```
import numpy as np
import matplotlib.pyplot as plt
import scipy.stats as sts
```

```
# posterior parameters for control group
alpha_post = 58
beta_post = 65

# data for control group
patients = np.array([15, 18, 10, 39, 29, 10])
improved = np.array([9, 11, 4, 21, 12, 0])
```

```
distr = sts.beta(alpha_post, beta_post)
p = distr.rvs(10000)
```

We can first try modeling the number of successes. This will give us a picture of how biasedness changes for each dataset. Ideally, the mode of the binomial distribution should be close enough to the study results, assuming that each trial is i.i.d. (RCT).

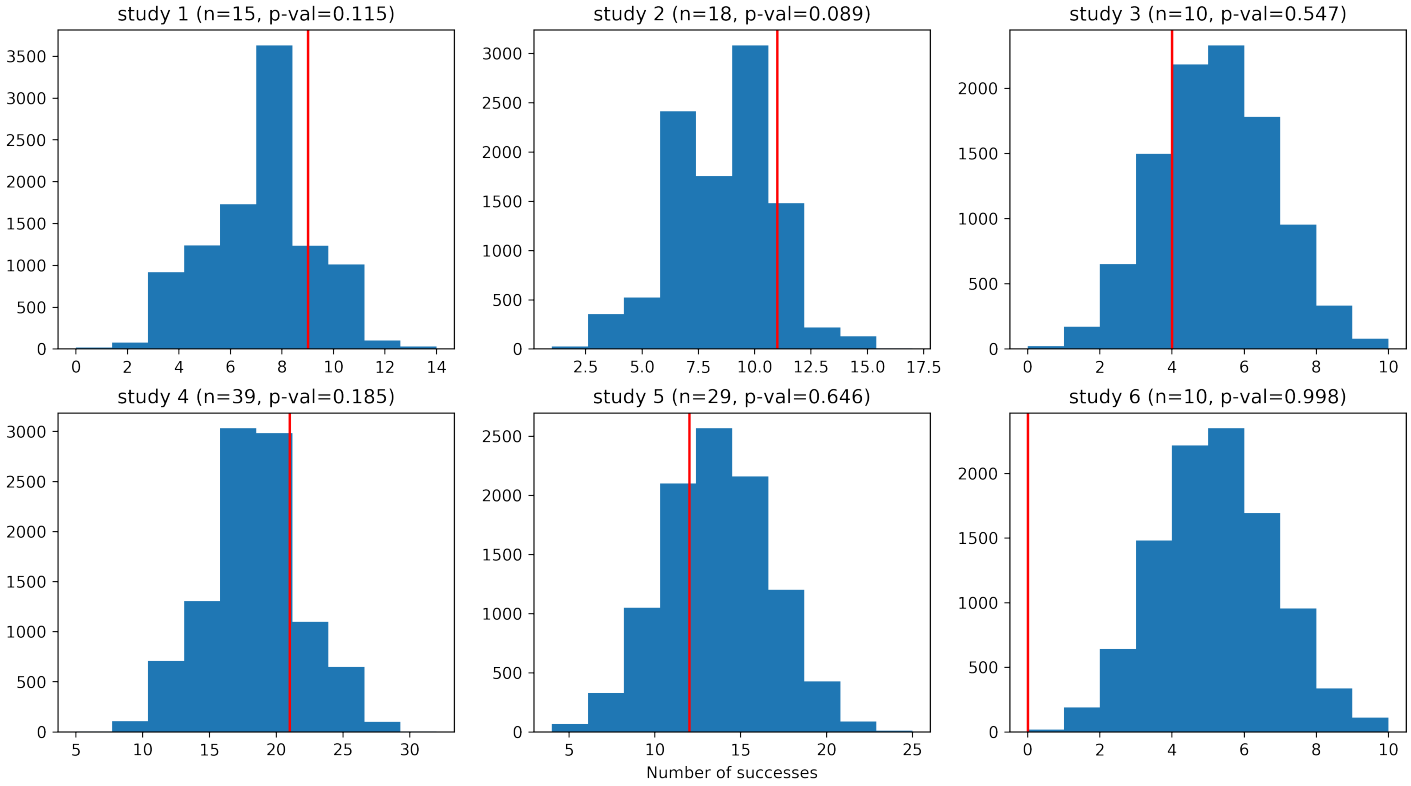
```
def test_stat_1(trial_success): # number of successes
    return trial_success
```

```
plt.figure(figsize=(15, 8), dpi=330)
for i in range(len(patients)):
    samples = sts.binom.rvs(n=patients[i], p=p)
    p_val = np.sum(test_stat_1(samples) > test_stat_1(improved[i])) / len(samples)

    plt.subplot(2, len(patients) // 2, i + 1)
    plt.title('study {0} (n={1}, p-val={2})'.format(i + 1, patients[i], np.round(p_v
    plt.hist(samples, bins=10)
    plt.axvline(improved[i], color="red")

    if i + 1 == 5:
        plt.xlabel('Number of successes')

plt.show()
```



As we can see, study 6 looks pretty bad, and all other studies (except for study 3) are quite off from the median. Study 6 indicates that at least it should be modeled with a different set of hyperparameters.

Let's now try to collect the median of resulting binomial distributions and see how do those compare to the actual outcome.

```
def test_stat_2(binomial_dist): # median of successes
    return np.median(binomial_dist)
```

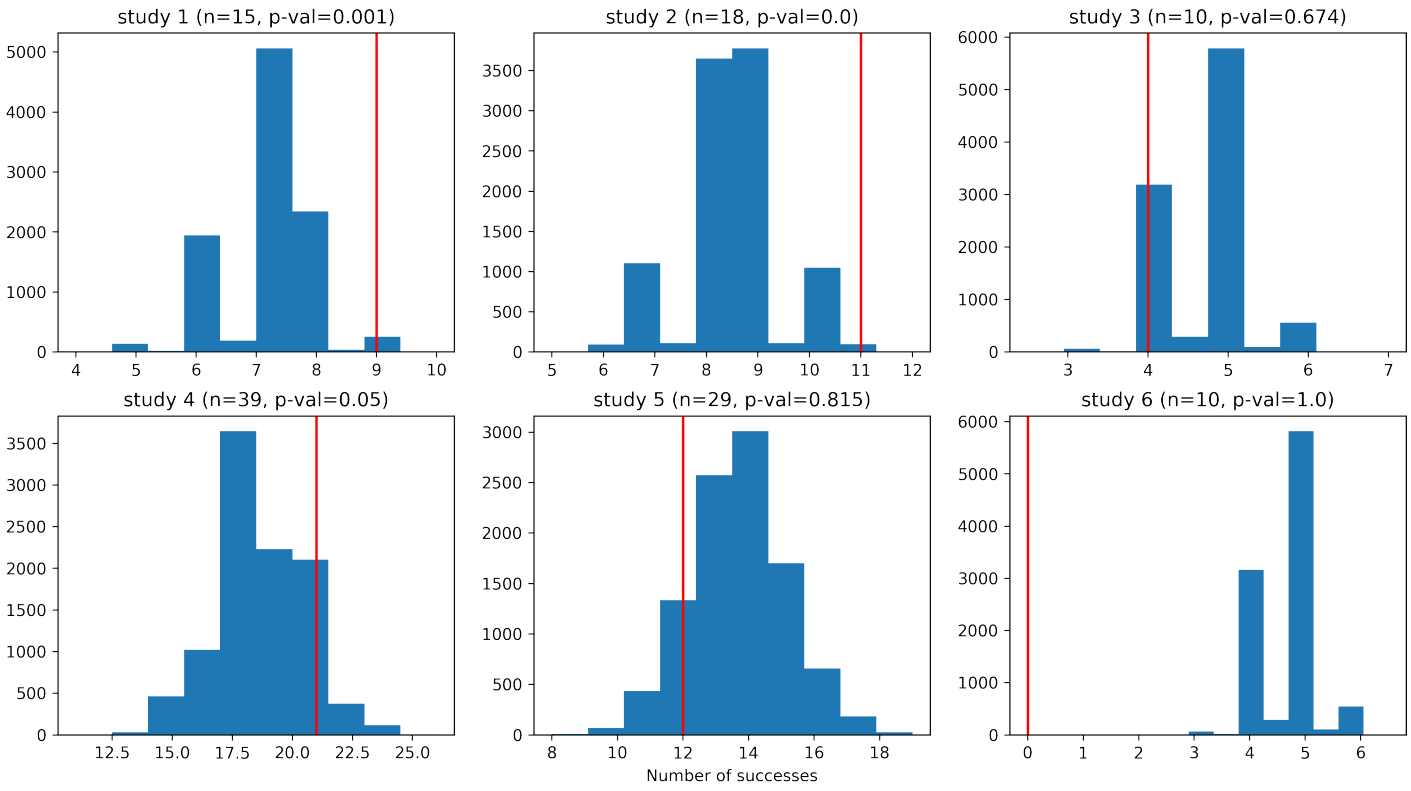
```
plt.figure(figsize=(15, 8), dpi=330)
for i in range(len(patients)):
    median_store = []
    for prob in p:
        samples = sts.binom.rvs(n=patients[i], p=prob, size=100)
        med = test_stat_2(samples)
        median_store.append(med)

    p_val = np.sum(median_store > improved[i]) / len(median_store)

    plt.subplot(2, len(patients) // 2, i + 1)
    plt.title('study {0} (n={1}, p-val={2})'.format(i + 1, patients[i], np.round(p_v
    plt.hist(median_store, bins=10)
    plt.axvline(improved[i], color="red")

    if i + 1 == 5:
        plt.xlabel('Number of successes')

plt.show()
```



Most of the studies them are very off, great! We need separate hyperparameters (hierarchichal model then).