WMAN 633 Homework 7

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Question 1

Load data and place into an unmarkedFrameOccu object

```
#Set working directory
#setwd(choose.dir())
bobcat <- read.csv("Bobcat.csv") # detection/non-detection data
p_covs <- read.csv("p covariates.csv") #Detection covarites
psi_covs <- read.csv("psi covariates.csv") #Site level covairates

bobcat_mat <- as.matrix(bobcat)

det_covs <- list(
  People = data.frame(p_covs[,c(1:71)]))
head(det_covs$People)
```

```
##   People1 People2 People3 People4 People5 People6 People7 People8 People9
## 1    0.82    0.25    0.15    0.09    0.07    0.28    1.39    1.14    0.13
## 2    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
## 3    0.74    0.12    0.18    0.59    0.53    0.41    1.03    0.53    0.15
## 4    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
## 5    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
## 6    0.37    0.24    0.06    0.14    0.10    0.22    0.53    0.32    0.06
##   People10 People11 People12 People13 People14 People15 People16 People17
## 1     0.43     0.44     0.63     0.26     1.15     0.43     0.00     0.00
## 2     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
## 3     0.32     0.34     0.19     0.20     0.96       NA       NA       NA
## 4     0.00     0.00     0.00     0.00     0.01     0.01     0.00     0.00
## 5     0.00     0.00     0.00     0.00     0.02     0.00     0.00     0.00
## 6     0.02     0.01     0.06     0.09     0.37     0.55     0.05     0.04
##   People18 People19 People20 People21 People22 People23 People24 People25
## 1     0.00     0.00     0.00      0.0     0.91       NA       NA       NA
## 2     0.00     0.00     0.00       NA       NA       NA       NA       NA
## 3       NA       NA       NA       NA       NA       NA       NA       NA
## 4     0.00       NA       NA       NA       NA       NA       NA       NA
## 5     0.00     0.00     0.00      0.0       NA       NA       NA       NA
## 6     0.06     0.19     0.19      0.2       NA       NA       NA       NA
##   People26 People27 People28 People29 People30 People31 People32 People33
## 1       NA       NA       NA       NA       NA       NA       NA       NA
## 2       NA       NA       NA       NA       NA       NA       NA       NA
## 3       NA       NA       NA       NA       NA       NA       NA       NA
## 4       NA       NA       NA       NA       NA       NA       NA       NA
## 5       NA       NA       NA       NA       NA       NA       NA       NA
```

```
## 6       NA       NA       NA       NA       NA       NA       NA       NA
##   People34 People35 People36 People37 People38 People39 People40 People41
## 1       NA       NA       NA       NA       NA       NA       NA       NA
## 2       NA       NA       NA       NA       NA       NA       NA       NA
## 3       NA       NA       NA       NA       NA       NA       NA       NA
## 4       NA       NA       NA       NA       NA       NA       NA       NA
## 5       NA       NA       NA       NA       NA       NA       NA       NA
## 6       NA       NA       NA       NA       NA       NA       NA       NA
##   People42 People43 People44 People45 People46 People47 People48 People49
## 1       NA       NA       NA       NA       NA       NA       NA       NA
## 2       NA       NA       NA       NA       NA       NA       NA       NA
## 3       NA       NA       NA       NA       NA       NA       NA       NA
## 4       NA       NA       NA       NA       NA       NA       NA       NA
## 5       NA       NA       NA       NA       NA       NA       NA       NA
## 6       NA       NA       NA       NA       NA       NA       NA       NA
##   People50 People51 People52 People53 People54 People55 People56 People57
## 1       NA       NA       NA       NA       NA       NA       NA       NA
## 2       NA       NA       NA       NA       NA       NA       NA       NA
## 3       NA       NA       NA       NA       NA       NA       NA       NA
## 4       NA       NA       NA       NA       NA       NA       NA       NA
## 5       NA       NA       NA       NA       NA       NA       NA       NA
## 6       NA       NA       NA       NA       NA       NA       NA       NA
##   People58 People59 People60 People61 People62 People63 People64 People65
## 1       NA       NA       NA       NA       NA       NA       NA       NA
## 2       NA       NA       NA       NA       NA       NA       NA       NA
## 3       NA       NA       NA       NA       NA       NA       NA       NA
## 4       NA       NA       NA       NA       NA       NA       NA       NA
## 5       NA       NA       NA       NA       NA       NA       NA       NA
## 6       NA       NA       NA       NA       NA       NA       NA       NA
##   People66 People67 People68 People69 People70 People71
## 1       NA       NA       NA       NA       NA       NA
## 2       NA       NA       NA       NA       NA       NA
## 3       NA       NA       NA       NA       NA       NA
## 4       NA       NA       NA       NA       NA       NA
## 5       NA       NA       NA       NA       NA       NA
## 6       NA       NA       NA       NA       NA       NA
```

```
library(unmarked)
```

```
## Warning: package 'unmarked' was built under R version 4.0.4
```

```
## Loading required package: lattice
```

```
occu_data <- unmarkedFrameOccu(y = bobcat_mat, siteCovs = psi_covs, obsCovs = det_covs)
head(occu_data)
```

```
## Data frame representation of unmarkedFrame object.
##    y.1 y.2 y.3 y.4 y.5 y.6 y.7 y.8 y.9 y.10 y.11 y.12 y.13 y.14 y.15 y.16 y.17
## 1    0   0   0   0   0   0   0   0   0    0    0    0    0    0    0    0    0
## 2    0   0   0   0   0   0   0   0   0    0    0    0    0    0    0    0    0
## 3    0   0   0   0   0   0   0   0   0    0    0    0    0    0   NA   NA   NA
## 4    0   0   0   0   0   0   0   0   0    0    0    0    0    0    0    0    0
```

```
## 5    0   0   0   0   0   0   0   0   0    0    0    0    0    0    0    0    0
## 6    0   0   0   0   0   0   0   0   0    0    0    0    0    0    0    0    0
## 7    0   0   0   0   0   0   0   0   0    0    0    0    0    0    0    0    0
## 8    0   0   0   0   0   0   0   0   0    0    0    0    0    0    0    0    0
## 9    0   0   0   0   0   0   0   0   0    0    0    0    0    0    0    0    0
## 10   0   0   0   0   0   0   0   0   0    0    0    0    0    0    0    0    0
##    y.18 y.19 y.20 y.21 y.22 y.23 y.24 y.25 y.26 y.27 y.28 y.29 y.30 y.31 y.32
## 1     0    0    0    0    0   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 2     0    0    0   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 3    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 4     0   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 5     0    0    0    0   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 6     0    0    0    0   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 7     0    0    0    0   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 8     0    0    0    0   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 9     0    0    0    0    0    0    0    0    0    0    0    0    0    0   NA
## 10    0    0    0    0    0    0    0    0    0    0    0    0    0    0   NA
##    y.33 y.34 y.35 y.36 y.37 y.38 y.39 y.40 y.41 y.42 y.43 y.44 y.45 y.46 y.47
## 1    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 2    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 3    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 4    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 5    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 6    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 7    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 8    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 9    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 10   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
##    y.48 y.49 y.50 y.51 y.52 y.53 y.54 y.55 y.56 y.57 y.58 y.59 y.60 y.61 y.62
## 1    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 2    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 3    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 4    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 5    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 6    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 7    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 8    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 9    NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## 10   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
##    y.63 y.64 y.65 y.66 y.67 y.68 y.69 y.70 y.71 Dist_5km People.1 People.2
## 1    NA   NA   NA   NA   NA   NA   NA   NA   NA     0.04     0.82     0.25
## 2    NA   NA   NA   NA   NA   NA   NA   NA   NA     0.04     0.00     0.00
## 3    NA   NA   NA   NA   NA   NA   NA   NA   NA     0.03     0.74     0.12
## 4    NA   NA   NA   NA   NA   NA   NA   NA   NA     0.03     0.00     0.00
## 5    NA   NA   NA   NA   NA   NA   NA   NA   NA     0.03     0.00     0.00
## 6    NA   NA   NA   NA   NA   NA   NA   NA   NA     0.03     0.37     0.24
## 7    NA   NA   NA   NA   NA   NA   NA   NA   NA     0.03     0.00     0.00
## 8    NA   NA   NA   NA   NA   NA   NA   NA   NA     0.03     0.00     0.00
## 9    NA   NA   NA   NA   NA   NA   NA   NA   NA     0.03     0.24     0.14
## 10   NA   NA   NA   NA   NA   NA   NA   NA   NA     0.03     0.00     0.00
##    People.3 People.4 People.5 People.6 People.7 People.8 People.9 People.10
## 1      0.15     0.09     0.07     0.28     1.39     1.14     0.13      0.43
## 2      0.00     0.00     0.00     0.00     0.00     0.00     0.00      0.00
## 3      0.18     0.59     0.53     0.41     1.03     0.53     0.15      0.32
```

```
## 4      0.00     0.00     0.00     0.00     0.00     0.00     0.00      0.00
## 5      0.00     0.00     0.00     0.00     0.00     0.00     0.00      0.00
## 6      0.06     0.14     0.10     0.22     0.53     0.32     0.06      0.02
## 7      0.00     0.00     0.00     0.00     0.00     0.00     0.00      0.00
## 8      0.00     0.00     0.00     0.00     0.00     0.00     0.00      0.00
## 9      0.07     0.05     0.10     0.12     0.30     0.27     0.27      0.06
## 10     0.00     0.00     0.00     0.00     0.00     0.00     0.00      0.00
##    People.11 People.12 People.13 People.14 People.15 People.16 People.17
## 1       0.44      0.63      0.26      1.15      0.43      0.00      0.00
## 2       0.00      0.00      0.00      0.00      0.00      0.00      0.00
## 3       0.34      0.19      0.20      0.96        NA        NA        NA
## 4       0.00      0.00      0.00      0.01      0.01      0.00      0.00
## 5       0.00      0.00      0.00      0.02      0.00      0.00      0.00
## 6       0.01      0.06      0.09      0.37      0.55      0.05      0.04
## 7       0.00      0.00      0.00      0.00      0.00      0.00      0.00
## 8       0.00      0.00      0.00      0.00      0.00      0.00      0.00
## 9       0.08      0.15      0.04      0.18      0.46      0.09      0.04
## 10      0.00      0.00      0.00      0.00      0.00      0.00      0.00
##    People.18 People.19 People.20 People.21 People.22 People.23 People.24
## 1       0.00      0.00      0.00      0.00      0.91        NA        NA
## 2       0.00      0.00      0.00        NA        NA        NA        NA
## 3         NA        NA        NA        NA        NA        NA        NA
## 4       0.00        NA        NA        NA        NA        NA        NA
## 5       0.00      0.00      0.00      0.00        NA        NA        NA
## 6       0.06      0.19      0.19      0.20        NA        NA        NA
## 7       0.00      0.03      0.00      0.00        NA        NA        NA
## 8       0.00      0.00      0.00      0.00        NA        NA        NA
## 9       0.09      0.03      0.03      0.04      0.03      0.18       0.2
## 10      0.00      0.00      0.00      0.00      0.00      0.00       0.0
##    People.25 People.26 People.27 People.28 People.29 People.30 People.31
## 1         NA        NA        NA        NA        NA        NA        NA
## 2         NA        NA        NA        NA        NA        NA        NA
## 3         NA        NA        NA        NA        NA        NA        NA
## 4         NA        NA        NA        NA        NA        NA        NA
## 5         NA        NA        NA        NA        NA        NA        NA
## 6         NA        NA        NA        NA        NA        NA        NA
## 7         NA        NA        NA        NA        NA        NA        NA
## 8         NA        NA        NA        NA        NA        NA        NA
## 9       0.14      0.11      0.06      0.18      0.38      0.21      0.09
## 10      0.00      0.00      0.00      0.00      0.00      0.00      0.00
##    People.32 People.33 People.34 People.35 People.36 People.37 People.38
## 1         NA        NA        NA        NA        NA        NA        NA
## 2         NA        NA        NA        NA        NA        NA        NA
## 3         NA        NA        NA        NA        NA        NA        NA
## 4         NA        NA        NA        NA        NA        NA        NA
## 5         NA        NA        NA        NA        NA        NA        NA
## 6         NA        NA        NA        NA        NA        NA        NA
## 7         NA        NA        NA        NA        NA        NA        NA
## 8         NA        NA        NA        NA        NA        NA        NA
## 9         NA        NA        NA        NA        NA        NA        NA
## 10        NA        NA        NA        NA        NA        NA        NA
##    People.39 People.40 People.41 People.42 People.43 People.44 People.45
## 1         NA        NA        NA        NA        NA        NA        NA
## 2         NA        NA        NA        NA        NA        NA        NA
```

```
## 3         NA        NA        NA        NA        NA        NA        NA
## 4         NA        NA        NA        NA        NA        NA        NA
## 5         NA        NA        NA        NA        NA        NA        NA
## 6         NA        NA        NA        NA        NA        NA        NA
## 7         NA        NA        NA        NA        NA        NA        NA
## 8         NA        NA        NA        NA        NA        NA        NA
## 9         NA        NA        NA        NA        NA        NA        NA
## 10        NA        NA        NA        NA        NA        NA        NA
##    People.46 People.47 People.48 People.49 People.50 People.51 People.52
## 1         NA        NA        NA        NA        NA        NA        NA
## 2         NA        NA        NA        NA        NA        NA        NA
## 3         NA        NA        NA        NA        NA        NA        NA
## 4         NA        NA        NA        NA        NA        NA        NA
## 5         NA        NA        NA        NA        NA        NA        NA
## 6         NA        NA        NA        NA        NA        NA        NA
## 7         NA        NA        NA        NA        NA        NA        NA
## 8         NA        NA        NA        NA        NA        NA        NA
## 9         NA        NA        NA        NA        NA        NA        NA
## 10        NA        NA        NA        NA        NA        NA        NA
##    People.53 People.54 People.55 People.56 People.57 People.58 People.59
## 1         NA        NA        NA        NA        NA        NA        NA
## 2         NA        NA        NA        NA        NA        NA        NA
## 3         NA        NA        NA        NA        NA        NA        NA
## 4         NA        NA        NA        NA        NA        NA        NA
## 5         NA        NA        NA        NA        NA        NA        NA
## 6         NA        NA        NA        NA        NA        NA        NA
## 7         NA        NA        NA        NA        NA        NA        NA
## 8         NA        NA        NA        NA        NA        NA        NA
## 9         NA        NA        NA        NA        NA        NA        NA
## 10        NA        NA        NA        NA        NA        NA        NA
##    People.60 People.61 People.62 People.63 People.64 People.65 People.66
## 1         NA        NA        NA        NA        NA        NA        NA
## 2         NA        NA        NA        NA        NA        NA        NA
## 3         NA        NA        NA        NA        NA        NA        NA
## 4         NA        NA        NA        NA        NA        NA        NA
## 5         NA        NA        NA        NA        NA        NA        NA
## 6         NA        NA        NA        NA        NA        NA        NA
## 7         NA        NA        NA        NA        NA        NA        NA
## 8         NA        NA        NA        NA        NA        NA        NA
## 9         NA        NA        NA        NA        NA        NA        NA
## 10        NA        NA        NA        NA        NA        NA        NA
##    People.67 People.68 People.69 People.70 People.71
## 1         NA        NA        NA        NA        NA
## 2         NA        NA        NA        NA        NA
## 3         NA        NA        NA        NA        NA
## 4         NA        NA        NA        NA        NA
## 5         NA        NA        NA        NA        NA
## 6         NA        NA        NA        NA        NA
## 7         NA        NA        NA        NA        NA
## 8         NA        NA        NA        NA        NA
## 9         NA        NA        NA        NA        NA
## 10        NA        NA        NA        NA        NA
```

Question 2

Fit the following candidate set of models:

Detection model	Occupancy model
intercept-only	intercept-only
people	intercept-only
intercept-only	disturbance
people	disturbance

```
fit1 <- occu(~ 1 ~ 1, data = occu_data)
fit2 <- occu(~ People ~ 1, data = occu_data)
fit3 <- occu(~ 1 ~ Dist_5km, data = occu_data)
fit4 <- occu(~ People ~ Dist_5km, data = occu_data)
summary(fit1)
```

```
##
## Call:
## occu(formula = ~1 ~ 1, data = occu_data)
##
## Occupancy (logit-scale):
##  Estimate     SE   z P(>|z|)
##     -1.32 0.0879 -15 7.6e-51
##
## Detection (logit-scale):
##  Estimate     SE     z P(>|z|)
##     -3.02 0.0734 -41.1       0
##
## AIC: 4490.771
## Number of sites: 1951
## optim convergence code: 0
## optim iterations: 29
## Bootstrap iterations: 0
```

```
summary(fit2)
```

```
##
## Call:
## occu(formula = ~People ~ 1, data = occu_data)
##
## Occupancy (logit-scale):
##  Estimate     SE   z  P(>|z|)
##     -1.32 0.0879 -15 9.21e-51
##
## Detection (logit-scale):
##             Estimate     SE       z P(>|z|)
## (Intercept)  -3.0141 0.0743 -40.550   0.000
## People       -0.0765 0.3759  -0.203   0.839
##
## AIC: 4492.729
## Number of sites: 1951
```

```
## optim convergence code: 0
## optim iterations: 35
## Bootstrap iterations: 0
```

```
summary(fit3)
```

```
##
## Call:
## occu(formula = ~1 ~ Dist_5km, data = occu_data)
##
## Occupancy (logit-scale):
##             Estimate    SE      z  P(>|z|)
## (Intercept)    -1.05 0.101 -10.40 2.42e-25
## Dist_5km      -23.65 4.773  -4.96 7.23e-07
##
## Detection (logit-scale):
##  Estimate     SE     z P(>|z|)
##     -3.02 0.0732 -41.2       0
##
## AIC: 4461.006
## Number of sites: 1951
## optim convergence code: 0
## optim iterations: 52
## Bootstrap iterations: 0
```

```
summary(fit4)
```

```
##
## Call:
## occu(formula = ~People ~ Dist_5km, data = occu_data)
##
## Occupancy (logit-scale):
##             Estimate    SE      z  P(>|z|)
## (Intercept)    -1.05 0.101 -10.39 2.63e-25
## Dist_5km      -23.64 4.773  -4.95 7.28e-07
##
## Detection (logit-scale):
##             Estimate     SE       z P(>|z|)
## (Intercept)  -3.0133 0.0741 -40.646   0.000
## People       -0.0609 0.3779  -0.161   0.872
##
## AIC: 4462.98
## Number of sites: 1951
## optim convergence code: 0
## optim iterations: 39
## Bootstrap iterations: 0
```

Question 3

Perform model selection with AIC. What is your top model? How do you know? Is there model selection uncertainty?

```
library(AICcmodavg)
```

```
## Warning: package 'AICcmodavg' was built under R version 4.0.5
```

```
occu_cand.set <- list(
  F1 = fit1, F2 = fit2, F3 = fit3, F4 = fit4)

occu_mods <- aictab(cand.set = occu_cand.set, second.ord = F)
occu_mods
```

```
##
## Model selection based on AIC:
##
##    K     AIC Delta_AIC AICWt Cum.Wt       LL
## F3 3 4461.01      0.00  0.73   0.73 -2227.50
## F4 4 4462.98      1.97  0.27   1.00 -2227.49
## F1 2 4490.77     29.77  0.00   1.00 -2243.39
## F2 3 4492.73     31.72  0.00   1.00 -2243.36
```

My top model is model 3, fit3, which uses the intercept-only for the detection model and the disturbance within 5km for the abundance model. I know this is my top model because the ΔAIC for Model 1 and Model 2 is greater than 2. There is some uncertainty between model 3 and model because the ΔAIC between Model 3 and Model 4 is less than 2.

Question 4

Average both the effect of people on detection, and disturbance on occupancy, over all models. Report model-averaged slope coefficients and 95% confidence intervals.

```
#People's effect on detection across all models
people_avg <- modavgShrink(cand.set = occu_cand.set, parm = 'People', second.ord = F, parm.type = 'dete

People_slopecoef <- people_avg$Mod.avg.beta
People_slopecoef
```

```
## [1] -0.01653469
```

```
people_95 <- cbind(people_avg$Lower.CL,people_avg$Upper.CL)
people_95
```

```
##            [,1]      [,2]
## [1,] -0.4061781 0.3731087
```

```
#Effect of disturbance on occupancy across all models
dist_avg <- modavgShrink(cand.set = occu_cand.set, parm = 'Dist_5km', second.ord = F, parm.type = 'psi')

Dist_5km_slopecoef <-  dist_avg$Mod.avg.beta
Dist_5km_slopecoef
```

```
## [1] -23.65047
```

```r
dist_95 <- cbind(dist_avg$Lower.CL, dist_avg$Upper.CL)
dist_95
```

```
##         [,1]      [,2]
## [1,] -33.006 -14.29494
```

Question 5

Obtain and plot model-averaged predictions of occupancy probability and detection probability. Average over all models, and make predictions over the observed range of each variable.

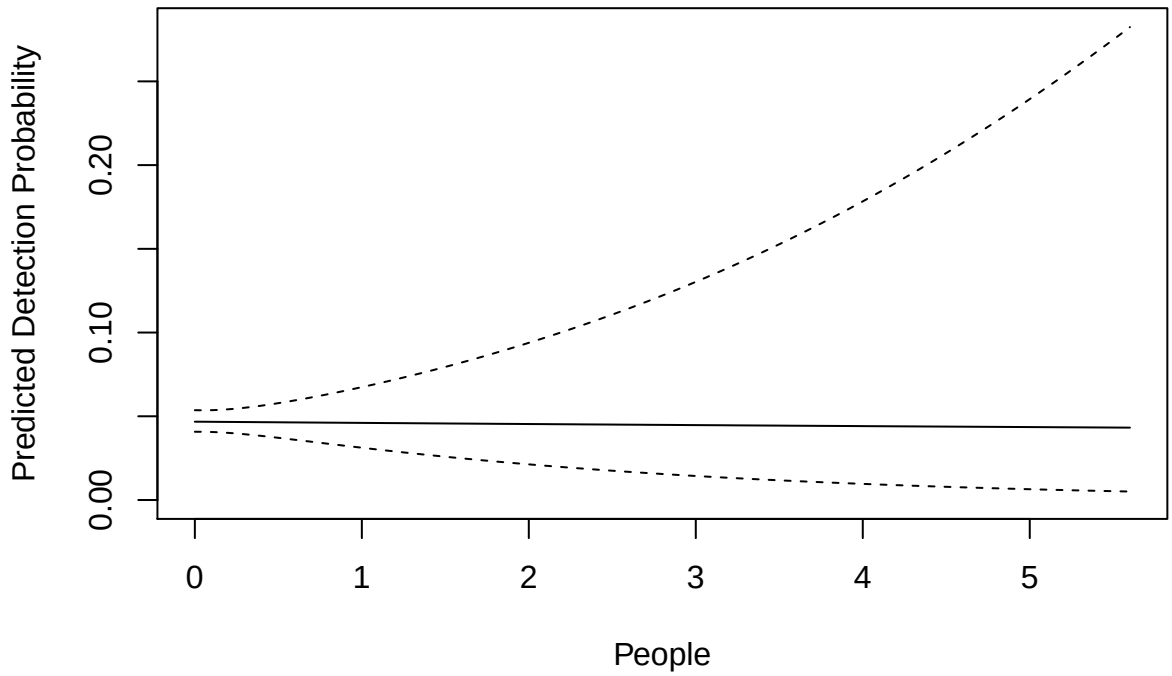
```r
#Detection predictions
p_covs[is.na(p_covs)] = 0 #Necessary because you can't generate new data with NAs
new_p <- data.frame(
  People = seq(min(p_covs[1:71]), to = max(p_covs[1:71]), length.out = 100))

avg_prd_det <- modavgPred(cand.set = occu_cand.set, newdata = new_p, second.ord = F, parm.type = 'detec
avg_prd_det
```

```
##
## Model-averaged predictions on the response scale
## based on entire model set and 95% confidence interval:
##
##     mod.avg.pred uncond.se lower.CL upper.CL
## 1          0.047     0.003    0.041    0.054
## 2          0.047     0.003    0.041    0.054
## 3          0.047     0.003    0.041    0.054
## 4          0.047     0.003    0.040    0.054
## 5          0.047     0.004    0.040    0.054
## 6          0.047     0.004    0.039    0.055
## 7          0.047     0.004    0.039    0.056
## 8          0.046     0.005    0.038    0.056
## 9          0.046     0.005    0.038    0.057
## 10         0.046     0.005    0.037    0.058
## 11         0.046     0.006    0.036    0.059
## 12         0.046     0.006    0.036    0.060
## 13         0.046     0.006    0.035    0.061
## 14         0.046     0.007    0.034    0.062
## 15         0.046     0.007    0.034    0.063
## 16         0.046     0.008    0.033    0.064
## 17         0.046     0.008    0.032    0.065
## 18         0.046     0.008    0.032    0.067
## 19         0.046     0.009    0.031    0.068
## 20         0.046     0.009    0.030    0.069
## 21         0.046     0.010    0.030    0.070
## 22         0.046     0.010    0.029    0.072
## 23         0.046     0.011    0.028    0.073
## 24         0.046     0.011    0.028    0.074
## 25         0.046     0.011    0.027    0.076
## 26         0.046     0.012    0.027    0.077
## 27         0.046     0.012    0.026    0.079
## 28         0.046     0.013    0.026    0.080
```

```
## 29        0.046     0.013    0.025    0.082
## 30        0.046     0.013    0.024    0.083
## 31        0.046     0.014    0.024    0.085
## 32        0.046     0.014    0.023    0.086
## 33        0.046     0.015    0.023    0.088
## 34        0.045     0.015    0.022    0.090
## 35        0.045     0.015    0.022    0.092
## 36        0.045     0.016    0.021    0.093
## 37        0.045     0.016    0.021    0.095
## 38        0.045     0.017    0.021    0.097
## 39        0.045     0.017    0.020    0.099
## 40        0.045     0.017    0.020    0.101
## 41        0.045     0.018    0.019    0.102
## 42        0.045     0.018    0.019    0.104
## 43        0.045     0.019    0.018    0.106
## 44        0.045     0.019    0.018    0.108
## 45        0.045     0.019    0.018    0.110
## 46        0.045     0.020    0.017    0.112
## 47        0.045     0.020    0.017    0.114
## 48        0.045     0.020    0.016    0.117
## 49        0.045     0.021    0.016    0.119
## 50        0.045     0.021    0.016    0.121
## 51        0.045     0.021    0.015    0.123
## 52        0.045     0.022    0.015    0.126
## 53        0.045     0.022    0.015    0.128
## 54        0.045     0.023    0.014    0.130
## 55        0.045     0.023    0.014    0.133
## 56        0.045     0.023    0.014    0.135
## 57        0.045     0.024    0.013    0.137
## 58        0.045     0.024    0.013    0.140
## 59        0.045     0.024    0.013    0.143
## 60        0.045     0.025    0.013    0.145
## 61        0.044     0.025    0.012    0.148
## 62        0.044     0.025    0.012    0.150
## 63        0.044     0.026    0.012    0.153
## 64        0.044     0.026    0.011    0.156
## 65        0.044     0.026    0.011    0.159
## 66        0.044     0.027    0.011    0.161
## 67        0.044     0.027    0.011    0.164
## 68        0.044     0.027    0.010    0.167
## 69        0.044     0.028    0.010    0.170
## 70        0.044     0.028    0.010    0.173
## 71        0.044     0.028    0.010    0.176
## 72        0.044     0.028    0.010    0.179
## 73        0.044     0.029    0.009    0.182
## 74        0.044     0.029    0.009    0.185
## 75        0.044     0.029    0.009    0.189
## 76        0.044     0.030    0.009    0.192
## 77        0.044     0.030    0.009    0.195
## 78        0.044     0.030    0.008    0.199
## 79        0.044     0.031    0.008    0.202
## 80        0.044     0.031    0.008    0.205
## 81        0.044     0.031    0.008    0.209
## 82        0.044     0.031    0.008    0.212
```

```
## 83         0.044     0.032    0.007    0.216
## 84         0.044     0.032    0.007    0.219
## 85         0.044     0.032    0.007    0.223
## 86         0.044     0.033    0.007    0.227
## 87         0.044     0.033    0.007    0.230
## 88         0.044     0.033    0.007    0.234
## 89         0.044     0.033    0.006    0.238
## 90         0.044     0.034    0.006    0.242
## 91         0.043     0.034    0.006    0.246
## 92         0.043     0.034    0.006    0.250
## 93         0.043     0.035    0.006    0.254
## 94         0.043     0.035    0.006    0.258
## 95         0.043     0.035    0.006    0.262
## 96         0.043     0.035    0.006    0.266
## 97         0.043     0.036    0.005    0.270
## 98         0.043     0.036    0.005    0.274
## 99         0.043     0.036    0.005    0.278
## 100        0.043     0.036    0.005    0.282
```

```r
plot(x = new_p$People, y = avg_prd_det$mod.avg.pred, type = 'l', ylab = 'Predicted Detection Probability
lines(x = new_p$People, y = avg_prd_det$upper.CL, lwd = 1, lty = 2)
lines(x = new_p$People, y = avg_prd_det$lower.CL , lty = 2)
```




```r
#Occupancy predictions
new_psi <- data.frame(Dist_5km = seq(from = min(psi_covs), to = max(psi_covs), length.out = 100))
new_psi
```

```
##        Dist_5km
## 1   0.000000000
## 2   0.001313131
## 3   0.002626263
## 4   0.003939394
## 5   0.005252525
## 6   0.006565657
## 7   0.007878788
## 8   0.009191919
## 9   0.010505051
## 10  0.011818182
## 11  0.013131313
## 12  0.014444444
## 13  0.015757576
## 14  0.017070707
## 15  0.018383838
## 16  0.019696970
## 17  0.021010101
## 18  0.022323232
## 19  0.023636364
## 20  0.024949495
## 21  0.026262626
## 22  0.027575758
## 23  0.028888889
## 24  0.030202020
## 25  0.031515152
## 26  0.032828283
## 27  0.034141414
## 28  0.035454545
## 29  0.036767677
## 30  0.038080808
## 31  0.039393939
## 32  0.040707071
## 33  0.042020202
## 34  0.043333333
## 35  0.044646465
## 36  0.045959596
## 37  0.047272727
## 38  0.048585859
## 39  0.049898990
## 40  0.051212121
## 41  0.052525253
## 42  0.053838384
## 43  0.055151515
## 44  0.056464646
## 45  0.057777778
## 46  0.059090909
## 47  0.060404040
## 48  0.061717172
## 49  0.063030303
## 50  0.064343434
## 51  0.065656566
## 52  0.066969697
## 53  0.068282828
```

```
## 54  0.069595960
## 55  0.070909091
## 56  0.072222222
## 57  0.073535354
## 58  0.074848485
## 59  0.076161616
## 60  0.077474747
## 61  0.078787879
## 62  0.080101010
## 63  0.081414141
## 64  0.082727273
## 65  0.084040404
## 66  0.085353535
## 67  0.086666667
## 68  0.087979798
## 69  0.089292929
## 70  0.090606061
## 71  0.091919192
## 72  0.093232323
## 73  0.094545455
## 74  0.095858586
## 75  0.097171717
## 76  0.098484848
## 77  0.099797980
## 78  0.101111111
## 79  0.102424242
## 80  0.103737374
## 81  0.105050505
## 82  0.106363636
## 83  0.107676768
## 84  0.108989899
## 85  0.110303030
## 86  0.111616162
## 87  0.112929293
## 88  0.114242424
## 89  0.115555556
## 90  0.116868687
## 91  0.118181818
## 92  0.119494949
## 93  0.120808081
## 94  0.122121212
## 95  0.123434343
## 96  0.124747475
## 97  0.126060606
## 98  0.127373737
## 99  0.128686869
## 100 0.130000000
```

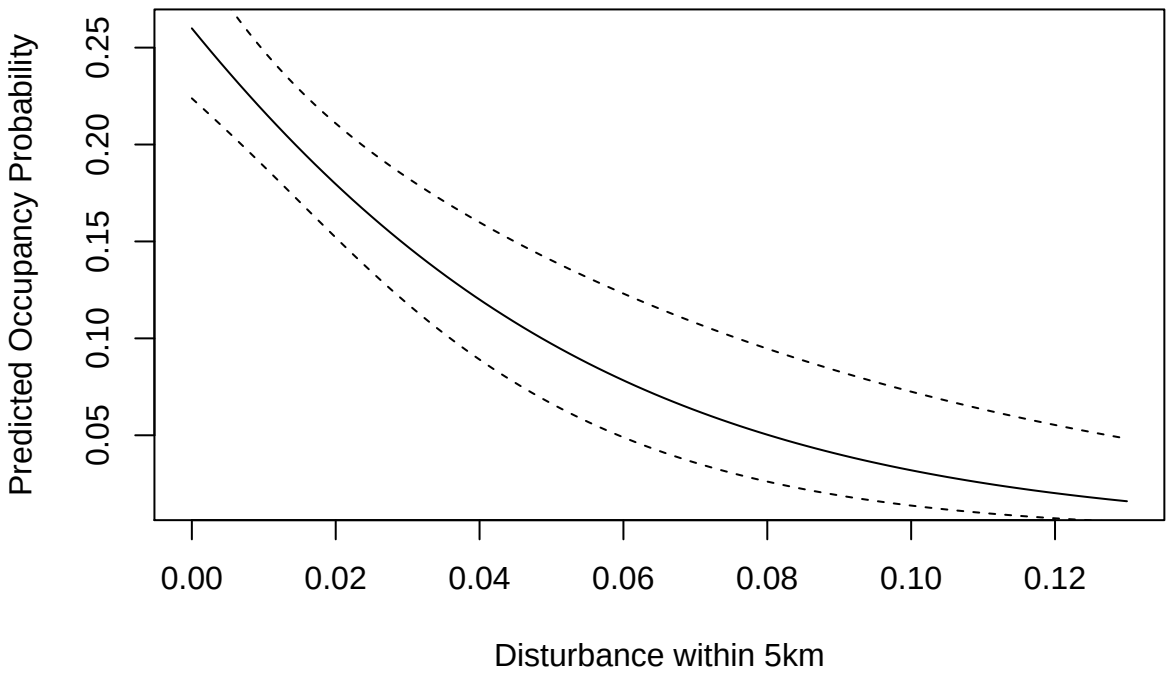
```
avg_prd_occupancy <- modavgPred(cand.set = occu_cand.set, newdata = new_psi, second.ord = F, parm.type =
avg_prd_occupancy
```

```
##
## Model-averaged predictions on the response scale
## based on entire model set and 95% confidence interval:
```

```
##
##     mod.avg.pred uncond.se lower.CL upper.CL
## 1          0.260     0.019    0.224    0.300
## 2          0.254     0.019    0.219    0.292
## 3          0.248     0.018    0.215    0.285
## 4          0.242     0.017    0.210    0.278
## 5          0.237     0.017    0.206    0.271
## 6          0.231     0.016    0.201    0.264
## 7          0.226     0.016    0.196    0.258
## 8          0.220     0.015    0.192    0.252
## 9          0.215     0.015    0.187    0.246
## 10         0.210     0.015    0.182    0.241
## 11         0.205     0.015    0.177    0.235
## 12         0.200     0.015    0.172    0.230
## 13         0.195     0.015    0.168    0.225
## 14         0.190     0.015    0.163    0.221
## 15         0.185     0.015    0.158    0.216
## 16         0.181     0.015    0.153    0.212
## 17         0.176     0.015    0.148    0.208
## 18         0.172     0.015    0.144    0.204
## 19         0.167     0.016    0.139    0.200
## 20         0.163     0.016    0.134    0.196
## 21         0.159     0.016    0.130    0.193
## 22         0.155     0.016    0.126    0.189
## 23         0.151     0.016    0.121    0.186
## 24         0.147     0.017    0.117    0.182
## 25         0.143     0.017    0.113    0.179
## 26         0.139     0.017    0.109    0.176
## 27         0.135     0.017    0.105    0.173
## 28         0.132     0.017    0.101    0.170
## 29         0.128     0.018    0.098    0.167
## 30         0.125     0.018    0.094    0.164
## 31         0.122     0.018    0.091    0.161
## 32         0.118     0.018    0.087    0.158
## 33         0.115     0.018    0.084    0.156
## 34         0.112     0.018    0.081    0.153
## 35         0.109     0.018    0.078    0.150
## 36         0.106     0.018    0.075    0.148
## 37         0.103     0.019    0.072    0.145
## 38         0.100     0.019    0.069    0.143
## 39         0.097     0.019    0.067    0.140
## 40         0.095     0.019    0.064    0.138
## 41         0.092     0.019    0.061    0.136
## 42         0.090     0.019    0.059    0.133
## 43         0.087     0.019    0.057    0.131
## 44         0.085     0.019    0.055    0.129
## 45         0.082     0.019    0.052    0.127
## 46         0.080     0.019    0.050    0.125
## 47         0.078     0.018    0.048    0.122
## 48         0.075     0.018    0.046    0.120
## 49         0.073     0.018    0.045    0.118
## 50         0.071     0.018    0.043    0.116
## 51         0.069     0.018    0.041    0.114
## 52         0.067     0.018    0.039    0.112
```

```
## 53         0.065     0.018    0.038    0.110
## 54         0.063     0.018    0.036    0.109
## 55         0.062     0.018    0.035    0.107
## 56         0.060     0.018    0.033    0.105
## 57         0.058     0.017    0.032    0.103
## 58         0.056     0.017    0.031    0.101
## 59         0.055     0.017    0.030    0.100
## 60         0.053     0.017    0.028    0.098
## 61         0.052     0.017    0.027    0.096
## 62         0.050     0.017    0.026    0.095
## 63         0.049     0.016    0.025    0.093
## 64         0.047     0.016    0.024    0.091
## 65         0.046     0.016    0.023    0.090
## 66         0.045     0.016    0.022    0.088
## 67         0.043     0.016    0.021    0.087
## 68         0.042     0.015    0.020    0.085
## 69         0.041     0.015    0.019    0.084
## 70         0.040     0.015    0.019    0.082
## 71         0.038     0.015    0.018    0.081
## 72         0.037     0.015    0.017    0.079
## 73         0.036     0.014    0.016    0.078
## 74         0.035     0.014    0.016    0.077
## 75         0.034     0.014    0.015    0.075
## 76         0.033     0.014    0.014    0.074
## 77         0.032     0.014    0.014    0.073
## 78         0.031     0.013    0.013    0.071
## 79         0.030     0.013    0.013    0.070
## 80         0.029     0.013    0.012    0.069
## 81         0.028     0.013    0.012    0.068
## 82         0.028     0.013    0.011    0.067
## 83         0.027     0.012    0.011    0.065
## 84         0.026     0.012    0.010    0.064
## 85         0.025     0.012    0.010    0.063
## 86         0.024     0.012    0.009    0.062
## 87         0.024     0.012    0.009    0.061
## 88         0.023     0.011    0.009    0.060
## 89         0.022     0.011    0.008    0.059
## 90         0.022     0.011    0.008    0.058
## 91         0.021     0.011    0.008    0.057
## 92         0.020     0.011    0.007    0.056
## 93         0.020     0.010    0.007    0.055
## 94         0.019     0.010    0.007    0.054
## 95         0.019     0.010    0.006    0.053
## 96         0.018     0.010    0.006    0.052
## 97         0.018     0.010    0.006    0.051
## 98         0.017     0.009    0.006    0.050
## 99         0.016     0.009    0.005    0.049
## 100        0.016     0.009    0.005    0.048
```

```
plot(x = new_psi$Dist_5km, y = avg_prd_occupancy$mod.avg.pred, type = 'l', ylab = 'Predicted Occupancy
lines(x = new_psi$Dist_5km, y = avg_prd_occupancy$upper.CL, lwd = 1, lty = 2)
lines(x = new_psi$Dist_5km, y = avg_prd_occupancy$lower.CL , lty = 2)
```


Predicted Occupancy Probability
0.05
0.10
0.15
0.20
0.25
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Disturbance within 5km