Hello everyone, my name is Fangzhou Song. I’m here to give you a data example that how Bayesian inference applied in two-way contingency table.

As can be seen from the table, group 1 is experimental treatment, which has 108 success and 19 failure, group 2 is control treatment which has 87 success and 40 failure,

As my teammates talked before, the prior distribution of pi 1 and pi 2 are Beta a b and Beta c d. Yi has binomial distribution ni and pi i. Therefore the posterior distribution of pi 1 and pi 2 are like these.

So, here comes to a problem. How do we precisely decide the prior distribution of parameter when we use the Bayesian methods in real life?

Generally, we have 3 approaches to do that.

Before do that, let me define a notation first:

In [Bayesian statistics](https://en.wikipedia.org/wiki/Bayesian_statistics), a **hyperparameter** is a parameter of a [prior distribution](https://en.wikipedia.org/wiki/Prior_distribution); the term is used to distinguish them from parameters of the model for the underlying system under analysis.

1. This method is based on our experience and knowledge, which is a kind of subjective belif

2.

3.

The approach of estimating the prior distribution is a big topic in Bayesian method. For simplifying, here we simply use uniform distribution for prior distribution which is beta(1,1) for pi 1 and pi 2

This is calculating process

* 1. simulation

this method is easy to understand. We simply generate 10 thousand sample for each distribution. Compare each of them and compute the proportion that pi 1 is larger that pi 2.

Then, we have estimated probability.

In Section 1.2

we are going to find is difference of proportions

Let us find Equal tail first.

The simulation is also quite straight forward. We generate a big sample data z1 and z2 first. Let z=z1-z2 . sort it. Find its corresponding value of the order number of its position. these two values are approximate credible interval for difference of interval by simulation.

The next function is a more precise approximation

Just use the method we talked before, trying to find the distribution of pi 1 – pi 2 by integrate the double integral of the joint posterior distribution of pi 1 and pi 2. This is the inside step integral. T=pi1-pi2. This the outside integral. This is the process of find solution for equation. These are the results.

Next part is to find the Highest Posterior Density Intervals. The HPD interval function is kind of different from the function finding equal tail but has the same logic. So I don’t want to talk too much here. The result is here, which is a narrow interval compared to the equal tail

1.2.2 section is to find relative risk . We have already know that there are some disadvantage for HPD interval used in RR and OR. So, it is just equal tail interval here. Function is same logic as the former one. The result is this. Which does not include 1.

Next part is Odds ratio. The function is kind of same, This is more precise interval which does not include 1

The next big section is using frequentist method to deal with this 2way contingency table which we have learned in class. Just quickly go through it .

The last part is

From the table ,we can see that there is not much difference respect to the interval between two methods So, in this example we can have same conclusion through two different method. However, generally, there is some difference between these two method

The chart is a summary of some difference between frequentist and Bayesian.

Our presentation ends up here, I hope that we gave a good picture for you about Bayesian inference for 2 -way contingency table and we also hope that this can be helpful for your future study in Bayesian method That’s all. Thank you