EXAM TWO FORMULA SHEET

Differentiation:

$$\frac{d}{dx}(x^n) = nx^{n-1} (\text{if } n \neq 0)$$

$$\frac{d}{dx}(\ln(|x|)) = \frac{1}{x}$$

$$\frac{d}{dx}(e^{rx}) = re^{rx}$$

Product Rule: $(uv)' = u'v + uv'$

Quotient Rule: $\left(\frac{u}{v}\right)' = \frac{u'v - uv'}{v^2}$

Chain Rule: $\frac{d}{dx}(f(g(x))) = f'(g(x))g'(x)$

Integration:

$$\int x^n \, dx = \frac{x^{n+1}}{n+1} + C \text{ if } n \neq -1$$

$$\int \frac{1}{x} \, dx = \ln(|x|) + C$$

$$\int e^{rx} \, dx = \frac{1}{r}e^{rx} + C$$

Integration by Parts: $\int u \, dv = uv - \int v \, du$

Substitution: $\int f(u(x))u'(x) \, dx = \int f(u) \, du$

Continuous Random Variables and their density functions:

Distribution	General Continuous	Uniform	Exponential	Normal
Density Function	$f(x)$	$\frac{1}{b-a}$	$\lambda e^{-\lambda x}$	$\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$
Domain	$a \leq x \leq b$	$a \leq x \leq b$	$0 \leq x < \infty$	$-\infty < x < \infty$

Random Variable X	$\Pr(X)$	$\mu = E(X)$	$\sigma^2 = \text{Var}(X)$
Discrete	$\Pr(X = x_k) = p_k$	$\sum_{k=1}^{N} x_k \cdot p_k$	
	Special case: $\Pr(X = x_k) = \frac{1}{N}$	$\frac{x_1 + x_2 + \cdots + x_N}{N}$	$\frac{(x_1 - \mu)^2 + \cdots + (x_N - \mu)^2}{N}$
Continuous	$\Pr(c \leq X \leq d) = \int_c^d f(x) \, dx$	$\int_a^b xf(x) \, dx$	$\int_a^b (x-\mu)^2 f(x) \, dx = \int_a^b x^2 f(x) \, dx - \mu^2$
Uniform	(as continuous)	$\frac{b-a}{2}$	$\frac{(b-a)^2}{12}$
Exponential	(as continuous)	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$
Normal	(as continuous)	μ	σ^2

Bernoulli Trials: $b(n, k; p) = \binom{n}{k} p^k q^{n-k}$ where $q = 1 - p$. In this case, $\mu = n \cdot p$ and $\sigma^2 = n \cdot p \cdot q$

Chebychev's Theorem: If a distribution X has mean μ and standard deviation σ, then

$$\Pr(\mu - k \leq X \leq \mu + k) \geq 1 - \frac{\sigma^2}{k^2}.$$