The **delta-gamma approximation** is used to estimate option price movements if the underlying stock price changes. It is used as it is better than the delta approximation which is linear. The option price is a non-linear function of the stock price. To take account of this we can use gamma to make our option price estimate more precise. Delta-gamma makes our approximation non-linear.

The delta-gamma approximation for call options can be expressed via the following formula:

\[
C(S_{T+1}) = C(S_T) + \Delta(S_T) \times \bar{e} + 0.5 \times \Gamma(S_T) \times \bar{e}^2
\]

In words: New option price = old option price + delta * (new stock price at time t+1 – starting stock price at time t) + 0.5 * gamma * (new stock price at time t+1 - starting stock price)².

For a put option, the same formula holds, but delta is now negative - so the put price will decrease if the stock price increases.

**Meaning of variables:**

- \( S_T \): stock price at time t.
- \( S_{T+1} \): stock price at time t+1.
- \( C \): call option price.
- \( e \): stock price change from time t to time t+1.
- \( \Delta \): option delta.
- \( \Gamma \): option gamma.