STAT PHYS SCIENCE Final Cheat Sheet

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1 Continuous Random Distribution

1.1 Uniform Distribution

$$f(x) = \frac{1}{b-a}, a \leq x \leq b$$

$$\mu = E(x) = \frac{(a+b)}{2}$$

$$\sigma^2 = V(X) = \frac{(b-a)^2}{12}$$

1.2 Normal Distribution

$$E(X) = \mu$$

$$V(X) = \sigma^2$$

1.2.1 Standardizing a Normal Random Variable

$$Z = \frac{X-\mu}{\sigma}$$

$$P(X \leq x) = P(\frac{X-\mu}{\sigma} \leq \frac{x-\mu}{\sigma}) = P(Z < z)$$

1.3 Exponential Distribution

$$f(x) = \lambda e^{-\lambda x}, \text{ for } 0 \leq x < \infty$$

$$\mu = E(X) = \frac{1}{\lambda} \text{ and } \sigma^2 = V(x) = \frac{1}{\lambda^2}$$

1.4 Gamma Distribution

$$\mu = E(X) = \frac{r}{\lambda} \text{ and } \sigma^2 = V(X) = \frac{r}{\lambda^2}$$

2 Sampling Distribution

2.1 Probability Distribution of Mean ($\bar{X}$)

2.1.1 Known Variance

$$Z = \frac{\bar{X} - \mu_{\bar{X}}}{\frac{\sigma}{\sqrt{n}}}$$

2.1.2 $n \geq 30$

$$Z = \frac{\bar{X} - \mu_{\bar{X}}}{\frac{s}{\sqrt{n}}}$$

2.1.3 Unknown Variance

$$T = \frac{X - \mu}{\frac{S}{\sqrt{n}}}$$

has a t distribution with $n-1$ degree of freedom.

2.2 Probability Distribution of Difference of Mean ($\bar{X}_1 - \bar{X}_2$)

2.2.1 Central Limit Theorem ($n \geq 30$)

$$Z = \frac{\bar{X}_1 - \bar{X}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

2.2.2 $\sigma_1^2 = \sigma_2^2$

Random varaible T with degree of freedom $n_1 + n_2 - 2$

$$T = \frac{\bar{X}_1 - X_2 - (\bar{\mu}_1 - \mu_2)}{\sqrt{S_p^2(\frac{1}{n_1} + \frac{1}{n_2})}}$$

$$S_p^2 = \frac{(n-1)s_1^2 + (n-1)s_2^2}{n_1 + n_2 - 2}$$

2.2.3 $\sigma_1^2 \neq \sigma_2^2$

t distribution with degree of freedom

$$\nu = \frac{(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2})^2}{\frac{(s_1^2/n_1)^2}{n_1-1} + \frac{(s_2^2/n_2)^2}{n_2-1}}$$

$$T = \frac{\bar{X}_1 - \bar{X}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

2.2.4 Dependent data between two groups

$$T(n-1) = \frac{\bar{D} - \mu_D}{\frac{\sigma_D}{\sqrt{n}}} \text{ with } \sigma_D \approx S_D = \sqrt{\frac{\sum_{j=1}^{n} D_j^2 - nD^2}{n-1}}$$

2.3 Probability Distribution of Variance (S^2)

$$\chi^2(n-1) = \frac{(n-1)S^2}{\sigma^2}$$

2.4 Probability Distribution of Variance Ratio $(\frac{S_1^2}{S_2^2})$

$$F(n_1-1, n_2-1) = \frac{S_1^2/\sigma_1^2}{S_2^2/\sigma_2^2}$$