This represents the likelihood of continuing after each round - thus, the expected payout is a sum:

$$\frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} \cdots$$

$$= \sum_{n=0}^{\infty} \frac{1}{n!}$$

This is the sum of the infinite series, which we know to be e.

Since we are working in hundreds of dollars, we multiply to get an expected payout of

$$e \cdot \$100 = \$271.82\ldots$$