1-sample Hypothesis Tests

Module 9 review

Statistics 251: Statistical Methods

Checklist

(1) State hypotheses, check assumptions if requested
(2) State t statistic, df, and $pvalue$ from output
(3) State test results
(4) Make conclusion in context from results
(5) State possible error that could have been made and discuss it within the context

Silicon dioxide

The desired average amount of silicon dioxide (SiO2) in a certain type of aluminous cement is 5.5. To test whether the true average percentage is 5.5 for a certain facility, 16 independently obtained random samples are analyzed; percentage of SiO2 is normally distributed. Is there sufficient evidence the true average percentage of SiO2 differs from 5.5?

```
t.test(sio2,mu=5.5)
```

```
    One Sample t-test

data:  sio2
t = -2.4544, df = 15, p-value = 0.02681
alternative hypothesis: true mean is not equal to 5.5
95 percent confidence interval:
 5.129985 5.473945
sample estimates:
mean of x
 5.301965
```

Silicon dioxide

$$H_0 : \mu = 5.5 \;\; vs. \;\; H_a : \mu \neq 5.5$$

Assumptions:
(1) Independence: random so yes
(2) Randomization: yes
(3) Normality: stated SiO_2 were normal so yes

Organization of information:
$\mu_0 = 5.5$ (claimed mean)
$n = 16$ (acceptable because SiO_2 is normal)
$H_a : \;\neq$ (two tail test)
$\alpha = 0.05$ (assumed because not specifically stated otherwise)

Silicon dioxide

$t = -2.4544$, $df = 15$, $pvalue = 0.02681$

Results: $pvalue = 0.02681 \leq \alpha(0.05) \therefore$ (therefore) H_0 is rejected

Conclusion: since the null is rejected, there is sufficient evidence the true mean percentage of SiO_2 differs from 5.5. Results are significant.

Error: since H_0 was rejected, a Type I error (reject null when null is true) could have been made; we think the SiO_2 is different that 5.5 but it is not.

Pupil reaction times

In an experiment designed to measure the time necessary for an inspector's eyes to become used to the reduced amount of light necessary for penetrate inspection, assuming a random sample of adaptation times ($n = 9$) shows an approximate normal distribution. It was previously assumed that the average adaption time was about 7 seconds. Is there evidence the adaptation time differs from the usual 7 seconds? Let $\alpha = 0.1$.

```
t.test(eyes,mu=7,conf.level=.9)
```

```
    One Sample t-test

data:  eyes
t = 0.44436, df = 8, p-value = 0.6686
alternative hypothesis: true mean is not equal to 7
90 percent confidence interval:
 5.866778 8.844861
sample estimates:
mean of x
 7.355819
```

Pupil reaction times

$$H_0 : \mu = 7 \quad vs. \quad H_a : \mu \neq 7$$

Assumptions:
(1) Independence: random so yes
(2) Randomization: yes
(3) Normality: stated reaction times were normal so yes

Organization of information:
$\mu_0 = 7$ (claimed mean)
$n = 9$ (acceptable because reaction times are normal)
$H_a : \ \neq$ (two tail test)
$\alpha = 0.1$ (specifically stated)

Pupil reaction times

$t = 0.44436$, $df = 8$, $pvalue = 0.6686$

Results: $pvalue = 0.6686 \nleq \alpha(0.05) \therefore$ H_0 is not rejected

Conclusion: since the null is not rejected, mean pupil reaction times are not significantly different from 7 seconds. Results are not significant.

Error: since H_0 was not rejected, a Type II error (failing to reject null when null is false) could have been made; we think the reaction times are not different than 7 seconds but they are.

DMV exams

State DMV records indicate that of all vehicles undergoing emissions testing during the previous year, 70% passed on the first try. A random sample of 200 cars tested in a particular county during the current year yields 124 that passed on the initial test. Does this suggest that the true proportion for this county during the current year differs from the previous statewide proportion?

```
t.test(dmv,mu=.7)
```

```
    One Sample t-test

data:  dmv
t = -2.325, df = 199, p-value = 0.02108
alternative hypothesis: true mean is not equal to 0.7
95 percent confidence interval:
 0.5521487 0.6878513
sample estimates:
mean of x
     0.62
```

DMV exams

$$H_0 : \pi = 0.7 \;\; vs. \;\; H_a : \pi \neq 0.7$$

Assumptions:
(1) Independence: random so yes
(2) Randomization: yes
(3) Normality: $n = 200 \geq 60 \;\; \therefore$ met

Organization of information:
$\pi_0 = 0.7$ (claimed proportion (which is a mean))
$n = 200$ (acceptable because $n = 200 \geq 60$)
$H_a : \;\; \neq$ (two tail test)
$\alpha = 0.05$ (assumed because not specifically stated otherwise)

DMV exams

$t = -2.325$, $df = 199$, $pvalue = 0.02108$

Results: $pvalue = 0.02108 \leq \alpha(0.05) \therefore \; H_0$ is rejected

Conclusion: since the null is rejected, there is sufficient evidence to suggest that the true proportion for this county during the current year differs from the previous statewide proportion of 70%. Results are significant.

Error: since H_0 was rejected, a Type I error (reject null when null is true) could have been made; we think the proportion for this county during the current year differs from the previous statewide proportion when it does not