Worksheet – Sections 8.2-8.3

Steps of hypothesis testing:

- Hypothesize: make H_0 and H_a
- Prepare: if you want to use Central Limit Theorem, make sure that all conditions are met.
- Compute p-value: probability of the event as extreme as or more extreme than the observed event.
- Conclude: reject H_0 if p-value $<$ significance level.

One-sided alternative hypothesis: $H_a: p < p_0$ (left-sided) or $H_a: p > p_0$ (right-sided)

Two-sided alternative hypothesis: $H_a: p \neq p_0$

Two types of mistake:

- Type I (false positive): reject H_0 while it is in fact true.
- Type II (false negative): not reject H_0 while it is in fact false.

If the hypothesis test is about *population proportion*, you may use *Central Limit Theorem* to compute the p-value. In that case, **z-test statistic** $= \frac{\hat{p}-p_0}{SE}$ where p_0 is the population proportion claimed by the null hypothesis and $SE = \sqrt{\frac{p_0(1-p_0)}{n}}$.

StatCrunch: Stat → Proportion Stats → One Sample → With Summary

Relation with confidence interval: In most cases, doing a hypothesis test with a two-sided alternative hypothesis and significance level α will lead to the same conclusion as finding a confidence interval with a confidence level $1-\alpha$ and rejecting the null hypothesis if its value does not lie in the interval.

1) A national survey reports that 64% of adults wear a bicycle helmet whenever they ride. A safety advocate believes helmet use is higher in Hawaii. She surveys 150 adult cyclists and finds that 105 always wear a helmet.

a) If Hawaii had the same helmet-use rate as the nation, how many cyclists would she expect to always wear a helmet? Round your answer to a whole number.

b) Determine the null hypothesis and alternative hypothesis. What type of alternative hypothesis is this? (left-sided, right-sided, two-sided)

c) Check if the Central Limit Theorem conditions are satisfied.

d) Describe the event as extreme as or more extreme than the observed event.

e) Find the z-test statistic and use the Standard Normal Table to find the p-value.

f) Sketch the p-value graph.

g) Interpret the graph by filling in the blank:

If 64% of adult cyclists in Hawaii always wear a helmet, then there is a _____% chance of observing a z-score of _____ or greater.

h) Reject or not reject the null hypothesis at significance level 0.05.

i) Find the z-test statistic, p-value, and p-value graph using StatCrunch.

2) Suppose a nonprofit organization is testing whether the proportion of adults who volunteer has changed from a value of 25% five years ago. In a random sample of 600 adults, 180 report volunteering in 2025.

a) Determine the null hypothesis and alternative hypothesis. What type of alternative hypothesis is this? (left-sided, right-sided, two-sided)

b) Assume that the significance level is 1%. Type I error says that the proportion of volunteers in 2025 was _____ when, in fact, the it was _____ Type II error says that the proportion of volunteers in 2025 was _____when, in fact, it was_____ The 1% significance level means that there is only 1% chance of mistakenly concluding that the proportion of volunteers in 2025 was _____ when, in fact, it was_____.

c) Describe the event as extreme as or more extreme than the observed event.

d) Find the z-test statistic and use the Standard Normal Table to find the p-value.

e) Sketch the p-value graph.

f) Reject or not reject the null hypothesis at significance level 1%. What is the chance of making a mistake in drawing this conclusion?

g) Use the confidence interval method to test the hypotheses.

h) Find the z-test statistic, p-value, and p-value graph using StatCrunch.

3) You toss a coin 10 times and get only one Head. You suspect that the coin is biased.

a) State the null hypothesis and alternative hypothesis.

b) Describe the event as extreme as or more extreme than the observed event.

c) Find the p-value.

d) Reject or not reject the null hypothesis at significance level 0.05.

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
−3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
−2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
−2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
−2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
−2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
−2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
−2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
−2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
−2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
−2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
−2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
−1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
−1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
−1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
−1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
−1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
−1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
−1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
−1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
−1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
−1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
−0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
−0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
−0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
−0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
−0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
−0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
−0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
−0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
−0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
−0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641