

## EMTH211-19S2 ASSIGNMENT 1

This assignment is due at **4:00 PM Friday 4 October** and is to be handed through the boxes on Level 4 in the Mathematics & Statistics Department. This assignment is worth **20%** of your final grade. You may work by yourself or with one other person. If you hand in a joint assignment, you will each be given the same mark. Please complete and attach the cover sheet to your assignment before submitting your assignment.

**A1.1** The 100m sprint for women was first held in the 1928 Olympic Games. The event has been held in every Olympic Games since. The winning times are

Year	Time	Year	Time
1928	12.2	1972	11.07
1932	11.9	1976	11.08
1936	11.5	1980	11.60
1948	11.9	1984	10.97
1952	11.5	1988	10.54
1956	11.5	1992	10.82
1960	11.0	1996	10.94
1964	11.4	2000	10.75
1968	11.0	2004	10.93

Fit this data set with polynomials of degree 1, 2 and 3 using the QR decomposition of  $A$ . Check your results using MATLAB'S backslash operator. What is the error in each of these fits? In the case of the cubic fit, MATLAB issues a warning. Why does MATLAB do this? What can be done to avoid this (potential) problem? Use each of these fits to predict the winning time for the Beijing Olympic Games in 2008.

**A1.2** A conic section (in the plane) is described implicitly by

$$Ax^2 + By^2 + Cxy + Dx + Ey + F = 0.$$

In the file `A1.mat` on the EMTH211 Learn website, there is a matrix a  $2 \times 20$  matrix  $X$  that has measurements of 20 points in the plane (first row is the  $x$ -coordinate and second row  $y$ -coordinate of each of these measurements). Using least squares, find the best conic section passing through these points.

**A1.3** In the file `A1.mat` on the EMTH211 Learn website, is a matrix  $A$  which represents a  $480 \times 640$  pixel, 256-level grayscale image. In order to view this image in MATLAB the colour map must be set to `gray(256)`; that is

```
colormap(gray(256))  
image(A)
```

- (a) Compute the SVD for this matrix  $A$ . What is the largest and smallest singular value of  $A$ .
- (b) Output the image based on only the 2, 6, 10, 15, 20, 30, 50 and 100 largest singular values are used (that is, all other singular values are set to zero).
- (c) How much storage is required if only the  $k$  largest singular values are used (compute this as a percentage of the number of bytes taken to store the original image)?
- (d) In each of the cases of part (b), what is the storage required (as a percentage of the original file)?

## EMTH211 — ASSIGNMENT COVER SHEET

NAME(S):	
STUDENT ID(S):	
TUTORIAL GROUP(S):	
SIGNATURE(S):	

**This assignment MUST be your own work or the work of a pair.  
STAPLE this page to the front of your assignment.**

**Due: 4:00 pm, Friday 4 October 2019.**