Math 160 – Hypothesis Testing Name Key
8.5 Testing Claims about Means: sigma unknown

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Determine whether the hypothesis test involves a sampling distribution of means that is a normal distribution, Student t distribution, or neither.

1) Claim: $\mu = 950$. Sample data: $n = 24$, $\bar{x} = 997$, $s = 27$. The sample data appear to come from a normally distributed population with $\sigma = 30$. 1) B

A) Neither B) Normal C) Student t

2) Claim: $\mu = 119$. Sample data: $n = 11$, $\bar{x} = 110$, $s = 15.2$. The sample data appear to come from a normally distributed population with unknown μ and σ. 2) C

A) Neither B) Normal C) Student t

3) Claim: $\mu = 77$. Sample data: $n = 22$, $\bar{x} = 101$, $s = 15.4$. The sample data appear to come from a population with a distribution that is very far from normal, and σ is unknown. 3) A

A) Neither B) Normal C) Student t

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Assume that a simple random sample has been selected from a normally distributed population and test the given claim. Use either the traditional method or P-value method as indicated. Identify the null and alternative hypotheses, test statistic, critical value(s) or P-value (or range of P-values) as appropriate, and state the final conclusion that addresses the original claim.

4) A test of sobriety involves measuring the subject's motor skills. Twenty randomly selected sober subjects take the test and produce a mean score of 41.0 with a standard deviation of 3.7. At the 0.01 level of significance, test the claim that the true mean score for all sober subjects is equal to 35.0. Use the traditional method of testing hypotheses. 4) ______________

5) A large software company gives job applicants a test of programming ability and the mean for that test has been 160 in the past. Twenty-five job applicants are randomly selected from one large university and they produce a mean score and standard deviation of 183 and 12, respectively. Use a 0.05 level of significance to test the claim that this sample comes from a population with a mean score greater than 160. Use the P-value method of testing hypotheses. 5) ______________

(4) $n = 20$

$\bar{X} = 41$

$s = 3.7$

$\alpha = 0.01$

Claim: the true mean score for all sober subjects is 35.

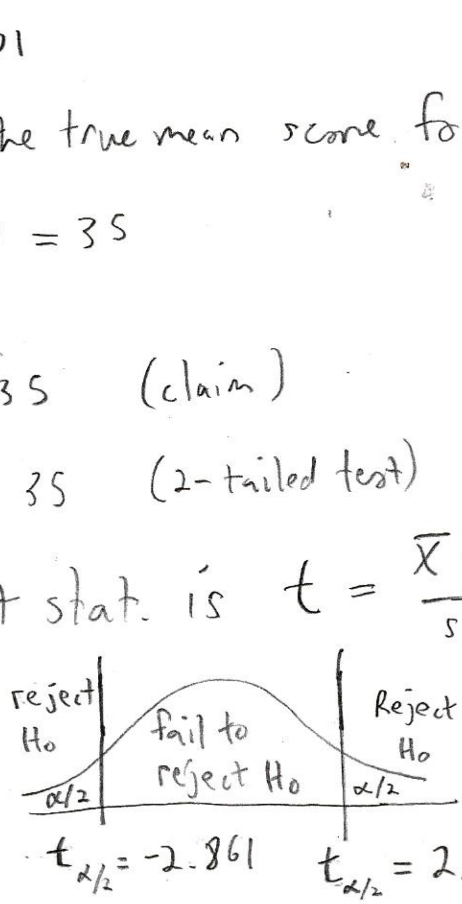
Symbolic form: $\mu = 35$

Step 1: $H_0: \mu = 35$ (claim)

Step 2: $H_1: \mu \neq 35$ (2-tailed test)

Step 3: the test stat. is $t = \dfrac{\bar{X} - \mu}{s/\sqrt{n}} = \dfrac{41 - 35}{3.7/\sqrt{20}} = \dfrac{6}{.8273} = 7.25$

Step 4: $\boxed{\text{CV method}}$



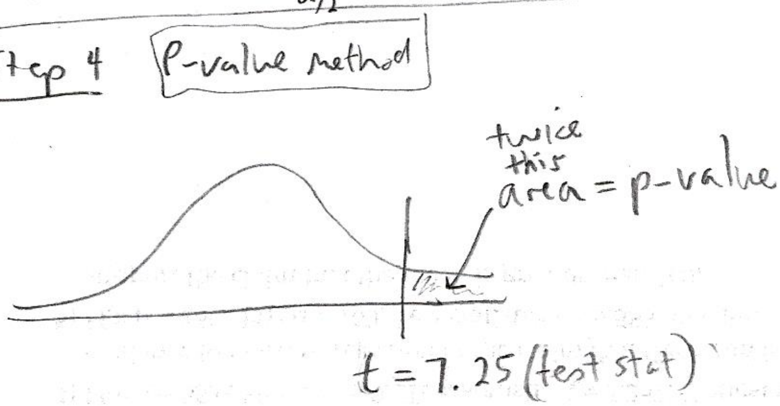
$df = n - 1 = 19$

Area in 2 tails $= \alpha = 0.01$

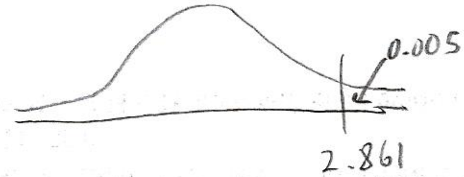
So, the CV is $t_{\alpha/2} = \pm 2.861$.

The test stat, 7.25, lies in the rejection region, so reject Ho.

Step 4: $\boxed{\text{P-value method}}$



$df = n - 1 = 19 \Rightarrow$ use row 19 of t table. (Or get the p-value using t-test on the TI 83)



Using the t-table, the best estimate for the p value is that it is much less that $2 \cdot (0.005) = 0.01$. (TI-84 calculator gives a p value $= 6.9 \times 10^{-7}$).

Since this is much less than α, we reject Ho.

Step 5: There is sufficient evidence to warrant rejection of the claim that the true mean score for all sober subjects is 35.

(5) $n = 25$

$\bar{x} = 183$

$s = 12$

$\alpha = 0.05$

claim: the true mean score on the software companies entrance exam is greater than 160

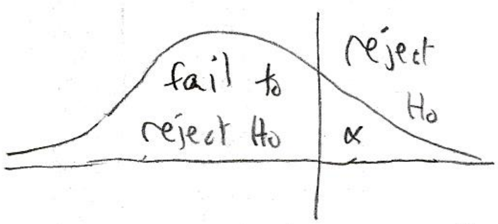
symbolic form $\mu > 160$

Step1 $H_0: \mu \le 160$

Step2 $H_1: \mu > 160$ (claim) right-tailed test

Step3 The test statistic is $t = \dfrac{\bar{x} - \mu}{s/\sqrt{n}} = \dfrac{183 - 160}{12/\sqrt{25}} = \dfrac{23}{2.4} = 9.58$

Step4 $\boxed{\text{CV method}}$

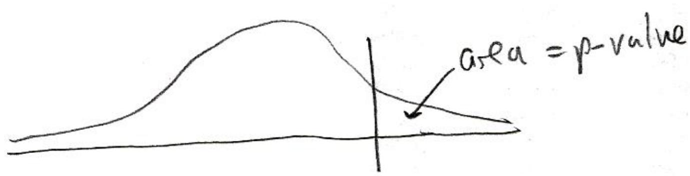


$df = n - 1 = 24 \Rightarrow$ use row 24 of the t table

$t_\alpha = 2.797$

Since the test stat, 9.58 is much greater than the CV, reject Ho.

Step 4 $\boxed{\text{P-value Method}}$



using row 24 of the t-table (since $df = n-1$) we find 2.797 is the value of t having an area to the right of 0.005. We can thus estimate the p-value is much less than 0.005. Since this is less than α, reject Ho.

Step5 The sample data support the claim that the true mean score on the entrance exam is greater than 183.

Degrees of freedom
$df = n-1$

TABLE A-3 *t* Distribution: Critical *t* Values

	Area in One Tail				
	0.005	0.01	0.025	0.05	0.10
Degrees of Freedom	**Area in Two Tails**				
	0.01	0.02	0.05	0.10	0.20
1	63.657	31.821	12.706	6.314	3.078
2	9.925	6.965	4.303	2.920	1.886
3	5.841	4.541	3.182	2.353	1.638
4	4.604	3.747	2.776	2.132	1.533
5	4.032	3.365	2.571	2.015	1.476
6	3.707	3.143	2.447	1.943	1.440
7	3.499	2.998	2.365	1.895	1.415
8	3.355	2.896	2.306	1.860	1.397
9	3.250	2.821	2.262	1.833	1.383
10	3.169	2.764	2.228	1.812	1.372
11	3.106	2.718	2.201	1.796	1.363
12	3.055	2.681	2.179	1.782	1.356
13	3.012	2.650	2.160	1.771	1.350
14	2.977	2.624	2.145	1.761	1.345
15	2.947	2.602	2.131	1.753	1.341
16	2.921	2.583	2.120	1.746	1.337
17	2.898	2.567	2.110	1.740	1.333
18	2.878	2.552	2.101	1.734	1.330
#4 → 19	2.861	2.539	2.093	1.729	1.328
20	2.845	2.528	2.086	1.725	1.325
21	2.831	2.518	2.080	1.721	1.323
22	2.819	2.508	2.074	1.717	1.321
23	2.807	2.500	2.069	1.714	1.319
#5 → 24	2.797	2.492	2.064	1.711	1.318
25	2.787	2.485	2.060	1.708	1.316
26	2.779	2.479	2.056	1.706	1.315
27	2.771	2.473	2.052	1.703	1.314
28	2.763	2.467	2.048	1.701	1.313
29	2.756	2.462	2.045	1.699	1.311
30	2.750	2.457	2.042	1.697	1.310
31	2.744	2.453	2.040	1.696	1.309
32	2.738	2.449	2.037	1.694	1.309
33	2.733	2.445	2.035	1.692	1.308
34	2.728	2.441	2.032	1.691	1.307
35	2.724	2.438	2.030	1.690	1.306
36	2.719	2.434	2.028	1.688	1.306
37	2.715	2.431	2.026	1.687	1.305
38	2.712	2.429	2.024	1.686	1.304
39	2.708	2.426	2.023	1.685	1.304
40	2.704	2.423	2.021	1.684	1.303
45	2.690	2.412	2.014	1.679	1.301
50	2.678	2.403	2.009	1.676	1.299
60	2.660	2.390	2.000	1.671	1.296
70	2.648	2.381	1.994	1.667	1.294
80	2.639	2.374	1.990	1.664	1.292
90	2.632	2.368	1.987	1.662	1.291
100	2.626	2.364	1.984	1.660	1.290
200	2.601	2.345	1.972	1.653	1.286
300	2.592	2.339	1.968	1.650	1.284
400	2.588	2.336	1.966	1.649	1.284
500	2.586	2.334	1.965	1.648	1.283
1000	2.581	2.330	1.962	1.646	1.282
2000	2.578	2.328	1.961	1.646	1.282
Large	2.576	2.326	1.960	1.645	1.282