

MATH 308 Assignment 11: Baseball World Series Hypothesis Testing

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1 Expected Values under the Null 2 Hypothesis Testing

To win the series after playing n games, the winning team must win 3 of the first $n-1$ games, and then win the last game. Thus, for each team, the probability of winning after playing n games is:

$$P(n = k) = \binom{k-1}{3} \left(\frac{1}{2}\right)^{k-1} \left(\frac{1}{2}\right)$$

However, the probability of n games being played is the probability of *either* team winning after n games. Thus, the p.m.f. of the number of games played, N , is twice the function above:

$$P(N = k) = \binom{k-1}{3} \left(\frac{1}{2}\right)^{k-1}$$

Thus, the expected number of series N won after k games is $P(N_k) \times (\text{number of games played})$. We can then tabulate the expected and observed values:

k	4	5	6	7
$\mathbb{E}(N_k)$	6.25	12.5	15.625	15.625
$\mathbb{O}(N_k)$	8	8	10	24

The test statistic t is given by $\sum_{k=4}^7 \frac{(\mathbb{O}(N_k) - \mathbb{E}(N_k))^2}{\mathbb{E}(N_k)} = 9.76$. Because k can take on only 4 values, we know that $t \sim \chi_3^2$. Hence, our p value is given by

$$p = \int_{9.76}^{\infty} \frac{e^{-x/2} \sqrt{x}}{\sqrt{2\pi}} dx \approx 0.02$$

Thus, we can reject the null at the 5% significance level.