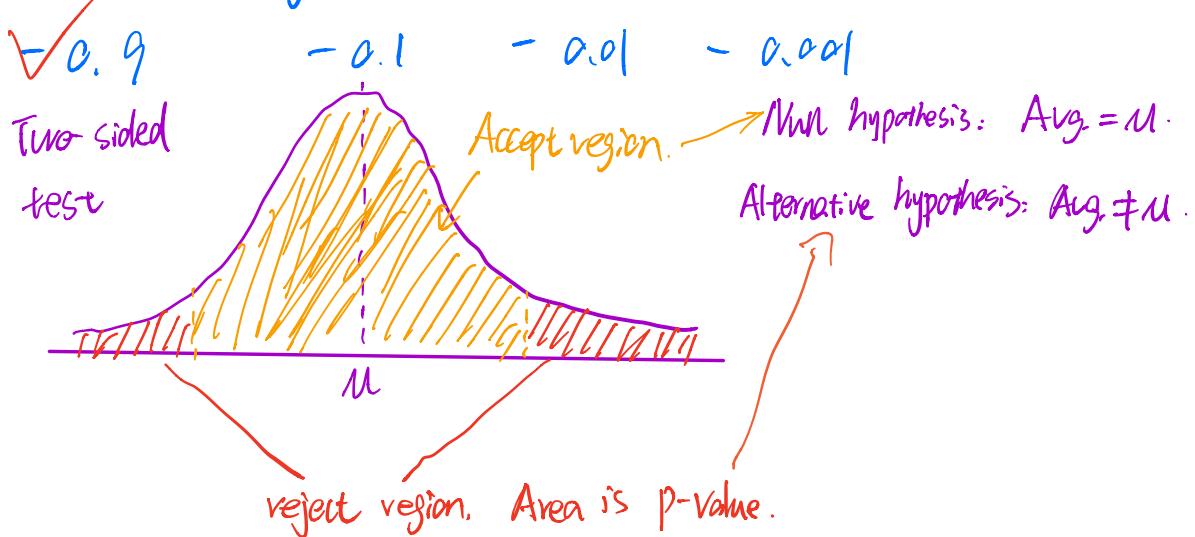


Quiz 9 review.

1. Which of the following P-values is most suggestive of the alternative hypothesis?

- 0.001 - 0.01 - 0.1 - 0.9

2. Which of the following P-values is most suggestive of the null hypothesis?



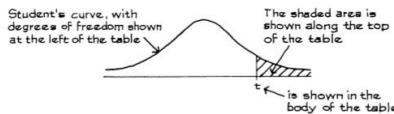
3. A carmaker seeks to design a new vehicle that has better gas mileage than the industry standard of

30 miles per gallon. The carmaker will measure the gas mileage in 100 of these new vehicles. What should be the carmaker's statistical null hypothesis?

- The new vehicle's gas mileage is 30 miles per gallon.
- The new vehicle's gas mileage is greater than 30 miles per gallon
- The new vehicle's gas mileage is 35 miles per gallon
- The new vehicle's gas mileage is less than 25 miles per gallon.

4. Which of the following is the area to the right of 4.30 under the student's t curve with two degrees of freedom?

- 0.025 (2.5%)
- 0.01 (1.0%)
- less than .01 (less than 1%)
- more than .05 (more than 5%)

A *t*-TABLE

Degrees of freedom	25%	10%	5%	2.5%	1%	0.5%
1	1.00	3.08	6.31	12.71	31.82	63.66
2	0.82	1.89	2.92	4.30	6.96	9.92
3	0.76	1.64	2.35	3.18	4.54	5.84
4	0.74	1.53	2.13	2.78	3.75	4.60
5	0.73	1.48	2.02	2.57	3.36	4.03
6	0.72	1.44	1.94	2.45	3.14	3.71
7	0.71	1.41	1.89	2.36	3.00	3.50
8	0.71	1.40	1.86	2.31	2.90	3.36
9	0.70	1.38	1.83	2.26	2.82	3.25
10	0.70	1.37	1.81	2.23	2.76	3.17
11	0.70	1.36	1.80	2.20	2.72	3.11
12	0.70	1.36	1.78	2.18	2.68	3.05
13	0.69	1.35	1.77	2.16	2.65	3.01
14	0.69	1.35	1.76	2.14	2.62	2.98
15	0.69	1.34	1.75	2.13	2.60	2.95
16	0.69	1.34	1.75	2.12	2.58	2.92
17	0.69	1.33	1.74	2.11	2.57	2.90
18	0.69	1.33	1.73	2.10	2.55	2.88
19	0.69	1.33	1.73	2.09	2.54	2.86
20	0.69	1.33	1.72	2.09	2.53	2.85
21	0.69	1.32	1.72	2.08	2.52	2.83
22	0.69	1.32	1.72	2.07	2.51	2.82
23	0.69	1.32	1.71	2.07	2.50	2.80
24	0.68	1.32	1.71	2.06	2.49	2.80
25	0.68	1.32	1.71	2.06	2.49	2.79

5. A manufacturer making supposedly a 25 mm diameter screws randomly samples 100 of the screws and measures their diameters. The average of these is 0.252 mm and the standard deviation is 0.01 mm. What is the p-value for a hypothesis test that the true mean screw diameter is 0.25 mm versus the alternative that it is not?

✓ 0.0455 -0.0134 -0.134 -0.00265

This is a one sample t-test.

The null hypothesis is: mean screw diameter is 0.25 mm

The alternative hypothesis is: mean screw diameter is not 0.25 mm

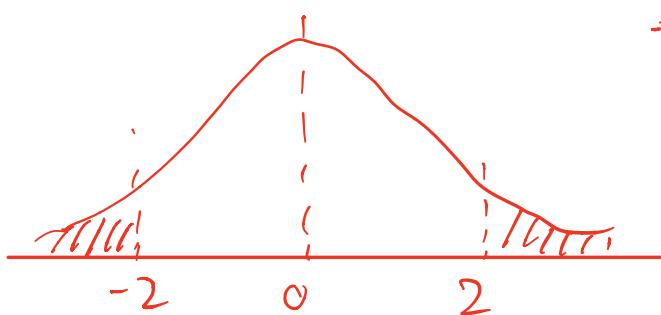
It's therefore a two-sided test.

The test statistic is $\frac{0.252 - 0.25}{SE} \approx \frac{0.002}{0.001} = 2$.

$$SE = \sqrt{\frac{100}{99}} \times \frac{0.01}{\sqrt{100}} \approx 0.001$$

The distribution of the test statistic is t distribution with degree of freedom 99, which can be approximate by standard normal distribution.

Therefore, instead of using a t-table, we can use z-table instead.



The shaded area is the p-value we are looking for.

$$1 - 0.9545 = 0.0455$$

6. In two high schools, Rap Station and Metal Cove, music comprehension tests were given to 100 students at each school. At Rap Station, the average score of the students was 47.3 and the standard deviation was 4.0. At Metal Cove, the average score was 47.8 and the standard deviation is 3.0. What is the absolute value of the z statistic used to test the hypothesis that the two schools have the same mean music comprehension of students?

1.0 -1.5 -2.0 -0.5

This is a two sample z-test.

The null hypothesis is the two schools have the same mean score.

The alternative hypothesis is the two schools have different mean score.

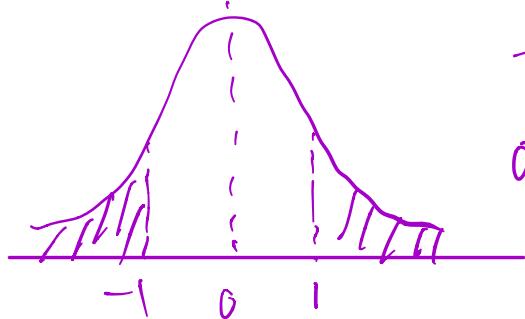
The test statistic is $\frac{47.3 - 47.8}{SE} = \frac{-0.5}{0.5} = -1$.

where $SE = \sqrt{\left(\frac{4}{\sqrt{100}}\right)^2 + \left(\frac{3}{\sqrt{100}}\right)^2}$

$$= \sqrt{\left(\frac{4}{10}\right)^2 + \left(\frac{3}{10}\right)^2} = \sqrt{\frac{16+9}{100}} = \sqrt{\frac{25}{100}} = 0.5$$

So the absolute value of test statistic is 1.

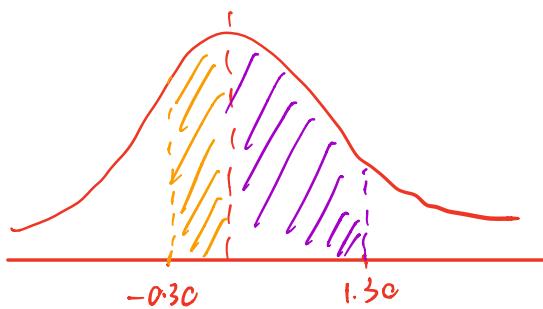
∴ What is the p-value?



the shadowed area, which is obtained from z-table as 31.73% or 0.3173.

Final Practice Questions

1. What is the area under the normal curve between -0.30 and 1.30 ?



$$\text{Orange} = \frac{23.58}{2} \quad \text{Purple} = \frac{80.64}{2}$$
$$\text{Total: } \frac{23.58}{2} + \frac{80.64}{2} = 52.11$$

2. Suppose a regression line is given by $y = -6.6 + 2x$. Now for a sample of $x=4$ and $y=2$, what is the residual of this sample?

$$\text{Residual} = y - y_{\text{predict}} = 2 - (-6.6 + 2 \times 4) = 2 - 1.4 = 0.6$$

3. Two independent events. $P(A) = 0.2$, $P(B) = 0.4$. What is the chance of both A and B happening?

$$\text{Since independent } P(AB) = P(A)P(B) = 0.2 \times 0.4 = 0.08$$

4. A fair coin is tossed. If it appears a head, you win 1 dollar. What is the standard error for the sum of 100 draws from the preferred box model?

Box: 0 1 SD of Box: $\sqrt{\frac{(1-0)^2(0+1)}{2}} = \frac{1}{2}$.

SE of 100 draws: $\sqrt{100} \times \frac{1}{2} = 10 \times \frac{1}{2} = 5$.

5. A fair coin is tossed 6 times. What is the chance of getting exactly 3 heads?

Binomial formula.
$$\binom{6}{3} \times \left(\frac{1}{2}\right)^3 \times \left(1-\frac{1}{2}\right)^{6-3}$$
$$= \frac{6 \times 5 \times 4}{3 \times 2 \times 1} \times \frac{1}{8} \times \frac{1}{8} = \frac{5}{16}$$
.

6. With a Nevada roulette wheel, there are 6 in 38 chances the ball will land on "6 number across". A wheel is going to be spun many times. There are two options:

i. 38 spins, win \$100 if the ball lands in any of the six numbers 8 or more times.

ii. 76 spins, win \$100 if the ball lands in any of the six numbers 16 or more times.

Which option is better?

Let event A : Spin 38 times, 8 or more times the ball lands in any of the 6 numbers.

In option 1, you win \$100 with chance $P(A)$

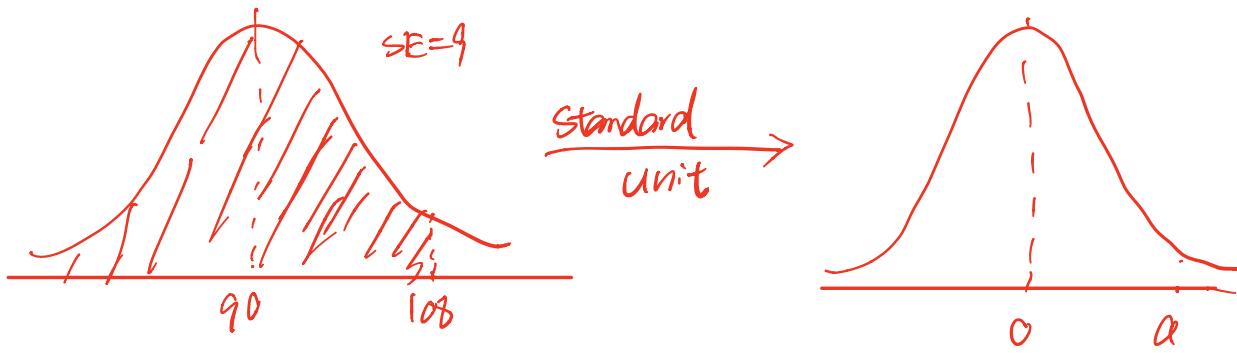
in option 2, you win \$100 with chance $P(A) \cdot P(A)$.

since $P(A) > P(A) \cdot P(A)$ option 1 is better.

7. A biased coin with Probability of getting a head = $\frac{1}{10}$. It is tossed 900 times. What is the probability of obtaining 108 or fewer heads?

$$\text{mean: } \frac{1}{10} \times 900 = 90.$$

$$\text{SE: } \sqrt{\frac{1}{10} \times (1 - \frac{1}{10})} \times \sqrt{900} = 0.3 \times 30 = 9.$$



$$\alpha = \frac{108 - 90}{4} = 2. \quad \text{Area}_\alpha = 100 - \frac{100 - 95.45}{2} \approx 97.73$$

8. 420 people were asked if they have been to college. 65% said they have. It is wished to test the null hypothesis that the proportion of people who has been to college is 60%. What is the test statistic?

Test Statistic for proportion test:

$$\frac{\text{Sample} - \text{true}}{\sqrt{\frac{\text{true} \times (1 - \text{true})}{\text{number of samples}}}} = \frac{0.65 - 0.6}{\sqrt{\frac{0.6 \times (1 - 0.6)}{420}}} \approx 2.092.$$