Power Logistic Regression

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Power a logistic regression model for Observational research

When designing an observational study many times a sample size will need to be decided. You may have the ability to delay a study for greater accrual of study subjects or you may have a cost function like chart abstraction that you need to optimize.

Observational models tend to be more complex than trial models. Usually this is due to the need to adjust for confounding.

Here is an toy example on how one would power a design for and exposure outcome relationship where there is a suspected confounder called "Age"

$$P(\text{Disease} = 1) = \frac{\exp(\beta_0 + \beta_1 \text{Exposure} + \beta_2 \text{Age})}{1 + \exp(\beta_0 + \beta_1 \text{Exposure} + \beta_2 \text{Age})}$$

Design Your Model, Simulate Your Model, and Record Your Result

```
sims <- 10000
alpha <-0.05


pvalues <- replicate(sims,{

  #simulate parameter values
  N <-300
  age <- round(runif(N, min = 60, max = 80), digits = 1)

  #first simulate your exposure model
  base_exposure <- -2.5
  beta0 <- -3.0

  b.ex.age <- 0.03
  b.age <- 0.02
  b.x <- 1

  linpred_exposure <- base_exposure + b.ex.age * age
  prob_exposure <- exp(linpred_exposure)/(1 + exp(linpred_exposure))
  exposure <- rbinom(N, 1, prob_exposure)

  #simulate your outcome model
  linpred <- beta0 + b.x * exposure + b.age * age
  prob <- exp(linpred)/(1 + exp(linpred))

  y <- rbinom(N, 1, prob)
```

```
  data <- data.frame(y, exposure, age)

  model <-glm(y ~ exposure + age, data = data, family = binomial)
  p.value <- summary(model)$coefficients[,4]
})
```

The proportion of statistically significant effects is your *power*

```
signficant.experiment <- matrix(data=NA, nrow=3, ncol=sims)
  for (i in 1:3){
    signficant.experiment[i,] <- (pvalues[i,] <= alpha)
  }
  power <-rowMeans(signficant.experiment)
  power[2]
```

```
## [1] 0.9523
```

##Caveats

There is a lot to be desired with this quick example. In this simple example there is no demonstration of
how to gauge the impact of a confounder and the subsequent impact on power. Furthermore in designing a
study you would need to be able to have realistic scenarios. Future directions would involve building several
different types of confounders common in the literature.