

Messina E1: The effect of margin on robustness

March 19, 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.design$alpha)
e1aii.design$threshold = e1aii.design$Delta/2

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

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

