Final Project Example: 20-sided die

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My friend gave me some 20-sided dice. She claimed some of those dice were weighted to give non-uniform distributions. To begin checking, I took one 20-sided die and rolled it 100 times. The rolls are shown here:

15	5	14	9	1	7	20	3	10	15
19	19	17	10	6	16	14	15	12	17
14	9	11	7	15	17	3	5	20	11
3	3	7	6	9	18	8	8	14	7
10	8	12	2	15	17	16	19	17	15
18	7	15	5	16	2	12	10	14	6
11	10	10	8	20	4	14	18	3	14
5	9	13	12	6	13	3	10	8	7
20	19	7	13	11	5	14	12	14	10
14	4	9	18	8	19	7	2	19	5

To determine the 95% confidence interval, I used R to run a t test. This is because I didn't know the die's true standard deviation.

In R's `t.test` function, a p-value can also be calculated. If the die is fair, it should have a expected value of 10.5 (see discrete uniform distribution). Thus, I used 10.5 as the null hypothesis's population mean.

```
x = c(15,19,14,3,10,18,11,5,20,14,5,19,9,3,8,7,10,9,19,4
      14,17,11,7,12,15,10,13,7,9,9,10,7,6,2,5,8,12,13,18
      1,6,15,9,15,16,20,6,11,8,7,16,17,18,17,2,4,13,5,19
      20,14,3,8,16,12,14,3,14,7,3,15,5,8,19,10,18,10,12,2
      10,12,20,14,17,14,3,8,14,19,15,17,11,7,15,6,14,7,10,5)
t.test(x,mu=10.5)
```

```
##
##  One Sample t-test
##
## data:  x
## t = 1.0095, df = 99, p-value = 0.3152
## alternative hypothesis: true mean is not equal to 10.5
## 95 percent confidence interval:
##   9.988244 12.071756
## sample estimates:
## mean of x
##     11.03
```

Thus, the 95% confidence interval suggests the die's expected value is between 9.99 and 12.07. Notice this confidence interval straddles 10.5, so we do not have sufficient evidence to conclude this die is unfair (and, equivalently, the p-value is 0.32, which is larger than 0.05, so the sample mean is not significantly far from 10.5).