$\mathbb{E}\left[\cancel{(XY - \mathbb{E})} ((XY) - \mathbb{E}(XY))^2 \right]$

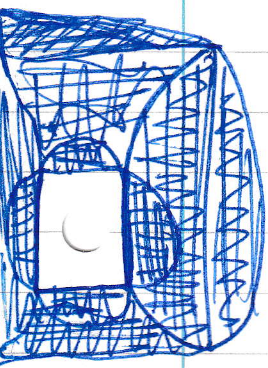
$\sum_i 2 X_i \nabla X_i \sim \cancel{XY}$ $\boxed{UZ}$

XX' $X''X + (X')^2$ $\cancel{f(f\,x)}$

$f(X_1, \ldots, X_n)$

$\mathbb{E}[F'(X)] = \mathbb{E}X' \, \mathbb{E}f'(X)$
$= 0$

$\nabla f(X_1, \ldots, X_n)$



$\sum X_i^2$ $\quad 2 \sum X_i \nabla X_i$ $\quad \mathbb{E}[\quad A_S(X)^2 \nearrow \infty$

$//$

$\sum_i X_1^{pi(1)} \ldots, X_n^{pi(n)}$

$\mathrm{var}(F'(X))$

$= \cancel{\mathrm{var}(X')\,\mathrm{var}(f'(X))}$

~~as X', X are indep~~

So

$= \mathrm{var}(X')\,\mathbb{E} f'(X)^2$

> 0 $\quad$ so $F' = 0 \Rightarrow \mathbb{E}(f'(X))^2 = 0$

$F = f(X)$.

$F' = X' f'(X)$

$\Rightarrow$ So If $F' = 0$ $\Rightarrow f'(X) = 0$!

Then $f'(X) = 0$

or $X' = 0$

$F'' = X'' f'(X) + X'^2 f''(X)$

So $F'' \mid \cancel{F''} = F' = 0$, $\cancel{X} = f(X)$

$= X'' f'(X)$ if $X' = 0$ or $X'^2 f''(X)$ if $f'(X) = 0$

Claim, if $\cancel{X, Y}$ $X \perp\!\!\!\perp Y$, & $\mathbb{E}Y = \mathbb{E}X = 0$ $\quad$ Proof: $\mathbb{E}XY = \mathbb{E}X\,\mathbb{E}Y = 0$

Then $\mathrm{var}(XY) = \mathrm{var}\,X \,\mathrm{var}\,Y$. $\quad \Rightarrow \mathrm{var}(XY) = \mathbb{E}[(XY - \mathbb{E}XY)^2]$

If just $\mathbb{E}X = 0$ then $\mathrm{var}(XY) = \mathrm{var}(X)\,\mathbb{E}Y^2$ $\quad = \mathbb{E}X^2Y^2 = \mathbb{E}X^2\,\mathbb{E}Y^2$