Appendix I

R Commands analysis

Figure 1.3

```
setwd("H:/Phd/Thesis/paper2V2/pun")
xmin = 550000
ymin = 620000
xmax = 850000
ymax = 900000
source("songPatDist.RCm")
zoom(xmin,ymin,xmax,ymax,0)
read.table("songPatDist.xy",h=T,as.is=T) -> songPatDistxy
read.table("songPatDist.txt",h=T,as.is=T) -> songPatDistdata
# get colours for regions
read.table("coloursPun.txt",h=T,as.is=T) -> colours
colourP <- colours$colour[colours$LUCode=="P100"]       # Pattani
colourS <- colours$colour[colours$LUCode=="S100"]       # Songkla
# Plot labelled circles indentifying regions
# Songkla
dx <- 0*(1:17)
dy <- dx
reg <- c(1:16)
lab <- c(1:16)
j <- 0
for (i in reg) {
 j <- j+1
points(songPatDistdata$x[i]+dx[j],songPatDistdata$y[i]+dy[j],cex=2,pch=21,bg="yellow")
text(songPatDistdata$x[i]+dx[j],songPatDistdata$y[i]+dy[j],paste("S",lab[j],sep=""),cex=0.5)
```

```
}
# Pattani
dx <- 0*(1:13)
dy <- dx
reg <- c(17:28)
j <- 0
for (i in reg) {
 j <- j+1
points(songPatDistdata$x[i]+dx[j],songPatDistdata$y[i]+dy[j],cex=2,pch=21,bg="yellow")
text(songPatDistdata$x[i]+dx[j],songPatDistdata$y[i]+dy[j],paste("P",j,sep=""),cex=0.5)
}
# Labels for Provinces & Seas
text(680000,640000,"Malaysia",cex=1.1)
text(744000,700000,"Yala",cex=0.9)
text(800000,680000,"Narathiwat",cex=0.9)
text(610000,760000,"Satun",cex=0.9)
text(615000,830000,"Phattalung",cex=0.9)
text(570000,840000,"Trang",cex=0.9)
text(590000,675000,"Andaman Sea",cex=1.1)
text(820000,760000,"Gulf of",cex=1.1)
text(820000,745000,"Thailand",cex=1.1)
axis(1,cex.axis=0.7)
axis(2,cex.axis=0.7)
# display legend
```

```
legS <- c("S1: Songkla City","S2: Chana","S3: NaThawi","S4: Thepa","S5: SabaYoi","S6: Ranot","S7: Rattaphum","S8 :Sadao","S9 :Hat Yai","S10:BangKlam","S11:SinghaNakorn","S12:Namom","S13:Krasaesin","S14:SathingPra","S15:KuanNiang","S16:KlongHoiKong")
legP <- c("P1: Pattani City","P2: KhokPho","P3: NongChik","P4: Panare","P5: Mayo","P6: Yaring","P7: Yarang","P8: Maelan","P9: Saiburi","P10: Maikean","P11: TungYangDeang","P12: Kaphor")
leg <- c(legS,legP)
legend("topright",leg,cex=0.7,bg="snow",inset=0.02,ncol=2)
```

Figure 2.2

```
setwd("H:/Phd/Thesis/paper2V2/pun")
xmin = 560000
ymin = 620000
xmax = 840000
ymax = 880000
source("songPatDist.RCm")
zoom(xmin,ymin,xmax,ymax,0)
read.table("songPatDist.xy",h=T,as.is=T) -> songPatDistxy
read.table("songPatDist.txt",h=T,as.is=T) -> songPatDistdata
# get colours for regions
read.table("coloursPun.txt",h=T,as.is=T) -> colours
colourP <- colours$colour[colours$LUCode=="P100"]       # Pattani
colourS <- colours$colour[colours$LUCode=="S100"]       # Songkla
# select districts to merge and get border points
```

```
# KhokPho and Maelan
d1 <- subset(songPatDistxy,plotID==9402)
d2 <- subset(songPatDistxy,plotID==9412)
merge(d1,d2,by.x=c("x","y"),by.y=c("x","y")) -> d12
# if border is not empty redraw it
if (dim(d12)[1]>1) {
 d12[order(d12$pointID.x),c(4,1:2)] -> border
# if border is not a single segment of first district, insert a blank
 nBorderPoints <- dim(border)[1]
 if (nBorderPoints < border$pointID.x[nBorderPoints]) {
  for (i in 2:nBorderPoints) {
   if (border$pointID.x[i]>i) break
  }
  border <- rbind(border[1:(i-1),],c(NaN,NaN,NaN),border[(i:nBorderPoints),])
 }
 lines(border$x,border$y,lwd=1,col=colourP)
 lines(border$x,border$y,lwd=1,lty="13")
}
# Panare and Saiburi
d1 <- subset(songPatDistxy,plotID==9404)
d2 <- subset(songPatDistxy,plotID==9407)
merge(d1,d2,by.x=c("x","y"),by.y=c("x","y")) -> d12
d12[order(d12$pointID.x),] -> border
nBorderPoints <- dim(border)[1]
if (dim(d12)[1]>1) {
```

```
 d12[order(d12$pointID.x),c(4,1:2)] -> border
 if (nBorderPoints < border$pointID.x[nBorderPoints]) {
  for (i in 2:nBorderPoints) {
   if (border$pointID.x[i]>i) break
  }
  border <- rbind(border[1:(i-1),],c(NaN,NaN,NaN),border[(i:nBorderPoints),])
 }
 lines(border$x,border$y,lwd=1,col=colourP)
 lines(border$x,border$y,lwd=1,lty="13")
}
# Saiburi and MaiKaen
d1 <- subset(songPatDistxy,plotID==9407)
d2 <- subset(songPatDistxy,plotID==9408)
merge(d1,d2,by.x=c("x","y"),by.y=c("x","y")) -> d12
d12[order(d12$pointID.x),] -> border
nBorderPoints <- dim(border)[1]
if (dim(d12)[1]>1) {
 d12[order(d12$pointID.x),c(4,1:2)] -> border
 if (nBorderPoints < border$pointID.x[nBorderPoints]) {
  for (i in 2:nBorderPoints) {
   if (border$pointID.x[i]>i) break
  }
  border <- rbind(border[1:(i-1),],c(NaN,NaN,NaN),border[(i:nBorderPoints),])
 }
 lines(border$x,border$y,lwd=1,col=colourP)
```

```
 lines(border$x,border$y,lwd=1,lty="13")
}
# Mayo and ThungYungDang
d1 <- subset(songPatDistxy,plotID==9405)
d2 <- subset(songPatDistxy,plotID==9406)
merge(d1,d2,by.x=c("x","y"),by.y=c("x","y")) -> d12
d12[order(d12$pointID.x),] -> border
nBorderPoints <- dim(border)[1]
if (dim(d12)[1]>1) {
 d12[order(d12$pointID.x),c(4,1:2)] -> border
 if (nBorderPoints < border$pointID.x[nBorderPoints]) {
  for (i in 2:nBorderPoints) {
   if (border$pointID.x[i]>i) break
  }
  border <- rbind(border[1:(i-1),],c(NaN,NaN,NaN),border[(i:nBorderPoints),])
 }
 lines(border$x,border$y,lwd=1,col=colourP)
 lines(border$x,border$y,lwd=1,lty="13")
}
# TYD and KhaPho
d1 <- subset(songPatDistxy,plotID==9406)
d2 <- subset(songPatDistxy,plotID==9411)
merge(d1,d2,by.x=c("x","y"),by.y=c("x","y")) -> d12
d12[order(d12$pointID.x),] -> border
nBorderPoints <- dim(border)[1]
```

```
if (dim(d12)[1]>1) {
 d12[order(d12$pointID.x),c(4,1:2)] -> border
 if (nBorderPoints < border$pointID.x[nBorderPoints]) {
  for (i in 2:nBorderPoints) {
   if (border$pointID.x[i]>i) break
  }
  border <- rbind(border[1:(i-1),],c(NaN,NaN,NaN),border[(i:nBorderPoints),])
 }
 lines(border$x,border$y,lwd=1,col=colourP)
 lines(border$x,border$y,lwd=1,lty="13")
}
# Chana and NaMom
d1 <- subset(songPatDistxy,plotID==9003)
d2 <- subset(songPatDistxy,plotID==9012)
merge(d1,d2,by.x=c("x","y"),by.y=c("x","y")) -> d12
d12[order(d12$pointID.x),] -> border
nBorderPoints <- dim(border)[1]
if (dim(d12)[1]>1) {
 d12[order(d12$pointID.x),c(4,1:2)] -> border
 if (nBorderPoints < border$pointID.x[nBorderPoints]) {
  for (i in 2:nBorderPoints) {
   if (border$pointID.x[i]>i) break
  }
  border <- rbind(border[1:(i-1),],c(NaN,NaN,NaN),border[(i:nBorderPoints),])
 }
```

```
 lines(border$x,border$y,lwd=1,col=colourS)
 lines(border$x,border$y,lwd=1,lty="13")
}
# Sadao and KlongHoiKong
d1 <- subset(songPatDistxy,plotID==9010)
d2 <- subset(songPatDistxy,plotID==9016)
merge(d1,d2,by.x=c("x","y"),by.y=c("x","y")) -> d12
d12[order(d12$pointID.x),] -> border
nBorderPoints <- dim(border)[1]
if (dim(d12)[1]>1) {
 d12[order(d12$pointID.x),c(4,1:2)] -> border
 if (nBorderPoints < border$pointID.x[nBorderPoints]) {
  for (i in 2:nBorderPoints) {
   if (border$pointID.x[i]>i) break
  }
  border <- rbind(border[1:(i-1),],c(NaN,NaN,NaN),border[(i:nBorderPoints),])
 }
 lines(border$x,border$y,lwd=1,col=colourS)
 lines(border$x,border$y,lwd=1,lty="13")
}
# Ranot and KraSaSing
d1 <- subset(songPatDistxy,plotID==9007)
d2 <- subset(songPatDistxy,plotID==9008)
merge(d1,d2,by.x=c("x","y"),by.y=c("x","y")) -> d12
d12[order(d12$pointID.x),] -> border
```

```
nBorderPoints <- dim(border)[1]
if (dim(d12)[1]>1) {
 d12[order(d12$pointID.x),c(4,1:2)] -> border
 if (nBorderPoints < border$pointID.x[nBorderPoints]) {
  for (i in 2:nBorderPoints) {
   if (border$pointID.x[i]>i) break
  }
  border <- rbind(border[1:(i-1),],c(NaN,NaN,NaN),border[(i:nBorderPoints),])
 }
 lines(border$x,border$y,lwd=1,col=colourS)
 lines(border$x,border$y,lwd=1,lty="13")
}
# Ranot and SathingPra
d1 <- subset(songPatDistxy,plotID==9007)
d2 <- subset(songPatDistxy,plotID==9002)
merge(d1,d2,by.x=c("x","y"),by.y=c("x","y")) -> d12
d12[order(d12$pointID.x),] -> border
nBorderPoints <- dim(border)[1]
if (dim(d12)[1]>1) {
 d12[order(d12$pointID.x),c(4,1:2)] -> border
 if (nBorderPoints < border$pointID.x[nBorderPoints]) {
  for (i in 2:nBorderPoints) {
   if (border$pointID.x[i]>i) break
  }
  border <- rbind(border[1:(i-1),],c(NaN,NaN,NaN),border[(i:nBorderPoints),])
```

```
 }
 lines(border$x,border$y,lwd=1,col=colourS)
 lines(border$x,border$y,lwd=1,lty="13")
}
# KraSaSing and SathingPra
d1 <- subset(songPatDistxy,plotID==9008)
d2 <- subset(songPatDistxy,plotID==9002)
merge(d1,d2,by.x=c("x","y"),by.y=c("x","y")) -> d12
d12[order(d12$pointID.x),] -> border
nBorderPoints <- dim(border)[1]
if (dim(d12)[1]>1) {
 d12[order(d12$pointID.x),c(4,1:2)] -> border
 if (nBorderPoints < border$pointID.x[nBorderPoints]) {
  for (i in 2:nBorderPoints) {
   if (border$pointID.x[i]>i) break
  }
  border <- rbind(border[1:(i-1),],c(NaN,NaN,NaN),border[(i:nBorderPoints),])
 }
 lines(border$x,border$y,lwd=1,col=colourS)
 lines(border$x,border$y,lwd=1,lty="13")
}
# Plot labelled circles indentifying regions
# Songkla
dx <- 0*(1:12)
dy <- dx
```

```
dx[1] <- 1300
dx[2] <- -4000
dx[6] <- 10000
dy[8] <- 10000
dx[9] <- -6000
dx[11] <- 6000
dy[10] <- -3000
dy[11] <- -2000
dy[12] <- -2000
dy[6] <- -17000
dy[5] <- 6000
reg <- c(1,3:7,9:11,12,13:15)
lab <- c(1:9,7,10:11)
j <- 0
for (i in reg) {
 j <- j+1
points(songPatDistdata$x[i]+dx[j],songPatDistdata$y[i]+dy[j],cex=3,pch=21,bg="yellow")
text(songPatDistdata$x[i]+dx[j],songPatDistdata$y[i]+dy[j],paste("S",lab[j],sep=""),cex=0.6)
}
# Pattani
dx <- 0*(1:12)
dy <- dx
dx[2] <- 2000
dx[6] <- 4000
dy[6] <- -3000
```

```
dx[4] <- 4000
dy[4] <- -8000
dy[3] <- 3000
reg <- c(17:21,25:26)
j <- 0
for (i in reg) {
 j <- j+1
points(songPatDistdata$x[i]+dx[j],songPatDistdata$y[i]+dy[j],cex=3,pch=21,bg="yellow")
text(songPatDistdata$x[i]+dx[j],songPatDistdata$y[i]+dy[j],paste("P",j,sep=""),cex=0.6)
}
# Labels for Provinces & Seas
text(680000,640000,"Malaysia",cex=1.1)
text(744000,700000,"Yala",cex=0.9)
text(800000,680000,"Narathiwat",cex=0.9)
text(610000,760000,"Satun",cex=0.9)
text(615000,830000,"Phattalung",cex=0.9)
text(570000,840000,"Trang",cex=0.9)
text(590000,675000,"Andaman Sea",cex=1.1)
text(763000,785000,"Gulf of Thailand",cex=1.1)
axis(1,cex.axis=0.7)
axis(2,cex.axis=0.7)
# display legend
legS <- c("S1: Songkla City","S2: Chana+Namom","S3: NaThawi","S4: Thepa","S5: SabaYoi","S6: Ranot+KS+ST+KN","S7: Rattaphum","S8 :Sadao+KHK","S9 :Hat Yai","S10:BangKlam","S11:SinghaNakorn")
```

```
legP <- c("P1: Pattani City","P2: KhokPho+ML","P3: NongChik","P4:
Panare+SB+MK","P5: Mayo+TYD+KP","P6: Yaring","P7: Yarang")
leg <- c(legS,legP)
legend("topright",leg,cex=0.7,bg="snow",inset=0.02,ncol=2)
```

Table 3.7

```
setwd("H:/Phd/Thesis/paper1")
read.table("songklaMod.txt",h=T,as.is=T)->s
str(s)
s$age2<-s$ageGrp^2
#MODEL 1 (sexReligion: "1:maleOther")
s1 <-s
s1 <- subset(s1,substr(sexReligion,1,1)==1)
model1 <-
glm(family=binomial,cbind(PopSec1,PopSec0)~factor(district)+ageGrp:factor(district)+age2
:factor(district),data=s1)
summary(model1)
model1$fitted.values->s1$fv1
str(s1)
write.table(s1,"fv1.txt")
#MODEL 2 (sexReligion: "2:femaleOther")
s1 <-s
s1 <- subset(s1,substr(sexReligion,1,1)==2)
```

```
model2 <-
glm(family=binomial,cbind(PopSec1,PopSec0)~factor(district)+ageGrp:factor(district)+age2
:factor(district),data=s1)
summary(model2)
model2$fitted.values->s1$fv2
str(s1)
write.table(s1,"fv2.txt")
#MODEL 3 (sexReligion: "3:maleIslam")
s1 <-s
s1 <- subset(s1,substr(sexReligion,1,1)==3)
model3 <-
glm(family=binomial,cbind(PopSec1,PopSec0)~factor(district)+ageGrp:factor(district)+age2
:factor(district),data=s1)
summary(model3)
model3$fitted.values->s1$fv3
str(s1)
write.table(s1,"fv3.txt")
#MODEL 4 (sexReligion: "4:femaleIslam")
s1 <-s
s1 <- subset(s1,substr(sexReligion,1,1)==4)
model4 <-
glm(family=binomial,cbind(PopSec1,PopSec0)~factor(district)+ageGrp:factor(district)+age2
:factor(district),data=s1)
summary(model4)
model4$fitted.values->s1$fv4
```

```
str(s1)
write.table(s1,"fv4.txt")
```

Figure 3.8

```
setwd("H:/Phd/Thesis/paper2V1")
read.table("pun2.txt",as.is=T,h=T) -> p2
str(p2)
windows(7,5)
par(mfrow=c(1,2),mar=c(1.3,1.5,0.4,0.2),oma=c(2,2,2,0.8),las=1,tcl=0.2,mgp=c(1.1,0,0))
groups <- c("1","2","3","M Other 4","5","6","7")
groups <- c(groups,groups,groups,groups)
groups[11] <- "F Other 4"
groups[18] <- "M Islam 4"
groups[25] <- "F Islam 4"
pat <- p2[p2$prov=="pattani",]
yPos <- c(33:27,25:19,17:11,9:3)
CI1 <- (pat$second-1.96*pat$secondSE)/log(2)
CI2 <- (pat$second+1.96*pat$secondSE)/log(2)
xmin <- min(CI1)
xmax <- max(CI2)
plot((pat$second)/log(2),yPos,type="n",pch=16,cex=0.7,xlim=c(-
3,3.2),ylim=c(0,33),ylab="",xaxt="n",yaxt="n",cex.axis=0.7)
abline(v=0,col="red")
points((pat$second)/log(2),yPos,pch=16,cex=0.7)
points(0.2989/log(2),0.5,pch=23,cex=1,col="blue",bg="blue")
```

```
text(-3,29,"*",cex=0.8)
for (j in yPos) {
 lines((0:1)*0.1-3.3,(0:1)*0+j)
}
i <- 0
for (j in yPos) {
 i <- i+1
 lines(c(CI1[i],CI2[i]),(0:1)*0+j)
}
xx <- c((0.2989-
1.96*0.0184)/log(2),0.2989/log(2),(0.2989+1.96*0.0184)/log(2),0.2989/log(2),(0.2989-
1.96*0.0184)/log(2))
yy <- c(2,1.7,2,2.3,2)
lines(c((0.2989-
1.96*0.0184)/log(2),(0.2989+1.96*0.0184)/log(2)),c(0.5,0.5),lwd=2,col="blue")
maPoint <- cbind(xx,yy)
#polygon(maPoint,col="blue")
abline(h=c(26,18,10,2),lty="13")
mtext(groups,side=2,padj=(17-yPos)*1.23-0.25,line=0.3,cex=0.7)
xlabelPos <- (-3):3
xlabels <- c("1/8","1/4","1/2","1","2","4","8")
mtext(xlabels,side=1,adj=(xlabelPos+3.1)/6.45,cex=0.7,line=0)
for (j in xlabelPos) {
 lines(j+0*(0:1),-1.2+(0:1)*0.3)
}
```

```
mtext("Pattani Province",cex=0.9,side=3,line=0.25)
mtext("Odds Ratio: Secondary/Primary",side=1,line=1,cex=0.8)
groups <- 1:11
groups <- c(groups,groups,groups,groups)
song <- p2[p2$prov=="songkla",]
yPos <- c(49:39,37:27,25:15,13:3)
CI1 <- (song$second-1.96*song$secondSE)/log(2)
CI2 <- (song$second+1.96*song$secondSE)/log(2)
xmin <- min(CI1)
xmax <- max(CI2)
plot((song$second)/log(2),yPos,pch=16,type="n",cex=0.7,xlim=c(-
3,3.2),ylim=c(0,49),xlab="",ylab="",xaxt="n",yaxt="n",cex.axis=0.7)
abline(v=0,col="red")
points((song$second)/log(2),yPos,pch=16,cex=0.7)
points((-0.0032)/log(2),0,pch=23,cex=0.9,col="blue",bg="blue")
for (j in yPos) {
 lines((0:1)*0.1-3.3,(0:1)*0+j)
}
i <- 0
for (j in yPos) {
 i <- i+1
 lines(c(CI1[i],CI2[i]),(0:1)*0+j)
}
lines(c((-0.0032-1.96*0.0145)/log(2),(-0.0032+1.96*0.0145)/log(2)),c(0,0),col="blue")
abline(h=c(38,26,14,2),lty="13")
```

```
mtext(groups,side=2,padj=(25-yPos)*0.94,line=0.3,cex=0.6)
mtext(xlabels,side=1,adj=(xlabelPos+3.1)/6.45,cex=0.7,line=0)
for (j in xlabelPos) {
 lines(j+0*(0:1),-2+(0:1)*0.6)
}
mtext("Songkla Province",cex=0.9,side=3,line=0.25)
mtext("Odds Ratio: Secondary/Primary",side=1,line=1,cex=0.8)
mtext("Unemployment by Highest Completed Education
Level",adj=0.55,line=1,outer=T,side=3)
```

Appendix II

Manuscript I :

Trends in Secondary School Education Completion in Pattani Province of Thailand

บทความวิจัย

แนวโน้มการจบการศึกษาระดับมัธยมศึกษาในจังหวัดปัตตานี

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คณะวิทยาศาสตร์และเทคโนโลยี มหาวิทยาลัยสงขลานครินทร์ วิทยาเขตปัตตานี

บทคัดย่อ

การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อศึกษาแนวโน้มการจบการศึกษาระดับมัธยมของคนในจังหวัดปัตตานีโดยเป็นการศึกษาเปรียบเทียบระหว่างกลุ่มเพศและศาสนา ข้อมูลที่ใช้ได้จากการสำรวจสำมะโนประชากรของสำนักงานสถิติแห่งชาติประจำปี 2543 ตัวแปรตามในการศึกษาคือสัดส่วนการจบการศึกษาระดับมัธยมต่อผู้ที่ไม่จบการศึกษาระดับมัธยม โดยแบ่งช่วงกลุ่มอายุที่ศึกษาออกเป็น 10 ช่วงคือ 20..24, 25..29, .. และ 65+ วิเคราะห์ข้อมูลโดยใช้โมเดลโลจิสติกแบบควอดราติกซึ่งทำให้สามารถแสดงแนวโน้มการเปลี่ยนแปลงของสัดส่วนการจบการศึกษาระดับมัธยมช่วงปี พ.ศ. 2503-2543 ได้อย่างชัดเจน ผลการศึกษาพบว่า นับตั้งแต่ พ.ศ.2503 ถึง พ.ศ.2543 สัดส่วนการจบการศึกษาระดับมัธยมของคนในจังหวัดปัตตานีมีแนวโน้มที่เพิ่มขึ้นในทุกกลุ่มเพศและศาสนา โดยในปี พ.ศ.2543 กลุ่มมุสลิมทั้งเพศชายและหญิงที่มีสัดส่วนการจบการศึกษาระดับมัธยมสูงสุดจะอาศัยอยู่ในเขตอำเภอเมือง ส่วนในเขตพื้นที่อื่นๆ มีสัดส่วนการจบที่น้อยกว่าโดยเฉพาะในเขตอำเภอหนองจิกพบว่า มีสัดส่วนการจบต่ำสุดโดยอยู่ที่ระดับน้อยกว่าร้อยละ 30 สำหรับกลุ่มที่ไม่ใช่มุสลิมทั้งเพศชายและหญิงนั้นถึงแม้ในเขตอำเภอเมืองจะมีสัดส่วนการจบการศึกษาระดับมัธยมศึกษาต่ำสุดแต่ก็ยังมีสัดส่วนการจบการศึกษาอยู่ที่ประมาณร้อยละ 70

คำสำคัญ: การจบการศึกษาระดับมัธยม, การถดถอยโลจิสติก, ปัตตานี, ภาคใต้ของประเทศไทย

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RESEARCH ARTICLE

Trends in Secondary School Education Completion in Pattani Province of Thailand

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Abstract

This study examines the trends in secondary school education completion by gender and religion (Muslim or other) in districts of Pattani Province in Southern Thailand, based on data from the 2000 Population Census of Thailand. The outcome is the proportion of residents in the demographic group who completed secondary school. For each 5-year age group from 20-24 to 60-64 and 65+, logistic regression is used to fit a quadratic model for this proportion for each combination of gender, religion and district. The resulting trajectories fit the data well and show how different cohorts have improved their educational qualifications over the period from 1960 to 2000, indicating clearly that some gender-religious groups have reached high levels of educational completion in some districts, but others have not. The log-odds for these secondary school completion trajectories can be modelled as quadratic curves using logistic regression. While secondary education completion in Pattani increased in all four gender-religion groups from 1960 to 2000, for Muslim groups, the highest secondary education completion level in Pattani was achieved in the Pattani city district. However, low proportions of secondary school education completion were found among Muslim men and women in rural areas, particularly in NongChik district, where the completion rate was still below 30%. For non-Muslim men and women, although the lowest level in secondary school education completion was in Pattani city district, but it was still about 70%.

Keywords: Secondary education completion, Pattani province, southern Thailand, logistic regression

Introduction

The progress in various sciences in the age of globalization has greatly affected the change in social and economic conditions of every country in the world. Therefore, each country has attempted to use education as a tool to improve the quality of its people so as to be able to keep pace with the state-of-the-art sciences. Several countries have endeavored to become educational leaders as they realize that education contributes to their security and wealth. In Thailand, every government has also placed importance on education as reflected in the implementation of various National Educational Plans which set the objectives in accordance with the change in the globalization age. As a result, the quality of Thai people's education has improved as shown in the UNESCO report indicating that the average time Thai people spent on tertiary education increased from 0.8 year in 1991 to 2.2 years in 2004 (www.uis.unesco.org/TEMPLATE/pdf/ged/2006/GED2006.pdf, 2006). The educational provision before the tertiary education level has been considered as foundation education in the 6:3:3 system (primary school: lower secondary: upper secondary) since 1999 and as a 9-year compulsory education replacing the previous 6-year system (www.secondary.kku.ac.th/curr-dev/variety/hist.htm, 2006). The main objectives of compulsory education are to enable learners to possess learning motivation, thinking and life skills, self-worth, discipline, and enough basic knowledge for higher education. However, implementing the new system of nine-year compulsory education and achieving its specified objectives is not easy, because Thailand is composed of several groups of people from diverse cultures, ways of life and beliefs. As reported in the 2000 census survey, Pattani and Songkla provinces, both in the South and next to each other, have different rates of secondary education completion. That is, among people from the age of 20, in Songkla province, 36.6% of them had completed secondary school, whereas in Pattani province, there were only 24.6% (National Statistical Office, 2006). The difference in the number of graduates had different impacts on social and economic conditions in particular areas. This study, thus, has selected Pattani province as an area for investigating factors affecting the secondary school education completion of the people in the province.

Pattani is the most densely populated of Thailand's 14 Southern provinces and according to the population registration and housing survey in 2000 (National Statistical Office, 2006), at the turn of the century had 595,985 residents. With 80.6% of the people Islamic, Pattani is one of four provinces with a Muslim majority (the others are Naratiwat 82%, Yala 69% and Satun 68%) and 75% of the population had not completed elementary school.

Figure 1 Location of Pattani Province in Southern Thailand

Our study investigates the factors associated with failure to complete secondary education in Pattani Province.

Methodology

Study design and variables

The study is cross-sectional, based on population data selected from the 2000 Population and Housing Census of Thailand. Following Cox and Wermuth (1966), the variables are shown as a path diagram in Figure 2.

The outcome variable is completion of secondary education. Table 1 shows a cross-tabulation of education completion by age group for Pattani Province. Persons aged less than 20 were omitted because they could still be in the process of completing their secondary education, and others who did not state their education completion status at the 2000 Census were also omitted from the study, giving a total study sample of 342,047 persons.

The study factors are gender, religion (Muslim or other), 10 age groups, and District. Data from smaller geographically proximate similar districts were combined to avoid zero counts in the statistical analysis, reducing the number of regions from 12 to 7, as Figure 3 shows.

In preliminary data analysis we compare the secondary education completion rates within the seven district-based regions of Pattani Province by plotting these proportions against age group separately for each combination of gender and religion. Since persons in a specified age group were all born within the same 5-year period, these plots will show how the secondary education completion rates within each district have changed over the period from 1960 to 2000 for each group gender-religion group.

The secondary school completion rates can be modeled using logistic regression, which provides a method for modeling the association between a binary outcome and multiple

Figure 2 Path diagram of variables considered in study

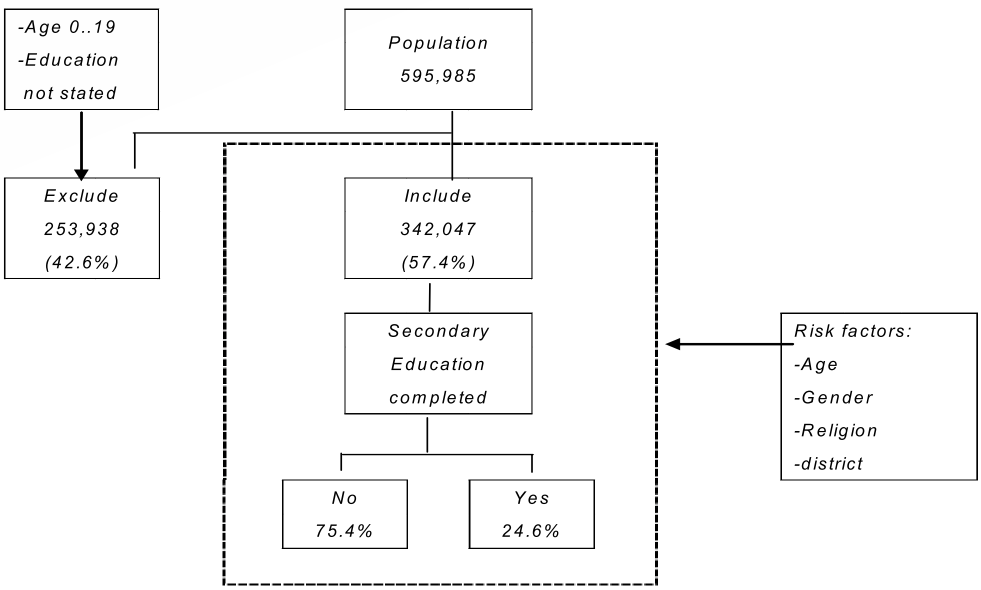
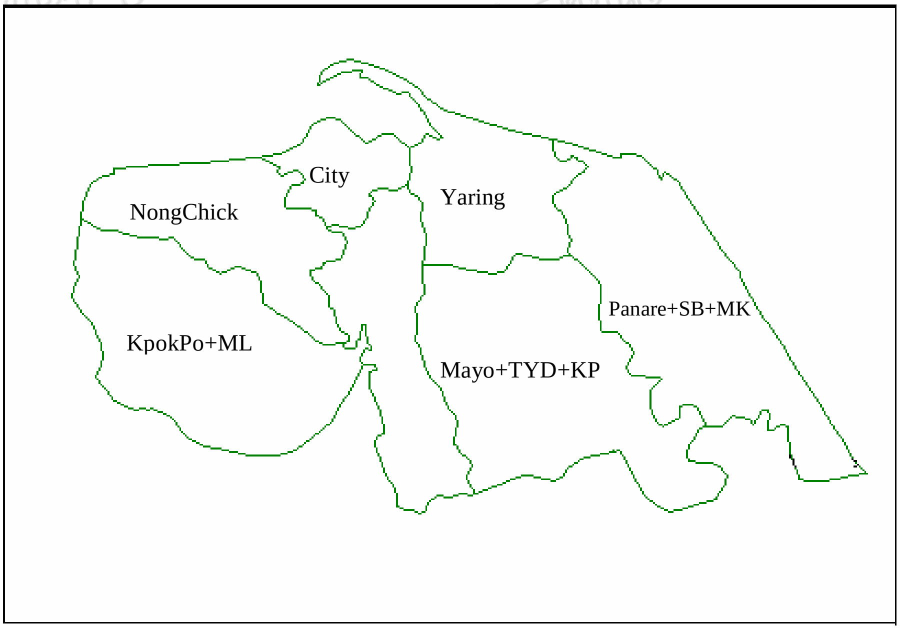


Table 1 Cross tabulation of education completion by age group for Pattani Province

Age Group	Education Completion					Total
	none	elementary	secondary	high	Not stated	
0..14	*37,232*	*81,099*	*8,216*	*20*	*66,358*	*192925*
15..19	*1,632*	*21,186*	*29,506*	*4,123*	*731*	*57178*
20..24	2,231	25,951	13,696	9,656	*723*	52257
25..29	2,717	27,829	11,029	6,161	*477*	48213
30..34	3,980	26,260	8,347	5,293	*462*	44342
35..39	4,591	25,474	5,322	5,758	*432*	41577
40..44	5,710	19,537	3,518	4,713	*319*	33797
45..49	7,205	16,488	1,884	2,615	*271*	28463
50..54	7,843	11,210	1,166	1,440	*220*	21879
55..59	8,598	7,787	818	861	*175*	18239
60..64	11,718	6,596	400	379	*191*	19284
64+	25,646	10,507	743	370	*565*	37831
Total	119103	279924	84645	41389	*70924*	595985

Figure 3 Districts in Pattani Province Statistical methods



ML =Maelan
TYD=Thungyangdeang
KP =Kaphor
SB =Saiburi
MK =Maikean

determinants. In the simplest case, when there is a single continuously varying determinant *x*, the model takes the form

$$\ln\left(\frac{p}{1-p}\right)=\alpha+\beta x, \qquad (1)$$

where *p* is the probability that the outcome is in the specified category. Equation (1) can be inverted to give an expression for the probability of the event as

$$p=\frac{1}{1+\exp(-\alpha-\beta x)}. \qquad (2)$$

The functional form of Equation (2) ensures that its values are always between 0 and 1, as they should be given that they are probabilities.

This model is easily extended to handle multiple determinants. For *m* continuous or binary determinants (x_1, x_2, …, x_m), it may be written as

$$\ln\left(\frac{p}{1-p}\right)=\alpha+\sum_{j=1}^{m}\beta_j x_j \qquad (3)$$

Nominal determinants are handled by separating them into their binary components, giving *k*-1 such components for a determinant with *k* categories. Asymptotic results based on statistical theory provide estimates based on maximum likelihood fitting of the model, together with confidence intervals and *p*-values for testing relevant null hypotheses (see, for example, Kleinbaum & Klein, 2002).

For our study we use a special case of Equation (3) where the model contains district as a nominal determinant together with its multiplicative interactions with *x* and x^2, where *x* denotes age coded as a continuous determinant, with values 1 for age group 20-24, 2 for age group 25-29, …, 10 for age group 65+. This model can be written as

$$\ln\left(\frac{p}{1-p}\right)=\alpha_i+\beta_i x+\gamma_i x^2. \qquad (4)$$

The terms a_i, b_i and g_i represent constant, linear and quadratic effects of age for district i. Since a goal of the analysis to compare the district effects with each other, the model is more appropriately expressed as

$$\ln\left(\frac{p}{1-p}\right)=\alpha_1+\beta_1 x+\gamma_1 x^2+\delta\left(\alpha_i+\beta_i x+\gamma_i x^2\right), \qquad (5)$$

where $d = 0$ if $i = 1$, $d = 1$ otherwise. With this reformulation, the parameters a_i, b_i and g_i represent the differences between the effects for district *i* and district 1. Since any district may be specified as district 1, this makes it possible to compare any district with any other district.

Results

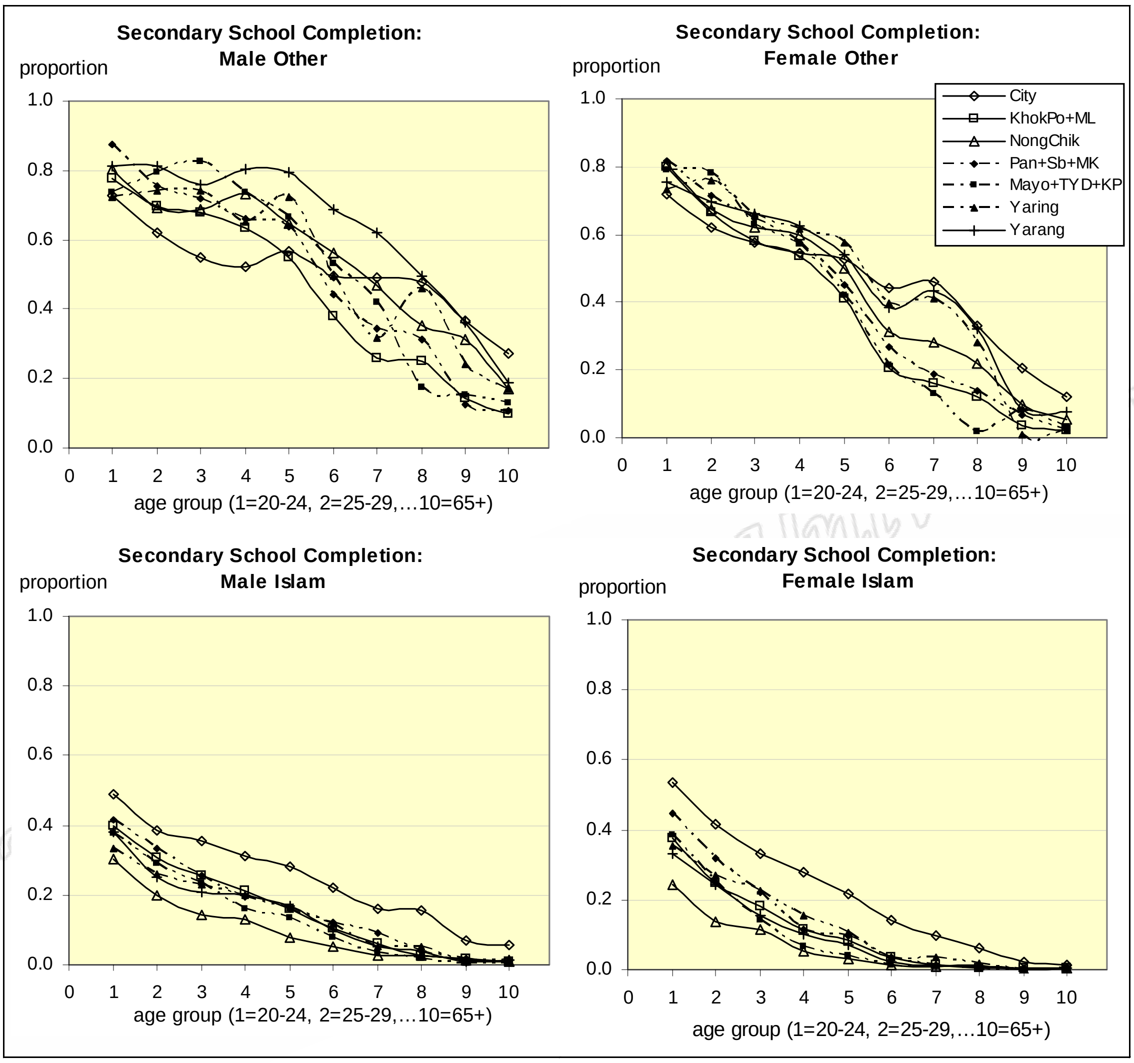
Preliminary analysis

Figure 4 shows the plots of the secondary school completion rates. These rates increase for each combination of gender and religion. The rates have a similar increasing pattern from 0.1 to 0.8 for male and female non-Islamic groups, whereas they increase from nearly zero to 0.5 for male and female Islamic groups. In Pattani city, the completion rates for Muslim residents are higher than for other districts.

Logistic regression modeling

Table 2 shows the results of fitting the logistic model given by Equation (5) separately for each gender-religion combination. The bottom line show the residual deviance from the saturated model

Figure 4 Secondary school completion rates versus age group by district, gender and religion



based on the 70 cells corresponding to combinations of district and age group for each gender-religion group.

Figure 5 shows the proportions of secondary school education completion plotted against age based on the logistic model, for each combination of gender and religion, male non-Islamic, female non-Islamic, male Islamic and female Islamic. In 1960 the proportions of secondary school education completion for Islamic residents were extremely low in all areas outside Pattani city. The graph shows clearly that the lowest proportion of secondary school education completion was for Islamic residents in Nong Chik district.

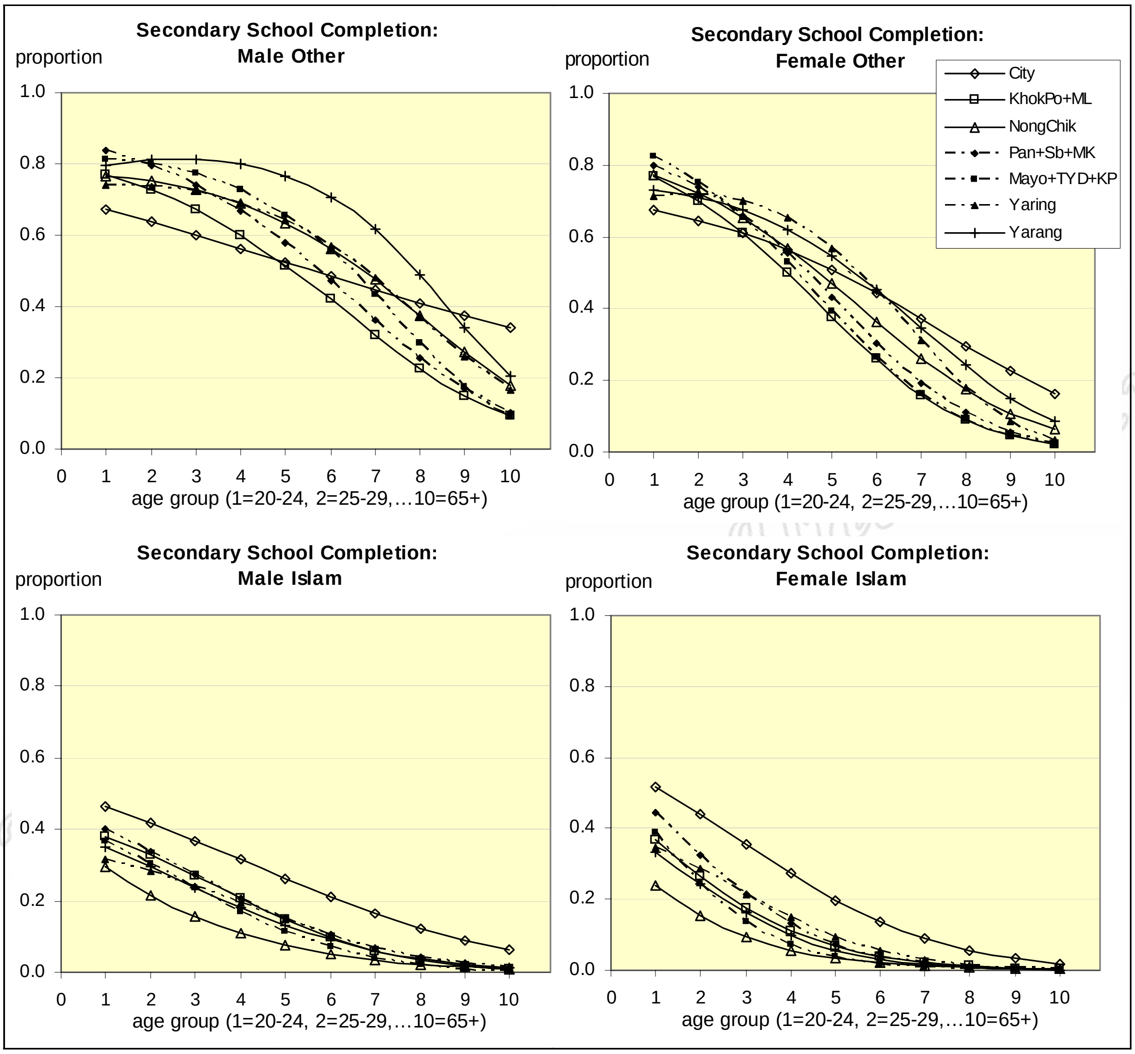
Discussion

The study of the trends in the secondary school completion rates can be modelled using logistic regression with quadratic curves representing age groups. The graphs display that

Table 2 Logistic model results

Factor	Male Other		Female Other		Male Islam		Female Islam	
	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Constant terms	0.8885	0.0637	0.8092	0.0592	0.0127	0.0502	0.3592	0.0526
City	0	-	0	-	0	-	0	-
KhokPo+ML	0.5136	0.1025	0.6865	0.1018	-0.3312	0.0933	-0.4516	0.1000
NongChik	0.3006	0.1559	0.6457	0.1702	-0.4869	0.0821	-0.9246	0.0976
Panare+Sb+MK	0.9861	0.1336	0.8419	0.1256	-0.1680	0.0707	-0.1106	0.0769
Mayo+TYD+KP	0.5548	0.3300	1.1285	0.3422	-0.3379	0.0781	-0.1257	0.0859
Yaring	0.0798	0.2268	-0.0528	0.2592	-0.6679	0.0770	-0.7632	0.0828
Yarang	0.2690	0.2048	0.2090	0.2316	-0.4219	0.0754	-0.6619	0.0870
Linear terms	-0.1612	0.0279	-0.0651	0.0271	-0.1492	0.0261	-0.2723	0.0295
City	0	-	0	-	0	-	0	-
KhokPo+ML	-0.0044	0.0437	-0.2055	0.0461	0.0114	0.0524	-0.1691	0.0627
NongChik	0.1781	0.0663	-0.1481	0.0736	-0.2531	0.0485	-0.3154	0.0633
Panare+Sb+MK	-0.0583	0.0544	-0.1808	0.0549	-0.0717	0.0384	-0.1797	0.0476
Mayo+TYD+KP	0.2204	0.1404	-0.3136	0.1536	-0.0397	0.0446	-0.4069	0.0568
Yaring	0.2668	0.0971	0.2850	0.1128	0.0663	0.0421	0.0855	0.0503
Yarang	0.4229	0.0862	0.0724	0.0977	-0.0454	0.0417	-0.0971	0.0552
Quadratic terms	0.0006	0.0026	-0.0181	0.0027	-0.0121	0.0027	-0.0159	0.0034
City	0	-	0	-	0	-	0	-
KhokPo+ML	-0.0209	0.0040	-0.0076	0.0046	-0.0179	0.0061	0.0027	0.0081
NongChik	-0.0293	0.0061	-0.0023	0.0070	0.0108	0.0056	0.0211	0.0080
Panare+Sb+MK	-0.0190	0.0049	-0.0097	0.0053	-0.0063	0.0042	-0.0045	0.0062
Mayo+TYD+KP	-0.0441	0.0126	-0.0009	0.0150	-0.0193	0.0053	0.0126	0.0078
Yaring	-0.0371	0.0087	-0.0448	0.0107	-0.0157	0.0047	-0.0204	0.0064
Yarang	-0.0520	0.0079	-0.0166	0.0091	-0.0078	0.0046	-0.0099	0.0073
Deviance (df)	45513 (119)		45128 (119)		110523 (119)		93335 (115)	
Residual Deviance (df)	249.3 (49)		237.1 (49)		260.1 (49)		207.6 (49)	

Figure 5 Secondary school completion rates versus age based on fitted logistic models



during the last 40 years (1960-2000), there was a tendency toward increasing proportion of Pattani people of all gender-religion groups in every area who completed their secondary education. In 1960, there was a higher proportion of secondary school completion in the Pattani city area than in other areas. In other districts, only primary education, which was compulsory, was prevalent. Later on, with the government's decentralization policy, secondary education was introduced to every district, and in some cases, to subdistricts. This policy was financially supported by the World Bank under the "Rural Secondary School Development Project" which had two phases: 1973-1974 and 1975-1978. This policy resulted in more secondary education opportunities for local students and a rapid increase of secondary school completion. In 2000, about 80% of non-Muslims completed their secondary education (compared with 20% in 1960) whereas 35% of Muslims did (compared with only

5% in 1960). It is noteworthy that, compared with other areas, a lower proportion of non-Muslims of both sexes in the area of Pattani city completed their secondary education in 2000. This is probably because here, there were more industries and businesses which required a larger labour force with education lower than the secondary level to move in the area. On the other hand, it was found that in 2000 there was a higher proportion of Muslims with secondary education in Pattani city, compared with that in other areas. This suggests that, (1) this group of people valued education more than other groups did, and (2) most of the labour force who came here were non-Muslims since most local Muslims labourers would prefer going to work in Malaysia if they needed employment. It should be noted that people in Nongchik District paid less attention to education than those in other areas in 2000, an than 30% of them completed secondary education. This was probably because of the state failure to provide the kind of education that responded to the need of the locals who firmly held to their traditional attitudes culture and religious beliefs.

Conclusion

The conclusions are as follows:

(a) Secondary school completion rates can be modelled using logistic regression with quadratic curves representing age groups.

(b) For a forty-years period (1960-2000), the proportion of secondary education completion in Pattani increased among all gender-religion groups.

(c) In 1960, the highest proportion of secondary school education completion in Pattani was for non-Islamic men and women Pattani city district.

(d) For the Islamic groups, the proportions of secondary school education completion were very low in all areas, particularly in NongChik district (less than 30%).

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