Family size models

Contents

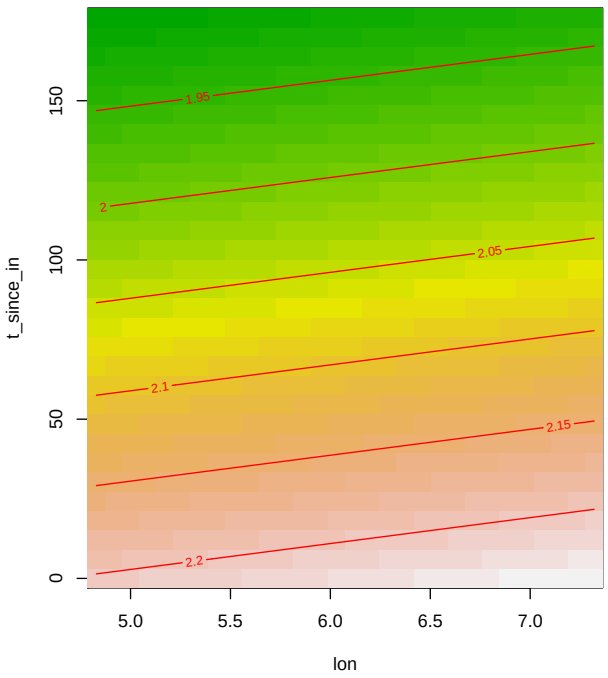
Hypotheses

1. Families with more juveniles are found in the west, and,
2. Families with more juveniles are found in smaller flocks, and,
3. Family size decreases over the winter.
4. Flock sizes are lower in the west.
5. Larger flocks have more families.

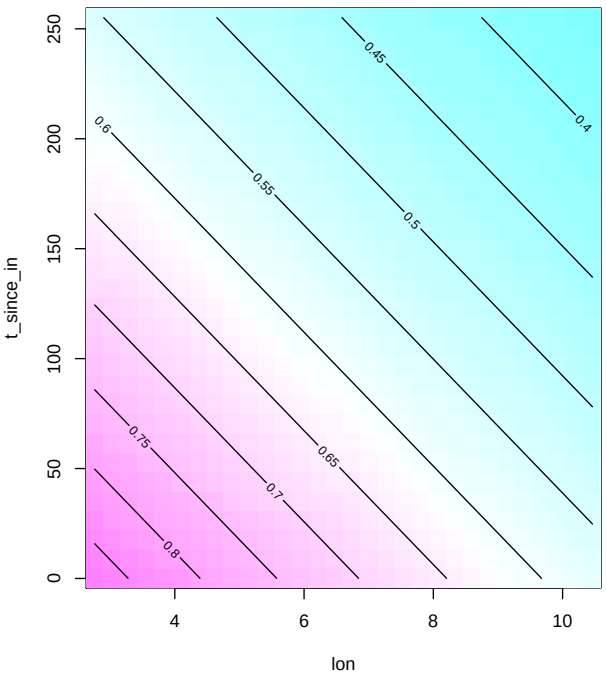
Hpotheses 1 - 3

Family size plots

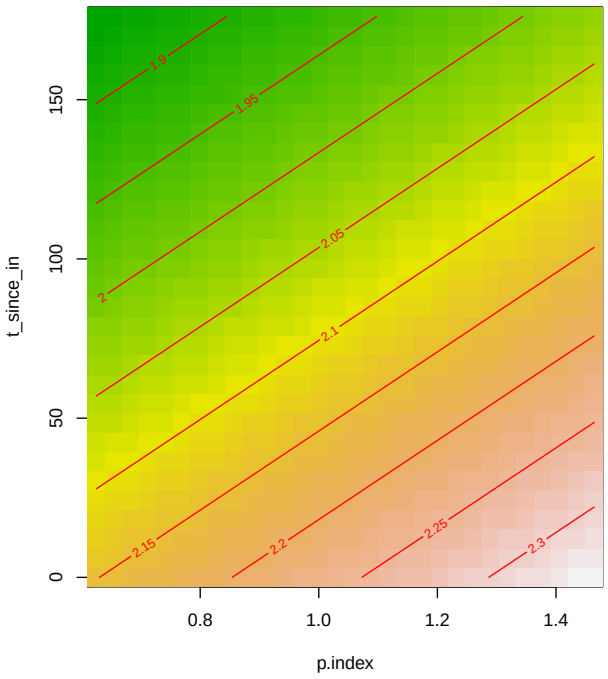
famsize: SOVON: days ~ lon



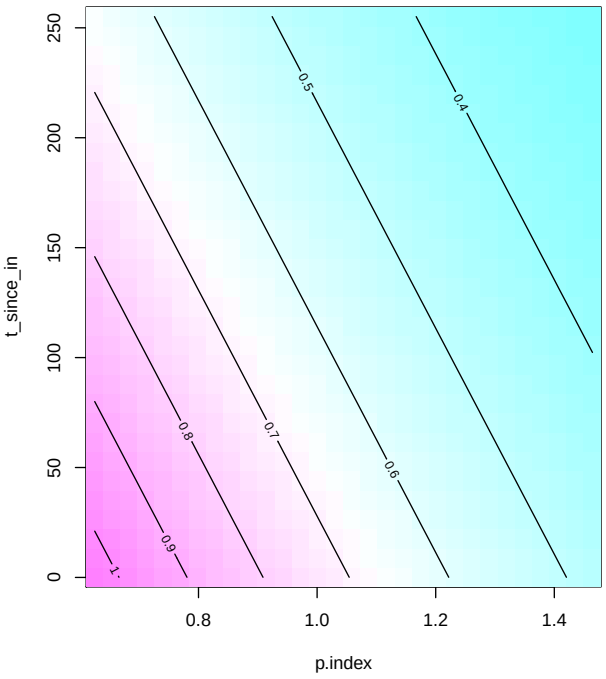
famsize: geese.org: days ~ lon



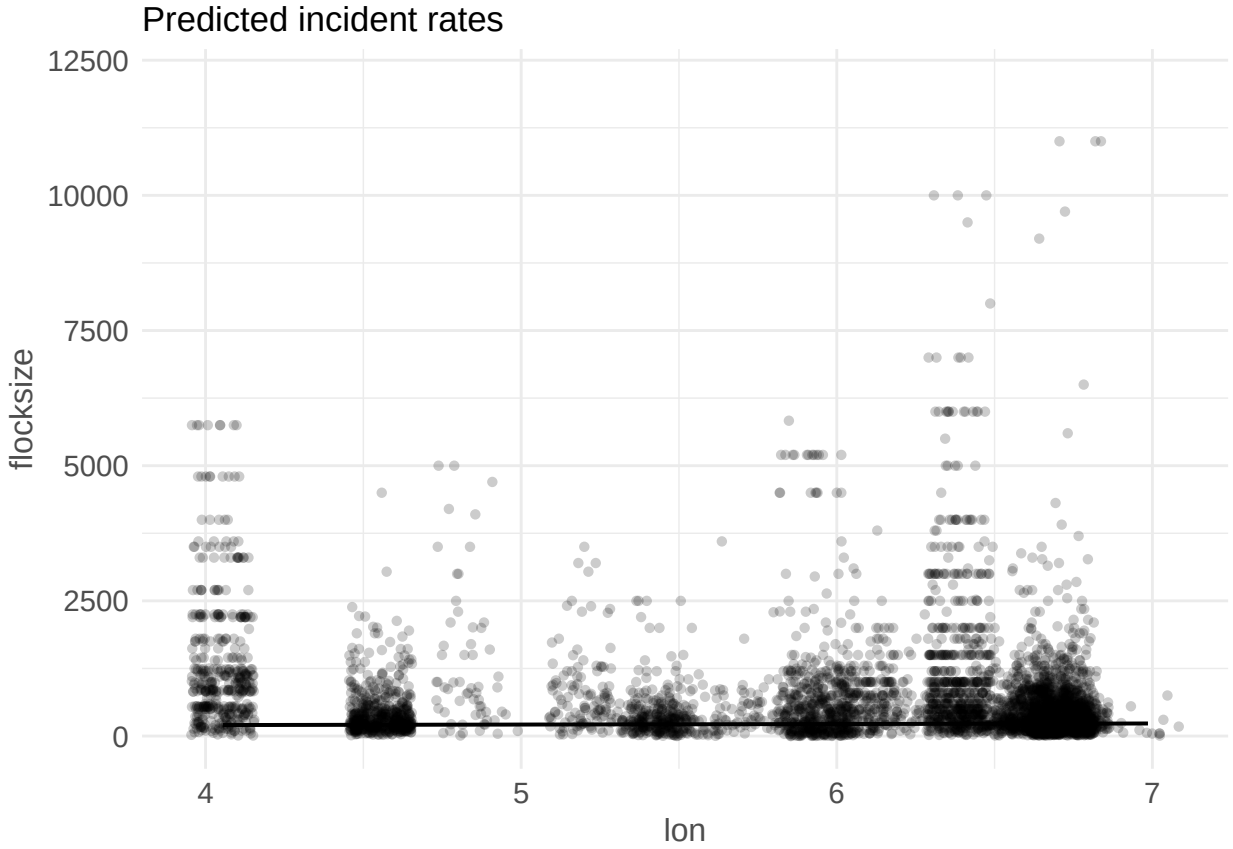
famsize: SOVON: days ~ p.index



famsize: geese.org: days ~ p.index



Hypothesis 04



H1-3 GAM summaries

SOVON data summary

```
##
## Family: poisson
## Link function: log
##
## Formula:
## famsize ~ lon + flocksize + t_since_in + p.index + s(Food_type,
##     bs = "re") + s(Observer, bs = "re") + s(Breeding_year, bs = "re")
##
## Parametric coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)  4.653e-01  1.849e-01   2.516   0.0119 *
## lon          8.799e-03  2.020e-02   0.436   0.6632
## flocksize   -5.317e-06  3.919e-06  -1.357   0.1748
## t_since_in  -8.270e-04  9.213e-05  -8.977   <2e-16 ***
## p.index      1.027e-01  1.258e-01   0.817   0.4141
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

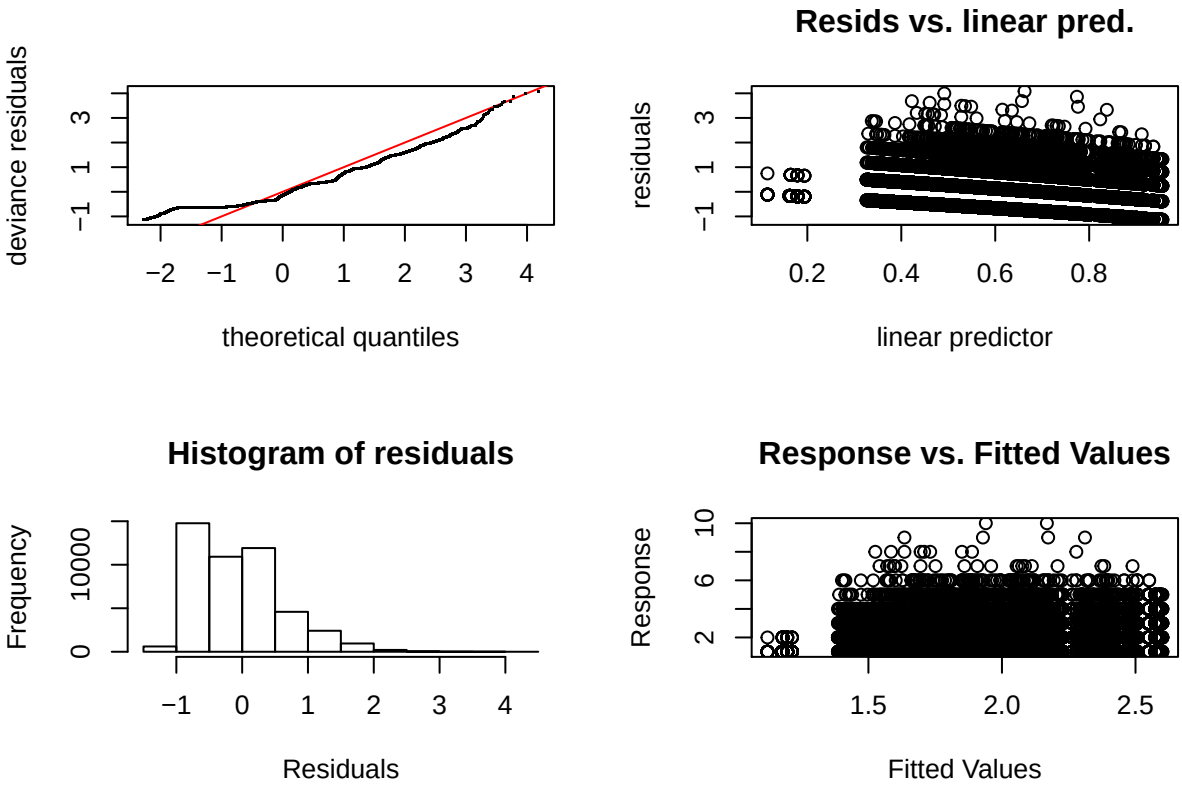
```
##
## Approximate significance of smooth terms:
##                     edf Ref.df  Chi.sq  p-value
## s(Food_type)      4.148     27   15.72    0.146
## s(Observer)      13.120     16 1029.82 2.36e-14 ***
## s(Breeding_year) 13.304     14 4990.30  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) =  0.0766   Deviance explained = 8.56%
## fREML =  54219  Scale est. = 1         n = 46444
```

geese.org data summary

```
##
## Family: poisson
## Link function: log
##
## Formula:
## famsize ~ lon + p.index + t_since_in + s(id, bs = "re") + s(breedyr,
##     bs = "re")
##
## Parametric coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)  0.5279665  0.4309590   1.225   0.2205
## lon         -0.0544409  0.0138750  -3.924 8.72e-05 ***
## p.index     -0.9186095  0.4089896  -2.246   0.0247 *
## t_since_in  -0.0017875  0.0002604  -6.864 6.68e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Approximate significance of smooth terms:
##                edf Ref.df Chi.sq  p-value
## s(id)       0.9587      1  708.1 8.71e-07 ***
## s(breedyr) 13.1169     14  495.9  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) =  0.0309   Deviance explained =  3.6%
## fREML =  20684  Scale est. = 1         n = 10832
```

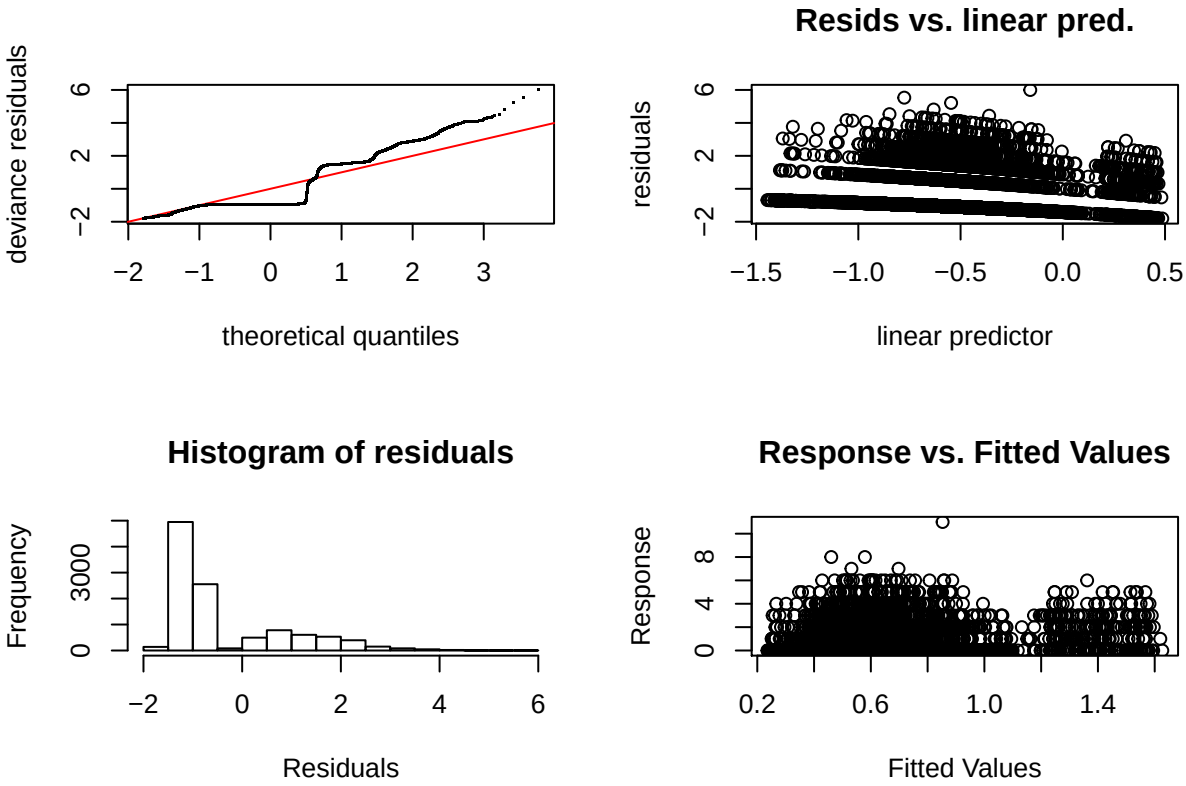
H1-3 GAM checks

SOVON data




```
##
## Method: fREML   Optimizer: perf newton
## full convergence after 5 iterations.
## Gradient range [-4.640142e-10,6.619385e-08]
## (score 54219.18 & scale 1).
## Hessian positive definite, eigenvalue range [0.786649,6.642661].
## Model rank =  66 / 66
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
##
##                     k'   edf k-index p-value
## s(Food_type)     28.00  4.15      NA      NA
## s(Observer)      17.00 13.12      NA      NA
## s(Breeding_year) 16.00 13.30      NA      NA
```

geese.org data




```
##
## Method: fREML   Optimizer: perf newton
## full convergence after 6 iterations.
## Gradient range [-2.468972e-08,3.456183e-07]
## (score 20684.14 & scale 1).
## Hessian positive definite, eigenvalue range [0.4593542,6.128081].
## Model rank =  21 / 21
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
##
##                k'    edf k-index p-value
## s(id)       1.000  0.959      NA      NA
## s(breedyr) 16.000 13.117      NA      NA
```

H4 model summary

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: poisson  ( log )
## Formula: flocksize ~ lon + lat + days + p.index + (1 | Breeding_year) +
##     (1 | Observer) + (1 | Food_type)
##    Data: geese
##
```

```
##      AIC      BIC   logLik deviance df.resid
##  2933510  2933562 -1466747  2933494     5058
##
## Scaled residuals:
##    Min     1Q Median     3Q    Max
## -46.25 -15.24  -6.72   6.37 330.73
##
## Random effects:
##  Groups        Name        Variance Std.Dev.
##  Food_type     (Intercept) 1.70313  1.3050
##  Observer      (Intercept) 0.80137  0.8952
##  Breeding_year (Intercept) 0.08783  0.2964
## Number of obs: 5066, groups:
## Food_type, 42; Observer, 37; Breeding_year, 16
##
## Fixed effects:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept) -1.921e+01  4.100e-01  -46.86   <2e-16 ***
## lon          4.155e-02  4.509e-03    9.21   <2e-16 ***
## lat          4.646e-01  2.796e-03  166.17   <2e-16 ***
## days         5.723e-04  1.321e-05   43.33   <2e-16 ***
## p.index      1.669e-01  3.303e-01    0.51    0.613
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##         (Intr) lon    lat    days
## lon     -0.204
## lat     -0.303  0.552
## days     0.001 -0.033 -0.004
## p.index -0.713 -0.042 -0.069  0.001
## convergence code: 0
## Model failed to converge with max|grad| = 0.00282889 (tol = 0.001, component 1)
## Model is nearly unidentifiable: very large eigenvalue
##  - Rescale variables?
## Model is nearly unidentifiable: large eigenvalue ratio
##  - Rescale variables?
```

H5 model summary

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: poisson  ( log )
## Formula:
## fams ~ log(flocksize + 0.01) + (1 | Breeding_year) + (1 | Observer) +
##     (1 | Food_type) + (1 | zone)
##    Data: fams
##
##      AIC      BIC   logLik deviance df.resid
##  17493.7  17526.4  -8740.8  17481.7     1716
##
## Scaled residuals:
```

```
##    Min     1Q Median     3Q    Max
## -9.627 -1.456 -0.274  1.187 56.587
##
## Random effects:
##  Groups        Name        Variance Std.Dev.
##  Food_type     (Intercept) 0.10099  0.3178
##  Observer      (Intercept) 0.24267  0.4926
##  Breeding_year (Intercept) 0.04343  0.2084
##  zone          (Intercept) 0.02238  0.1496
## Number of obs: 1722, groups:
## Food_type, 28; Observer, 17; Breeding_year, 16; zone, 4
##
## Fixed effects:
##                        Estimate Std. Error z value Pr(>|z|)
## (Intercept)           -0.430727   0.168285   -2.56   0.0105 *
## log(flocksize + 0.01)  0.564839   0.005107  110.61   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr)
## lg(fl+0.01) -0.170
```