Workshop 10.5a: Logistic regression

Murray Logan

05 Sep 2016

Section 1

Logistic regression

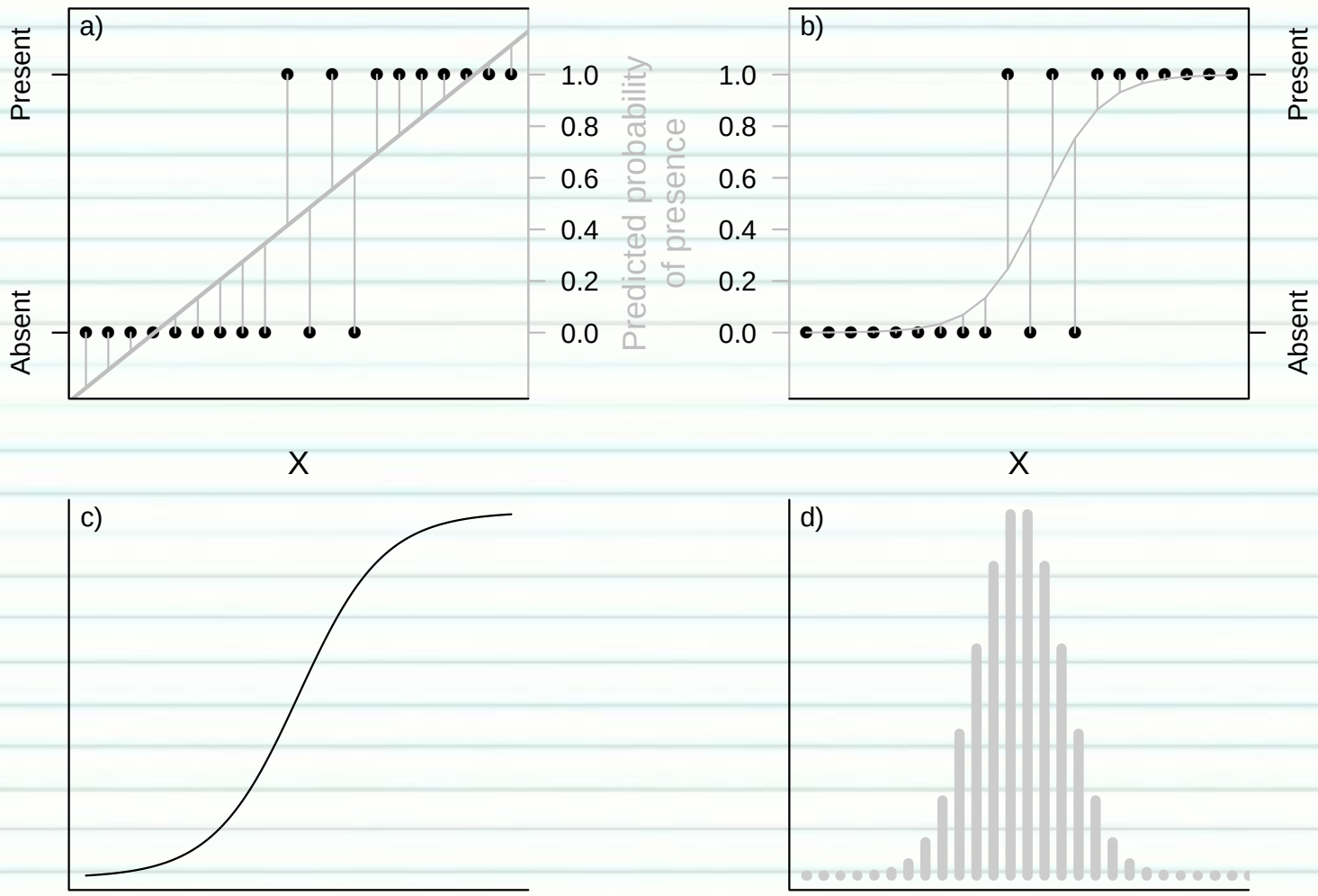
Logistic regression

BINARY DATA

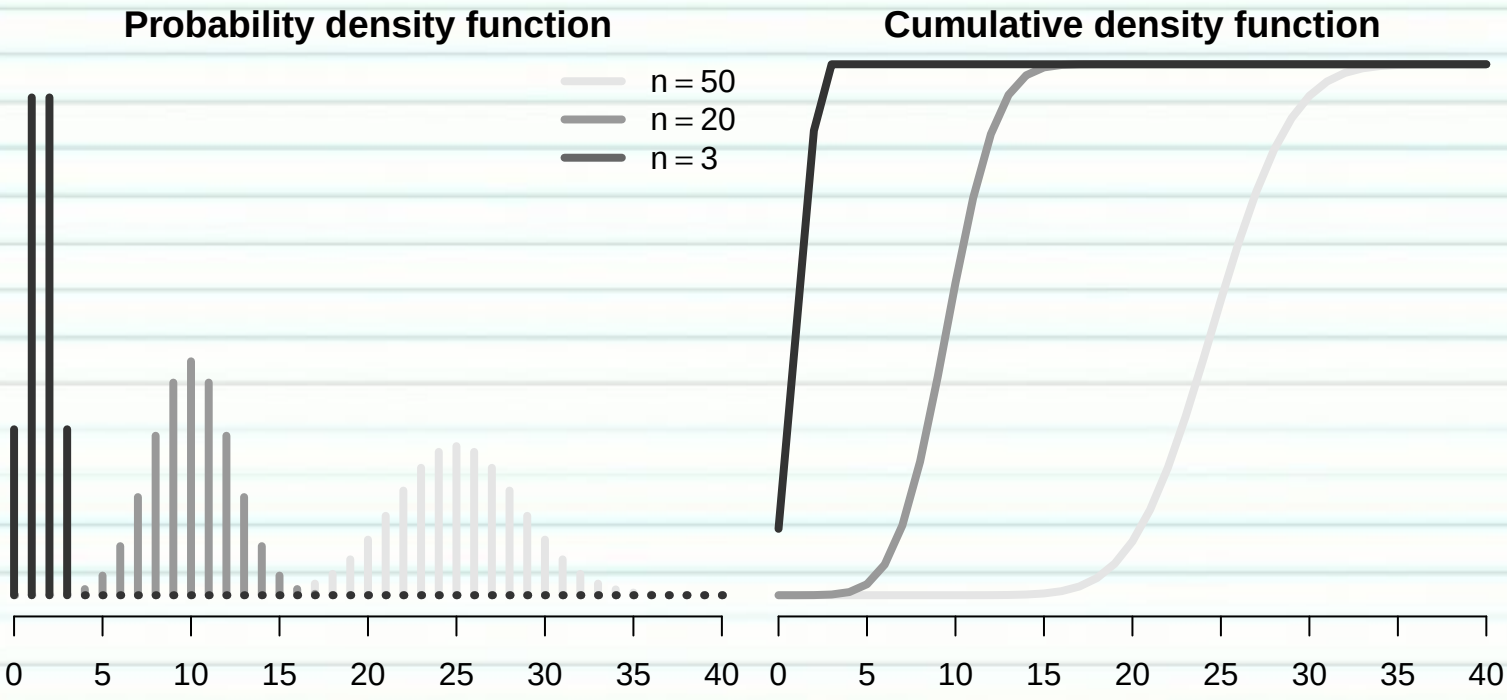
Link: $\log\left(\frac{\pi}{1-\pi}\right)$

Transform scale of linear predictor $(-\infty, \infty)$ into that of the response (0,1)

Logistic regression



Logistic regression



$$\mathrm{E}(Y) = \binom{n}{x} p^x (1-p)^{n-x}$$

Spread assumed to be equal to mean. ($\phi = 1$)

Dispersion

OVER-DISPERSION

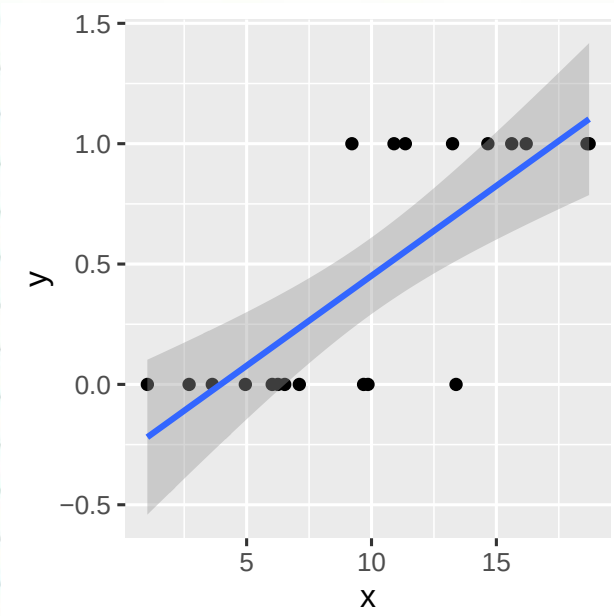
Sample more varied than expected from its mean

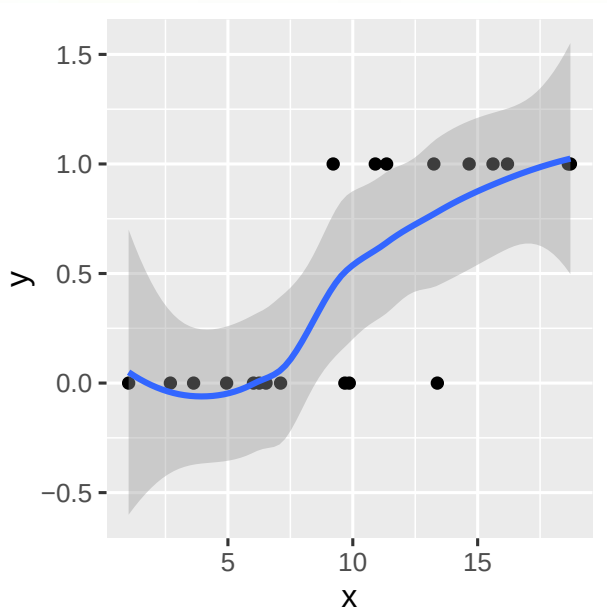
- variability due to other unmeasured influences
    - quasi- model
- due to more zeros than expected
    - zero-inflated model

Logistic regression

Example data

	y	x
1	0	1.024733
2	0	2.696719
3	0	3.626263
4	0	4.948643
5	0	6.024718
6	0	6.254113





Logistic regression

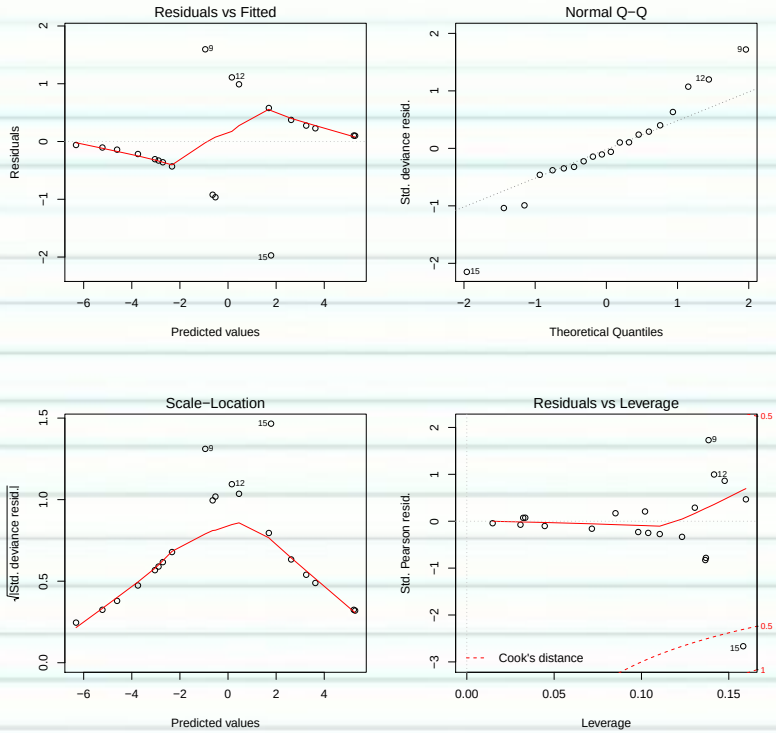
- Fit model

```
> dat.glmL <- glm(y ~ x, data = dat, family = "binomial")
```

Logistic regression

- Explore residuals

```
> par(mfrow=c(2,2))
> plot(dat.glmL)
```



Logistic regression

- Explore goodness of fit
- Pearson's χ^2 residuals

```
> dat.resid <- sum(resid(dat.glmL, type = "pearson")^2)
> 1 - pchisq(dat.resid, dat.glmL$df.resid)
```

```
[1] 0.8571451
```

- Deviance (G^2)

```
> 1-pchisq(dat.glmL$deviance, dat.glmL$df.resid)
```

```
[1] 0.8647024
```

Logistic regression

- Explore model parameters

Slope parameter is on log odds-ratio scale

```
> summary(dat.glmL)
```

```
Call:
glm(formula = y ~ x, family = "binomial", data = dat)

Deviance Residuals:
     Min        1Q    Median        3Q       Max
-1.97157  -0.33665  -0.08191   0.30035   1.59628

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  -6.9899     3.1599  -2.212   0.0270 *
x             0.6559     0.2936   2.234   0.0255 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 27.526  on 19  degrees of freedom
```

Logistic regression

- Quasi R^2

$$\text{quasi}R^2 = 1 - \left(\frac{\text{deviance}}{\text{null deviance}} \right)$$

```
> 1-(dat.glmL$deviance/dat.glmL$null)
```

```
[1] 0.5767057
```

Logistic regression

- LD50

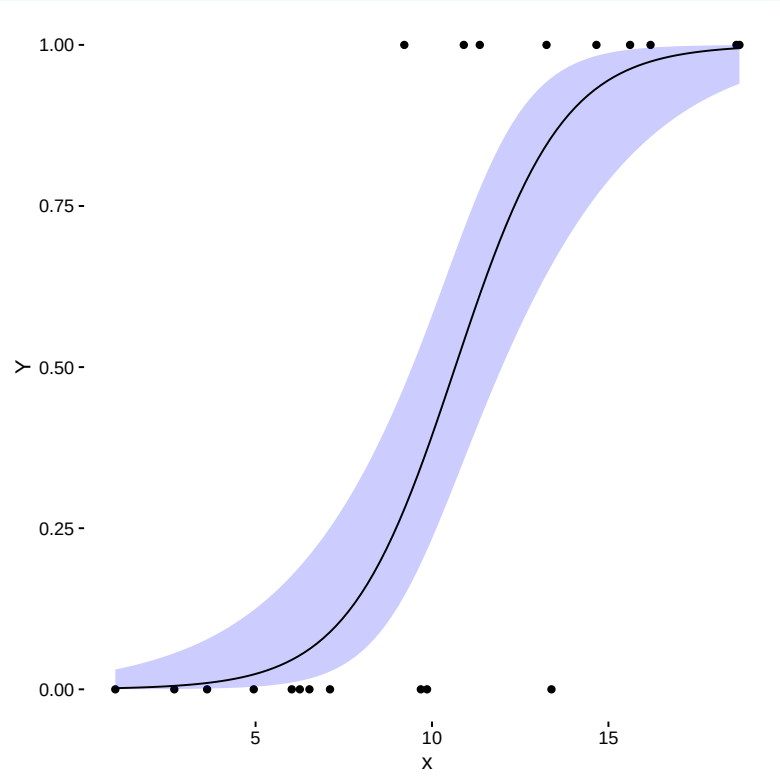
$$\text{LD50} = -\frac{\text{intercept}}{\text{slope}}$$

```
> -dat.glmL$coef[1]/dat.glmL$coef[2]
```

```
(Intercept)
   10.65781
```

Logistic regression

- summary figure



Section 2

Worked Examples

Worked Examples