Project: Applications of Linear Algebra

Objective: This project aims to use the concepts of linear algebra given in MA332 to practical applications.
Grading and Due Dates: This project will be graded with 35 marks total (worth 8% towards the final grade):
5 marks will be given for having topic selected appropriately on time **(due in class on April 27, 2019)**;
30 marks will be given for the report and presentation described below. **(due on May 11, 2019)**.
Topic selection:
Topics that can be chosen include, but not limited to the following list.

1. Constructing Curves and Surfaces Through Specified Points
2. The Earliest Applications of Linear Algebra
3. Cubic Spline Interpolation
4. Markov Chains
5. Graph Theory
6. Games of Strategy
7. Leontief Economic Models or Other Economic Models
8. Forest Management
9. Computer Graphics
10. Equilibrium Temperature Distributions
11. Computed Tomography
12. Fractals
13. Chaos
14. Cryptography
15. Genetics
16. Age-Specific Population Growth
17. Harvesting of Animal Populations
18. Least Squares Model (for any data set)
19. Warps and Morphs
20. Internet Search Engines

Remarks: The details of these topics can be found in Chapter 10 of the course's main text book: Howard Anton, Chris Rorres, *Elementary Linear Algebra with Supplemental Applications*, 11th Edition, John Wiley & Sons, 2013. You are highly encouraged to use **additional resources** for this project.

Project Requirements

1. Students will work in groups of no more than 3 members.
2. This project will consist of a written (typed) report and a brief presentation.
3. The report should contain answers to the questions outlined in "**Project Description**" below.
4. The presentation should be around 10-15 minutes in length and provide a summary of the report.
5. Cited references are required for the report and optional for the presentation.
6. Both the report and the presentation have to be turned in via email: `saifon@mathstat.sci.tu.ac.th` with the email subject `[MA332:Project]` followed by student IDs of the group's members.
7. A hard copy of the report is also required to be handed in before the presentation.

Project Description

Your project report and presentation should, at a minimum, include the following information.

1. **Project title**
   An appropriate title that briefly describes the focus of your project.
2. **Introduction: Project background/Questions and Goals**
   - What is the applications of interest, and why is it interesting?
   - What mathematical concepts in linear algebra arise in the given application?
3. **Methods**
   - Describe in details the the notion in linear algebra is used in selected application.
   - Demonstrate how the concept in linear algebra is applied.
   - Give some examples.
4. **Computer program** (if any):
   - Which language do you use to program in this project?
   - How do you apply the mathematical formula in the computer code?
5. **Results**
   - What kinds of results are obtained?
   - Demonstrate the results through some examples.
   - Use graphs, tables, figures, to display your results, if appropriate.
   - Analyze the results,e.g. give some interpretation.
6. **Conclusion**
   Summarize your investigation.
7. **Appendix**
   - A copy of your codes in the appendix (if any).
   - References.

Databases

In the case of least squares application, you may choose any type of data set. The following links provide available resources for international data sets arising in practice. You can also use other resources not listed here.

- **UN demographic data**
  `http://unstats.un.org/unsd/demographic/products/dyb/dyb2.htm`

  Population size, birth rates, population density, etc. for more than 190 countries.

- **World Health Organization Statistical Information System**
  `http://www.who.int/whosis/en/`

  50 health indicators (e.g. life expectancy, infant mortality, per capita expenditure on health) and morbidity and mortality information by country.

- **UNDP statistical information**
  `http://hdr.undp.org/en/data`

  Statistics of the Human Development Report 2007 for 177 countries (United Nations Development Program)

- **UNESCO Education Statistics**

  `http://www.uis.unesco.org/datacentre/pages/default.aspx?SPSLanguage=EN`

  School enrollment, literacy rates, etc. by country

- **UN Food and Agriculture Organization statistics**
  `http://www.fao.org/economic/ess/en/`

  Agriculture commodities, food production, etc. by country.

- **Gapminder**
  `http://www.gapminder.org/downloads/`

  Country level data for literacy, GDP and school enrollment from 1970 to 2000 is available via interactive graphics programs. Click on this website, then download the "World Education Chart" file (zipped), then click on the right facing triangle, then click on one of the tabs (Schoollife by GDP, Literacy by GDP, Literacy by gender, etc.). You can move the time frame forward by using the buttons at the bottom. If you put your pointer on an area it will show the name of the country and give the statistics. The size of the circle for each country gives the population size and they are color coded by region. You can use this to collect data different ways.

- **UNdata**
  `http://data.un.org/`

  UNdata gives access to a wide variety of international data from the UN agencies. Data are available on about 200 countries for some, but not all, variables. For most variables you will find data available on 80 to 170 countries. Some data are only available for a subset of developing countries, depending on the focus of the UN agency collecting that data.