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Prob1. Write a R function to return a 100×(1−α)% confidence interval with the exact confidence level for any data set X, then use it to validate the results for two samples on p.55

```
f=function(x){
  l=length(x)
  x=sort(x)
  s=0
  al=2^l
  for(i in 0:l){
    s=s+choose(l,i)
    if(s*20>al){
      return(c(x[i],x[l-i+1],(al-s*2+2*choose(l,i))/al))
    }
  }
}
x1=c(5.5 ,6.0 ,6.5 ,7.6 ,7.6 ,7.7 ,8.0 ,8.2 ,9.1 ,15.1)
x2=c(5.6 ,6.1 ,6.3 ,6.3 ,6.5 ,6.6 ,7.0 ,7.5, 7.9, 8.0 ,8.0, 8.1, 8.1 ,8.2 ,8.4 ,8.5 ,8.7 ,9.4,14.3, 26.0)
```

```
> f(x1)
[1] 6.0000000 9.1000000 0.9785156
> f(x2)
[1] 6.6000000 8.4000000 0.9586105
```

3. 2 In Comment 4 on Example 3.10 we asserted that the usual t -statistic could be used in place of S_+ as the test statistic for the Pitman test because there was a one-to-one correspondence between the ordering of the two statistics. Establish that this is so. (Hint: show that the denominator of the t -statistic is invariant under all permutations of the signs of the deviations d_i.)

The raw data as scores indicate the variance occurring in the denominator of the t statistic is the same for all permutations of the signs attached to the xi; it follows therefore that the denominator is invariant under permutation.

3. 5 Establish that the permutation distribution of the Wilcoxon signed-rank statistic for testing the hypothesis $\mathrm{H}_0 : \theta = 6$, given the observations 4,4,8,8,8 8,8 has a distribution equivalent to that for the sign test of the same hypothesis. Would this equivalence hold if the null hypothesis was changed to $\mathrm{H}_0 : \theta = 7$?

All deviations from 6 are either +2 or -2 .Thus Wilcoxon test easily seen to be equivalent to sign test.

This equivalence will not hold when $\mathrm{H}_0 : \theta = 7$, because that the signed deviations are of magnitudes 1 and 3

3.8 The numbers of pages in the sample of 12 books given in Exercise 2.5 were

$$126 \quad 142 \quad 156 \quad 228 \quad 245 \quad 246 \quad 370 \quad 419 \quad 433 \quad 454 \quad 478 \quad 503$$

Use the Wilcoxon signed-rank test to test the hypothesis that the mean number of pages in the statistics books in the library from which the sample was taken is 400. Obtain a 95 percent confidence interval for the mean number of pages based on the Wilcoxon test and compare it with the interval obtained using a t -test under an assumption of normality.

$P = 0.13$ (two-tail).

95 percent Wilcoxon interval is $(200.5, 443)$.

Normal theory interval is (227.4,405.9)

```
> x<-c(126 , 142 , 156 , 228 , 245 , 246 , 370 , 419 , 433 , 454 , 478 , 503)
> wilcox.test(x, mu=400,conf.int = TRUE)

  Wilcoxon signed rank test

data:  x
V = 19, p-value = 0.1294
alternative hypothesis: true location is not equal to 400
95 percent confidence interval:
 200.5 433.0
sample estimates:
(pseudo)median
        315.75
> t.test(x)

  One Sample t-test

data:  x
t = 7.8079, df = 11, p-value = 8.225e-06
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 227.4005 405.9328
sample estimates:
mean of x
 316.6667
```