

ChatGPT 3.5 ▾

**You**

The integral of $(a^2 e^{-a^2/(2\sigma^2)}) da$ over minus infinity to plus infinity?

**ChatGPT**

The integral you provided is related to the normal distribution and is commonly encountered in probability and statistics. The integral you're asking about is:

$$\int_{-\infty}^{\infty} a^2 e^{-\frac{a^2}{2\sigma^2}} da$$

To solve this integral, you can use the fact that it involves a Gaussian function. One way to solve it is by completing the square. The integral can be rewritten as follows:

$$\int_{-\infty}^{\infty} a^2 e^{-\frac{a^2}{2\sigma^2}} da = \sqrt{2\pi}\sigma^3 \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}\sigma} a^2 e^{-\frac{a^2}{2\sigma^2}} da$$

Now, if you let $u = \frac{a}{\sigma}$, the integral becomes:

$$\sqrt{2\pi}\sigma^3 \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}\sigma} a^2 e^{-\frac{a^2}{2\sigma^2}} da = \sqrt{2\pi}\sigma^3 \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}} (\sigma u)^2 e^{-\frac{u^2}{2}} du$$

Solving this integral involves standard Gaussian integral results. The final answer is:

$$\int_{-\infty}^{\infty} a^2 e^{-\frac{a^2}{2\sigma^2}} da = \sqrt{2\pi}\sigma^3$$

So, the integral evaluates to $\sqrt{2\pi}\sigma^3$.

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