

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 **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?

```

      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
          do 20 k=1,n
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 χ_m^2 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 π 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?