Exam 2 Notes Name: Cooper Morris

C2S4:

Random Variable: X, assigns a numeric value to outcomes in a sample space.
Discrete Random Variable: Possible values are countable, sum of two dice.
Continuous Random Variable: Possible values continuous, weight of random person.
Probability Mass Function: $P(X = x) = p(x)$
Cumulative Distribution Function: $P(X \leq x)$
Denoted by $F(x)$
$0 \leq p(x) \leq 1$
$\sum_x p(x) = 1$
Support: the set of values such that $f(x) > 0$
Percentile: x_p such that $P(X \leq x_p) = \frac{p}{100}$
$F(x_p) = \int_{-\infty}^{x_p} f(x)\,dx = \frac{p}{100}$

C2S6:

Jointly Distributed Random Variable: Two or more random variables that are related when considering "individuals" in a population.
Joint Probability Mass Function: $P(X = x, Y = y) = p(x, y)$ $P(X = x \cap Y = y)$
Marginal Probability Mass Function:
$P_x(x) = \sum_y p(x, y)$
$f_x(x) = \int_{-\infty}^{\infty} f(x, y)\,dy$
Summing or integrating out the opposite variable gives you the marginal probability mass function for the variable you desire.

Discrete Random Variables:
$\mu_x = \mathbb{E}[X] = \sum_x x \cdot p(x)$
$\sigma^2 = \sum_x x^2 \cdot p(x) - \mu_x^2$
$\mathbb{E}[g(X)] = \sum_x g(x) \cdot p(x)$
Continuous Random Variables:
$P(a \leq X \leq b) = \int_a^b f(x)\, dx$
$\mu_x = \mathbb{E}[X] = \int_{-\infty}^{\infty} x \cdot f(x)\, dx$
$\sigma^2 = \int_{-\infty}^{\infty} x^2 \cdot f(x)\, dx - \mu_x^2$
$\mathbb{E}[g(X)] = \int_{-\infty}^{\infty} g(x) \cdot f(x)\, dx$

$(\mu \pm k\sigma_x)$
$P(|X - \mu_x| > k\sigma_x) = \frac{1}{k^2}$
C2S5:
Linear Functions of Random Variables
Linear Function: $Y = aX + b$
Expected Value: $a\mathbb{E}[X] + b$
Variance: $a^2 \cdot \mathrm{Var}(X)$
Standard Deviation: $|a| \cdot \sigma_x$

Linear Combinations of Random Variables
Linear Combinations: $\sum_{i=1}^n c_i X_i$
Expected Value: $\sum_{i=1}^n c_i \mathbb{E}[X_i]$
Variance: $\sum_{i=1}^n c_i^2 \mathrm{Var}(X)$ where X_is are independent
Var(x+y) = Var(x) + Var(y)
Var(x-y) = Var(x) + Var(y)

Simple Random Samples
$\bar{x} = \sum_{i=1}^n \frac{1}{n} \cdot x_i$
$\mu_{\bar{x}} = \mathbb{E}[\bar{x}] = \mu$
$\sigma_{\bar{x}}^2 = \mathrm{Var}(\bar{x})$
$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}}$
C2S6:
$0 \leq p(x, y) \leq 1$
$\sum_x \sum_y p(x, y) = 1$
$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(x, y)\, dx\, dy = 1$
$P(a \leq x \leq b, c \leq y \leq d) = \int_c^d \int_a^b f(x, y)\, dx\, dy$
$\mathbb{E}[h(X, Y)] = \sum_x \sum_y h(x, y) p(x, y)$
$\mathbb{E}[h(X, Y)] = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} h(x, y) f(x, y)\, dx\, dy$
$\mathrm{Cov}(X, Y) = \mu_{XY} - \mu_x \mu_y$
$\rho_{X,Y} = \frac{\mathrm{Cov}(X,Y)}{\sqrt{\mathrm{Var}(X)\mathrm{Var}(Y)}}$
C3:
$\sigma_{g(X)} \approx |g'(X)| \cdot \sigma_X$