Term test 2: Practice Problem

Problem 1. Consider a population of size 100. The following table shows the ANOVA calculation for all possible 1-in-20 systematic samples of size n=5.

Source	df	SS	MS
Factor	19	85.5	
Error			
Total		2560.5	

Based on the above ANOVA table, answer the following questions:

(i) Complete the above ANOVA table.

(ii) Find the value of the intra-cluster correlation (ICC).

(iii) Do you expect that the systematic sampling design to be better than the sample random sample design for this population, and why?

Problem 2. A SRS of n=6 is selected from a population of N=100. Data obtained were analyzed in R and produced R output below. Note that y is the response variable, and x auxiliary variable. It is known that $\mu_x = 20$

```
> sum(x)
[1] 500
> sum(y)
[1] 6630
> sum(x^2)
[1] 75000
> sum(y^2)
[1] 11089100
> sum(x*y)
[1] 861500
> var(x)
[1] 64.54972^2
> var(y)
[1] 182.46^2
```

```
> sd(y-x)
[1] 125
> r<-mean(y)/mean(x)
> sd(y-r*x)
[1] 690.2149
> cor(x,y)
[1] 0.9268894
> fit<- lm(y~x)
> coef(fit)
(Intercept)            x
   1330.00         2.62
> res=residuals(fit)
> sum(res^2)
[1] 14070
```

(a) Find the basic estimate of the total of y. Is this estimator unbiased?

(b) Find a ratio estimate of μ_y. Place an approximate 95% bound on the error of estimation.

(c) Find a difference estimate of μ_y. Place an approximate 95% bound on the error of estimation.

(d) Find a regression estimate of the mean of y. Estimate the standard deviation of the estimator.