# Read in data file

AkuPlot<-read.table("Aku\_PsiCat.txt", header=TRUE, sep="\t")

names(AkuPlot)

[1] "Date" "Year" "Transect" "station" "old.station" "end.meter" "Substrate" "Psicat"

# Calculate transect-level means

Aku\_means<-tapply(AkuPlot$Psicat, list(AkuPlot$Year, AkuPlot$Transect), mean)

# Create data set for trend analysis

Aku<-data.frame(cbind(Transect=c(1,1,2,2,3,3,4,4,5,5), Year=rep(c(2000,2008),5), Y1= rep(c(1,0),5), Y2= rep(c(0,1),5), Psicat= matrix(Aku\_means,10,1)))

names(Aku)[5]<-"Psicat"

# Download the following libraries into R

library(gamlss)

library(betareg)

# Copy and paste these functions into R for summarizing results:

expit<-function(x) ifelse(x>700,1,exp(x)/(1+exp(x)))

logit<-function(x) log(x/(1-x))

PsiCatLik <-function(parms,vars, data, full=TRUE){

tmp<-rep(0,7)

names(tmp)<-c("const.p","const", "Y1.p", "Y2.p", "Y1", "Y2", "phi")

tmp[vars]<-parms

Rows<- dim(data)[1]

Y1<- data$Y1

Y2<- data$Y2

ones <-rep(1,Rows)

# Model detection probs:

if(full==TRUE) etap<- tmp[3]\*Y1 + tmp[4]\*Y2

if(full==FALSE) etap<- tmp[1]\*ones

p0 <- 1/(1+exp(-etap))

q0 <- 1-p0

# Model occupancy rates

if(full==TRUE) eta<- tmp[5]\*Y1 + tmp[6]\*Y2

if(full==FALSE) eta<- tmp[2]\*ones

mu <- 1/(1+exp(-eta))

ymat<-data$Psicat

prob<- rep(1,Rows)

phi<- tmp[7]

# Calc Log likelihood

prob<- dBEZI(x=ymat, mu=mu, sigma=phi, nu=p0, log=TRUE)

-sum(prob)

}

# Obtain starting values for the parameters

# Starting values – full model = cell means model by year

fit.full.p<-glm((Psicat==0)~ -1+ Y1 +Y2, family = binomial, data=Aku)

summary(fit.full.p)

*Coefficients:*

*Estimate Std. Error z value Pr(>|z|)*

*Y1 -1.386 1.118 -1.240 0.215*

*Y2 -20.566 7929.262 -0.003 0.998*

fit.full.mu<-betareg(Psicat ~ -1 + Y1 +Y2, data=Aku[Aku$Psicat>0,])

summary(fit.full.mu)

*Coefficients (mean model with logit link):*

*Estimate Std. Error z value Pr(>|z|)*

*Y1 -1.2472 0.5639 -2.212 0.027 \**

*Y2 -0.3299 0.4641 -0.711 0.477*

*Phi coefficients (precision model with identity link):*

*Estimate Std. Error z value Pr(>|z|)*

*(phi) 2.547 1.092 2.333 0.0196 \**

# Starting values – reduced model = equal mean for all years

fit.red.p<-glm((Psicat==0)~ 1, family = binomial, data=Aku)

summary(fit.red.p)

*Coefficients:*

*Estimate Std. Error z value Pr(>|z|)*

*(Intercept) -2.197 1.054 -2.085 0.0371 \**

fit.red.mu<-betareg(Psicat ~ 1, data=Aku[Aku$Psicat>0,])

summary(fit.red.mu)

*Coefficients (mean model with logit link):*

*Estimate Std. Error z value Pr(>|z|)*

*(Intercept) -0.7167 0.3851 -1.861 0.0627 .*

*Phi coefficients (precision model with identity link):*

*Estimate Std. Error z value Pr(>|z|)*

*(phi) 2.1268 0.8866 2.399 0.0164 \**

# Obtain maximum likelihood estimates of the coefficients for the

# logistic regression models of the parameters of the zero-

# inflated beta distribution

v.full= c("Y1.p", "Y2.p", "Y1", "Y2", "phi")

x.full<-nlm(PsiCatLik, p=c(-1.386, -20.566, -1.2472, -0.3299,2.547),vars=v.full, data=Aku, full=TRUE, hessian=TRUE)

x.full

*> x.full*

*$minimum*

*[1] -0.1653552*

*$estimate*

*[1] -1.3862944 -20.5660000 -1.2471635 -0.3298929 2.5468909*

*$gradient*

*[1] 5.268836e-07 5.857201e-09 -4.868050e-07 -6.795398e-07 5.296344e-08*

*$hessian*

*[,1] [,2] [,3] [,4] [,5]*

*[1,] 0.800048 0.000000e+00 0.0000000 0.0000000 0.0000000*

*[2,] 0.000000 5.551115e-08 0.0000000 0.0000000 0.0000000*

*[3,] 0.000000 0.000000e+00 3.6111226 0.0000000 0.6704323*

*[4,] 0.000000 0.000000e+00 0.0000000 4.7065777 0.2321562*

*[5,] 0.000000 0.000000e+00 0.6704323 0.2321562 0.9750312*

# Hypothesis test for effect of year

v.red= c("const.p","const","phi")

x.red<-nlm(PsiCatLik, p=c(-2.197, -0.7167, 2.1268),vars=v.red, data=Aku, full=FALSE, hessian=TRUE)

x.red

*$minimum*

*[1] 1.367477*

*$estimate*

*[1] -2.1972256 -0.7167187 2.1268059*

*$gradient*

*[1] 2.859908e-08 -1.532108e-07 1.117215e-06*

*$hessian*

*[,1] [,2] [,3]*

*[1,] 9.000713e-01 2.220446e-08 1.044029e-08*

*[2,] 2.220446e-08 7.608618e+00 1.115423e+00*

*[3,] 1.044029e-08 1.115423e+00 1.435302e+00*

LR.full<- x.full$minimum

LR.red<- x.red$minimum

LRT.stat<- 2\*(LR.red-LR.full)

LRT<-1-pchisq(LR.red-LR.full,1)

cbind(LRT.stat, LRT.pvalue=LRT)

*LRT.stat LRT.pvalue*

*[1,] 3.065665 0.2156878*

# The results of the likelihood ratio test indicate no significant

# effect of year at the alpha = 0.10 level.

# Note that this analysis tests for a simple effect between two years.

# When more years of data are available, the test can examine the cell

# means model for multiple years and also include linear and higher-

# order effects of time.