

## Math 330 HW 7, Due Tuesday, Dec. 6

For the Lorenz equations

$$x' = \sigma(y - x) \tag{1}$$

$$y' = rx - y - xz \tag{2}$$

$$z' = xy - bz \tag{3}$$

1. Show that a pitchfork bifurcation occurs at  $r = 1$
2. Determine where a Hopf bifurcation occurs.