

STATISTICS – FORMULA SHEET

1. Descriptive Statistics

Sample mean

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

Sample variance

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

Sample standard deviation

$$s = \sqrt{s^2}$$

2. Correlation & Regression

Pearson correlation coefficient

$$r = \frac{\text{Cov}(X, Y)}{s_X s_Y}$$

Coefficient of determination

$$R^2 = r^2$$

3. Sampling Distributions

Mean of the sampling distribution

$$\mu_{\bar{X}} = \mu$$

Standard deviation of the sample mean

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

4. Normal Distribution

Standardization (z-score)

$$z = \frac{x - \mu}{\sigma}$$

Empirical rule

- 68% within 1σ
 - 95% within 2σ
 - 99.7% within 3σ
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5. Confidence Intervals

5.1 Mean (σ unknown)

$$\bar{x} \pm t_{\alpha/2, n-1} \frac{s}{\sqrt{n}}$$

5.2 Population Proportion

$$\hat{p} \pm z_{\alpha/2} \sqrt{\frac{\hat{p}(1 - \hat{p})}{n}}$$

Margin of Error

$$ME = z_{\alpha/2} \sqrt{\frac{\hat{p}(1 - \hat{p})}{n}}$$

5.3 Population Variance

$$\left(\frac{(n-1)s^2}{\chi^2_{1-\alpha/2, n-1}}, \frac{(n-1)s^2}{\chi^2_{\alpha/2, n-1}} \right)$$

6. Hypothesis Testing (Mean)

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

Decision rule

- Reject H_0 if $p\text{-value} \leq \alpha$
 - Fail to reject H_0 if $p\text{-value} > \alpha$
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7. Chi-Square Goodness-of-Fit Test

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

8. Uniform Distribution

If $X \sim U(a, b)$:

$$P(c \leq X \leq d) = \frac{d - c}{b - a}$$

9. Binomial Distribution

If $X \sim \text{Bin}(n, p)$:

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

Mean

$$E(X) = np$$

Variance

$$\text{Var}(X) = np(1 - p)$$

10. Poisson Distribution

$$P(X = k) = \frac{e^{-\lambda} \lambda^k}{k!}$$

If $X \sim \text{Poisson}(\lambda_1)$ and $Y \sim \text{Poisson}(\lambda_2)$, independent:

$$X + Y \sim \text{Poisson}(\lambda_1 + \lambda_2)$$

11. Exponential Distribution

$$f(t) = \lambda e^{-\lambda t}, \quad t \geq 0$$

$$P(T > t) = e^{-\lambda t}$$

Memoryless property

$$P(T > s + t \mid T > s) = P(T > t)$$

All necessary formulas are provided. A basic calculator is allowed.