

Math 1180:Lab11

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1 Confidence Interval

The confidence interval is the set of values which lie between the lower and upper confidence limit. The upper and lower confidence limits are the smallest and largest values that are consistent with the data. The confidence interval is the range of parameter values that might plausibly have produced the data set and is the range of values in which the parameter is likely to lie. It is important to note that this is not a probability, a 95 percent confidence interval means that we are 95 percent sure that the parameter lies within the interval. The parameter of a process is a fixed value, it either lies within the interval or it doesn't. A 95 percent confidence interval **doesn't** mean that the parameter lies within the interval with probability .95.

2 Monte Carlo Method for Finding Confidence Limits

1. Compute the maximum likelihood estimator of the parameter.
2. To find the lower confidence limit, simulate the experiment many times on the computer with the values of the parameter smaller than the maximum likelihood estimator and find the fraction of times the result is greater than or equal to the measured result.
3. With the degree of confidence $1 - \alpha$, the lower confidence limit is the point where this fraction is equal to $\frac{\alpha}{2}$.
4. To find the upper confidence limit, simulate the experiment many times on the computer with a value of the parameter larger than the maximum likelihood estimator and find the fraction of times the results are less than or equal to the measured result.
5. The upper confidence limit is the point where this fraction is equal to $\frac{\alpha}{2}$.

2.1 Monte Carlo Simulation

In order to calculate a confidence interval we first need to create a data set. Suppose that we wish to simulate 1000 repetitions of choosing 100 Bernoulli random variables. We will vary the probability, p , of the Bernoulli random variable.

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a=rbinom(1000,size=100,p=.1)
TwentyPlus=sum(a>19)/1000
TwentyLess=sum(a<21)/1000
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3 Assignment for the Week

1. Complete the table (like table 8.1 in section 8.2) for p values ranging from $p=0.1$ to $p=0.36$ going by steps of 0.02 simulate the number of times you get 20 or more positive results and the number of times you get 20 or less positive results. Calculate the fraction (by dividing by 1000).
2. Use this information to calculate an approximation for the lower and upper confidence limits.
3. How does this compare to the result from the book (pg. 724-725)? Did you get the same answer? If not explain why not. If you did get the same answer explain what may cause you not to.
4. Now increase the number of trials from 1000 to 100,000 and recreate the table this time using $p=0.1$ to $p=0.16$ going by 0.005 steps and $p=0.27$ to $p=0.32$ going by 0.005 steps. What were the lower and upper confidence values now? How does this compare to the actual values of $p_l = 0.127$ and $p_h = 0.292$