



Midterm 1

Due: 18 March 8pm.

1 Stability

- (15 Points) Test the linear stability of the zero solution $x_1(t) \equiv 0$, $x_2(t) \equiv 0$, in the following system using the linearization method

$$\begin{aligned}x_1' &= -1 - x_2 + e^{x_1} \\x_2' &= 4x_1 - 2 \sin x_2.\end{aligned}$$

2 Linear optimization

(15 Points) Nelson Vargas co-founded recently an astrology¹ group and acquired a loan of \$16670 from Salomon to start his business, i.e., to produce three types of services—read Tarot cards, horoscopes, and tasseographies²—with 137 students. An student can produce an average of 135 Tarot reads, 45 horoscopes, or 100 tasseographies in one week. Whenever each serviced is finished the student must write a report. The net profit per Tarot reads is \$2.25, for horoscope is \$1.70, and for tasseography is \$3.05. After the week these results must be stored in Dropbox. At present, his Dropbox can store 3895 reports. The salary per student is \$95.00 to read Tarot cards, \$205.00 to produce one horoscope and \$115.00 for each tasseography performed.

What amount of students should Nelson plan to dedicate to each fortune-telling method in order to optimize profit?

3 Fitting

- (5 Points) Plot the following data.

x	0.5	1.0	1.5	2.0	2.5
y	0.541	0.398	0.232	0.106	0.052

- (10 Points) Fit the function

$$f(x) = axe^{bx}$$

and compute the standard deviation.

- (5 Points) Determine the value of y for $x = 1.8$ using the model found.

¹The study of the movements and relative positions of celestial bodies interpreted as having an influence on human affairs, the natural world and the student's tests results.

²A fortune-telling method that interprets patterns in tea leaves.