# Basic Statistics Formulas

## Population Measures

$$\text{Mean } \mu = \frac{1}{n}\sum x_i \tag{1}$$

$$\text{Variance } \sigma^2 = \frac{1}{n}\sum (x_i - \bar{x})^2 \tag{2}$$

$$\text{Standard Deviation } \sigma = \sqrt{\frac{1}{n}\sum (x_i - \bar{x})^2} \tag{3}$$

## Sampling

$$\text{Sample mean } \bar{x} = \frac{1}{n}\sum x_i \tag{4}$$

$$\text{Sample variance } s_x^2 = \frac{1}{n-1}\sum (x_i - \bar{x})^2 \tag{5}$$

$$\text{Std. Deviation } s_x = \sqrt{\frac{1}{n-1}\sum (x_i - \bar{x})^2} \tag{6}$$

$$\text{z-score } z = \frac{x - \mu}{\sigma} \tag{7}$$

$$\text{Correlation } r =$$

$$\frac{1}{n-1}\sum_{i=1}^{n}\left(\frac{(x_i - \bar{x})}{s_x}\right)\left(\frac{(y_i - \bar{y})}{s_y}\right) \tag{8}$$

## Linear Regression

$$\text{Line } \hat{y} = a + bx \tag{9}$$

$$b = r\frac{s_y}{s_x}, a = \bar{y} - b\bar{x} \tag{10}$$

$$s = \sqrt{\frac{1}{n-2}\sum_{i=1}^{n}(y_i - \hat{y})^2} \tag{11}$$

$$SE_b = \frac{s}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}} \tag{12}$$

$$\text{To test } H_0 : b = 0, \text{ use } t = \frac{b}{SE_b} \tag{13}$$

$$CI = b \pm t^* SE_b \tag{14}$$

## Probability

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \tag{15}$$

$$P(\text{not } A) = 1 - P(A) \tag{16}$$

$$P(A \text{ and } B) = P(A)P(B) \text{ (independent)} \tag{17}$$

$$P(B|A) = P(A \text{ and } B)/P(A) \tag{18}$$

$$0! = 1; n! = 1 \times 2 \times 3 \cdots \times (n-1) \times n \tag{19}$$

$$\binom{n}{k} = \frac{n!}{k!(n-k)!} \tag{20}$$

Binomial Distribution :

$$P(X = k) = \binom{n}{k}p^k(1-p)^{n-k} \tag{21}$$

$$\mu = np, \sigma = \sqrt{np(1-p)} \tag{22}$$

## One-Sample z-statistic

$$\text{To test } H_0 : \mu = \mu_0 \text{ use } z = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}} \tag{23}$$

$$\text{Confidence Interval for } \mu = \bar{x} \pm z^* \frac{\sigma}{\sqrt{n}} \tag{24}$$

$$\text{Margin of Error } ME = z^* \frac{\sigma}{\sqrt{n}} \tag{25}$$

$$\text{Minimum sample size } n \geq \left[\frac{z^* \sigma}{ME}\right]^2 \tag{26}$$

## One-Sample t-statistic

$$SEM = \frac{s_x}{\sqrt{n}}, t = \frac{\bar{x} - \mu}{s_x/\sqrt{n}} \tag{27}$$

$$\text{Confidence Interval} = \bar{x} \pm t^* \frac{s_x}{\sqrt{n}} \tag{28}$$

## Two-Sample t-statistic

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \tag{29}$$

$$\text{Conf. Interval} = (\bar{x}_1 - \bar{x}_2) \pm t^* \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \tag{30}$$

## Sample Proportions

$$\mu_{\hat{p}} = p, \sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}} \tag{31}$$

$$\text{Conf. Int.} = \hat{p} \pm z^*(SE) \tag{32}$$

$$SE = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \tag{33}$$

$$\text{sample size } n > \left[\frac{z^*}{ME}\right]^2 \hat{p}^*(1-\hat{p}^*) \tag{34}$$

$$\text{To test } H_0 : p = p_0, \text{ use } z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} \tag{35}$$

## Two-Sample Proportions

$$SE = \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}} \tag{36}$$

$$CI = (\hat{p}_1 - \hat{p}_2) \pm z^*(SE) \tag{37}$$

$$\text{To test } H_0 : p_1 = p_2, \text{ use} \tag{38}$$

$$z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \tag{39}$$

$$\hat{p} = \frac{X_1 + X_2}{n_1 + n_2}, X_i = \text{successes} \tag{40}$$

## Chi-Square Statistic

$$\chi^2 = \sum_{i=1}^{n}\frac{(o_i - e_i)^2}{e_i} \tag{41}$$

$$o_i = \text{observed}, e_i = \text{expected}$$

## Central Limit Theorem

$$\sigma_{\bar{x}} \to \frac{\sigma}{\sqrt{n}} \text{ as } n \to \infty \tag{42}$$

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