②

~~$\det(A - xI)$~~

~~$\det(\Lambda\ Z - xV$~~

$$\det\left(Z - \frac{x\Lambda}{\sigma^2}\right) = \frac{\det(\Lambda)}{(\sigma^2)^D}\det\left(\cancel{Z}\,\sigma^2\Lambda^{-1}Z - \frac{x}{\cancel{\sigma}}I\right)$$

coeff of x^{D} here is $\cancel{I}$ $(-1)^N$.

$= 0$

so coeff of x^D here is $\dfrac{(-1)^N \det(\Lambda)}{(\sigma^2)^D}$

So we can write:

$$\mathbb{E}\left[\, |\det \nabla^2 X(t_0)|\, \mathbb{1}[X(t_0) > v]\, \mathbb{1}\left[\left\| \frac{\nabla^2 X(t_0)}{X(t_0)} + \frac{\Lambda(t_0)}{\sigma^2}\right\| > u\right] \,\middle|\, \nabla X(t_0) = 0 \right]$$

$$= \int_v^\infty \int |\det x''|\, \mathbb{1}\left[\left|\frac{x''}{x} + \frac{\Lambda(t_0)}{\sigma^2}\right| > u\right] \mathbb{1}[x > v]\, p(x, x'' | x' = 0)\, dx''\, dx$$

$$= \int_v p(x) \int \mathbb{1}\left[\left|\frac{x''}{x} + \frac{\Lambda(t_0)}{\sigma^2}\right| > u\right] \mathbb{1}[x > v]\, |\det x''|\, p(x'' | x, x' = 0)\, dx''\, dx$$