Congratulations! You passed!

TO PASS 80% or higher

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Quiz 4

LATEST SUBMISSION GRADE

100%

1. A pharmaceutical company is interested in testing a potential blood pressure lowering medication. Their first examination considers only subjects that received the medication at baseline then two weeks later. The data are as follows (SBP in mmHg)

1 / 1 point

Subject	Baseline	Week 2
1	140	132
2	138	135
3	150	151
4	148	146
5	135	130

Consider testing the hypothesis that there was a mean reduction in blood pressure? Give the P-value for the associated two sided T test.

(Hint, consider that the observations are paired.)

- ○ 0.043
- ○ 0.05
- ○ 0.10
- ◉ 0.087

Correct

$H_0 : \mu_d = 0$ versus $H_0 : \mu_d \neq 0$ where μ_d is the mean difference between followup and baseline.

```
bl <- c(140, 138, 150, 148, 135)
fu <- c(132, 135, 151, 146, 130)
t.test(fu, bl, alternative = "two.sided", paired = TRUE)
```

```
Paired t-test
data: fu and bl
t = -2.262, df = 4, p-value = 0.08652
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-7.5739 0.7739
sample estimates:
mean of the differences
-3.4
```

Note the equivalence with this

```
t.test(fu - bl, alternative = "two.sided")
```

```
One Sample t-test
data: fu - bl
t = -2.262, df = 4, p-value = 0.08652
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
-7.5739 0.7739
sample estimates:
mean of x
-3.4
```

Note the difference if the test were one sided

```
-t.test(fu, bl, alternative = "less", paired = TRUE)
```

```
Paired t-test
data: fu and bl
t = -2.262, df = 4, p-value = 0.04326
alternative hypothesis: true difference in means is less than 0
95 percent confidence interval:-Inf -0.1951
sample estimates:
mean of the differences
-3.4
```

2. A sample of 9 men yielded a sample average brain volume of 1,100cc and a standard deviation of 30cc. What is the complete set of values of μ_0 that a test of $H_0 : \mu = \mu_0$ would fail to reject the null hypothesis in a two sided 5% Students t-test?

1 / 1 point

- ○ 1080 to 1120

◯ 1081 to 1119

◉ 1077 to 1123

◯ 1031 to 1169

Correct

This is the 95% student's T confidence interval.

```
1100 + c(-1, 1) * qt(0.975, 8) * 30/sqrt(9)
```

```
[1] 1077 1123
```

Potential incorrect answers

```
1100 + c(-1, 1) * qnorm(0.975) * 30/sqrt(9)
```

```
[1] 1080 1120
```

```
1100 + c(-1, 1) * qt(0.95, 8) * 30/sqrt(9)
```

```
[1] 1081 1119
```

```
1100 + c(-1, 1) * qt(0.975, 8) * 30
```

```
[1] 1031 1169
```

3. Researchers conducted a blind taste test of Coke versus Pepsi. Each of four people was asked which of two blinded drinks given in random order that they preferred. The data was such that 3 of the 4 people chose Coke. Assuming that this sample is representative, report a P-value for a test of the hypothesis that Coke is preferred to Pepsi using a one sided exact test. **1 / 1 point**

◯ 0.62

◉ 0.31

◯ 0.005

◯ 0.10

Correct

Let p be the proportion of people who prefer Coke. Then, we want to test

$H_0 : p = .5$ versus $H_a : p > .5$. Let X be the number out of 4 that prefer

Coke; assume $X \sim Binomial(p, .5)$.

$Pvalue = P(X \geq 3) = \text{choose}(4,3)0.5^3 0.5^1 + \text{choose}(4,4)0.5^4 0.5^0$

```
pbinom(2, size = 4, prob = 0.5, lower.tail = FALSE)
```

```
[1] 0.3125
```

```
choose(4, 3) * 0.5^4 + choose(4, 4) * 0.5^4
```

```
[1] 0.3125
```

4. Infection rates at a hospital above 1 infection per 100 person days at risk are believed to be too high and are used as a benchmark. A hospital that had previously been above the benchmark recently had 10 infections over the last 1,787 person days at risk. About what is the one sided P-value for the relevant test of whether the hospital is *below* the standard? **1 / 1 point**

◉ 0.03

◯ 0.22

- 0.11
- 0.52

✓ **Correct**

$H_0 : \lambda = 0.01$ versus $H_a : \lambda < 0.01$. $X = 11, t = 1,787$ and assume $X \sim_{H_0} Poisson(0.01 \times t)$

```
ppois(10, lambda = 0.01 * 1787)
```

```
## [1] 0.03237
```

5. Suppose that 18 obese subjects were randomized, 9 each, to a new diet pill and a placebo. Subjects' body mass indices (BMIs) were measured at a baseline and again after having received the treatment or placebo for four weeks. The average difference from follow-up to the baseline (followup - baseline) was −3 kg/m2 for the treated group and 1 kg/m2 for the placebo group. The corresponding standard deviations of the differences was 1.5 kg/m2 for the treatment group and 1.8 kg/m2 for the placebo group. Does the change in BMI appear to differ between the treated and placebo groups? Assuming normality of the underlying data and a common population variance, give a pvalue for a two sided t test.

1 / 1 point

- Less than 0.10 but larger than 0.05
- Less than 0.05, but larger than 0.01
- Larger than 0.10
- (selected) Less than 0.01

✓ **Correct**

$$H_0 : \mu_{difference,treated} = \mu_{difference,placebo}$$

```
n1 <- n2 <- 9
x1 <- -3 ##treated
x2 <- 1 ##placebo
s1 <- 1.5 ##treated
s2 <- 1.8 ##placebo
s <- sqrt(((n1 - 1) * s1^2 + (n2 - 1) * s2^2)/(n1 + n2 - 2))
ts <- (x1 - x2)/(s * sqrt(1/n1 + 1/n2))
2 * pt(ts, n1 + n2 - 2)
```

```
[1] 0.0001025
```

6. Brain volumes for 9 men yielded a 90% confidence interval of 1,077 cc to 1,123 cc. Would you reject in a two sided 5% hypothesis test of

1 / 1 point

$H_0 : \mu = 1,078$?

- It's impossible to tell.
- Yes you would reject.
- (selected) No you wouldn't reject.
- Where does Brian come up with these questions?

✓ **Correct**

No, you would fail to reject. The 95% interval would be wider than the 90% interval. Since 1,078 is in the narrower 90% interval, it would also be in the wider 95% interval. Thus, in either case it's in the interval and so you would fail to reject.

7. Researchers would like to conduct a study of 100 healthy adults to detect a four year mean brain volume loss of $.01\ mm^3$. Assume that the standard deviation of four year volume loss in this population is $.04\ mm^3$. About what would be the power of the study for a 5% one sided test versus a null hypothesis of no volume loss?

1 / 1 point

- 0.50
- 0.60
- 0.70
- (selected) 0.80

✓ **Correct**

The hypothesis is $H_0 : \mu_\Delta = 0$ versus $H_a : \mu_\Delta > 0$ where μ_Δ is volume loss (change defined as Baseline - Four Weeks). The test statistics is $10 \frac{\bar{X}_\Delta}{.04}$ which is rejected if it is larger than $Z_{.95} = 1.645$.

We want to calculate

$$P\left(\frac{\bar{X}_\Delta}{\sigma_\Delta/10} > 1.645 \mid \mu_\Delta = .01\right) = P\left(\frac{\bar{X}_\Delta - .01}{.004} > 1.645 - \frac{.01}{.004} \mid \mu_\Delta = .01\right) = P(Z > -.855) = .80$$

Or note that $\bar{X}_\Delta$ is $N(.01, .004)$ under the alternative and we want the $P(\bar{X}_\Delta > 1.645 * .004)$ under H_a.

```
pnorm(1.645 * 0.004, mean = 0.01, sd = 0.004, lower.tail = FALSE)
```

```
pnorm(1.645 * 0.004, mean = 0.01, sd = 0.004, lower.tail = FALSE)
```

```
[1] 0.8037
```

8. Researchers would like to conduct a study of n healthy adults to detect a four year mean brain volume loss of $.01\ mm^3$. Assume that the standard deviation of four year volume loss in this population is $.04\ mm^3$. About what would be the value of n needed for 90% power of type one error rate of 5% one sided test versus a null hypothesis of no volume loss?

1 / 1 point

- (x) 140
- ( ) 120
- ( ) 180
- ( ) 160

Correct

The hypothesis is $H_0 : \mu_\Delta = 0$ versus $H_a : \mu_\Delta > 0$ where μ_Δ is volume loss (change defined as Baseline - Four Weeks). The test statistics is $\frac{\bar X_\Delta}{.04/\sqrt{n}}$ which is rejected if it is larger than $Z_{.95} = 1.645$.

We want to calculate

$$P\left(\frac{\bar X_\Delta}{\sigma_\Delta/\sqrt{n}} > 1.645 \mid \mu_\Delta = .01\right) = P\left(\frac{\bar X_\Delta - .01}{.04/\sqrt{n}} > 1.645 - \frac{.01}{.04/\sqrt{n}} \mid \mu_\Delta = .01\right) = P(Z > 1.645 - \sqrt{n}/4) = .90$$

So we need $1.645 - \sqrt{n}/4 = Z_{.10} = -1.282$ and thus

$n = (4 * (1.645 + 1.282))^2$.

```
ceiling((4 * (qnorm(0.95) - qnorm(0.1)))^2)
```

```
[1] 138
```

9. As you increase the type one error rate, α, what happens to power?

1 / 1 point

- (x) You will get larger power.
- ( ) No, for real, where does Brian come up with these problems?
- ( ) It's impossible to tell given the information in the problem.
- ( ) You will get smaller power.

Correct

As you require less evidence to reject, i.e. your α rate goes up, you will have larger power.