Final Exam Formula Sheet

- **Numerical Summary**

$$\bar{x} = \frac{x_1 + \ldots + x_n}{n}, \quad \text{sd} = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}, \quad \text{z-score} = \frac{x-\mu}{\sigma}\,(\mu, \sigma \text{known})$$

When μ, σ unknown, replace μ, σ with $\bar{x}$ and sd, accordingly.

- **Regression**

$$\hat{y} = b_0 + b_1 x, \quad \text{resid} = y - \hat{y}, \quad r = \pm\sqrt{R^2}$$

- **Probability Rules**

$$P(A) = \frac{\#A}{\#S} \qquad P(A \cup B) = P(A) + P(B) - P(A \cap B) \quad P(A \cap B) = P(A|B)P(B)$$

$$P(A \cap B) = P(B|A)P(A) \qquad P(A|B) = \frac{P(A \cap B)}{P(B)} \qquad P(B|A) = \frac{P(B \cap A)}{P(A)}$$

Mutually Exclusive: $P(A \cap B) = 0$
Independent Events: $P(A \cap B) = P(A) \times P(B),\ P(A|B) = P(A),\ P(B|A) = P(B)$

- **Binomial Distribution**

$$X \sim Binomial(n, p),\ \mu_X = np, \sigma_X = \sqrt{np(1-p)}$$

$$P(X = x) = \binom{n}{x} p^x (1-p)^{(n-x)} = \frac{n!}{x!(n-x)!} p^x (1-p)^{(n-x)}$$

- **Central Limit Theorem**

Data Type	**Formula**	**Condition**
Continuous	$\bar{x} \sim N(\mu_X, \frac{\sigma_X}{\sqrt{n}})$	$n \geq 30$
Categorical	$\hat{p} \sim N(p, \sqrt{\frac{p(1-p)}{n}})$	$np \geq 15, n(1-p) \geq 15$

- **Confidence Interval**

Data Type	**Formula**	**Condition**
Continuous	$\bar{x} \pm t\frac{s}{\sqrt{n}}$	Approx. Normal
Categorical	$\hat{p} \pm z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}})$	$n\hat{p} \geq 15, n(1-\hat{p}) \geq 15$

Confidence Level	Z
90%	1.64
95%	1.96
90%	2.58

- **Hypothesis Test(one-sample)**

Steps	**Categorical**	**Continuous**
Assumption	Random Sample Categorical $np_0 \geq 15, n(1-p_0) \geq 15$	Random Sample Continuous Approx. Normal
Statements	$H_0 : p = p_0$ vs. $H_a : p \neq p_0$	$H_0 : \mu = \mu_0$ vs. $H_a : \mu \neq \mu_0$
Test-Statistic	$z = \frac{\hat{p}-p_0}{\sqrt{\frac{p_0(1-P_0)}{n}}}$	$t = \frac{\hat{x}-\mu_0}{s/\sqrt{n}}$
P-value	$P(\lvert Z\rvert > \lvert z\rvert)$	$P(\lvert T\rvert > \lvert t\rvert)$
Conclusion	Reject H_0 if $P - value < \alpha$ Do not reject H_0 if $P - value > \alpha$	Reject H_0 if $P - value < \alpha$ Do not reject H_0 if $P - value > \alpha$