Homework 03

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Sun Oct 2 13:42:24 2022

Instructions

- Do not make changes to this file above this line.
- Do not change the statements of the questions
- Insert your computations in the "code chunks" provided (between three backtics)
- Add textual answers, outside the code chunks
- Click on the "Knit" button above in order to run the computations and create the pdf file (you might have to allow pop-ups in your web browser to see the pdf)
- Upload the final PDF file to the Homework 3 assignment in Canvas.

Questions

[1] -0.2428387

For the questions in this homework assignment you are allowed to use the function t.test.

1. Generate a sample of size n=20 of random numbers from the standard normal distribution, and store them in a vector called X. Find a 95% confidence interval for the mean, based on the t distribution.

```
X = rnorm(20)
                ## creating and storing a sample of size 20
my.test <- t.test(X,conf.level = 0.95,mu=0) ## finding 95% confidence interval by using conf.level func
names(my.test) ## knowing the names of the interval
   [1] "statistic"
                                     "p.value"
                                                   "conf.int"
                                                                 "estimate"
##
                      "parameter"
                                     "alternative" "method"
   [6] "null.value"
                      "stderr"
                                                                 "data.name"
my.test$conf.int
## [1] -0.6420509 0.1563736
## attr(,"conf.level")
## [1] 0.95
N=mean(X)
            \#mean for X
  ##knowing the values of A
```

Does the interval contain the true value of μ ? Answer: Yes,if we take the true value of mu = 0 then the interval contains in the value.

2. Repeat the steps in Question 1 10,000 times. Record whether each time the interval contained μ or not into a logical (boolean) vector of length 10,000, called **contained**.

```
nrep <- 10000 ##taking repettion till 10,000
maxs <- rep(0,nrep) ##assigning max
mins <- rep(0,nrep) ## assigning mins
for(i in 1:nrep){
  X<- rnorm(20)
  my.test<- t.test(X,conf.level=0.95,mu=0)
  maxs[i] <- my.test$conf.int[2]</pre>
  mins[i] <- my.test$conf.int[1]
}
my.test$conf.int
## [1] -0.2589772 0.5064298
## attr(,"conf.level")
## [1] 0.95
contained <- mins < 0 \& maxs > 0
table(contained)/nrep
## contained
    FALSE
            TRUE
## 0.0481 0.9519
contained
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[6133] TRUE FALSE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [6145]TRUE TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE [6157] TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [6169] TRUE TRUE TRUE ## [6181] **FALSE** TRUE ## [6193] TRUE ## [6205] TRUE [6217] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [6229] TRUE ## TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [6241]TRUE TRUE ## [6253] TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE ## [6265] TRUE TRUE **FALSE** TRUE TRUE ## [6277] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [6289] TRUE FALSE ## [6301] TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [6313] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE [6325] ## [6337] TRUE ## [6349] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [6361] TRUE ## [6373] **FALSE** TRUE ## [6385] TRUE ## [6397] TRUE [6409] TRUE ## TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [6421]TRUE TRUE TRUE TRUE [6433] ## TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6445]TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE [6457] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6469] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE [6481] TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6493] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [6505] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6517] TRUE TRUE TRUE ## [6529] TRUE ## [6541] TRUE ## [6553] TRUE ## [6565]TRUE TRUE ## [6577] TRUE TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [6589] TRUE ## [6601] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6613] TRUE FALSE TRUE ## [6625] TRUE [6637] TRUE ## TRUE TRUE ## [6649] TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6661] TRUE ## [6673] TRUE TRUE **FALSE** TRUE [6685] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE ## [6697] TRUE ## [6709] TRUE [6721] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [6733] TRUE [6745] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE ## [6757] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [6769] TRUE ## TRUE FALSE

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[8725] TRUE ## [8737] FALSE TRUE ## [8749] TRUE [8761] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE ## [8773] TRUE ## [8785] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [8797] TRUE FALSE TRUE [8809] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## TRUE TRUE TRUE TRUE ## [8821] TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [8833] TRUE TRUE TRUE TRUE ## [8845] **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [8857] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## [8869] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [8881] TRUE ## [8893] TRUE ## [8905] TRUE TRUE **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [8917] TRUE ## [8929] **FALSE** TRUE ## [8941] TRUE ## [8953] TRUE ## [8965] TRUE ## [8977] TRUE ## [8989] TRUE [9001] TRUE ## TRUE [9013] TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE [9025] ## TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE ## [9037] TRUE [9049] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [9061] TRUE TRUE TRUE TRUE TRUE [9073] TRUE FALSE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [9085] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE ## [9097] TRUE [9109] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE [9121] TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE ## TRUE ## [9133] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [9145] TRUE ## [9157] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [9169] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [9181] TRUE ## [9193] TRUE FALSE ## [9205] TRUE ## [9217] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [9229] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## TRUE TRUE ## [9241] TRUE ## [9253] TRUE [9265] TRUE ## TRUE TRUE [9277] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [9289] TRUE ## [9301] TRUE FALSE TRUE [9313] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [9325] TRUE ## [9337] TRUE ## [9349] TRUE [9361] ## TRUE TRUE

[9373] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## [9385] TRUE ## [9397] TRUE ## [9409] TRUE TRUE TRUE TRUE TRUE ## [9421] TRUE ## [9433] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [9445] TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE [9457] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE ## [9469] TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [9481] TRUE TRUE TRUE ## [9493] TRUE ## [9505] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [9517] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [9529] TRUE ## [9541] TRUE ## [9553] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE **FALSE** TRUE TRUE TRUE ## [9565] FALSE TRUE ## [9577] TRUE ## [9589] TRUE ## [9601] TRUE ## [9613] TRUE ## [9625] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [9637] TRUE [9649] TRUE ## [9661] TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE [9673] TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [9685] TRUE [9697] TRUE ## ## [9709] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE [9721] TRUE TRUE TRUE TRUE TRUE ## TRUE ## [9733] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [9745] TRUE ## [9757] TRUE TRUE TRUE TRUE [9769] TRUE ## TRUE TRUE TRUE ## [9781] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [9793] TRUE ## [9805] TRUE ## [9817] TRUE ## [9829] TRUE ## [9841] TRUE ## [9853] TRUE ## [9865] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE [9877] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE ## [9889] TRUE ## [9901] TRUE [9913] TRUE ## TRUE TRUE [9925] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [9937] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE ## [9949] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [9961] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [9973] TRUE [9985] TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE ## [9997] TRUE TRUE TRUE TRUE

What proportion of times did the t-based CI cover the true μ ? Does this match the theory? Answer:approximately it is becoming 95% true for mu

3. Repeat the steps in Question 2, now using the standard exponential distribution to generate the sample X, but still using the t-based CI. (Recall that the mean in this case is 1.)

```
nrep <- 10000
maxs <- rep(0,nrep)</pre>
mins <- rep(0,nrep)
for(i in 1:nrep){
  X<- rexp(n=20,rate=1/1)</pre>
  my.test<- t.test(X,conf.level=0.95,mu=0)
  maxs[i] <- my.test$conf.int[2]</pre>
  mins[i] <- my.test$conf.int[1]
}
contained <- mins < 1 & maxs > 1
my.test$conf.int
## [1] 0.5810901 1.3570950
## attr(,"conf.level")
## [1] 0.95
table(contained)/nrep
## contained
    FALSE
             TRUE
## 0.0825 0.9175
contained
```

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        [1]
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[253] TRUE ## [265] TRUE ## [277] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE FALSE ## [289] FALSE TRUE TRUE TRUE ## [301] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [313] TRUE ## [325] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE [337] TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE FALSE TRUE FALSE FALSE TRUE TRUE ## [349] TRUE ## [361] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [373] TRUE [385] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE FALSE TRUE [397] TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE ## [409] TRUE ## [421] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [433] **FALSE** TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [445] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [457] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [469] TRUE ## [481] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [493] TRUE ## [505] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [517] TRUE [529] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [541] ## TRUE ## [553] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [565] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [577] TRUE ## [589] TRUE FALSE TRUE TRUE FALSE TRUE FALSE FALSE TRUE TRUE TRUE TRUE ## [601] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## TRUE TRUE TRUE TRUE TRUE ## [613]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [625]TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [637] TRUE TRUE TRUE FALSE ## [649] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE ## [661] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [673] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [685] FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE FALSE ## [697] TRUE ## [709] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [721] TRUE ## [733] TRUE ## [745]TRUE TRUE [757] TRUE ## TRUE FALSE ## [769] TRUE ## [781] TRUE [793] FALSE TRUE ## TRUE [805] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE ## [817] TRUE ## [829] TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE ## [841] TRUE TRUE TRUE TRUE ## [853] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [865] TRUE FALSE TRUE TRUE TRUE ## TRUE FALSE TRUE TRUE TRUE FALSE TRUE ## [877] TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [889] TRUE ## TRUE FALSE

[901] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [913] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE [925] TRUE ## TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE ## [937] TRUE TRUE TRUE TRUE ## [949] TRUE ## [961] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [973] TRUE [985] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE ## [997] TRUE ## TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE [1009] FALSE TRUE FALSE TRUE ## [1021] FALSE TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [1033] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [1045] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [1057] **FALSE** TRUE FALSE ## [1069] TRUE ## [1081] TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE ## [1093] TRUE TRUE TRUE FALSE TRUE ## [1105] **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [1117]TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [1129]TRUE TRUE FALSE TRUE ## [1141] TRUE ## [1153] TRUE ## [1165] TRUE [1177] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [1189]TRUE TRUE TRUE ## [1201] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [1213] **FALSE** TRUE [1225] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## ## TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE [1237] FALSE FALSE TRUE TRUE [1249] TRUE TRUE TRUE TRUE FALSE FALSE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [1261] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE ## [1273] TRUE [1285] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [1297] TRUE ## [1309] TRUE ## [1321] TRUE ## [1333] TRUE ## [1345] TRUE ## [1357] FALSE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [1369] FALSE TRUE TRUE TRUE TRUE TRUE FALSE TRUE FALSE [1381] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [1393] TRUE TRUE FALSE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE [1405] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [1417]TRUE TRUE TRUE TRUE [1429] FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [1441] TRUE TRUE FALSE TRUE TRUE TRUE FALSE TRUE TRUE ## [1453] FALSE FALSE TRUE FALSE ## [1465] TRUE TRUE FALSE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [1477]TRUE TRUE FALSE ## [1489] **FALSE** TRUE ## [1501] TRUE ## [1513]TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [1525] TRUE ## [1537] TRUE TRUE

[1549] TRUE FALSE TRUE ## [1561] TRUE FALSE FALSE [1573] ## TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [1585] TRUE TRUE TRUE TRUE ## [1597] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [1609] TRUE [1621] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE [1633] TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## TRUE TRUE FALSE TRUE TRUE ## [1645] TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE [1657] TRUE TRUE TRUE TRUE FALSE FALSE ## [1669] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [1681] **FALSE** TRUE TRUE TRUE TRUE ## [1693] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [1705] TRUE ## [1717] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE ## [1729] TRUE FALSE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [1741] TRUE TRUE FALSE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [1753] TRUE ## [1765] TRUE ## [1777]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [1789] TRUE ## [1801] TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [1813] TRUE [1825] TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [1837] TRUE TRUE TRUE ## [1849] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [1861] TRUE [1873] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE FALSE FALSE TRUE ## TRUE [1885] TRUE TRUE TRUE TRUE FALSE TRUE ## TRUE TRUE FALSE TRUE TRUE TRUE [1897] TRUE TRUE TRUE TRUE ## TRUE ## [1909] TRUE ## [1921] TRUE [1933] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE FALSE FALSE [1945] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## ## [1957] TRUE ## [1969] TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [1981] TRUE ## [1993] FALSE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [2005] TRUE FALSE ## [2017] TRUE ## [2029] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [2041] TRUE [2053] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## TRUE TRUE TRUE ## [2065] TRUE ## [2077] TRUE [2089] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [2101] TRUE TRUE TRUE TRUE TRUE TRUE ## [2113] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [2125] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [2137] TRUE TRUE TRUE TRUE TRUE ## [2149] TRUE ## [2161] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [2173] TRUE ## [2185]TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE

[2197] TRUE ## [2209] TRUE FALSE TRUE ## [2221] TRUE [2233] TRUE TRUE TRUE TRUE TRUE ## TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [2245] TRUE FALSE TRUE ## [2257] TRUE ## [2269] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE FALSE [2281] TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [2293] TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE [2305] TRUE TRUE FALSE TRUE TRUE ## [2317] TRUE TRUE TRUE FALSE TRUE FALSE TRUE FALSE TRUE ## [2329] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [2341] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [2353] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [2365] TRUE ## [2377] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [2389] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [2401] TRUE ## [2413] **FALSE** TRUE ## [2425]TRUE TRUE ## [2437] TRUE FALSE TRUE ## [2449] TRUE ## [2461] TRUE FALSE TRUE [2473] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [2485] TRUE TRUE TRUE TRUE TRUE ## [2497] TRUE ## [2509] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE [2521] TRUE FALSE FALSE ## TRUE TRUE TRUE TRUE TRUE TRUE ## [2533] **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [2545] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [2557] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [2569] FALSE FALSE TRUE ## [2581] TRUE FALSE TRUE TRUE ## [2593] TRUE TRUE TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [2605] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE FALSE ## [2617] TRUE ## [2629] TRUE ## [2641] TRUE TRUE TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE ## [2653] TRUE ## [2665] TRUE FALSE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [2677] TRUE ## [2689] TRUE [2701] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE FALSE ## TRUE TRUE TRUE TRUE TRUE TRUE [2713] TRUE TRUE TRUE TRUE TRUE TRUE ## [2725] TRUE [2737] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE [2749] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE FALSE TRUE TRUE ## [2761] TRUE ## [2773] **FALSE** TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [2785] TRUE TRUE TRUE TRUE TRUE ## [2797] TRUE ## [2809] TRUE ## [2821] TRUE ## [2833] TRUE TRUE

[2845] FALSE TRUE ## TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [2857] ## [2869] TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE [2881] TRUE TRUE TRUE ## TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [2893] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE TRUE TRUE ## [2905] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [2917] TRUE TRUE TRUE TRUE TRUE TRUE [2929] TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE ## [2941] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## TRUE TRUE FALSE TRUE TRUE TRUE TRUE [2953] TRUE TRUE TRUE TRUE TRUE ## [2965] TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [2977] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [2989] TRUE ## [3001] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE ## [3013] TRUE ## [3025] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [3037] TRUE FALSE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [3049] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE FALSE TRUE TRUE [3061] ## TRUE FALSE ## [3073] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE FALSE TRUE FALSE ## [3085] FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [3097] FALSE TRUE ## [3109] TRUE FALSE TRUE [3121] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [3133] TRUE FALSE TRUE TRUE TRUE ## [3145]TRUE TRUE ## [3157] **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE [3169] TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [3181] TRUE TRUE FALSE FALSE TRUE TRUE [3193] TRUE TRUE TRUE ## TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [3205] TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE ## [3217] **FALSE** TRUE TRUE TRUE FALSE TRUE FALSE TRUE ## [3229] TRUE TRUE TRUE TRUE TRUE TRUE ## [3241] TRUE ## [3253] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [3265] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [3277]TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [3289] TRUE ## [3301] TRUE FALSE ## [3313] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE [3325]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## TRUE TRUE ## [3337] FALSE TRUE ## [3349] TRUE TRUE TRUE TRUE ## [3361] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE FALSE TRUE [3373] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [3385] **FALSE** TRUE ## [3397] TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [3409] TRUE FALSE TRUE ## [3421] TRUE TRUE TRUE FALSE TRUE ## [3433] TRUE TRUE TRUE TRUE ## [3445] **FALSE** TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [3457] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [3469] TRUE ## [3481] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE

[3493] TRUE ## [3505] TRUE ## [3517] TRUE ## [3529] TRUE TRUE TRUE TRUE FALSE FALSE TRUE TRUE ## [3541] TRUE ## [3553] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## [3565] TRUE [3577] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE ## [3589] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE [3601] TRUE TRUE FALSE TRUE TRUE TRUE ## [3613] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [3625] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [3637] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [3649] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [3661] TRUE ## [3673] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE ## [3685] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [3697] TRUE ## [3709] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [3721] TRUE ## [3733] TRUE ## [3745] TRUE ## [3757] FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE [3769] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [3781] TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE ## [3793] TRUE ## [3805] TRUE [3817] TRUE ## TRUE [3829] TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE [3841] TRUE TRUE TRUE TRUE TRUE ## TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [3853] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [3865] FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [3877] TRUE [3889] TRUE FALSE TRUE ## TRUE TRUE ## [3901] TRUE ## [3913] FALSE FALSE TRUE TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE ## [3925] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [3937] TRUE ## [3949] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [3961] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [3973] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [3985] TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE [3997] TRUE TRUE FALSE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## [4009] TRUE ## [4021] TRUE [4033] FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE FALSE [4045] TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE ## [4057]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [4069] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [4081] TRUE TRUE **FALSE** TRUE FALSE TRUE TRUE ## [4093] TRUE ## [4105]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [4117]TRUE TRUE ## [4129]TRUE FALSE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE

[4141] TRUE FALSE ## [4153]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE [4165]TRUE ## TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [4177]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [4189]TRUE TRUE ## [4201] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE [4213] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE [4225]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## TRUE TRUE TRUE ## [4237]TRUE TRUE ## TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE [4249]TRUE TRUE TRUE TRUE ## [4261] TRUE FALSE TRUE FALSE ## [4273] TRUE TRUE TRUE TRUE TRUE TRUE ## [4285] **FALSE** TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [4297]TRUE TRUE ## [4309] FALSE TRUE FALSE ## [4321] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [4333] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE FALSE TRUE ## [4345] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [4357]TRUE TRUE ## [4369]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [4381] TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [4393] TRUE ## [4405]TRUE TRUE [4417]TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE FALSE ## TRUE TRUE TRUE TRUE TRUE FALSE ## [4429]TRUE TRUE TRUE TRUE TRUE TRUE ## [4441]TRUE TRUE ## [4453]TRUE TRUE **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [4465] TRUE TRUE FALSE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [4477]TRUE TRUE FALSE TRUE TRUE FALSE [4489] TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE ## [4501] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [4513]TRUE TRUE [4525] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [4537] TRUE ## [4549] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [4561] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## [4573]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE ## [4585] FALSE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [4597] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE ## [4609] TRUE [4621] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE ## [4633]TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [4645]TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE FALSE TRUE ## [4657] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE FALSE FALSE TRUE TRUE ## [4669] TRUE [4681] FALSE TRUE TRUE FALSE TRUE TRUE ## TRUE TRUE TRUE TRUE FALSE TRUE [4693] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [4705]TRUE TRUE ## [4717]TRUE FALSE TRUE [4729] TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE **FALSE** FALSE TRUE TRUE ## [4741] TRUE ## [4753]TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [4765] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [4777] FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE

[4789] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [4801] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [4813]TRUE TRUE ## [4825]TRUE FALSE TRUE TRUE TRUE TRUE ## [4837] TRUE ## [4849] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [4861] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE [4873] TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE FALSE TRUE TRUE TRUE ## [4885]TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE [4897] **FALSE** TRUE TRUE TRUE FALSE ## [4909] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE [4921] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE [4933] TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [4945] TRUE ## [4957] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [4969] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## [4981] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [4993] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE FALSE TRUE TRUE ## [5005] TRUE ## [5017] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [5029] **FALSE** TRUE ## [5041] TRUE ## [5053] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE [5065] TRUE ## TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [5077] TRUE TRUE TRUE TRUE ## [5089] TRUE ## [5101] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE [5113] TRUE ## TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [5125] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [5137] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## [5149] **FALSE** TRUE TRUE FALSE FALSE TRUE FALSE TRUE FALSE TRUE FALSE TRUE ## [5161] TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [5173] TRUE TRUE TRUE TRUE TRUE TRUE ## [5185] FALSE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [5197] TRUE FALSE ## [5209] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [5221] FALSE TRUE ## [5233] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [5245] TRUE TRUE TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [5257] FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## [5269] TRUE TRUE TRUE TRUE TRUE TRUE TRUE **FALSE** TRUE TRUE TRUE TRUE ## [5281] FALSE TRUE [5293] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## TRUE ## [5305] TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE FALSE TRUE ## [5317] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE [5329] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE **FALSE** TRUE [5341] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE ## [5353] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [5365] TRUE ## [5377] TRUE TRUE TRUE TRUE TRUE TRUE ## [5389] **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [5401] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [5413] TRUE TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [5425] TRUE TRUE

[5437] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE TRUE ## [5449] TRUE ## [5461] TRUE ## [5473] TRUE TRUE TRUE TRUE ## [5485] TRUE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [5497] TRUE TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE ## [5509] TRUE FALSE TRUE [5521] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE ## [5533] TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE [5545] TRUE TRUE FALSE TRUE FALSE FALSE ## [5557] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [5569] TRUE FALSE TRUE TRUE [5581] TRUE TRUE TRUE ## TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [5593] TRUE ## [5605] TRUE ## [5617] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [5629] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [5641] TRUE ## [5653] **FALSE** TRUE ## [5665] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [5677] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [5689] TRUE ## [5701] TRUE [5713] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [5725] TRUE TRUE TRUE ## [5737] TRUE ## [5749] FALSE FALSE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE [5761] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [5773] FALSE TRUE TRUE TRUE TRUE [5785] TRUE TRUE TRUE TRUE TRUE ## TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [5797] TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE FALSE TRUE TRUE ## [5809] TRUE FALSE TRUE TRUE TRUE TRUE ## [5821] TRUE TRUE **FALSE** TRUE ## [5833] TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [5845] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE TRUE ## [5857] TRUE ## [5869] TRUE FALSE TRUE ## [5881] TRUE ## [5893] TRUE ## [5905] FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [5917] TRUE ## [5929] TRUE [5941] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [5953] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [5965] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE [5977] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE [5989] TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE FALSE ## [6001] TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6013] TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE ## [6025]TRUE TRUE TRUE FALSE TRUE TRUE ## [6037] TRUE FALSE ## [6049]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6061] FALSE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [6073]TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE FALSE

[6085] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [6097] TRUE ## [6109]TRUE TRUE ## [6121] TRUE TRUE TRUE TRUE ## [6133]TRUE TRUE ## [6145]TRUE TRUE [6157] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE [6169] TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE FALSE FALSE TRUE FALSE TRUE ## [6181] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE [6193] FALSE ## [6205] TRUE FALSE TRUE ## [6217] TRUE TRUE TRUE TRUE [6229] TRUE TRUE TRUE TRUE ## TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE ## [6241] TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [6253] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [6265] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [6277] TRUE ## [6289] TRUE ## [6301] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE ## [6313]TRUE TRUE ## [6325] TRUE ## [6337] TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE ## [6349] FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE [6361] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE TRUE ## TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE ## [6373]TRUE TRUE TRUE ## [6385] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [6397] TRUE TRUE **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [6409] TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE FALSE TRUE ## ## [6421] TRUE [6433] TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [6445]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6457] TRUE FALSE FALSE TRUE TRUE TRUE FALSE TRUE FALSE TRUE ## [6469] TRUE TRUE TRUE TRUE ## [6481] TRUE ## [6493] **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [6505] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6517]TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [6529] TRUE ## [6541] TRUE ## [6553] TRUE TRUE TRUE TRUE FALSE FALSE FALSE TRUE TRUE TRUE ## [6565] TRUE FALSE TRUE ## [6577] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE [6589] TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE ## [6601] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6613] TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE ## [6625] TRUE TRUE [6637] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE ## [6649] TRUE FALSE ## [6661] TRUE TRUE FALSE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [6673] TRUE TRUE TRUE TRUE TRUE TRUE ## [6685] TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE FALSE TRUE TRUE [6697] TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## [6709] TRUE [6721] TRUE ## TRUE TRUE

[6733] TRUE ## [6745]TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6757]TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [6769] TRUE TRUE TRUE TRUE TRUE TRUE ## [6781] TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE TRUE TRUE FALSE TRUE ## [6793] TRUE ## [6805] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE [6817] TRUE FALSE TRUE TRUE ## TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [6829] TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [6841] TRUE TRUE TRUE TRUE ## [6853] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE FALSE FALSE TRUE ## [6865] TRUE FALSE TRUE TRUE TRUE ## [6877] TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6889] TRUE ## [6901] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE **FALSE** TRUE TRUE FALSE ## [6913] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE ## [6925] TRUE ## [6937] TRUE ## [6949] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [6961] TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [6973] TRUE ## [6985] FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE **FALSE** TRUE TRUE TRUE TRUE ## [6997] FALSE TRUE TRUE TRUE FALSE TRUE TRUE FALSE TRUE TRUE TRUE [7009] TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [7021] TRUE TRUE TRUE TRUE ## [7033] FALSE TRUE ## [7045] FALSE TRUE **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE [7057] **FALSE** TRUE ## TRUE [7069] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE [7081] TRUE TRUE TRUE TRUE ## TRUE ## [7093] **FALSE** TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [7105] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE [7117] TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE TRUE TRUE TRUE TRUE [7129] TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## ## [7141]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [7153] TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE ## [7165]TRUE TRUE ## [7177]TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [7189] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [7201] TRUE TRUE TRUE TRUE FALSE TRUE FALSE TRUE TRUE TRUE TRUE [7213]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE TRUE ## [7225] FALSE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE FALSE TRUE [7237] TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE ## TRUE TRUE TRUE ## [7249] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE ## [7261] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE [7273] TRUE ## TRUE [7285] FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## TRUE ## TRUE [7297]TRUE ## [7309] FALSE TRUE TRUE TRUE FALSE TRUE TRUE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [7321] TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE ## [7333] FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE ## [7345]TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE ## [7357] TRUE [7369] ## TRUE TRUE TRUE FALSE TRUE TRUE TRUE TRUE FALSE TRUE TRUE TRUE

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What is your conclusion?

Answer: the true value are containing in approximately 92%.

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4. Repeat the steps in Question 3, but using a sample size of n = 100.
 container=logical(1e4)
 for(i in 1:1e4)
 X=rexp(100,1)
my.test=t.test(X,conf.level=0.95)
 container[i]=ifelse(my.test$p.value<0.05, "Yes", "No")</pre>
 table(container)
## container
                                                       Yes
 ## 10000
container ## printing the values of container (sometimes it may print till 1000 and omits other values)
                                                                                [1] "Yes" "Y
##
                                                                        [13] "Yes" "
##
                                                                                                                        "Yes" 
 ##
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[37] "Yes" "
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[337] "Yes" 
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[985] "Yes" 
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  ##
```

What is your conclusion?

Answer: approx 94% does theinterval contain the true value of 'mu'

5. Set $\mu_1 = 0$, $\sigma_1 = 3$, $\mu_2 = 1$, and $\sigma_2 = 2$. Generate one sample X of $n_1 = 20$ random numbers from $\mathcal{N}(\mu_1, \sigma_1^2)$ and another sample Y of $n_2 = 25$ random numbers from $\mathcal{N}(\mu_2, \sigma_2^2)$. Perform a two-sample t-test for difference of means.

```
X = rnorm(n=20, mean=0, sd=3)
Y = rnorm(n=25, mean=1, sd=2)
my.test = t.test(X,Y)
my.test
##
##
    Welch Two Sample t-test
##
## data: X and Y
## t = -1.5655, df = 37.518, p-value = 0.1259
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
## -2.4257530 0.3105955
## sample estimates:
## mean of x mean of y
## -0.5170883 0.5404905
my.ans = ifelse(my.test$p.value < 0.05,"Yes","No")</pre>
```

Does the test reject the null hypothesis $H_0: \mu_1 = \mu_2$ at the level of significance $\alpha = 0.05$?

Answer: No

6. Repeat the computation in Question 5 10,000 times. Store in a logical vector of length 10,000 whether the null hypothesis is rejected at the level $\alpha = 0.05$ or not.

```
m=1e4
result= logical(m)
for(i in 1:m){
X=rnorm(n=20,mean=0,sd=3)
Y=rnorm(n=25,mean=1,sd=2)
my.test=t.test(X,Y)
my.test
result[i]=ifelse(my.test$p.value < 0.05, "Yes", "No")
}
table(result)
## result
   No Yes
## 7671 2329
result
##
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```

What is the proportion of times that the null hypothesis is rejected? (This proportion, interpreted as a probability, is the *power* of the test.)

Answer:approximately 7567 times is is becoming false and 2400 times true

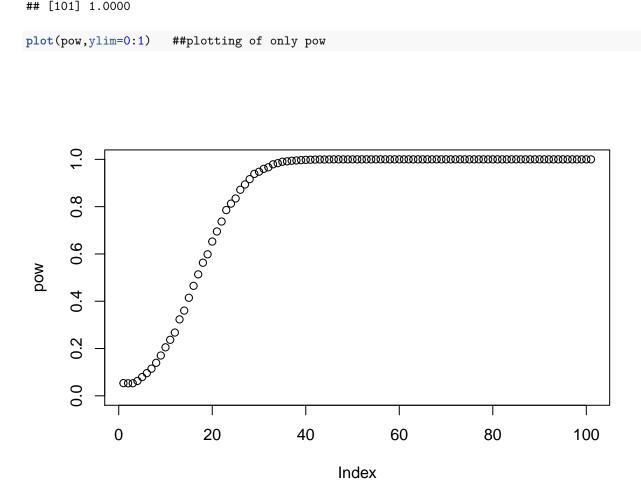
7. Repeat the computations in Question 6 for each of these values of μ_2 : 0, 0.1, 0.2, 0.3, ..., 10. Plot the resulting power curve (power vs. μ_2).

```
m=1e4
mu2s=seq(0,10,bv=0.1)
pow=numeric(length(mu2s))
for(j in 1:length(mu2s))
  result=logical(m)
  for(i in 1:m)
    {
    X=rnorm(n=20,mean=0,sd=3)
    Y=rnorm(n=25,mean=mu2s[j],sd=2)
    my.test=t.test(X,Y)
    my.test
    result[i]=my.test$p.value<0.05
  }
  pow[j]=mean(result)
}
pow #to know the pow values
```

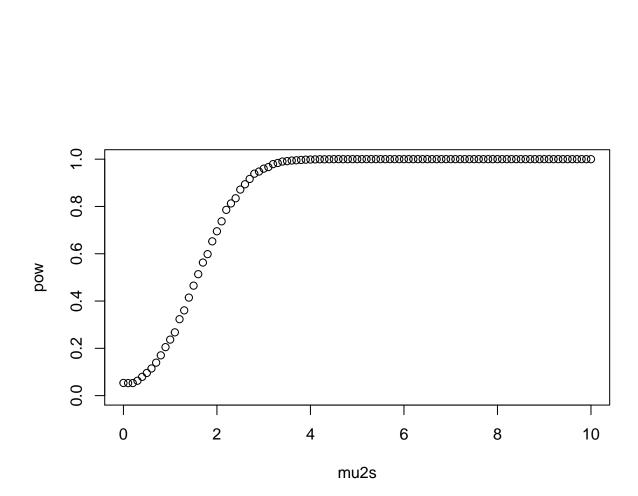
```
## [1] 0.0536 0.0529 0.0531 0.0629 0.0793 0.0958 0.1148 0.1395 0.1704 0.2051
## [11] 0.2369 0.2676 0.3232 0.3605 0.4146 0.4651 0.5136 0.5628 0.5984 0.6524
## [21] 0.6951 0.7371 0.7856 0.8128 0.8347 0.8715 0.8939 0.9164 0.9386 0.9477
```

```
[31] 0.9599 0.9665 0.9791 0.9839 0.9899 0.9917 0.9942 0.9953 0.9968 0.9980
   [41] 0.9985 0.9990 0.9996 0.9994 0.9996 1.0000 1.0000 0.9999 0.9999 1.0000
##
   [51] 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
##
##
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   [71] 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
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##
  [91] 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
## [101] 1.0000
```

plot(pow,ylim=0:1)



plot(mu2s,pow,ylim=0:1) ## plotting of mu2s and pow



What are your conclusions?

Answer:in the above question we have plotted a graph in between mu2s and power. and i can conclude that for most of the cases in null hypothesis can be true only in one way buut can be false in many ways.