Lab 4: Fitting Poisson models

This session is concerned with Poisson point process models.
The lecturer's R script is available here (right click and save).

Exercise 1

The command `rpoispp(100)` generates realisations of the Poisson process with intensity $\lambda = 100$ in the unit square.

1. Repeat the command `plot(rpoispp(100))` several times to build your intuition about the appearance of a completely random pattern of points.
2. Try the same thing with intensity $\lambda = 1.5$.

Exercise 2

Returning to the Japanese Pines data,

1. Fit the uniform Poisson point process model to the Japanese Pines data

   ```
   ppm(japanesepines~1)
   ```

2. Read off the fitted intensity. Check that this is the correct value of the maximum likelihood estimate of the intensity.

Exercise 3

The `japanesepines` dataset is believed to exhibit spatial inhomogeneity.

1. Plot a kernel smoothed intensity estimate.
2. Fit the Poisson point process models with loglinear intensity (trend formula `~x+y`) and log-quadratic intensity (trend formula `~polynom(x,y,2)`) to the Japanese Pines data.
3. extract the fitted coefficients for these models using `coef`.
4. Plot the fitted model intensity (using `plot(fit)`)
5. perform the Likelihood Ratio Test for the null hypothesis of a loglinear intensity against the alternative of a log-quadratic intensity, using `anova`.
6. Generate 10 simulated realisations of the fitted log-quadratic model, and plot them, using `plot(simulate(fit, nsim=10))` where `fit` is the fitted model.

Exercise 4

The `update` command can be used to re-fit a point process model using a different model formula.

1. Type the following commands and interpret the results:

```r
fit0 <- ppm(japanesepines ~ 1)
fit1 <- update(fit0, . ~ x)
fit1
fit2 <- update(fit1, . ~ . + y)
fit2
```

2. Now type `step(fit2)` and interpret the results.

Exercise 5

The `bei` dataset gives the locations of trees in a survey area with additional covariate information in a list `bei.extra`.

1. Fit a Poisson point process model to the data which assumes that the intensity is a loglinear function of terrain slope and elevation (hint: use `data = bei.extra` in `ppm`).
2. Read off the fitted coefficients and write down the fitted intensity function.
3. Plot the fitted intensity as a colour image.
4. extract the estimated variance-covariance matrix of the coefficient estimates, using `vcov`.
5. Compute and plot the standard error of the intensity estimate (see `help(predict.ppm)`).

Exercise 6

Fit Poisson point process models to the Japanese Pines data, with the following trend formulas. Read off an expression for the fitted intensity function in each case.

Trend formula	Fitted intensity function
`~1`	
`~x`	
`~sin(x)`	
`~x+y`	
`~polynom(x,y,2)`	
`~factor(x < 0.4)`	

Exercise 7

Make image plots of the fitted intensities for the inhomogeneous models above.