Ordinary Differential Equations - Homework 2

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"You don't see them at first. But then you see them everywhere."
— *A Beautiful Mind*

1. Simmons, third edition, page number 73: 2,11,14,18,21.
2. Simmons, third edition, page number 80: 1,2.a,2.f,2.i,2.j,4.g,4.h,4.l,5.
3. Simmons, third edition, page number 83: 2.a,2.h,3,8,9.
4. Simmons, third edition, page number 99-101: 1,10,15,25,30,45,52.
5. **Price adjustment in a competitive market.**

   Consider a competitive market for a single good. Let $p(t)$ denote the market price at time t. At each instant, excess demand is given by

   $$Z(p) = D(p) - S(p),$$

   where $D(p)$ and $S(p)$ are continuously differentiable demand and supply functions. Assume that prices adjust continuously over time according to the Walrasian adjustment rule

   $$\frac{dp}{dt} = \kappa Z(p), \qquad \kappa > 0.$$

   Suppose that there exists an equilibrium price p^* such that $Z(p^*) = 0$, and that near p^* the excess demand function admits a first order Taylor approximation given by

   $$Z(p) = -c(p - p^*), \qquad c > 0.$$

   (a) Solve the differential equation for p given an initial price $p(0) = p_0$.

   (b) Determine the long-run behavior of $p(t)$ and explain the role of the constant c in stability.

   (c) Consider linear demand and linear supply curves. Using a diagram, illustrate the behavior of prices near equilibrium implied by the adjustment rule.