STAT 291 - Statistics for the Mathematical Sciences I

Final Exam Formulae

$$P(A_j \mid B) = \frac{P(A_j \bigcap B)}{P(B)} = \frac{P(B \mid A_j)P(A_j)}{\sum_{i=1}^{k} P(B \mid A_i)P(A_i)}$$

$$F(x) = \sum_{y \le x} p(y) \qquad E(X) = \mu = \sum_{\text{all } x} x \cdot p(x)$$

$$V(X) = \sigma^2 = E\left[(X-\mu)^2\right] = \sum_{\text{all } x} (x-\mu)^2 \cdot p(x)$$

$$E[h(X)] = \sum_{\text{all } x} h(x) \cdot p(x) \qquad V[h(X)] = \sum_{\text{all } x} (h(x) - E[h(x)])^2 \cdot p(x)$$

$$F(x) = \int_{-\infty}^{x} f(y)dy \qquad E(X) = \mu = \int_{-\infty}^{\infty} x \cdot f(x)dx$$

$$V(X) = \sigma^2 = E\left[(X-\mu)^2\right] = \int_{-\infty}^{\infty} (x-\mu)^2 \cdot f(x)dx$$

$$E[h(X)] = \int_{-\infty}^{\infty} h(x) \cdot f(x)dx \qquad V[h(X)] = \int_{-\infty}^{\infty} (h(x) - E[h(x)])^2 \cdot f(x)dx$$

$$p(x) = \binom{n}{x} p^x (1-p)^{n-x} \quad x = 0, 1, 2, \ldots, n \qquad E(X) = np,\ V(X) = np(1-p)$$

$$p(x) = e^{-\lambda}\frac{\lambda^x}{x!} \quad x = 0, 1, 2, \ldots \qquad E(X) = \lambda,\ V(X) = \lambda$$

$$f(x) = \frac{1}{B-A} \quad A \le x \le B \qquad E(X) = \frac{A+B}{2},\ V(X) = \frac{(B-A)^2}{12}$$

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{\frac{-(x-\mu)^2}{2\sigma^2}} \quad -\infty < x < \infty \qquad E(X) = \mu,\ V(X) = \sigma^2$$

$$\Gamma(\alpha) = \int_0^{\infty} x^{\alpha-1} e^{-x} dx \quad \alpha > 0$$

$$\Gamma(\alpha) = (\alpha-1)\Gamma(\alpha-1),\ \Gamma\left(\frac{1}{2}\right) = \sqrt{\pi},\ \Gamma(n) = (n-1)! \text{ for } n = 1, 2, 3, \ldots$$

$$f(x) = \frac{1}{\beta^\alpha \Gamma(\alpha)} x^{\alpha-1} e^{-\frac{x}{\beta}} \quad 0 \le x < \infty \qquad E(X) = \alpha\beta,\ V(X) = \alpha\beta^2$$

Special Cases: $\alpha = 1,\ \beta = \frac{1}{\lambda};$ $\alpha = \frac{\nu}{2},\ \beta = 2$

$$f(x) = \frac{1}{(B-A)}\frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)}\left(\frac{x-A}{B-A}\right)^{\alpha-1}\left(\frac{B-x}{B-A}\right)^{\beta-1} \quad A \leq x \leq B$$

$$E(X) = A + (B-A)\frac{\alpha}{\alpha+\beta} \qquad V(X) = \frac{(B-A)^2\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$$

$$Y = \sum_{i=1}^{n} a_i X_i \qquad E(Y) = \mu_Y = \sum_{i=1}^{n} a_i E(X_i) = \sum_{i=1}^{n} a_i \mu_i$$

$$V(Y) = {\sigma_Y}^2 = \sum_{i=1}^{n} a_i^2 V(X_i) = \sum_{i=1}^{n} a_i^2 {\sigma_i}^2$$

$$E\left(XY\right) = \sum_x \sum_y \left(x \cdot y \cdot p(x,y)\right) \qquad E\left(XY\right) = \int\int \left(x \cdot y \cdot f(x,y)\right) dy\, dx$$

$$Cov\left(X,Y\right) = E\left(XY\right) - E\left(X\right)E\left(Y\right)$$

$$\rho = Corr\left(X,Y\right) = \frac{Cov\left(X,Y\right)}{\sqrt{V(X)\cdot V(Y)}}$$

$$\frac{\bar{x} - \mu_0}{\frac{\sigma}{\sqrt{n}}}$$