

| Scenario | One Categorical Response | Two Categorical Variables | One Quantitative Response OR Paired Differences | Two Quantitative Variables | Quant. Response and Categ. Explanatory (independent samples) |
|---|--|--|--|---|--|
| Type of plot | Bar plot | Segmented bar plot, Mosaic plot | Dotplot, histogram, boxplot | Scatterplot | Side-by-sided boxplots, Stacked dotplots or histograms |
| Summary measure | Proportion | Difference in proportions | Mean or Mean Difference | Slope or correlation | Difference in means |
| Parameter notation | π | $\pi_1 - \pi_2$ | μ or μ_d | β_1 or ρ | $\mu_1 - \mu_2$ |
| Statistic notation | \hat{p} | $\hat{p}_1 - \hat{p}_2$ | \bar{x} or \bar{x}_d | b_1 or r | $\bar{x}_1 - \bar{x}_2$ |
| Null hypothesis | $H_0: \pi = \pi_0$ | $H_0: \pi_1 - \pi_2 = 0$ | $H_0: \mu = \mu_0$ or $H_0: \mu_d = 0$ | $H_0: \beta_1 = 0$ or $H_0: \rho = 0$ | $H_0: \mu_1 - \mu_2 = 0$ |
| Conditions for simulation methods | Independent cases; | Independence (within and between groups); | Independent cases; | Independent cases; Linear form; | Independence (within and between groups); |
| Simulation test (how to generate a null distn) p-value = proportion of null simulations at or beyond (H_A direction) the observed statistic | Spin spinner with probability equal to π_0 , n times or draw with replacement n times from a deck of cards created to reflect π_0 as probability of success. Plot the proportion of successes. Repeat 1000's of times. Centered at π_0 | Label cards with response values from original data; mix cards together; shuffle into two new groups of sizes n_1 and n_2 . Plot difference in proportion of successes. Repeat 1000's of times. Centered at 0. | Shift the original data by adding $(\mu_0 - \bar{x})$ or $(0 - \bar{x}_d)$. Sample with replacement from the shifted data n times. Plot sample mean. Repeat 1000's of times. Centered at μ_0 (single mean) or 0 (paired mean difference). | Hold the x values constant; shuffle new y 's to x 's. Find the regression line for shuffled data; plot the slope or the correlation for the shuffled data. Repeat 1000's of times. Centered at 0. | Label cards with response variable values from original data; mix cards together; shuffle into two new groups of sizes n_1 and n_2 . Plot difference in means. Repeat 1000's of times. Centered at 0. |
| Bootstrap CI (how to generate a boot. distn) X% CI: $\left(\frac{1-X}{2}\right)\%tile,$ $\left(X + \frac{1-X}{2}\right)\%tile$ | Label n cards with the original responses. Randomly draw with replacement n times. Plot the resampled proportion of successes. Repeat 1000's of times. Centered at \hat{p} . | Label $n_1 + n_2$ cards with the original responses. Randomly draw with replacement n_1 times from group 1 and n_2 times from group 2. Plot the resampled difference in proportion of successes. Repeat 1000's of times. Centered at $\hat{p}_1 - \hat{p}_2$ | Label n cards with the original responses. Randomly draw with replacement n times. Plot the resample mean. Repeat 1000's of times. Centered at \bar{x} or \bar{x}_d . | Label n cards with the original (response, explanatory) values. Randomly draw with replacement n times. Plot the resampled slope or correlation. Repeat 1000's of times. Centered at b_1 or r . | Label $n_1 + n_2$ cards with the original responses. Randomly draw with replacement n_1 times from group 1 and n_2 times from group 2. Plot the resampled difference in means. Repeat 1000's of times. Centered at $\bar{x}_1 - \bar{x}_2$. |
| Theory-based distribution | Standard Normal | Standard Normal | t - distribution with $n - 1$ df | t - distribution with $n - 2$ df | t - distribution with min of n_1-1 or n_2-1 df |
| Conditions for theory-based hypothesis tests and confidence intervals | Independent cases; Number of successes and number of failures in the sample both at least 10. | Independence (within and between groups); Number of successes and number of failures in EACH sample all at least 10. (All four cell counts at least 10.) | Independent cases; $n < 30$ with no clear outliers OR $n \geq 30$ with no extreme outliers OR $n \geq 100$ | Linear form; Independent cases; Nearly normal residuals; Variability around the regression line is roughly constant. | Independent cases (within and between groups); In each sample, $n < 30$ with no clear outliers OR $n \geq 30$ with no extreme outliers OR $n \geq 100$ |
| Theory-based standardized statistic (test statistic) | $z = \frac{\hat{p} - \pi_0}{SE_0(\hat{p})}$ $SE_0(\hat{p}) = \sqrt{\frac{\pi_0 \times (1 - \pi_0)}{n}}$ | $z = \frac{\hat{p}_1 - \hat{p}_2}{SE_0(\hat{p}_1 - \hat{p}_2)}$ $SE_0(\hat{p}_1 - \hat{p}_2) = \sqrt{\widehat{p_{pool}} \times (1 - \widehat{p_{pool}}) \times \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$ | $t = \frac{\bar{x} - \mu_0}{SE(\bar{x})}$ $SE(\bar{x}) = \frac{s}{\sqrt{n}}$ | $t = \frac{b_1}{SE(b_1)}$ $SE(b_1)$ is the reported standard error (std. error) of the slope term in the lm() output from R. | $t = \frac{\bar{x}_1 - \bar{x}_2 - 0}{SE(\bar{x}_1 - \bar{x}_2)}$ $SE(\bar{x}_1 - \bar{x}_2) = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$ |
| Theory-based confidence interval | $\hat{p} \pm z^* \times SE(\hat{p})$ $SE(\hat{p}) = \sqrt{\frac{\hat{p} \times (1 - \hat{p})}{n}}$ | $\hat{p}_1 - \hat{p}_2 \pm z^* \times SE(\hat{p}_1 - \hat{p}_2)$ $SE(\hat{p}_1 - \hat{p}_2) = \sqrt{\frac{\hat{p}_1 \times (1 - \hat{p}_1)}{n_1} + \frac{\hat{p}_2 \times (1 - \hat{p}_2)}{n_2}}$ | $\bar{x} \pm t^* \times SE(\bar{x})$ $SE(\bar{x}) = \frac{s}{\sqrt{n}}$ | $b_1 \pm t^* \times SE(b_1)$ $SE(b_1)$ is the reported standard error (std. error) of the slope term in the lm() output from R. | $\bar{x}_1 - \bar{x}_2 \pm t^* \times SE(\bar{x}_1 - \bar{x}_2)$ $SE(\bar{x}_1 - \bar{x}_2) = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$ |