Messina E1: The effect of margin on robustness

March 30, 2015

1 Preparation

```
library(ggplot2)

## Loading required package:  methods

library(plyr)
library(reshape2)
```

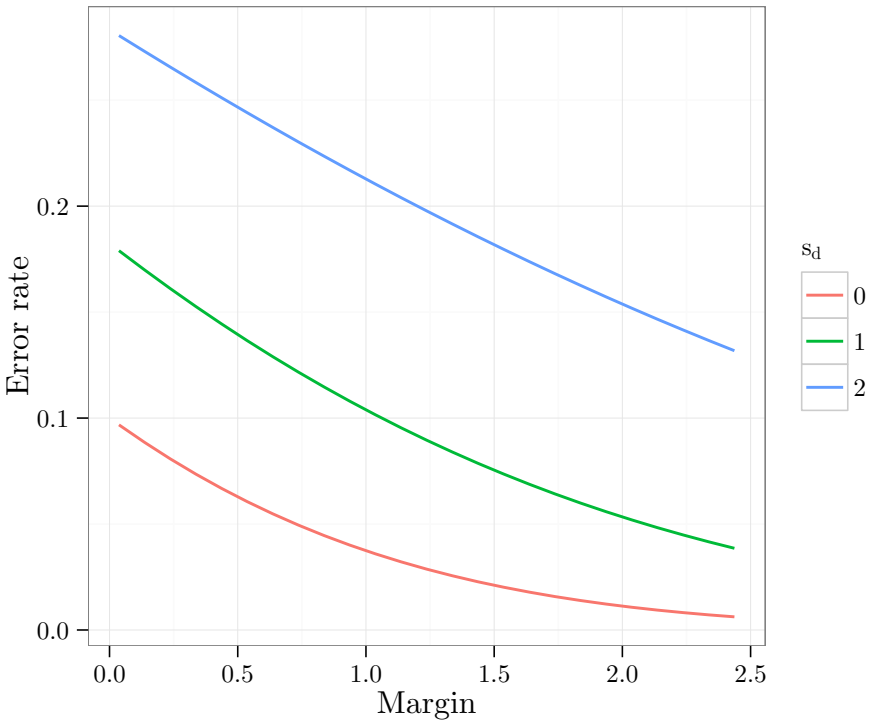
```
# I need to show: That higher margin leads to greater robustness
# to high sigma_delta and sigma_epsilon.

# Define margin as the distance between the 5% error bounds for both 0 and 1.
deltaForMargin = function(margin, sigma_epsilon = 1, alpha = 0.05) margin - 2*sigma_epsilon*qnorm(alpha)
marginForDelta = function(delta, sigma_epsilon = 1, alpha = 0.05) delta + 2*sigma_epsilon*qnorm(alpha)

e1aii.design = expand.grid(
        snr = seq(0, 5, 0.1),
# p1 = c(0.2, 0.5, 0.8),# Result is independent of p1
        p1 = 0.5,
        sigma_epsilon = 1,
        sigma_delta = seq(0, 2, 1),
        alpha = 0.1)
e1aii.design$Delta = e1aii.design$snr * e1aii.design$sigma_epsilon
e1aii.design$margin = marginForDelta(e1aii.design$Delta, e1aii.design$sigma_epsilon, alpha = e1aii.desig
e1aii.design$threshold = e1aii.design$Delta/2

e1aii.design$error = unlist(mlply(e1aii.design, function(threshold, p1, Delta, sigma_delta, sigma_epsilo
        Err_internal = function(d) ((1-p1)*(1-pnorm((threshold - d)/sigma_epsilon)) + p1*pnorm((thresho
        if (sigma_delta == 0)   {       return(Err_internal(0)) }
        else {                                          return(integrate(function(d) Err_internal(d) * 1
}))

# + ggtitle("High-margin classifiers are more robust")
ggplot(e1aii.design[e1aii.design$margin >= 0,], aes(x = margin, y = error, colour = factor(sigma_delta))
```




```
e1a3.design = expand.grid(Delta = seq(0, 4, 0.1), sigma_prime = c(0.5, 1, 2, 4))
e1a3.design$error = pnorm((-e1a3.design$Delta - 1.28)/e1a3.design$sigma_prime)

ggplot(e1a3.design, aes(x = Delta, y = error, colour = factor(sigma_prime))) + geom_line(lwd = 1) + xlab
```