Answer each question below using the 11 Step of any Hypothesis Test. ***Show ALL*** of your work, including any R code that you use. Maintain ***at least three digits*** on all intermediate calculations. Helpful information is on the back of this sheet.

1. A recent graduate was a HUGE fan of Star Trek. For one part of their capstone research the student asked whether the number of deaths of Star Trek Enterprise crew members differed depending on the crew members area of work, which is identified by the crew member’s shirt color (blue=science and medical; gold=command and helm; and red=operations, engineering, and security). Use the results in Table 1 to answer the student’s question at the 5% level.

**Table 1. Frequency of crew members by whether they lived or died and their shirt color.**

|  |  | **Lived** | **Died** |
| --- | --- | --- | --- |
| **Shirt**  **Color** | **Blue** | 129 | 7 |
| **Gold** | 46 | 9 |
| **Red** | 215 | 24 |

1. Jones *et al.* (2018; Royal Society of Open Science) examined the question of whether morphological changes will occur in animals held in captivity. To examine this question they measured the liver weight of House Mouses (*Mus musculus*) that were captured in the wild and raised in captivity. Use their results shown in Tables 2 and 3 to test, at the 5% level, if the mean liver weight differed between the two groups of House Mouses.

**Table 1. Summary statistics for liver weight (g) of wild and captive House Mouses.**

group n nvalid mean sd min Q1 median Q3 max

Captive 53 52 0.760 0.188 0.50 0.618 0.725 0.858 1.39

Wild 23 23 0.871 0.240 0.58 0.730 0.760 0.965 1.47

**Table 2. Levene’s test for liver weight (g) of wild and captive House Mouses.**

Df F value Pr(>F)

group 1 0.4287 0.5147

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1. The mean number of neurons in the prefrontal cortex in non-autistic male children aged 2-16 is about 1.15 billion. Autistic children often have a small head circumference at birth, followed by a sudden and excessive increase in head circumference during the first year of life. A recent study examined the brain tissue in autopsies of fifteen autistic male children between the ages of 2 and 16. This sample of fifteen children had a mean number of neurons in the prefrontal cortex of 1.94 billion with a standard deviation of 0.54 billion. A histogram of the sample was not heavily skewed. Test whether this sample provides evidence, at the 1% level, that autistic male children have more neurons (on average) in the prefrontal cortex than non-autistic male children.

**library(NCStats)**

**distrib(val,mean=meanval,sd=sdval,lower.tail=FALSE,type=”q”)**

**distrib(val,distrib=”X”,df=dfval,lower.tail=FALSE,type=”q”)**

where

* **val** is a value of the quant. variable or area (i.e., percentage as a proportion)
* **meanval** is population mean () for a normal distribution
* **sdval** is standard deviation () or error (SE) for a normal distribution
* **distrib=”X”** has “X” replaced with “t” for a t- and “chisq” for a 2-distribution
* **dfval** is the degrees-of-freedom for t- and 2-distributions
* **lower.tail=FALSE** is included for “right-of” calculations
* **type=”q”** is included for reverse calculations

# **11 Steps for any Significance Test**

1. **[2]** state the rejection criterion (),

2. **[4]** state the null and alternative hypotheses to be tested – define the parameter,

3. **[2]** determine which hypothesis test to use – thoroughly explain why,

4. **[2]** collect the data (address type of study and randomization),

5. **[4]** check all necessary assumptions – explain how you tested the validity,

6. **[2]** calculate the appropriate statistic(s),

7. **[4]** calculate the appropriate test statistic,

8. **[4]** calculate the p‑value,

9. **[2]** state rejection decision,

10. **[4]\*** summarize your findings in terms of the problem, and

11. **[4]\* If reject H0,** compute a **100(1-)%** *confidence region* for the parameter.

where