## Randomized Trials: computing p-values

An alternative to computing Z-scores using the CLT is to explicitly simulate the distribution under the null hypothesis. Going back to coin flip examples, say we flip a coin 30 times and end up with 13 Heads. This is our observed data. We would like to ask the question: is this a fair coin?

1. To create the null distribution, say we perform many trials and during each trial we flip a fair coin 30 times. The results of these trials are shown below - in each one I record the number of Heads. What is $T$, the number of trials?

$$
[19,14,12,16,12,16,13,18,18,12,17,16,11,12,12,15,15,16,15,13]
$$

2. What is $N_{e}$, the number of trials where we obtained a value as or more extreme than our observed (true) data? Since we are trying to determine if the coin is fair or not (as opposed to weighted towards Tails specifically), perform a two-sided computation.
3. Putting this all together, what is your estimate of the p-value? Based on your p-value, what do you conclude about the coin? (Note: this is a very small number of trials - just for illustration purposes!)
4. Roughly sketch the null distribution and shade the area(s) representing the p-value.
