1.5^2}{5}}\right) \approx N(9, 0.6708)$ and the sample mean for male cats is distributed $N\left(12, \sqrt{\frac{2.5^2}{5}}\right) \approx N(12, 1.118)$

0.5 pts The difference of sample means is therefore distributed $N\left(12 - 9, \sqrt{\frac{2.5^2}{5} + \frac{1.5^2}{5}}\right) \approx N(3, 1.3038)$ if you use Male – Female, or $N\left(9 - 12, \sqrt{\frac{1.5^2}{5} + \frac{2.5^2}{5}}\right) \approx N(-3, 1.3038)$

1 pt for the correct probability statement (either of the statements above)

3. In Problem 4 of the Lecture Exam, you (hopefully) modified the HQ Trivia rules to allow people to answer all 12 questions, even if they get a question wrong. Your young nephew has gotten a hold of the phone and is randomly touching the screen, so that he has a $1/3$ chance of getting any individual question correct. Round all probabilities below to three decimal places (tenth of a percent). If you are using Rguroo, use the approximation $1/3 = 0.3333$ as fractions may not be recognized.

Note: for this problem, I am including the screenshot of the dialog with the answer. You could have included the graph instead.

A) [1.5 pts] Under these new rules (12 questions, $1/3$ chance of getting each question correct), what is the probability that your nephew gets no questions correct?

The screenshot shows a probability calculator interface. At the top, there are two radio buttons: "Values \Rightarrow Probability" (selected) and "Probability \Rightarrow Values". Below this is a large display area showing the result 0.007712 . Underneath the display, there are three input fields: "Distribution" set to "Binomial", "No. of Trials" set to "12", and "Prob. of Success" set to "0.3333". At the bottom, there are two more input fields: "Equal" (selected) and "0".

The probability that he gets no questions correct is 0.008.

0.5 pts for the correct distribution, 1 pts for the correct probability statement

B) [2 pts] Under the new rules, what is the probability that your nephew gets 25% or fewer of the questions correct?

The screenshot shows a probability calculator interface. At the top, there are two radio buttons: "Values \Rightarrow Probability" (selected) and "Probability \Rightarrow Values". Below this is a large display area showing the result 0.39317 . Underneath the display, there are three input fields: "Distribution" set to "Binomial", "No. of Trials" set to "12", and "Prob. of Success" set to "0.3333". At the bottom, there are two more input fields: "Below" (selected) and "3".

The probability that he gets 25% or fewer of the questions correct is 0.393.

0.5 pts for the correct distribution, 1.5 pts for the correct probability statement