Statistical Inference - Quiz 04

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Quiz 04

Attempts	Score
1/3	9/9

Question 01

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)

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.)

Answer

- 0.087

Explanation

```
pharm <- data.frame(baseline = c(140, 138, 150, 148, 135), week2 = c(132, 135, 151, 146, 130))
t.test(pharm$baseline, pharm$week2, alternative = "two.sided", paired = T)
```

```
##
##  Paired t-test
##
## data:  pharm$baseline and pharm$week2
## t = 2.2616, df = 4, p-value = 0.08652
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.7739122  7.5739122
## sample estimates:
## mean of the differences
##                     3.4
```

Question 02

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?

Answer

- 1077 to 1123

Explanation

```
n <- 9
mu <- 1100
sd <- 30
alpha <- .05
tstat <- qt(1 - alpha/2, n - 1)
mu + c(-1, 1)*tstat*sd / sqrt(n)
```

```
## [1] 1076.94 1123.06
```

Question 03

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.

Answer

- 0.31

Explanation

```
library(stats)
binom.test(x = 3, n = 4, p = .5, alt = "greater")
```

```
##
##  Exact binomial test
##
## data:  3 and 4
## number of successes = 3, number of trials = 4, p-value = 0.3125
## alternative hypothesis: true probability of success is greater than 0.5
## 95 percent confidence interval:
##  0.2486046 1.0000000
## sample estimates:
## probability of success
##                   0.75
```

Question 04

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?

Answer

- 0.03

Explanation

```
p <- 1 / 100
pr <- 10 / 1787
n <- 1787
error <- sqrt(p * (1-p) / n)
z <- (p-pr) / error
pnorm(z, lower.tail = F)
```

```
## [1] 0.03066625
```

Question 05

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 `p-value` for a two-sided `t-test`.

Answer

- Less than 0.01

Explanation

```
n1 <- 9
n2 <- 9
df <- n1 + n2 - 2
meanTreat <- -3
meanPlacebo <- 1
sdTreat <- 1.5
sdPlacebo <- 1.8
pooledVar <- (sdTreat^2 * n1 + sdPlacebo^2 * n2)/df
se.diff <- sqrt(pooledVar/n1 + pooledVar/n2)
tstat <- (meanTreat - meanPlacebo) / se.diff
pValue <- 2 * pt(tstat, df = df)
pValue
```

```
## [1] 0.0001852248
```

Question 06

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 $H_0 : \mu = 1,078$?

Answer

- No you wouldn't reject.

Explanation

The 95% confidence interval contains 90% confidence interval. $\mu = 1,078$ falls within 90% confidence interval and hence we don't reject H_0.

Question 07

Researchers would like to conduct a study of 100 healthy adults to detect a four year mean brain volume loss of .01 mm3. Assume that the standard deviation of four year volume loss in this population is .04 mm3. About what would be the power of the study for a 5% one sided test versus a null hypothesis of no volume loss?

Answer

- 0.80

Explanation

```
n <- 100
mu <- .01
sd <- .04
power.t.test(n, delta = mu, sd = sd, type = "one.sample", alt = "one.sided")$power
```

```
## [1] 0.7989855
```

Question 08

Researchers would like to conduct a study of n healthy adults to detect a four year mean brain volume loss of .01 mm3. Assume that the standard deviation of four year volume loss in this population is .04 mm3. About what would be the value of n needded for 90% power of type one error rate of 5% one sided test versus a null hypothesis of no volume loss?

Answer

- 140

Explanation

```r
mu <- .01
sd <- .04
power <- .9
power.t.test(power = power, delta = mu, sd = sd, type = "one.sample", alt = "one.sided")$n
```

```
## [1] 138.3856
```

Question 09

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

Answer

- You will get larger power.

Explanation

As you increase the type one error rate α, or use one-sided test instead of two-sided test or increase n, power will get larger.