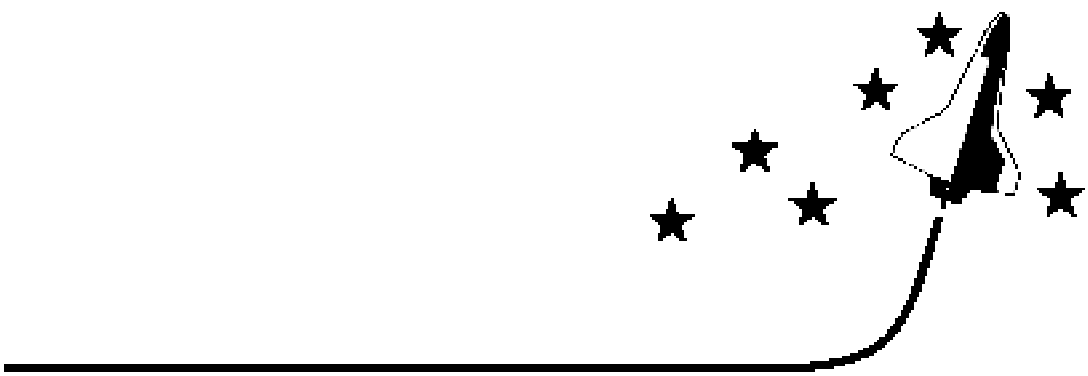
# *FACULTY NOTES*

The LTAs and Spinoffs are designed so that each professor can implement them in a way that is consistent with his/her teaching style and course objectives. This may range from using the materials as out-of-class projects with minimal in-class guidance to doing most of the work in class. The LTAs and Spinoffs are amenable to small group cooperative work and typically benefit from the use of some learning technology. Since the objective of the LTAs and Spinoffs is to support the specific academic goals you have set for your students, the Faculty Notes are not intended to be prescriptive. The purpose of the Faculty Notes is to provide information that assists you to take full advantage of the LTAs and Spinoffs. This includes suggestions for instruction as well as answers for the exercises.



# FACULTY NOTES

## LTA 6

## Surviving in a Lunar Base Station

### Background Information

Level of Presentation: College Algebra, Precalculus

Mathematics Prerequisites: Linear equations and graphing

Technology Requirement: Exercise 3 in Part A requires a scientific calculator with two-variable statistics, or a graphing calculator such as TI-82™ or TI-83™, or computer software capable of regression analysis. Part B requires a graphing calculator.

Time Required: 2 class hours (see comments below).

Recommended Working Format: Collaborative work in groups of four. Assign groups by selecting one student from each quartile (based on grades).

Recommended Requirements:

1) Oral report in class, with each group member participating by describing the solution to at least one of the exercises.
2) Written solutions, with relevant graphs, calculations, and a summary description of each exercise solution.

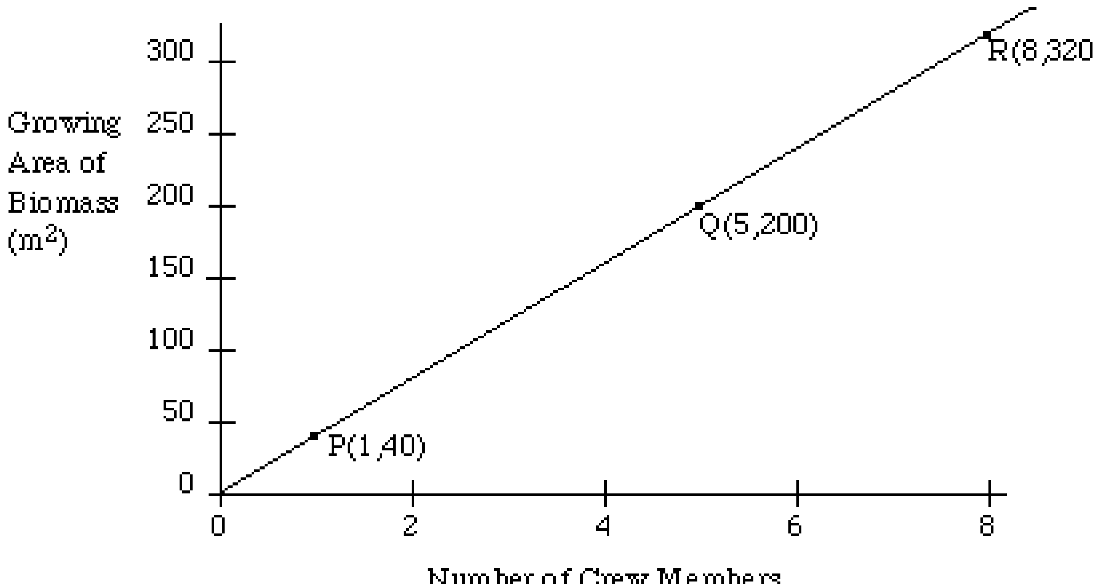
Comments:

1) Part A of the LTA is independent of Part B.
2) The complete solutions to all exercises may require more than two classes.
3) The instructor should introduce basic concepts in linear regression analysis, such as the definitions of best fit line and scatterplot before doing the LTA.

## Solutions

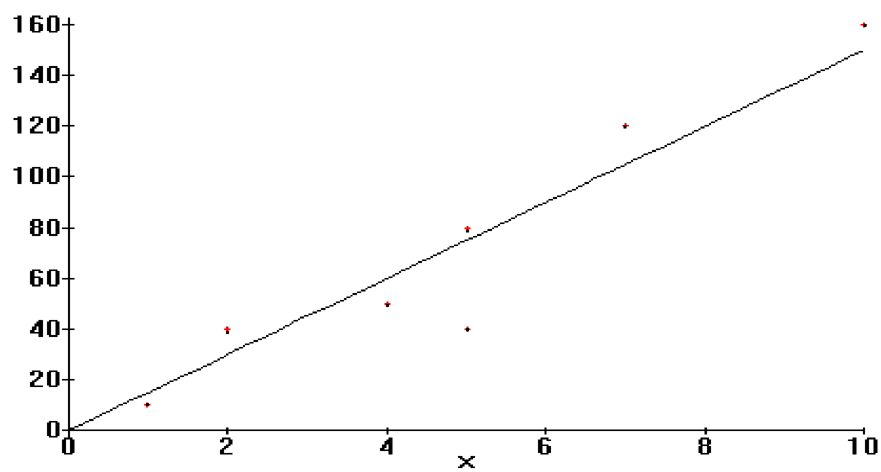
## Part A

1. a,b) Let the $x$-axis represent the number of crew members and the $y$-axis represent the growing area of biomass (in $m^2$). Using the graph, the area of biomass needed to feed a crew of 8 is between 310 $m^2$ and 330 $m^2$.
   c) The equation that describes the line is $y = 40x$.
   d) The exact growing area of biomass needed is 320 $m^2$.



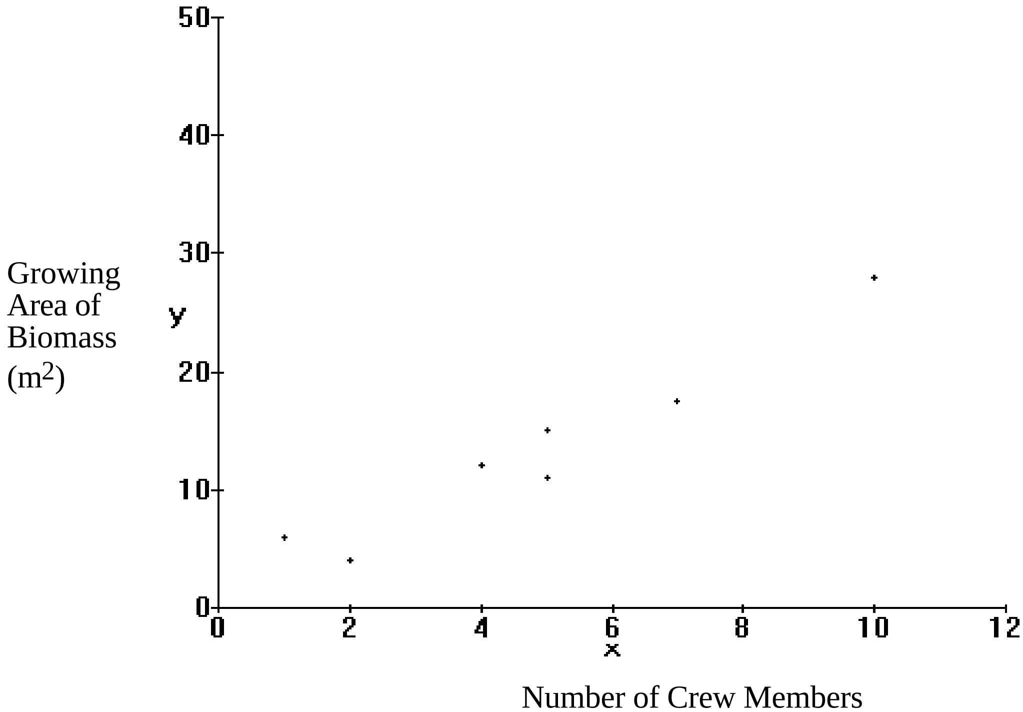

2. a,b) Let the $x$-axis represent the number of crew members, and let the $y$-axis represent the growing area of biomass in square meters ($m^2$).
   c) The area of biomass needed is approximately 120 $m^2$.

Growing Area of Biomass ($m^2$)




Number of Crew Members

3. a) Let the $x$-axis represent the number of crew members and the $y$-axis represent the growing area of biomass.




b) The equation of the regression line found using a TI-83™ is $y = 2.56x + 0.930$.

c) The area of biomass needed is 21.4 $m^2$.

4) The area of biomass needed is 320 $m^2$. In order to have sufficient food, oxygen, and water, you must select the *largest* of the three areas.

5. a) The minimum additional growing area is 40 $m^2$.

b) The marginal change needed is approximately 16 $m^2$.

c) The marginal change needed is 2.56 $m^2$.

d) Marginal change = slope of the line.

e) The marginal change needed is 40 $m^2$.

f) The area of biomass required is 360 $m^2$.

**Part B**

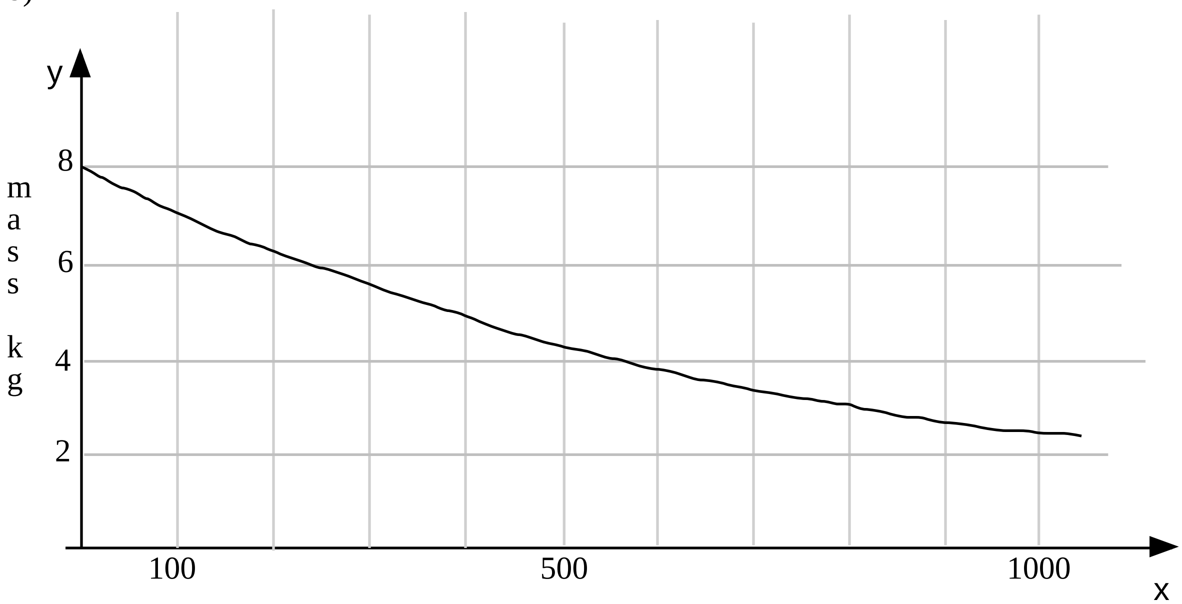
1) The function may be expressed by any of the following.

a) $y = f(t) = (8kg)(0.9)^{\frac{t}{90}}$

$y = f(t) = (8kg)(0.99883)^{t}$

$y = f(t) = (8kg)e^{-0.0011706\,t}$

b)




c) A part of the table is shown below.

| time (days) | amount of oxygen (days) |
|---|---|
| 550 | 4.20 |
| 560 | 4.15 |
| 570 | 4.10 |
| 580 | 4.06 |
| 590 | 4.01 |
| 600 | 3.96 |
| 610 | 3.92 |
| 620 | 3.87 |
| 630 | 3.83 |

2) f(14 days) = 7.87 kg
3) Using the graph of Exercise 1, we see that at the end of 8 weeks or 56 days there is about 7.5 kg of oxygen.
4) Using the the table in Exercise 1c we see that at the end of 90 weeks or 630 days there is 3.83 kg of oxygen.
5) The equation gives the following results: f(28 days) = 7.74 kg and f(365 days) = 5.22 kg.
6) Solving the equation 4 kg = 8kg$(0.99883)^t$, gives

$$t = \frac{\log(0.5)}{\log\ (0.99883)} = 592 \text{ days.}$$

The crew would have to schedule an earlier departure.

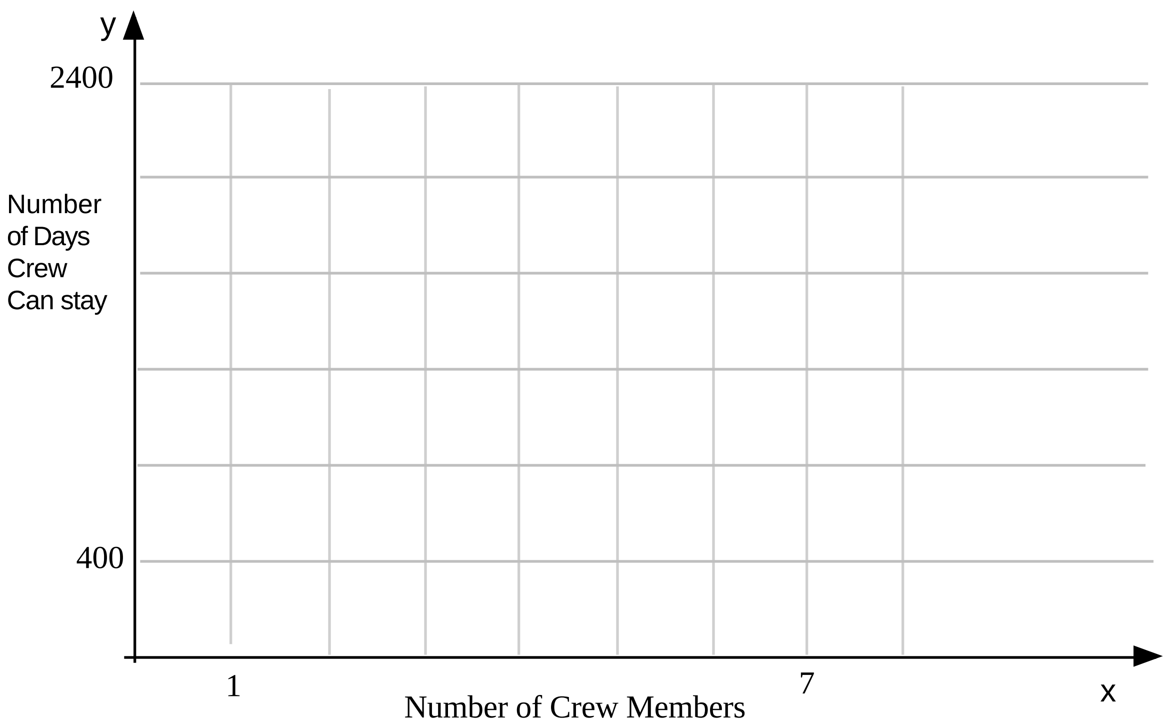
7. a) Determining the value for row 1 in the following table will exemplify the method for filling in the rest of the table.

If 7 crew members remain, they can stay there until the mass of oxygen equals 3.5 kg. We must solve the equation: 3.5 kg = $8\text{kg}(0.99883)^{t}$.

This gives $t = \dfrac{\log\left(\dfrac{3.5}{8}\right)}{\log\ (0.99883)} = 706$ days. (In the following table, y is used instead of *t*.)

| Number of crew members who depart | Number of crew members who remain (x) | Number of days (y) that remaining crew can stay in the Station |
|---|---|---|
| 1 | 7 | 706 |
| 2 | 6 | 838 |
| 3 | 5 | 994 |
| 4 | 4 | 1184 |
| 5 | 3 | 1430 |
| 6 | 2 | 1776 |
| 7 | 1 | 2368 |

7. b)




8) $y = \dfrac{\log\left(\dfrac{x}{16}\right)}{\log\ (0.99883)}$