398 Math in the City
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Homework 4

Due November 1

1. (40 points) Use *pdsolve* in Maple to find the general solution to the following partial differential equations:

   (a) $u_t - 4u_x = 0$
   (b) $u_t - 4u_x = u^2$
   (c) $u_t - 4u_{xx} = 0$
   (d) $u_t - 4xtu_x = u$

   In each case choose an initial condition (i.e. let $u(0)$ be a given function of your choice) and find the corresponding particular solution. Plot the particular solution as a surface. Print out your Maple program and also show your work for finding the particular solutions.

2. (50 points) Consider the predator-prey system of owls and rats given as an example in class of a discrete dynamical system (see handout)

$$\begin{cases} O_{k+1} = (.5)O_k + (.4)R_k \\ R_{k+1} = -p \cdot O_k + (1.1)R_k. \end{cases}$$

   (a) Use Maple to find the eigenvectors and eigenvalues of this system (which depend on p).
   (b) Find values of p for which the origin is (a) an attractor; (b) a repellor; (c) a saddle point.
   (c) For each case of stability (a),(b),(c) draw several trajectories for the dynamical system (plot the points of coordinates (R_k, O_k) when (R_1, O_1) given). Each case of stability should be illustrated on a different set of coordinates; plot the trajectories in different colors.

3. (15 points) The mean serum-creatinine level measured in 12 patients 24 hours after they received a newly proposed antibiotic was 1.2 mg/dL with a sample standard deviation (s) of 0.4mg/dL. If the mean of serum creatinine level in the general population is 1.0 mg/dL, using a significance level of 0.05, test if the mean serum-creatinine level in this group is higher from that of the general population. What is the p-value for the test?

4. (45 points) The data in the table below gives the infant-mortality rates per 1000 livebirths in the United States for the period 1960-1979 (x =year, y=infant mortality rate per 1,000 live births).

x	y	x	y
1960	26.0	1974	16.7
1965	24.7	1975	16.1
1970	20.0	1976	15.2
1971	19.1	1977	14.1
1972	18.5	1978	13.8
1973	17.7	1979	13.0

(a) Fit a linear-regression line relating infant mortality rate to chronological year using these data.

(b) Test for significance of the linear relationship developed in part (a).

(c) If the trends continued for the next 10 years, then what would be the predicted infant-mortality rate in 1989?

(d) Can the linear relationship developed in part (a) be expected to continue indefinitely? Why or why not?