

# Problem Set Econ - Week 3 - DSGE models - Perturbation Methods

Jeanne Sorin & Thomas Pellet

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## Exercise 1

From equation 5 (reading):

$$\begin{aligned} & F_{xx}\{x(u), u\}x_u(u)x_u(u) + F_{xu}\{x(u), u\}x_u(u) \\ & + F_x\{x(u), u\}x_{uu}(u) + F_{xu}\{x(u), u\}x_u(u) \\ & + F_{uu}\{x(u), u\} = 0 \end{aligned} \quad (0.1)$$

Taking the First Order Conditions with respect to U:

$$\begin{aligned} & F_{xxx}\{x(u), u\}x_u(u)^3 + 3(F_{xxu}\{x(u), u\}x_u(u)^2 \\ & + F_{uux}\{x(u), u\}x_u(u) + (F_{xu}\{x(u), u\}x_{uu}(u) \\ & + F_{xx}\{x(u), u\}x_u(u)x_{uu}(u)) + F_x\{x(u), u\}x_{uuu}(u) \\ & + F_{uuu}\{x(u), u\} = 0 \end{aligned} \quad (0.2)$$

Rearranging:

$$x_{uuu} = - \frac{F_{xxx}x_u^3 + 3(F_{xxu}x_u^2 + F_{uux}x_u + F_{xu}x_{uu} + F_{xx}x_u x_{uu}) + F_{uuu}}{F_x} \quad (0.3)$$