1. (20 points) Given regression data $y$ and $X$ where $X$ is $(n \times m)$ and least squares estimates $\hat{\beta}$, write a Fortran double precision function called SSR that calculates the sum of squares of residuals. You are not allowed to use any arrays other than $y$, $X$, and $\text{betah}$.

2. (10 points) What is the smallest number of multiplications and additions needed to multiply a lower triangular matrix $L$ times an upper triangular matrix $U$?

3. (10 points) Express 735 as an integer*2 and $-537$ as a real*4

4. (15 points) What would be printed by the following Fortran program?

   ```fortran
   dimension x(20,5),xtx(5,5)
   n=10
   m=2
   do 5 i=1,20
     do 5 j=1,5
       5 x(i,j)=0.
   do 10 i=1,n
     x(i,1)=1
   10 x(i,2)=i
   call xtx(x,n,m,xtx)
   do 20 i=1,m
   20 write(*,30) (xtx(i,j),j=1,m)
   stop
end
subroutine xtx(x,n,m,xtx)
   dimension x(n,m),xtx(m,m)
   do 10 i=1,m
     do 10 j=1,i
       c=0.0
     20 c=c+x(k,i)*x(k,j)
     xtx(i,j)=c
   10 xtx(j,i)=c
   return
end
```

5. (20 points) Show that sweeping an $(n \times n)$ matrix $A$ twice in a row on its $k$th diagonal gives $A$ back again.
6. (10 points) Given a N(0,1) random number generator, how would you generate a random sample of size $n$ from a $\chi^2_m$ population? How about from an $F_{m_1,m_2}$?

7. (15 points) What is the probability that a random point in the unit square is also in the unit circle? Use this to design a simulation that estimates $\pi$ by generating points in the unit square. How many points would you have to generate to be 95% sure that your estimate is within 0.01 of the true value?