AP Statistics

Chapter 9: Testing a Claim: Significance Tests

Day 1

HW: Lesson 1 Practice Worksheet

Why Do We Perform Significance Tests?

- There is a claim or a hypothesis that is supposed to be true. But we believe the claim or hypothesis may have changed over time.
- It could be higher than what is claimed, it could be lower than what is claimed, or it may have changed but I am not sure if it is now lower or higher than what I was claimed.
- I can perform a **significance test** to see if the claim has possibly changed or if it truly is what I was told.

Types of Significance Tests?

- One-sample t test for mean
  - One-sided test (less than or greater than)
  - Two-sided test (not equal to)
- One-sample z test for a proportion
  - One-sided test (less than or greater than)
  - Two-sided test (not equal to)
- Two-sample t test for mean, two-sample z test for proportions, chi-square goodness-of-fit test (chapters 10-11)

Let's Go Golfing

- Mr. Morgan says that his average score is 80. Do we believe him? Let us see him play some more games and prove it!!!

4 Step of a Hypothesis Test

1. State your hypotheses.
2. State your conditions.
3. Perform the test and find the p-value.
4. State your conclusion.

Hypotheses

There are only two hypotheses.

- **Null hypothesis:** H_o ("h-knot"):
  - This is the claim or what we assume to be true.
  - H_o: $\mu = 80$

Alternative hypothesis: H_a:

- This is what we think is true.
- H_a: $\mu < 80$, H_a: $\mu > 80$, or H_a: $\mu \neq 80$

Conditions

- The sample must be a SRS.
- We have to be able to assume that we are not sampling more than 10% of the population.

$$n \leq \frac{1}{10}N$$

- **Mean:**
  - The distribution is approximately normal or $n \geq 30$.
- **Proportion:**
  - There are at least 10 successes and 10 failures.

$$np \geq 10 \quad and \quad n(1-p) \geq 10$$

Perform the Test (p-value)

- The p-value is the probability that our result would happen if the null hypothesis were true.
- The test can be performed by hand or by using the calculator.
- **By hand:** $t = \dfrac{\bar{x} - u_o}{\frac{s_x}{\sqrt{n}}}$ $\quad z = \dfrac{\hat{p} - p_o}{\sqrt{\frac{p_o(1-p_o)}{n}}}$
- **Calculator:** T-Test or 1-PropZTest

Significance Level

- The symbol α is used represent the significance level.
- If the p-value is less than the significance level, then we reject the null hypothesis.
  - We say that the data are statistically significant at that α level.
- If the p-value is greater than the significance level, then I am going to fail to reject the null hypothesis.

Conclusion

Since the p-value is _____ and is less than/greater than the significance level of α = _____, we reject/fail to reject the null hypothesis. There is/is not sufficient evidence to conclude that (insert μ_0 in the context of the problem).

Is Mr. Morgan Telling the Truth?

Mr. Morgan claims his average score is 80. We randomly selected 32 of Mr. Morgan's scores.

Is there significant evidence at the 5% level that Mr. Morgan's average is greater than 80?

80	81	78	83	85	80	82	79
77	80	79	82	82	81	79	78
76	81	85	82	83	80	81	77
84	83	82	80	77	79	83	84

① Hypotheses:

$H_0: \mu = 80$ (Mr. Morgan's average is 80.

$H_a: \mu > 80$ (Mr. Morgan's average is greater than 80.

② • As stated, this is an SRS.

• $32 \le \frac{1}{10} N \rightarrow 320$
we can assume Mr. Morgan has played at least 320 games.

• Because $n \ge 30$, we can assume an approx. normal distribution

TABLE B: t-DISTRIBUTION CRITICAL VALUES

Is Mr. Morgan Telling the Truth?

80	81	78	83	85	80	82	79
77	80	79	82	82	81	79	78
76	81	85	82	83	80	81	77
84	83	82	80	77	79	83	84

$\bar{x} = 80.71875$

$S_{\bar{x}} = 2.413$

$\mu = 80$

③ $t = \dfrac{80.71875 - 80}{\frac{2.413}{\sqrt{32}}} = 1.685$

$df = 31$

$\alpha = .05$

p-value = between 5-10%

④ Since the p-value is between 5-10% (.05-.1) and is greater than the significance level of α = .05, we fail to reject the null hypothesis. There is not sufficient evidence to conclude that's Mr. Morgans average is greater than 80.

TABLE B: t-DISTRIBUTION CRITICAL VALUES

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	Tail probability p											
df	.25	.20	.15	.10	.05	.025	.02	.01	.005	.0025	.001	.0005
1	1.000	1.376	1.963	3.078	6.314	12.71	15.89	31.82	63.66	127.3	318.3	636.6
2	.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33	31.60
3	.765	.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21	12.92
4	.741	.941	1.190	1.533	2.132	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	.727	.920	1.156	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.893	6.869
6	.718	.906	1.134	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	.711	.896	1.119	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	.706	.889	1.108	1.397	1.860	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	.703	.883	1.100	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	.700	.879	1.093	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	.697	.876	1.088	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	.695	.873	1.083	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	.694	.870	1.079	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	.692	.868	1.076	1.345	1.761	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	.691	.866	1.074	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	.690	.865	1.071	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	.689	.863	1.069	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	.688	.862	1.067	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.611	3.922
19	.688	.861	1.066	1.328	1.729	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	.687	.860	1.064	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	.686	.859	1.063	1.323	1.721	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	.686	.858	1.061	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	.685	.858	1.060	1.319	1.714	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	.685	.857	1.059	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	.684	.856	1.058	1.316	1.708	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	.684	.856	1.058	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	.684	.855	1.057	1.314	1.703	2.052	2.158	2.473	2.771	3.057	3.421	3.690
28	.683	.855	1.056	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	.683	.854	1.055	1.311	1.699	2.045	2.150	2.462	2.756	3.038	3.396	3.659
30	.683	.854	1.055	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.385	3.646
40	.681	.851	1.050	1.303	1.684	2.021	2.123	2.423	2.704	2.971	3.307	3.551
50	.679	.849	1.047	1.299	1.676	2.009	2.109	2.403	2.678	2.937	3.261	3.496
60	.679	.848	1.045	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	.678	.846	1.043	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	.677	.845	1.042	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174	3.390
1000	.675	.842	1.037	1.282	1.646	1.962	2.056	2.330	2.581	2.813	3.098	3.300
∞	.674	.841	1.036	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.091	3.291
	50%	60%	70%	80%	90%	95%	96%	98%	99%	99.5%	99.8%	99.9%
	Confidence level C											