$$X : P(X=x) = p\cdot(1-p)^{x-1}$$

$$E[X],\ V[X] = ?$$

$$E(x) = \sum_{x=1}^{\infty} p(1-p)^{x-1} x$$

$\cancel{E[x]}$

$\cancel{E[x^2]}$

$$p\cdot(1-p)^{x-1}\cdot x$$

$$\sum_{x=1}^{\infty} \cancel{p}(1-p)^{x-1} = \frac{1}{p}$$

$$\sum_{x=1}^{\infty} (1-p)^{x} = \frac{1-p}{p}$$

$$-\sum_{x=1}^{\infty} (1-p)^{x-1} x = \frac{-1}{p^2}$$

$$\sum_{x=1}^{\infty} (1-p)^{x-1} x\cdot p = \frac{1}{p}$$

$$E(x) = \frac{1}{p}$$

$$E(x^2) = p\,(1-p)^{x-1}\,x^2$$

$$\frac{x}{p}$$

$$\sum_{x=1}^{\infty} (x-1)^2 (1-p)^{x-1} p + \sum_{x=1}^{\infty} 2(x-1)(1-p)^{x-1} p$$

$$+ \underbrace{\sum_{x=1}^{\infty} 1 (1-p)^{x-1} p}_{=1}$$

$$\sum_{s=0}^{\infty} s^2 (1-p)^{s-1} p_{(1-p)} + \sum_{s=0}^{\infty} 2s(1-p)^{s-1} p_{(1-p)} + 1$$

$$E(x^2) = (1-p)E(x^2) + 2(1-p)E(x) + 1$$

$$p\,E(x^2) = 2(1-p)\frac{1}{p} + 1$$

$$E(x^2) = \frac{2-2p}{p^2} + \frac{1}{p^2} = \frac{2-p}{p^2}$$

$$V(x) = \frac{2-p}{p^2} - \frac{1}{p^2} = \frac{1-p}{p^2}$$

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