**Exercise #8 – bootstrapping hypothesis testing and other tests**

For each of the below state what is the H0 and select the appropriate test. Explain what the test can tell you and compare (when applicable) to **one** other (if possible) test. Explain your selections.

1. The first reasonable attempt to measure the speed of light was made over 100 years ago by A.A. Michelson and Simon Newcomb. A sample of 64 measurements were taken by repeatedly measuring the length of time required for light to travel from Newcomb’s lab on the Potomac River to a mirror at the base of the Washington Monument and back (total distance about 7400 meters). Each observed value Xi = the number of time units required for light to travel over 7400m, i = 1,2,…,64. (Note: the time units were specially coded as whole numbers for easy recording. We can refer to them generically as ``time units’’, as they do not represent seconds or any other such commonly-used measure.) Later, when more precision was possible, the “true” speed in terms of Newcomb’s time units was determined to be 33.02. The data are shown below: 28 22 36 26 28 28 26 24 32 30 27 24 33 21 36 32 31 25 24 25 28 36 27 32 34 30 25 26 26 25 23 21 30 33 29 27 29 28 22 26 27 16 31 29 36 32 28 40 19 37 23 32 29 24 25 27 24 16 29 20 28 27 39 23

We would like to address these questions/issues:

* 1. Build a 95% confidence interval
  2. Does the data support the assumption that the speed is 33.02?

1. Consider a Phase II clinical trial designed to investigate the effectiveness of a new drug to reduce symptoms of asthma in children. A total of n=10 participants are randomized to receive either the new drug or a placebo. Participants are asked to record the number of episodes of shortness of breath over a 1 week period following receipt of the assigned treatment. The data are shown below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Placebo** | 7 | 5 | 6 | 4 | 12 |
| **New Drug** | 3 | 6 | 4 | 2 | 1 |

Is there a difference in the number of episodes of shortness of breath over a 1 week period in participants receiving the new drug as compared to those receiving the placebo? State exactly what you are testing and what is your conclusion.

1. A clinical investigation to assess the effectiveness of a new drug designed to reduce repetitive behaviors in children affected with autism. If the drug is effective, children will exhibit fewer repetitive behaviors on treatment as compared to when they are untreated. A total of 8 children with autism enroll in the study. Each child is observed by the study psychologist for a period of 3 hours both before treatment and then again after taking the new drug for 1 week. The time that each child is engaged in repetitive behavior during each 3 hour observation period is measured. The data are shown below.

Does the treatment improves the behavior?

|  |  |  |
| --- | --- | --- |
| **Child** | **Before Treatment** | **After 1 Week of Treatment** |
| 1 | 85 | 75 |
| 2 | 70 | 50 |
| 3 | 40 | 50 |
| 4 | 65 | 40 |
| 5 | 80 | 20 |
| 6 | 75 | 65 |
| 7 | 55 | 40 |
| 8 | 20 | 25 |

1. The eastern chipmunk trills when pursued by a predator, possibly to warn other chipmunks. Burke da Silva et al. (2002) released chipmunks either 10 or 100 meters from their home burrow, then chased them (to simulate predator pursuit). Out of 24 female chipmunks released 10 m from their burrow, 16 trilled and 8 did not trill. When released 100 m from their burrow, only 3 female chipmunks trilled, while 18 did not trill. Does the distance from home affect for the chipmunk trills?
2. מסובבים סביבון 20 פעמים
   1. נניח שקיבלו 4 פעמים את הרצף: נ.ג.ה.פ

האם הסביבון הזה תקין (כלומר לפאה יש סיכוי של רבע)?

1. Today the rate of positive covid-19 tests was found to be 3% out of 10000 tests.
   1. Yesterday the rate was 2%. Is there enough evidence that the rate increased from yesterday (that is, we need to announce new restrictions) or this is just random fluctuation?
   2. What if you know that the 2% value for yesterday`s sample comes from a survey of 20000 tests?
2. A study examined the number of covid-19 antigens one month after a vaccine and compare it to the number one month people recovered. The results are below.
   1. Is there evidence that the vaccine is better?

Vaccine = [10 12 13 15 16 20 20 20 21 24 25 31 33 55 66 89 91 93 100]

Recovery = [5 5 5 5 5 6 6 6 6 7 7 7 7 7 10 10 22 23 150 160 170 180]