

Stat 312: Lecture 15

P -values

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1. The P -value is the smallest level of significance at which H_0 would be rejected.

Example 8.5, 8.15. Nicotine contents $X_1, \dots, X_{32}$ of cigarettes follow $N(\mu, 0.2^2)$. We are interested in testing if

$$H_0 : \mu = 1.5 \text{ vs. } H_1 : \mu > 1.5.$$

Assume $\bar{x} = 1.57$. Given α level, the corresponding rejection regions are given by

```
> -qnorm(0.05)
[1] 1.644854
> -qnorm(0.025)
[1] 1.959964
> -qnorm(0.01)
[1] 2.326348
> -qnorm(0.005)
[1] 2.575829
```

```
> (1.57-1.5)/(0.2/sqrt(32))
[1] 1.979899
```

```
> 1-pnorm(1.979899)
[1] 0.02385744
```

2. $P\text{-value} \leq \alpha \rightarrow \text{reject } H_0 \text{ at level } \alpha.$
 $P\text{-value} > \alpha \rightarrow \text{do not reject } H_0 \text{ at level } \alpha.$
The smaller the P -value, the easier to reject H_0 .

Example. Dog IQ example.

```
> t.test(x,mu=100,alternative="less",
  conf.level=0.95)
      One Sample t-test
data:  x t = -4.2036, df = 9,
p-value = 0.001147
alternative hypothesis: true mean is
```

```
less than 100
95 percent confidence interval:
 -Inf 78.8531
sample estimates: mean of x 62.5
```

3. P -value computation for two sided tests. Let us continue the nicotine content example and find the P -value for testing

$$H_0 : \mu = 1.5 \text{ vs. } H_1 : \mu \neq 1.5.$$

```
> 2*(1-pnorm(1.979899))
[1] 0.04771488
```

Review Problems. Example 8.17., 8.18.