

ภาคผนวก

## ผนวก ก

### โปรแกรมที่ใช้ในการวิจัย

ในการวิจัยนี้จะใช้โปรแกรม R ในการจำลองข้อมูล คำนวณค่าสถิติ คำนวณเกณฑ์ที่ใช้ในการวิจัย และใช้โปรแกรมสำเร็จรูป SPSS ในการวิเคราะห์ข้อมูลสำหรับการทดสอบสมมติ โดยจะแสดงโปรแกรมสำหรับจำลองและประมวลผลข้อมูลและผลการวิเคราะห์สำหรับการทดสอบสมมติฐาน ดังต่อไปนี้

#### ก.1 โปรแกรมสำหรับจำลองและประมวลผลข้อมูล

กรณีจำนวนประชากรในแต่ละกลุ่มของแต่ละชั้นภูมิเท่ากัน

```
for(i in 1:1){
xx<-function(M,N,p1,n.1,addsample,nadd,psu1,oldssu){
if(addsample==F){
x1<-sample(0:1,size=N,replace=T,prob=c(1-p1,p1))
dim(x1)<-c(M,100)
a<-sample(1:M,size=5,replace=F)
psu1<-c(x1[a[1],1:100],x1[a[2],1:100],x1[a[3],1:100],x1[a[4],1:100],
x1[a[5],1:100])
dim(psu1)<-c(5,100)
ssu.random.index<-matrix(NA,nrow=5,ncol=n.1)
ssu1<-ssu.random.index
for(i in 1:5){
ssu.random.index[i,]<-sample(1:100,size=n.1)

ssu1[i,]<-psu1[i,ssu.random.index[i,]]
psu1[i,ssu.random.index[i,]]<--1
}
}
```

```

dim(ssu1)<-c(5,n.1)
k<-list(ssu1,psu1)
names(k)<-c("ssu","psu")
return(k)
}else{
  if(nadd>0){
    sizenew<-nadd
    ssu.random.index<-matrix(NA,nrow=5,ncol=sizenew)
    ssu.new<-ssu.random.index
    i<-1
    count.replace<-0
    while(i<=5){
      ssu.random.index[i,]<-sample(1:100,size=sizenew)
      count.replace<-matrix(1,nrow=sizenew,ncol=1)
      for(j in 1:sizenew){
        if(psu1[i,ssu.random.index[i,j]]!=-1){
          count.replace[j,1]<-0
        }else {count.replace[j,1]<-1}
      }

      if(sum(count.replace)==0){
        ssu.new[i,]<-psu1[i,ssu.random.index[i,]]
        psu1[i,ssu.random.index[i,]]<--1
        i<-i+1
      }
    }
    dim(ssu.new)<-c(5,sizenew)
    ssu.new<-cbind(oldssu,ssu.new)
  }else{

```

```
if(nadd==0){  
  
    ssu.new<-oldssu  
    }  
}  
  
k<-list(ssu.new,psu1)  
names(k)<-c("ssu","psu")  
return(k)  
}  
}  
  
## function findadd, calculate nadd##  
  
findnadd<-function(ndiff){  
    a<-0  
    nadd<-0  
    while(1){  
        if(ndiff>a){  
            nadd<-nadd+1  
            a<-a+20  
        }else{  
            break  
        }  
    }  
    return(nadd)  
}
```

```

# function estimate, calculate statistical estimate 1    #

estimate1<-function(stra1,stra2,stra3,stra4){
n<-4*dim(stra1$ssu)[1]*dim(stra1$ssu)[2]

# estimate proportion and variance (S.R.S)  ##

Phat.srs<-sum(stra1$ssu,stra2$ssu,stra3$ssu,stra4$ssu)/n
var.Phat.srs<-Phat.srs*(1-Phat.srs)/n

# estimate proportion and variance (complex sampling) #

Phat.1<-rowMeans(stra1$ssu)
Phat.2<-rowMeans(stra2$ssu)
Phat.3<-rowMeans(stra3$ssu)
Phat.4<-rowMeans(stra4$ssu)
Phat.stra1<-M1/m/N1*100*sum(Phat.1)
Phat.stra2<-M2/m/N2*100*sum(Phat.2)
Phat.stra3<-M3/m/N3*100*sum(Phat.3)
Phat.stra4<-M4/m/N4*100*sum(Phat.4)

Phat<-sum(Phat.stra1*N1,Phat.stra2*N2,Phat.stra3*N3,Phat.stra4*N4)/N

J1<-Phat.1
J2<-Phat.2
J3<-Phat.3
J4<-Phat.4
Vjk.Phat.stra1<-var(J1)/m
Vjk.Phat.stra2<-var(J2)/m

```

```

Vjk.Phat.stra3<-var(J3)/m
Vjk.Phat.stra4<-var(J4)/m

Vjk.Phat<-(((N1^2)*Vjk.Phat.stra1)+((N2^2)*Vjk.Phat.stra2)+
  ((N3^2)*Vjk.Phat.stra3)+((N4^2)*Vjk.Phat.stra4))/(N^2)

# estimate effect  #

if(var.Phat.srs==0||Vjk.Phat==0){
  deff<-0
  ndeff<-0
  ndiff<-0
}
else{
  deff<-Vjk.Phat/var.Phat.srs
  ndeff<-n/deff
  ndiff<-ndeff-n
}
k<-list(Phat.srs,var.Phat.srs,Phat,Vjk.Phat,deff,ndeff,ndiff,n)
names(k)<-c("Phat.srs","var.Phat.srs","Phat","Vjk.Phat","deff","ndeff","ndiff","n")
return(k)
}

# function estimate, calculate statistical estimate 2 #

estimate2<-function(stra.new1,stra.new2,stra.new3,stra.new4){
n.new<-4*dim(stra.new1$ssu)[1]*dim(stra.new1$ssu)[2]

```

```

# estimate proportion and variance (S.R.S)by n.new #

Phat.srs.new<-sum(stra.new1$ssu,stra.new2$ssu,stra.new3$ssu,stra.new4$ssu)/n.new
var.Phat.srs.new<-Phat.srs.new*(1-Phat.srs.new)/n.new

# estimate proportion and variance (complex sampling)by n.new ##

Phat.new1<-rowMeans(stra.new1$ssu)
Phat.new2<-rowMeans(stra.new2$ssu)
Phat.new3<-rowMeans(stra.new3$ssu)
Phat.new4<-rowMeans(stra.new4$ssu)
Phat.stra.new1<-M1/m/N1*100*sum(Phat.new1)
Phat.stra.new2<-M2/m/N2*100*sum(Phat.new2)
Phat.stra.new3<-M3/m/N3*100*sum(Phat.new3)
Phat.stra.new4<-M4/m/N4*100*sum(Phat.new4)

Phat.new<sum(Phat.stra.new1*N1,Phat.stra.new2*N2,Phat.stra.new3*N3,
             Phat.stra.new4*N4)/N

J1.new<-Phat.new1
J2.new<-Phat.new2
J3.new<-Phat.new3
J4.new<-Phat.new4

Vjk.Phat.stra.new1<-var(J1.new)/m
Vjk.Phat.stra.new2<-var(J2.new)/m
Vjk.Phat.stra.new3<-var(J3.new)/m
Vjk.Phat.stra.new4<-var(J4.new)/m

Vjk.Phat.new<-(((N1^2)*Vjk.Phat.stra.new1)+((N2^2)*Vjk.Phat.stra.new2)+
              ((N3^2)*Vjk.Phat.stra.new3)+((N4^2)*Vjk.Phat.stra.new4))/(N^2)

```

```

k<-list(Phat.srs.new,var.Phat.srs.new,Phat.new,Vjk.Phat.new,n.new)
names(k)<-c("Phat.srs.new","var.Phat.srs.new","Phat.new","Vjk.Phat.new","n.new")
return(k)
}

#####

# step 1   Main Program #

M1<-11
M2<-9
M3<-12
M4<-8
m<-5
N1<-1100
N2<-900
N3<-1200
N4<-800
N<-sum(N1,N2,N3,N4)
p<-0.1 #เปลี่ยนตามสถานการณ์ที่กำหนดในขอบเขตการวิจัยใน บทที่ 1)#
p1<-0.02 #เปลี่ยนตามสถานการณ์ที่กำหนดในขอบเขตการวิจัยใน บทที่ 1)#
p2<-0.05 #เปลี่ยนตามสถานการณ์ที่กำหนดในขอบเขตการวิจัยใน บทที่ 1)#
p3<-0.1 #เปลี่ยนตามสถานการณ์ที่กำหนดในขอบเขตการวิจัยใน บทที่ 1)#
p4<-((p*N)-(p1*N1)-(p2*N2)-(p3*N3))/N4
p4
n.1<-3 #เปลี่ยนตามสถานการณ์ที่กำหนดในขอบเขตการวิจัยใน บทที่ 1)#
simu<-1000
alpha<-0.05 (ค่า  $\alpha$  เปลี่ยนตามสถานการณ์ที่กำหนดค่าสัมประสิทธิ์ความเชื่อมั่นในขอบเขตการ
วิจัยใน บทที่ 1)
lavel<-936.5

```

```

result.simu1<-matrix(NA,nrow=simu,ncol=5)
result.simu2<-matrix(NA,nrow=simu,ncol=5)

# sampling -step ##

length<-matrix(nrow=simu,ncol=2)
for(rep in 1:simu){

stra1<-xx(M1,N1,p1,n.1,F,NA,NA,NA)
stra2<-xx(M2,N2,p2,n.1,F,NA,NA,NA)
stra3<-xx(M3,N3,p3,n.1,F,NA,NA,NA)
stra4<-xx(M4,N4,p4,n.1,F,NA,NA,NA)

result1<-estimate1(stra1,stra2,stra3,stra4)

# Addition Sampling -step #

if(result1$var.Phat.srs==0||result1$Vjk.Phat==0){
  nadd<-0
}
else{
  nadd<-findnadd(result1$ndiff)
}

stra.new1<-xx(M1,N1,p1,n.1,T,nadd,stra1$psu,stra1$ssu)
stra.new2<-xx(M2,N2,p2,n.1,T,nadd,stra2$psu,stra2$ssu)
stra.new3<-xx(M3,N3,p3,n.1,T,nadd,stra3$psu,stra3$ssu)
stra.new4<-xx(M4,N4,p4,n.1,T,nadd,stra4$psu,stra4$ssu)

```

```

result2<-estimate2(stra.new1,stra.new2,stra.new3,stra.new4)
print(result2$n.new)

# confidence interval estimation by n#

Zstar<-qnorm(1-alpha/2)

Pro1<-(((result1$Phat*result1$n)+((Zstar^2)/2))/(result1$n+(Zstar^2)))
Pro2<-((Zstar*sqrt(result1$n))/(result1$n+(Zstar^2)))*sqrt(result1$Phat*(1-
result1$Phat)+((Zstar^2)/(4*result1$n)))
Lower.w<-Pro1-Pro2
Upper.w<-Pro1+Pro2

# percent coverage#

if (Lower.w<=p && p<=Upper.w){
  cover<-1
}else {
cover<-0
}
length1<-Upper.w-Lower.w
result.simu1[rep,]<-c(rep,Lower.w,Upper.w,cover,length1)

# confidence interval estimation by n.new#

Zstar<-qnorm(1-alpha/2)
Pro1<-(((result2$Phat.new*result2$n.new)+((Zstar^2)/2))/(result2$n.new+(Zstar^2)))
Pro2<-((Zstar*sqrt(result2$n.new))/(result2$n.new+(Zstar^2)))*sqrt(result2$Phat.new*(1-
result2$Phat.new)+((Zstar^2)/(4*result2$n.new)))

```

```

Lower.wc<-Pro1-Pro2
Upper.wc<-Pro1+Pro2

# percent coverage#

if (Lower.wc<=p && p<=Upper.wc){
  cover<-1
}else {
cover<-0
}
length2<-Upper.wc-Lower.wc
length[rep,1:1]<-length1
length[rep,2:2]<-length2
result.simu2[rep,]<-c(rep,Lower.wc,Upper.wc,cover,length2)
}

print(length)
summary.simu1<-
c(mean(result.simu1[,2]),mean(result.simu1[,3]),sum(result.simu1[,4]),mean(result.simu1
[,5]))
summary.simu2<-
c(mean(result.simu2[,2]),mean(result.simu2[,3]),sum(result.simu2[,4]),mean(result.simu2
[,5]))
## Conclusion #####

if(sum(result.simu2[,4])<=lavel){
cat("\n\n\n Summary of simulation study is lower upper coverage and length bounary
\n\n","\t\tLower.w","\t\t Upper.w",

```

```

"\t cover","\t
length\n","\t\t",summary.simu1[1],"\t",summary.simu1[2],"\t",summary.simu1[3],"\t",summar
y.simu1[4],"\n")

cat("\n\n\n Summary of simulation study is lower upper coverage and length bounary
\n\n","\t\tLower.wc","\t Upper.wc",
    "\t cover","\t
length\n","\t\t",summary.simu2[1],"\t",summary.simu2[2],"\t",summary.simu2[3],"\t",summar
y.simu2[4],"\n")
}else{

    cat("\n\n\n *Summary of simulation study is lower upper coverage and length
boundary* \n\n","\t\tLower.w","\t Upper.w",
    "\t cover","\t
length\n","\t\t",summary.simu1[1],"\t",summary.simu1[2],"\t",summary.simu1[3],"\t",summar
y.simu1[4],"\n")

    cat("\n\n\n *Summary of simulation study is lower upper coverage and length
boundary* \n\n","\t\tLower.wc","\t Upper.wc",
    "\t cover","\t
length\n","\t\t",summary.simu2[1],"\t",summary.simu2[2],"\t",summary.simu2[3],"\t",summar
y.simu2[4],"\n")
}
}
}

```

กรณีจำนวนประชากรในแต่ละกลุ่มของแต่ละชั้นภูมิเท่ากัน

```

for(i in 1:1){
xx<-function(M,N,N.1,p1,n.1,addsample,nadd,psu1,oldssu,a,nn){
  if(addsample==F){
    x1<-sample(0:1,size=N,replace=TRUE,prob=c(1-p1,p1))
    b<-0
    c<-0
    maxcol=max(N.1)
    psu1<-matrix(-1,nrow=5,ncol=maxcol)
    nn<-matrix(NA,nrow=5,ncol=1)
    a<-sample(1:M,size=5,replace=F)
    for(j in 1:5){
      group<-matrix(NA,nrow=1,ncol=N.1[a[j]])
      if(a[j]==1){
        group<-x1[1:N.1[a[j]]]
      }else{
        b<-N.1[a[j]-1]+1
        c<-N.1[a[j]-1]+N.1[a[j]]
        group<-x1[b:c]
      }
      psu1[j,1:N.1[a[j]]]<-group
      nn[j,1]<-(n.1/100)*N.1[a[j]]
    }
  }
  nn<-ceiling(nn)
  ssu.random.index<-matrix(-1,nrow=5,ncol=max(nn))
  ssu1<-ssu.random.index
  for(i in 1:5){

```

```

ssu.random.index[i,1:nn[i]]<-sample(1:N.1[a[i]],size=nn[i])
  ssu1[i,1:nn[i]]<-psu1[i,ssu.random.index[i,1:nn[i]]]
  psu1[i,ssu.random.index[i,1:nn[i]]]<--1
}
k<-list(ssu1,psu1,nn,a)
names(k)<-c("ssu","psu","nn","a")
return(k)
}else{
  if(nadd>0){
    sizenew<-nadd
    ssu.random.index<-matrix(-1,nrow=5,ncol=sizenew)
    ssu.new<-ssu.random.index
    i<-1
    count.replace<-0
    while(i<=5){
      ssu.random.index[i,]<-sample(1:N.1[a[i]],size=sizenew)
      count.replace<-matrix(1,nrow=sizenew,ncol=1)
      for(j in 1:sizenew){
        if(psu1[i,ssu.random.index[i,j]]!=-1){
          count.replace[j,1]<-0
        }else {count.replace[j,1]<-1}
      }
    }
    if(sum(count.replace)==0){
      ssu.new[i,]<-psu1[i,ssu.random.index[i,]]
      psu1[i,ssu.random.index[i,]]<--1
      i<-i+1
    }
  }
}

```

```
    dim(ssu.new)<-c(5,sizenew)
    ssu.new<-cbind(oldssu,ssu.new)
  }else{
    if(nadd==0){
      ssu.new<-oldssu
    }
  }

  k<-list(ssu.new,psu1)
  names(k)<-c("ssu","psu")
  return(k)
}
}
```

```
# function findadd, calculate nadd#
```

```
findnadd<-function(ndiff){
  a<-0
  nadd<-0
  while(1){
    if(ndiff>a){
      nadd<-nadd+1
      a<-a+20
    }else{
      break
    }
  }
  return(nadd)
}
```

```

# function estimate, calculate statistical estimate 1#

estimate1<-function(stra1,stra2,stra3,stra4){
n<-sum(stra1$nn,stra2$nn,stra3$nn,stra4$nn)

# estimate proportion and variance (S.R.S) #

Phat.srs<-(sum(stra1$ssu,stra2$ssu,stra3$ssu,stra4$ssu)+
            sum(stra1$ssu==1,stra2$ssu==1,stra3$ssu==1,stra4$ssu==1))/n
var.Phat.srs<-Phat.srs*(1-Phat.srs)/n

# estimate proportion and variance (complex sampling) ##

Phat.1<-(rowSums(stra1$ssu)+rowSums(stra1$ssu==1))/(stra1$nn)
Phat.2<-(rowSums(stra2$ssu)+rowSums(stra2$ssu==1))/(stra2$nn)
Phat.3<-(rowSums(stra3$ssu)+rowSums(stra3$ssu==1))/(stra3$nn)
Phat.4<-(rowSums(stra4$ssu)+rowSums(stra4$ssu==1))/(stra4$nn)
Phat.stra1<-M1/m/N1*((N.1[stra1$a[1]]*Phat.1[1])+(N.1[stra1$a[2]]*Phat.1[2])+
                    (N.1[stra1$a[3]]*Phat.1[3])+(N.1[stra1$a[4]]*Phat.1[4])+
                    (N.1[stra1$a[5]]*Phat.1[5]))
Phat.stra2<-M2/m/N2*((N.2[stra2$a[1]]*Phat.2[1])+(N.2[stra2$a[2]]*Phat.2[2])+
                    (N.2[stra2$a[3]]*Phat.2[3])+(N.2[stra2$a[4]]*Phat.2[4])+
                    (N.2[stra2$a[5]]*Phat.2[5]))
Phat.stra3<-M3/m/N3*((N.3[stra3$a[1]]*Phat.3[1])+(N.3[stra3$a[2]]*Phat.3[2])+
                    (N.3[stra3$a[3]]*Phat.3[3])+(N.3[stra3$a[4]]*Phat.3[4])+
                    (N.3[stra3$a[5]]*Phat.3[5]))
Phat.stra4<-M4/m/N4*((N.4[stra4$a[1]]*Phat.4[1])+(N.4[stra4$a[2]]*Phat.4[2])+

```

$$(N.4[\text{stra4}\$a[3]]*\text{Phat}.4[3])+(N.4[\text{stra4}\$a[4]]*\text{Phat}.4[4])+$$

$$(N.4[\text{stra4}\$a[5]]*\text{Phat}.4[5]))$$

$$\text{Phat} <- ((\text{Phat}.\text{stra1}*N1)+(\text{Phat}. \text{stra2}*N2)+(\text{Phat}. \text{stra3}*N3)+(\text{Phat}. \text{stra4}*N4))/N$$

$$J1 <- \text{Phat}.1$$

$$J2 <- \text{Phat}.2$$

$$J3 <- \text{Phat}.3$$

$$J4 <- \text{Phat}.4$$

$$\text{Vjk}. \text{Phat}. \text{stra1} <- \text{var}(J1)/m$$

$$\text{Vjk}. \text{Phat}. \text{stra2} <- \text{var}(J2)/m$$

$$\text{Vjk}. \text{Phat}. \text{stra3} <- \text{var}(J3)/m$$

$$\text{Vjk}. \text{Phat}. \text{stra4} <- \text{var}(J4)/m$$

$$\text{Vjk}. \text{Phat} <- (((N1^2)*\text{Vjk}. \text{Phat}. \text{stra1})+((N2^2)*\text{Vjk}. \text{Phat}. \text{stra2})+((N3^2)*\text{Vjk}. \text{Phat}. \text{stra3})+((N4^2)*\text{Vjk}. \text{Phat}. \text{stra4}))/N^2$$

# estimate effect #

```
if(var.Phat.srs==0||Vjk.Phat==0){
```

```
  deff<-0
```

```
  ndeff<-0
```

```
  ndiff<-0
```

```
}
```

```
else{
```

```
  deff<-Vjk.Phat/var.Phat.srs
```

```
  ndeff<-n/deff
```

```
  ndiff<-ndeff-n
```

```
}
```

```

k<-list(Phat.srs,var.Phat.srs,Phat,Vjk.Phat,deff,ndeff,ndiff,n)
names(k)<-c("Phat.srs","var.Phat.srs","Phat","Vjk.Phat","deff","ndeff","ndiff","n")
return(k)
}

# function estimate, calculate statistical estimate 2 #

estimate2<-function(stra.new1,stra.new2,stra.new3,stra.new4){
n.new<-sum((stra1$nn+nadd),(stra2$nn+nadd),(stra3$nn+nadd),(stra4$nn+nadd))

# estimate proportion and variance (S.R.S)by n.new #

Phat.srs.new<-(sum(stra.new1$ssu,stra.new2$ssu,stra.new3$ssu,stra.new4$ssu)+
sum(stra.new1$ssu==-1,stra.new2$ssu==-1,stra.new3$ssu==
1,stra.new4$ssu==-1))/n.new
var.Phat.srs.new<-Phat.srs.new*(1-Phat.srs.new)/n.new

# estimate proportion and variance (complex sampling)by n.new #

Phat.new1<-(rowSums(stra.new1$ssu)+rowSums(stra.new1$ssu==-1))/(stra1$nn+nadd)
Phat.new2<-(rowSums(stra.new2$ssu)+rowSums(stra.new2$ssu==-1))/(stra2$nn+nadd)
Phat.new3<-(rowSums(stra.new3$ssu)+rowSums(stra.new3$ssu==-1))/(stra3$nn+nadd)
Phat.new4<-(rowSums(stra.new4$ssu)+rowSums(stra.new4$ssu==-1))/(stra4$nn+nadd)
Phat.stra.new1<-M1/m/N1*((N.1[stra1$a[1]]*Phat.new1[1])+
(N.1[stra1$a[2]]*Phat.new1[2])+
(N.1[stra1$a[3]]*Phat.new1[3])+(N.1[stra1$a[4]]*Phat.new1[4])+
(N.1[stra1$a[5]]*Phat.new1[5]))

```

```
Phat.stra.new2<-pM2/m/N2*((N.2[stra2$a[1]]*Phat.new2[1])+
  (N.2[stra2$a[2]]*Phat.new2[2])+
  (N.2[stra2$a[3]]*Phat.new2[3])+(N.2[stra2$a[4]]*Phat.new2[4])+
  (N.2[stra2$a[5]]*Phat.new2[5]))
```

```
Phat.stra.new3<-M3/m/N3*((N.3[stra3$a[1]]*Phat.new3[1])+
  (N.3[stra3$a[2]]*Phat.new3[2])+(N.3[stra3$a[3]]*Phat.new3[3])+
  (N.3[stra3$a[4]]*Phat.new3[4])+(N.3[stra3$a[5]]*Phat.new3[5]))
```

```
Phat.stra.new4<-M4/m/N4*((N.4[stra4$a[1]]*Phat.new4[1])+
  (N.4[stra4$a[2]]*Phat.new4[2])+(N.4[stra4$a[3]]*Phat.new4[3])+
  (N.4[stra4$a[4]]*Phat.new4[4])+(N.4[stra4$a[5]]*Phat.new4[5]))
```

```
Phat.new<sum(Phat.stra.new1*N1,Phat.stra.new2*N2,Phat.stra.new3*N3,
  Phat.stra.new4*N4)/N
```

```
J1.new<-Phat.new1
```

```
J2.new<-Phat.new2
```

```
J3.new<-Phat.new3
```

```
J4.new<-Phat.new4
```

```
Vjk.Phat.stra.new1<-var(J1.new)/m
```

```
Vjk.Phat.stra.new2<-var(J2.new)/m
```

```
Vjk.Phat.stra.new3<-var(J3.new)/m
```

```
Vjk.Phat.stra.new4<-var(J4.new)/m
```

```
Vjk.Phat.new<-(((N1^2)*Vjk.Phat.stra.new1)+((N2^2)*Vjk.Phat.stra.new2)+
  ((N3^2)*Vjk.Phat.stra.new3)+((N4^2)*Vjk.Phat.stra.new4))/(N^2)
```

```

k<-list(Phat.srs.new,var.Phat.srs.new,Phat.new,Vjk.Phat.new,n.new)
names(k)<-c("Phat.srs.new","var.Phat.srs.new","Phat.new","Vjk.Phat.new","n.new")
return(k)
}

```

```
# step 1 Main Program #
```

```
M1<-11
```

```
M2<-9
```

```
M3<-12
```

```
M4<-8
```

```
m<-5
```

```
N1<-1375
```

```
N2<-1575
```

```
N3<-2730
```

```
N4<-2220
```

```
N.1<-c(100,105,110,115,120,125,130,135,140,145,150)
```

```
N.2<-c(155,160,165,170,175,180,185,190,195)
```

```
N.3<-c(200,205,210,215,220,225,230,235,240,245,250,255)
```

```
N.4<-c(260,265,270,275,280,285,290,295)
```

```
N<-sum(N1,N2,N3,N4)
```

```
p<-0.1 #เปลี่ยนตามสถานการณ์ที่กำหนดในขอบเขตการวิจัยใน บทที่ 1)#
```

```
p1<-0.02 #เปลี่ยนตามสถานการณ์ที่กำหนดในขอบเขตการวิจัยใน บทที่ 1)#
```

```
p2<-0.05 #เปลี่ยนตามสถานการณ์ที่กำหนดในขอบเขตการวิจัยใน บทที่ 1)#
```

```
p3<-0.1 #เปลี่ยนตามสถานการณ์ที่กำหนดในขอบเขตการวิจัยใน บทที่ 1)#
```

```
p4<-((p*N)-(p1*N1)-(p2*N2)-(p3*N3))/N4
```

```
p4
```

```
n.1<-3 #เปลี่ยนตามสถานการณ์ที่กำหนดในขอบเขตการวิจัยใน บทที่ 1)#
```

```

simu<-1000
alpha<-0.05 #(ค่า  $\alpha$  เปลี่ยนตามสถานการณ์ที่กำหนดค่าสัมประสิทธิ์ความเชื่อมั่นในขอบเขต
          การวิจัยใน บทที่ 1)#
level<-936.5
result.simu1<-matrix(NA,nrow=simu,ncol=5)
result.simu2<-matrix(NA,nrow=simu,ncol=5)

#  sampling -step  ##

length<-matrix(nrow=simu,ncol=2)

for(rep in 1:simu){
j<-0
while(j<=1){

stra1<-xx(M1,N1,N.1,p1,n.1,F,NA,NA,NA,a,nn)
stra2<-xx(M2,N2,N.2,p2,n.1,F,NA,NA,NA,a,nn)
stra3<-xx(M3,N3,N.3,p3,n.1,F,NA,NA,NA,a,nn)
stra4<-xx(M4,N4,N.4,p4,n.1,F,NA,NA,NA,a,nn)

result1<-estimate1(stra1,stra2,stra3,stra4)

# Addition Sampling -step ##
if(result1$var.Phatsrs==0||result1$Vjk.Phats==0){
      nadd<-0
}
else{
      nadd<-findnadd(result1$ndiff)
}
}

```

```

if(nadd<100){
stra.new1<-xx(M1,N1,N.1,p1,n.1,T,nadd,stra1$psu,stra1$ssu,stra1$a,stra1$nn)
stra.new2<-xx(M2,N2,N.2,p2,n.1,T,nadd,stra2$psu,stra2$ssu,stra2$a,stra2$nn)
stra.new3<-xx(M3,N3,N.3,p3,n.1,T,nadd,stra3$psu,stra3$ssu,stra3$a,stra3$nn)
stra.new4<-xx(M4,N4,N.4,p4,n.1,T,nadd,stra4$psu,stra4$ssu,stra4$a,stra4$nn)

result2<-estimate2(stra.new1,stra.new2,stra.new3,stra.new4)
j<-j+1
}
}

# confidence interval estimation by n#

Zstar<-qnorm(1-alpha/2)

Pro1<-(((result1$Phat*result1$n)+(Zstar^2)/2))/(result1$n+(Zstar^2))
Pro2<-((Zstar*sqrt(result1$n))/(result1$n+(Zstar^2)))*sqrt(result1$Phat*(1-
result1$Phat)+((Zstar^2)/(4*result1$n)))
Lower.w<-Pro1-Pro2
Upper.w<-Pro1+Pro2

# percent coverage#

if (Lower.w<=p && p<=Upper.w){
  cover<-1
} else {
  cover<-0
}

```

```

length1<-Upper.w-Lower.w

result.simu1[rep,]<-c(rep,Lower.w,Upper.w,cover,length1)

# confidence interval estimation by n.new#

Zstar<-qnorm(1-alpha/2)

Pro1<-(((result2$Phat.new*result2$n.new)+((Zstar^2)/2))/(result2$n.new+(Zstar^2)))
Pro2<-((Zstar*sqrt(result2$n.new))/(result2$n.new+(Zstar^2)))*sqrt(result2$Phat.new*(1-
result2$Phat.new)+((Zstar^2)/(4*result2$n.new)))
Lower.wc<-Pro1-Pro2
Upper.wc<-Pro1+Pro2

# percent coverage#

if (Lower.wc<=p && p<=Upper.wc){
  cover<-1
}else {
cover<-0
}

length2<-Upper.wc-Lower.wc

result.simu2[rep,]<-c(rep,Lower.wc,Upper.wc,cover,length2)
length[rep,1:1]<-length1
length[rep,2:2]<-length2

}

```

```

print(length)

summary.simu1<-
c(mean(result.simu1[,2]),mean(result.simu1[,3]),sum(result.simu1[,4]),mean(result.simu1
[,5]))
summary.simu2<-
c(mean(result.simu2[,2]),mean(result.simu2[,3]),sum(result.simu2[,4]),mean(result.simu2
[,5]))

##  Conclution  ##
if(sum(result.simu2[,4])<=lavel){
cat("\n\n\n Summary of simulation study is lower upper coverage  and length bouary
\n\n","\t\tLower.w","\t  Upper.w",
    "\t cover","\t
length\n","\t\t",summary.simu1[1],"\t",summary.simu1[2],"\t",summary.simu1[3],"\t",summar
y.simu1[4],"\n")

cat("\n\n\n Summary of simulation study is lower upper coverage  and length bouary
\n\n","\t\tLower.wc","\t  Upper.wc",
    "\t cover","\t
length\n","\t\t",summary.simu2[1],"\t",summary.simu2[2],"\t",summary.simu2[3],"\t",summar
y.simu2[4],"\n")
}else{

    cat("\n\n\n *Summary of simulation study is lower upper coverage  and length
bouary* \n\n","\t\tLower.w","\t  Upper.w",
    "\t cover","\t
length\n","\t\t",summary.simu1[1],"\t",summary.simu1[2],"\t",summary.simu1[3],"\t",summar
y.simu1[4],"\n")

```

```

cat("\n\n\n *Summary of simulation study is lower upper coverage and length
boundary* \n\n", "\t\tLower.wc", "\t Upper.wc",
"\t cover", "\t
length\n", "\t\t", summary.simu2[1], "\t", summary.simu2[2], "\t", summary.simu2[3], "\t", summar
y.simu2[4], "\n")
}
}

```

## ก.2 ผลการวิเคราะห์สำหรับการทดสอบสมมติฐาน

ผลการวิเคราะห์

กรณีจำนวนประชากรในแต่ละกลุ่มของแต่ละชั้นภูมิเท่ากัน

เมื่อค่าสัมประสิทธิ์ความเชื่อมั่นที่กำหนดเท่ากับ 0.95

ตัวอย่างขนาดใหญ่

**Paired Samples Test**

|                      | Paired Differences |                |                 |   |           | t      | df  | Sig. (2-tailed) |
|----------------------|--------------------|----------------|-----------------|---|-----------|--------|-----|-----------------|
|                      | Mean               | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference |           |        |     |                 |
|                      |                    |                |                 | Lower                                     | Upper     |        |     |                 |
| Pair 1 L10.1 - L20.1 | 1.549E-02          | 1.377E-02      | 4.354E-04       | 1.464E-02                                 | 1.635E-02 | 35.579 | 999 | .000            |
| Pair 2 L10.2 - L20.2 | 2.315E-02          | 1.786E-02      | 5.647E-04       | 2.204E-02                                 | 2.426E-02 | 40.997 | 999 | .000            |
| Pair 3 L10.3 - L20.3 | 2.051E-02          | 1.961E-02      | 6.200E-04       | 1.929E-02                                 | 2.173E-02 | 33.081 | 999 | .000            |
| Pair 4 L10.4 - L20.4 | 2.318E-02          | 2.017E-02      | 6.379E-04       | 2.192E-02                                 | 2.443E-02 | 36.331 | 999 | .000            |
| Pair 5 L10.5 - L20.5 | 2.570E-02          | 2.043E-02      | 6.460E-04       | 2.443E-02                                 | 2.697E-02 | 39.782 | 999 | .000            |
| Pair 6 L10.6 - L20.6 | 2.202E-02          | 1.897E-02      | 6.000E-04       | 2.084E-02                                 | 2.320E-02 | 36.698 | 999 | .000            |

เมื่อค่าสัมประสิทธิ์ความเชื่อมั่นที่กำหนดเท่ากับ 0.99

ตัวอย่างขนาดเล็ก

**Paired Samples Test**

|        |               | Paired Differences |                |                 |   |           | t      | df  | Sig. (2-tailed) |
|--------|---------------|--------------------|----------------|-----------------|---|-----------|--------|-----|-----------------|
|        |               | Mean               | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference |           |        |     |                 |
|        |               |                    |                |                 | Lower                                     | Upper     |        |     |                 |
| Pair 1 | L10.1 - L20.1 | 3.601E-02          | 3.147E-02      | 9.951E-04       | 3.406E-02                                 | 3.796E-02 | 36.187 | 999 | .000            |
| Pair 2 | L10.2 - L20.2 | 4.875E-02          | 3.641E-02      | 1.151E-03       | 4.650E-02                                 | 5.101E-02 | 42.349 | 999 | .000            |
| Pair 3 | L10.3 - L20.3 | 3.897E-02          | 3.621E-02      | 1.145E-03       | 3.672E-02                                 | 4.121E-02 | 34.027 | 999 | .000            |
| Pair 4 | L10.4 - L20.4 | 4.654E-02          | 3.728E-02      | 1.179E-03       | 4.423E-02                                 | 4.885E-02 | 39.478 | 999 | .000            |
| Pair 5 | L10.5 - L20.5 | 5.165E-02          | 3.707E-02      | 1.172E-03       | 4.935E-02                                 | 5.395E-02 | 44.055 | 999 | .000            |
| Pair 6 | L10.6 - L20.6 | 4.119E-02          | 3.424E-02      | 1.083E-03       | 3.907E-02                                 | 4.332E-02 | 38.039 | 999 | .000            |

ตัวอย่างขนาดใหญ่

**Paired Samples Test**

|        |               | Paired Differences |                |                 |   |           | t      | df  | Sig. (2-tailed) |
|--------|---------------|--------------------|----------------|-----------------|---|-----------|--------|-----|-----------------|
|        |               | Mean               | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference |           |        |     |                 |
|        |               |                    |                |                 | Lower                                     | Upper     |        |     |                 |
| Pair 1 | L10.1 - L20.1 | 2.038E-02          | 1.850E-02      | 5.850E-04       | 1.923E-02                                 | 2.153E-02 | 34.835 | 999 | .000            |
| Pair 2 | L10.2 - L20.2 | 3.221E-02          | 2.430E-02      | 7.684E-04       | 3.071E-02                                 | 3.372E-02 | 41.923 | 999 | .000            |
| Pair 3 | L10.3 - L20.3 | 2.578E-02          | 2.590E-02      | 8.190E-04       | 2.417E-02                                 | 2.738E-02 | 31.471 | 999 | .000            |
| Pair 4 | L10.4 - L20.4 | 2.903E-02          | 2.590E-02      | 8.191E-04       | 2.743E-02                                 | 3.064E-02 | 35.447 | 999 | .000            |
| Pair 5 | L10.5 - L20.5 | 3.230E-02          | 2.584E-02      | 8.170E-04       | 3.070E-02                                 | 3.390E-02 | 39.532 | 999 | .000            |
| Pair 6 | L10.6 - L20.6 | 2.705E-02          | 2.401E-02      | 7.594E-04       | 2.556E-02                                 | 2.854E-02 | 35.622 | 999 | .000            |

กรณีจำนวนประชากรในแต่ละกลุ่มของแต่ละชั้นภูมิไม่เท่ากัน

เมื่อค่าสัมประสิทธิ์ความเชื่อมั่นที่กำหนดเท่ากับ 0.95

ตัวอย่างขนาดเล็ก

**Paired Samples Test**

|        |               | Paired Differences |                |                 |   |           | t      | df  | Sig. (2-tailed) |
|--------|---------------|--------------------|----------------|-----------------|---|-----------|--------|-----|-----------------|
|        |               | Mean               | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference |           |        |     |                 |
|        |               |                    |                |                 | Lower                                     | Upper     |        |     |                 |
| Pair 1 | L10.1 - L20.1 | 1.343E-02          | 1.459E-02      | 4.613E-04       | 1.252E-02                                 | 1.433E-02 | 29.107 | 999 | .000            |
| Pair 2 | L10.2 - L20.2 | 1.956E-02          | 1.877E-02      | 5.937E-04       | 1.839E-02                                 | 2.072E-02 | 32.946 | 999 | .000            |
| Pair 3 | L10.3 - L20.3 | 2.232E-02          | 2.138E-02      | 6.760E-04       | 2.099E-02                                 | 2.365E-02 | 33.020 | 999 | .000            |
| Pair 4 | L10.4 - L20.4 | 2.569E-02          | 2.157E-02      | 6.821E-04       | 2.435E-02                                 | 2.703E-02 | 37.662 | 999 | .000            |
| Pair 5 | L10.5 - L20.5 | 3.084E-02          | 2.117E-02      | 6.696E-04       | 2.952E-02                                 | 3.215E-02 | 46.052 | 999 | .000            |
| Pair 6 | L10.6 - L20.6 | 2.222E-02          | 1.935E-02      | 6.119E-04       | 2.102E-02                                 | 2.342E-02 | 36.320 | 999 | .000            |

เมื่อค่าสัมประสิทธิ์ความเชื่อมั่นที่กำหนดเท่ากับ 0.95

ตัวอย่างขนาดเล็ก

**Paired Samples Test**

|                      | Paired Differences |                |                 |   |           | t      | df  | Sig. (2-tailed) |
|----------------------|--------------------|----------------|-----------------|---|-----------|--------|-----|-----------------|
|                      | Mean               | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference |           |        |     |                 |
|                      |                    |                |                 | Lower                                     | Upper     |        |     |                 |
| Pair 1 L10.1 - L20.1 | 1.807E-02          | 1.860E-02      | 5.882E-04       | 1.692E-02                                 | 1.923E-02 | 30.722 | 999 | .000            |
| Pair 2 L10.2 - L20.2 | 2.571E-02          | 2.473E-02      | 7.820E-04       | 2.417E-02                                 | 2.724E-02 | 32.875 | 999 | .000            |
| Pair 3 L10.3 - L20.3 | 2.829E-02          | 2.785E-02      | 8.807E-04       | 2.656E-02                                 | 3.002E-02 | 32.121 | 999 | .000            |
| Pair 4 L10.4 - L20.4 | 3.473E-02          | 2.740E-02      | 8.665E-04       | 3.303E-02                                 | 3.643E-02 | 40.082 | 999 | .000            |
| Pair 5 L10.5 - L20.5 | 3.785E-02          | 2.828E-02      | 8.943E-04       | 3.610E-02                                 | 3.961E-02 | 42.326 | 999 | .000            |
| Pair 6 L10.6 - L20.6 | 2.961E-02          | 2.603E-02      | 8.231E-04       | 2.800E-02                                 | 3.123E-02 | 35.977 | 999 | .000            |