1. (12 pts) How would you \text{T\textsc{e}X} the following?

\[
X = \begin{bmatrix}
X_{11} & X_{12} & \cdots & X_{1p} \\
X_{21} & X_{22} & \cdots & X_{2p} \\
\vdots & \vdots & \ddots & \vdots \\
\vdots & \vdots & \ddots & \vdots \\
X_{n1} & X_{n2} & \cdots & X_{np}
\end{bmatrix}
\]

2. (12 pts) How is \(-73.4236\) represented as a \texttt{real*4}? How about 7,532 as an \texttt{integer*2}?

3. (12 pts) What would be the new values in the array \((6,4,10,2,3,9,8,7,11,1)\) after the first splitting in the quicksort algorithm?

4. (12 pts) Given a starting value \(x_0\), how would you use Newton's root finding method to find the roots of the function

\[f(x) = (1 - x^2) \sin(2\pi x), \quad x \in [0,1]？\]

When you get a root, how do you check to be sure that it corresponds to a relative minimum of \(f\)?

5. (12 pts) Find the \((2,2)\) element of the upper left hand \((2 \times 2)\) matrix in

\[
A = \begin{bmatrix}
6 & 4 & 3 \\
4 & 5 & 3 \\
3 & 3 & 4
\end{bmatrix}
\]

using the SWEEP algorithm.

6. (12 pts) What number would be printed by the following program?

```fortran
     double precision x(8,8),trace
     do 10 i=1,8
        do 10 j=1,8
          10 x(i,j)=10*(i-1)+j
     write(*,*) trace(x,3)
     stop
   end
   double precision trace(a,n)
   double precision a(n,n)
   trace=0.0
   do 10 i=1,n
     10 trace=trace+a(i,i)
   return
   end
```
7. (12 pts) Find the quantile function of the logistic distribution having cdf

\[ F(x; \mu, \beta) = \frac{1}{1 + e^{-(x-\mu)}/\beta}, \quad x > 0. \]

8. (12 pts) If a computer can perform 1,000,000 multiplications and additions in a second, how many minutes does it take to multiply a (300 by 200) matrix times a (200 by 100) matrix 500 times?

9. (4 pts) Given data \( y \) and \( X \) satisfying the multiple linear regression model \( y = X\beta + \epsilon \), what is the formula for the least squares estimator \( \hat{\beta} \) of \( \beta \)?