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Quiz – April 4, 2006

The series

$$1 - \tfrac{1}{3!} + \tfrac{1}{5!} - \tfrac{1}{7!} + \dots$$

satisfies the hypotheses of the Alternating Series Test; and therefore this series converges. Approximate the sum of this series with an error at most .005 . **Explain very thoroughly.**

Answer: Let S be the sum of the series. The Alternating Series test tells us that the distance between S and some partial sum of the series is at most the absolute value of the next term:

$$|S - 1| \le \tfrac{1}{3!}$$
$$|S - (1 - \tfrac{1}{3!})| \le \tfrac{1}{5!}$$
$$|S - (1 - \tfrac{1}{3!} + \tfrac{1}{5!})| \le \tfrac{1}{7!}$$
etc.

We want to find an odd number n with

$$\frac{1}{n!} \le .005 = \frac{5}{1000} = \frac{1}{200}.$$

We want $200 \le n!$. We know that $5! = 120$ and $7!$ is much more than 200 . We conclude that

$$\boxed{1 - \frac{1}{3!} + \frac{1}{5!} \text{ approximates } S \text{ with an error at most } .005.}$$