FAMILY NAME: .....
OTHER NAME(S): .....
STUDENT NUMBER: .....
SIGNATURE: .....

THE UNIVERSITY OF NEW SOUTH WALES

SCHOOL OF MATHEMATICS AND STATISTICS

Session I, 2012

MATH2089 Practice
Numerical Methods and Statistics

(1) TIME ALLOWED – 3 Hours

(2) TOTAL NUMBER OF QUESTIONS – 6

(3) ANSWER ALL QUESTIONS

(4) THE QUESTIONS ARE OF EQUAL VALUE

(5) THIS PAPER MAY **NOT** BE RETAINED BY THE CANDIDATE

(6) **ONLY** CALCULATORS WITH AN AFFIXED "UNSW APPROVED" STICKER MAY BE USED

(7) STATISTICAL FORMULAE ARE ATTACHED AT END OF PAPER
STATISTICAL TABLES ARE ATTACHED AT END OF PAPER

Part A – Numerical Methods consists of questions 1 – 3

Part B – Statistics consists of questions 4 – 6

Both parts must be answered

All answers must be written in ink. Except where they are expressly required pencils may only be used for drawing, sketching or graphical work.

Part A – Numerical Methods

1. Answer in a separate book marked Question 1

The computational complexity of some common operations with n by n matrices are given in Table 1.1

Operation	Flops
Matrix multiplication	$2n^3$
LU factorization	$\frac{2n^3}{3} + O(n^2)$
Cholesky factorization	$\frac{n^3}{3} + O(n^2)$
Back/forward substitution	$n^2 + O(n)$
Tridiagonal solve	$8n + O(1)$

Table 1.1: Flops for some operations with n by n matrices

In each part a) to j) of this question a claim is made. For each claim, state whether you believe the claim is true or false ($\frac{1}{2}$ mark) and justify your answer ($1\frac{1}{2}$ marks).

a) **Claim:** The MATLAB expression

```
f = @(z) exp( (-z).^2 / 2)
```

correctly defines an anonymous function to evaluate $e^{-z^2/2}$.

b) **Claim:** The following MATLAB commands

```
x = 1e4;
h = 1e-15;
z = x + h > x
```

give the value 1 (for true).

c) A and B are two n by n matrices with $n \approx 10,000$ which have been calculated using double precision IEEE floating point arithmetic.

Claim: The MATLAB command

```
norm(A-B, 1)
ans =
    1.3217e-14
```

shows that A and B are equal.

d) You are given that it takes 20 seconds to calculate the LU factorization of a large symmetric positive definite matrix A.

Claim: Using the Cholesky factorization it will take approximately 10 seconds to solve the linear system $A\mathbf{x} = \mathbf{b}$.

Please see over ...