Formulas Sheet

1. **The Binomial Distribution**

   If X is a binomial random variable with parameters n and p, then

   $$P(X=k)=\binom{n}{k}p^k(1-p)^{n-k} \quad \text{for } k=0,1,2,\ldots,n.$$

   The expected value of X is np and its variance is $np(1-p)$.

2. **The Hypergeometric Distribution**

   If X is a hypergeometric random variable with parameters M, number of objects of one type, N, the total number of objects (so that $N-M$ is the number of objects of the other type), and n, the sample size, then

   $$P(X=k)=\frac{\binom{M}{k}\cdot\binom{N-M}{n-k}}{\binom{N}{n}}, \qquad \text{for } M-(N-n)\leqslant k\leqslant M,$$

   is the probability of selecting k objects of the first type in a random sample of size n.

   The expected value of X is $\dfrac{nM}{N}$.

3. **Confidence Interval for the Mean**

   An approximate, level C, confidence interval for the mean, μ, of a distribution, for the case in which the standard deviation, σ, is known and n is a large sample size, is given by

   $$\left(\overline{X}_n - z^*\frac{\sigma}{\sqrt{n}}, \overline{X}_n + z^*\frac{\sigma}{\sqrt{n}}\right), \tag{1}$$

   where z^* is a positive value with

   $$P(-z^* < Z < z^*) \approx C,$$

   Z being the standard normal random variable, and $\overline{X}_n$ is the sample mean.

   For instance, when $C=0.95$, $z^*=1.96$.

   The expression $z^*\dfrac{\sigma}{\sqrt{n}}$ is known as the margin of error.

4. **Confidence Interval for a Proportion**

   An approximate, level C, confidence interval for a proportion is obtained from the confidence interval for the mean given above by letting $\overline{X}_n=\widehat{p}_n$, the sample proportion, and $\sigma=\sqrt{\widehat{p}_n(1-\widehat{p}_n)}$, in the formula (1) for the confidence interval for a mean.