Analysis of invasion times

Data are time series of single site invasions from 30 randomly selected locations (same 30 sites for each parameter combination).

Load some libraries

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(ggplot2)
```

Navigate to folder and read the data.

```
setwd('~/Documents/code/wasps/experiments/wasp-experiments')
wasps.invasion <- read.csv("wasps INVASION-EXPERIMENT-table.csv", skip=6)
```

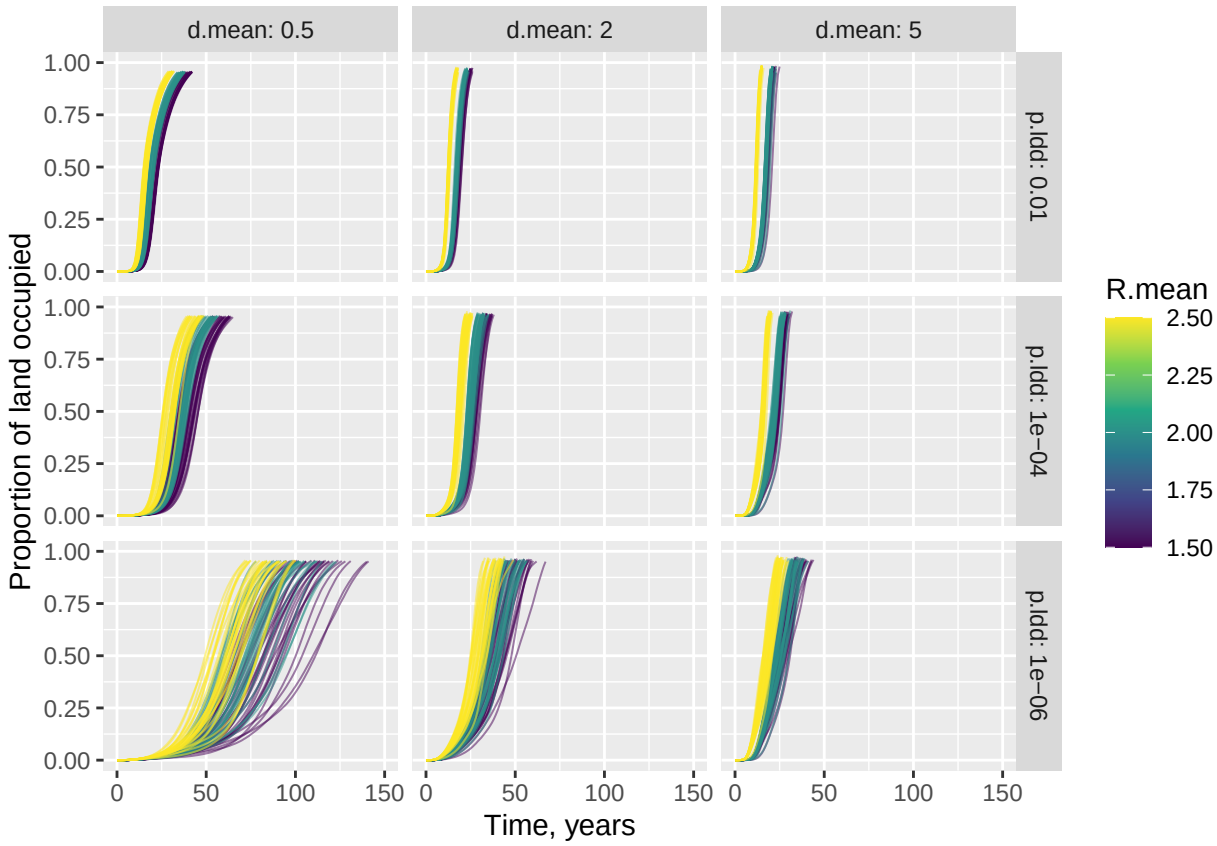
Select only variables we need.

```
wasps.sel <- wasps.invasion %>%
  select(X.step., prop.occupied, R.mean, X.run.number., d.mean, p.ldd)
```

Time series plots

Panel plot of time series, lines coloured by intrinsic growth-rate `R.mean`, panels arranged by local mean dispersal distance `d.mean` and probability of long distance dispersal `p.ldd`.

```
ggplot(wasps.sel, aes(x = X.step., y = prop.occupied, colour = R.mean)) +
  geom_line(aes(group = X.run.number.), lwd = .35, alpha = 0.5) +
  xlim(0, 150) + ylim(0, 1) +
  labs(x = 'Time, years', y = 'Proportion of land occupied') +
  scale_color_viridis_c(option = 'D') +
  facet_grid(p.ldd ~ d.mean, labeller = label_both, as.table = FALSE)
```



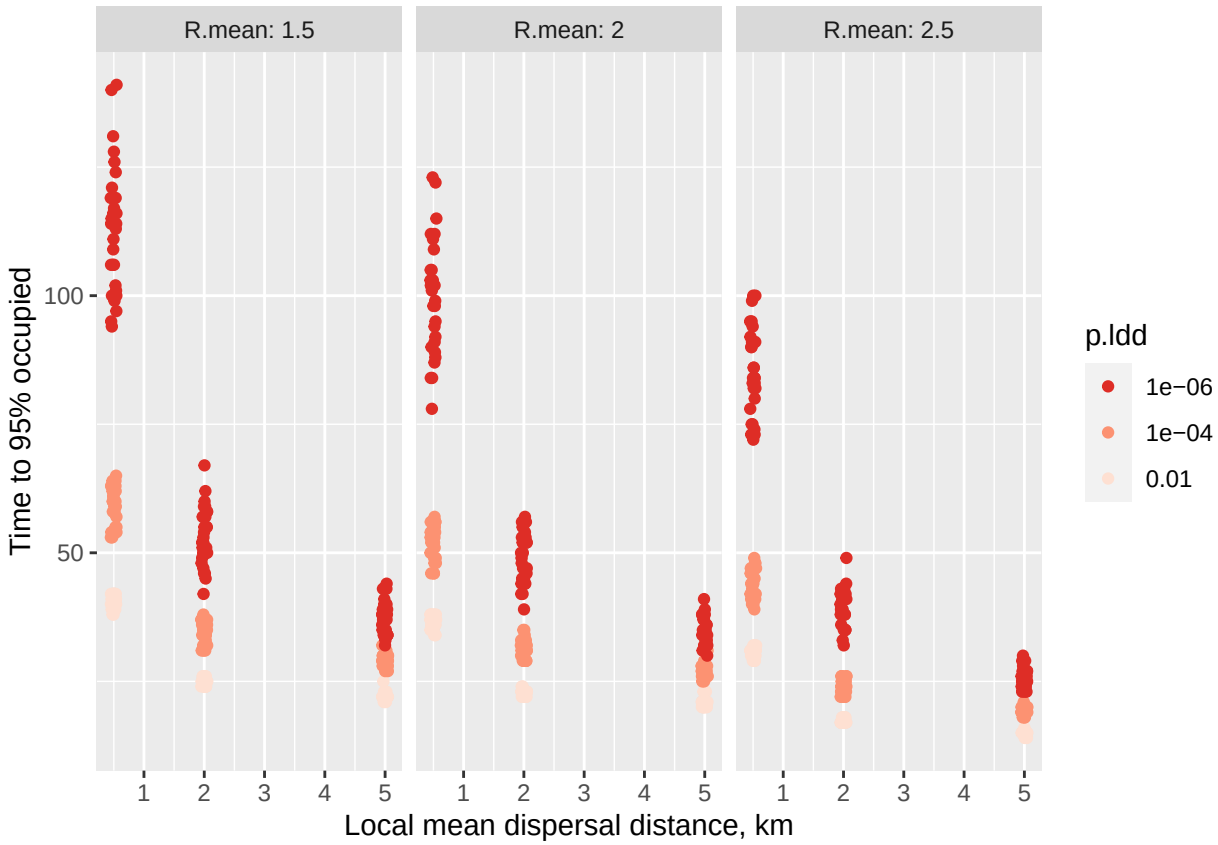
Trends in time to 50% occupancy

Determine times taken to 50% occupancy. These will be the last time step in each case, when `prop.occupied` >=0.5 at that time, since experiment runs used this as stopping criterion.

```
wasps.t <- wasps.sel %>%
  group_by(X.run.number., R.mean) %>%
  summarise_at('X.step.', max) %>%
  merge(wasps.invasion) %>%
  filter(prop.occupied >= 0.5)
```

And plot it

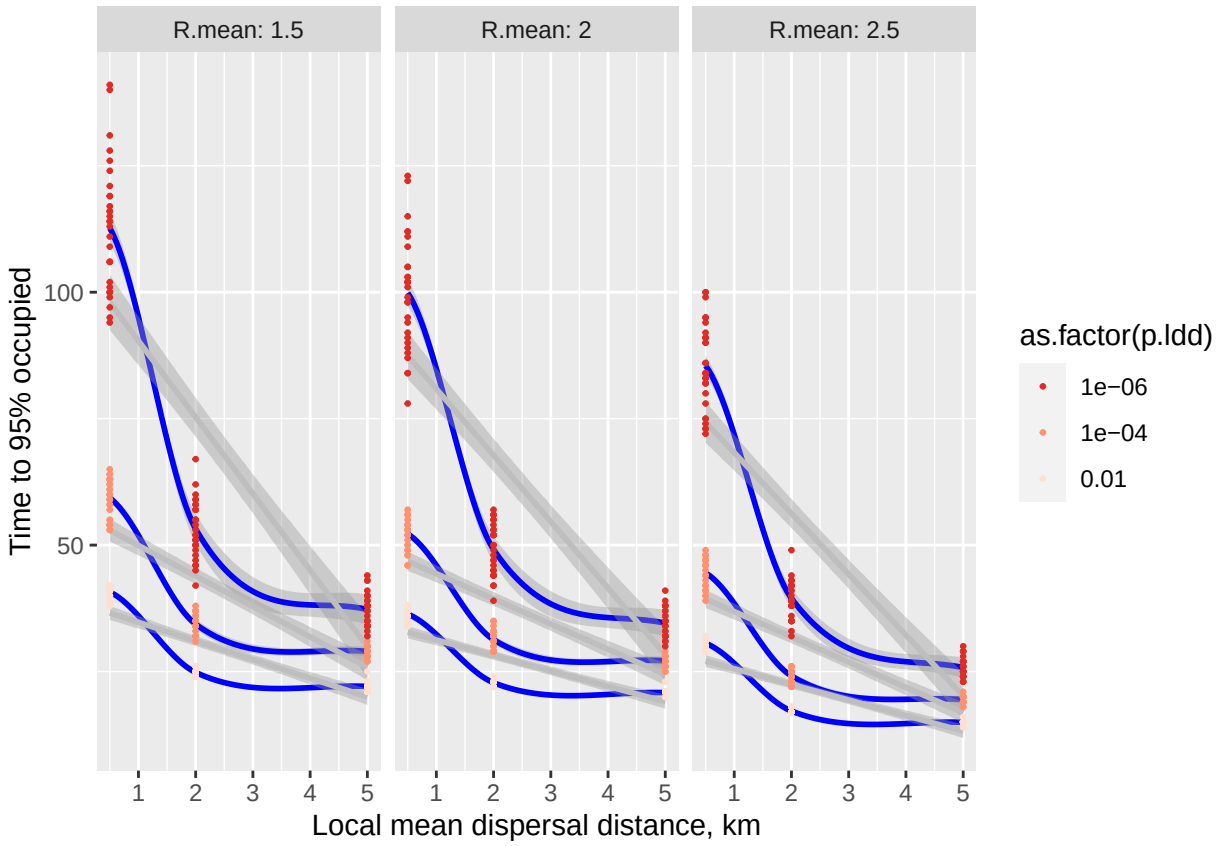
```
ggplot(wasps.t, aes(x = d.mean, y = X.step.)) +
  geom_jitter(aes(colour = as.factor(p.ldd)), width = .05, height = 0) +
  scale_color_brewer(palette = "Reds", direction = -1, name = "p.ldd") +
  facet_wrap(vars(R.mean), nrow = 1, labeller = label_both) +
  labs(y = 'Time to 95% occupied', x = 'Local mean dispersal distance, km')
```



Need more data to fit curves

To fit curves to these data we need more values of `d.mean` than $\{0.5, 2, 5\}$ to avoid warnings about near-singularities with the default Loess fitting, and also unlikely 'kinks' in the curves. A linear model is clearly not appropriate per the plots. See below:

```
ggplot(wasps.t, aes(x = d.mean, y = X.step., colour = as.factor(p.ldd))) +
  geom_smooth(aes(group = p.ldd), colour = 'blue') +
  geom_smooth(aes(group = p.ldd), colour = 'gray', method = 'glm') +
  geom_point(size = 0.5) +
  scale_colour_brewer(palette = "Reds", direction = -1) +
  facet_wrap(vars(R.mean), nrow = 1, labeller = label_both) +
  labs(y = 'Time to 95% occupied', x = 'Local mean dispersal distance, km')
```


R.mean: 1.5
R.mean: 2
R.mean: 2.5
Time to 95% occupied
100
50
1
2
3
4
5
Local mean dispersal distance, km
as.factor(p.ldd)
1e−06
1e−04
0.01