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```
clear all; close all;
randn('seed', 0);
```

Problem 5.1a Textbook p.316

```
mu1 = 0; sigma1 = 1; n1 = 100;
N1 = normrnd(mu1, sigma1, [n1 1]);

mu2 = 2; sigma2 = 1; n2 = 100;
N2 = normrnd(mu2, sigma2, [n2 1]);

[H, rho] = ttest2(N1, N2);
sprintf("For N1=N(%.2f,%.2f), %d samples and N2=N(%.2f,%.2f), %d
 samples, H and P are: %d, %.4f", ...
    mu1, sigma1, n1, mu2, sigma2, n2, H, rho)
```

```
ans =

    "For N1=N(0.00,1.00), 100 samples and N2=N(2.00,1.00), 100
 samples, H and P are: 1, 0.0000"
```

Problem 5.1b Textbook p.316

```
mu1 = 0; sigma1 = 1; n1 = 100;
N1 = normrnd(mu1, sigma1, [n1 1]);

mu2 = 0.2; sigma2 = 1; n2 = 100;
N2 = normrnd(mu2, sigma2, [n2 1]);

[H, rho] = ttest2(N1, N2);
sprintf("For N1=N(%.2f,%.2f), %d samples and N2=N(%.2f,%.2f), %d
 samples, H and P are: %d, %.4f", ...
    mu1, sigma1, n1, mu2, sigma2, n2, H, rho)
```

```
ans =

    "For N1=N(0.00,1.00), 100 samples and N2=N(0.20,1.00), 100
 samples, H and P are: 0, 0.1604"
```

Problem 5.1c Textbook p.316 part 1

```
mu1 = 0; sigma1 = 1; n1 = 150;
N1 = normrnd(mu1, sigma1, [n1 1]);

mu2 = 2; sigma2 = 1; n2 = 200;
N2 = normrnd(mu2, sigma2, [n2 1]);

[H, rho] = ttest2(N1, N2);
sprintf("For N1=N(%.2f,%.2f), %d samples and N2=N(%.2f,%.2f), %d
 samples, H and P are: %d, %.4f", ...
    mu1, sigma1, n1, mu2, sigma2, n2, H, rho)
```

```
ans =

    "For N1=N(0.00,1.00), 150 samples and N2=N(2.00,1.00), 200
 samples, H and P are: 1, 0.0000"
```

Problem 5.1c Textbook p.316 part 2

```
mu1 = 0; sigma1 = 1; n1 = 150;
N1 = normrnd(mu1, sigma1, [n1 1]);

mu2 = 0.2; sigma2 = 1; n2 = 400;
N2 = normrnd(mu2, sigma2, [n2 1]);

[H, rho] = ttest2(N1, N2);
sprintf("For N1=N(%.2f,%.2f), %d samples and N2=N(%.2f,%.2f), %d
 samples, H and P are: %d, %.4f", ...
    mu1, sigma1, n1, mu2, sigma2, n2, H, rho)
```

```
ans =

    "For N1=N(0.00,1.00), 150 samples and N2=N(0.20,1.00), 400
 samples, H and P are: 1, 0.0487"
```

Problem 5.1c Textbook p.316 verification

```
mu1 = 0; sigma1 = 1; n1 = 150;
N1 = normrnd(mu1, sigma1, [n1 1]);

mu2 = 0.2; sigma2 = 1; n2 = 400;
N2 = normrnd(mu2, sigma2, [n2 1]);
```

```
[H, rho] = ttest2(N1, N2);
sprintf("For N1=N(%.2f,%.2f), %d samples and N2=N(%.2f,%.2f), %d
 samples, H and P are: %d, %.4f", ...
    mu1, sigma1, n1, mu2, sigma2, n2, H, rho)
```

```
ans =

    "For N1=N(0.00,1.00), 150 samples and N2=N(0.20,1.00), 400
 samples, H and P are: 0, 0.0782"
```

Conclusion for Problem 5.1

```
% In this problem, MATLAB's ttest2 function, which performs t-test on
 2
% samples (assuming they come from the Normal Distribution with the
 null
% hypothesis that the they have equal means: H=0 means
% that the null hypothesis "cannot be rejected at the 5% signifiance
% level". H=1 means that the null hypothesis "can be rejected at the
 5%
% level". For part A, since the means of the 2 samples are far apart
 (0 and
% 2), H=1 -- the 2 data sets have significantly different means. when
 the 2
% means are very close (0 and 0.2) in part B, the t-test results in
 H=0 --
% the 2 data sets' means are not significantly different. In part C,
 the
% same results come out of the t-test for the 2 cases. However, in the
% case where the means are very close, as the number of points in data
 set
% 2 increases and that of data set 1 stays the same, rho
% ("the probability of observing the given result, or one more
% extreme, by chance if the null hypothesis is true") decreases and
 H=1
% (shown in the verification part of 5.1c). This observation is
 consistent
% to the intuition that the more points in a data set, the better the
% chances that the mean of such data set equal to the TRUE mean.
```

Answering question on how the table 5.1 in Textbook p.271 got generated

```
% Since the t-test statistic is q = (sample mean - given mean)/(sample
% variance/sqrt(N)), a distribution that's made up of this statistical
% variable can be made by considering the Central Limit Theorem --
 N(given
% mean, sample variance^2/N). When N tends to infinity, this
 distribution
```

```
% tends toward the Normal Distribution with 0 mean and unit variance.
% Hence, the acceptance interval in table 5.1 can be calculated using
% N(0,1) and 1-rho (a.k.a the ratio of the area under the curve vs the
 area
% of the entire distribution) => The 95% confidence interval -- or,
 the
% 5% acceptance interval is 1.967.
```

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