

**Extra Problem 1:** In the lecture we we estimated the expected number of signal events  $s$  by

$$\hat{s} = n - b ,$$

where  $n$  is the number of events accepted and  $b$  is the expected background. We showed that the relative statistical error in  $\hat{s}$  is given by

$$\frac{\sigma_{\hat{s}}}{s} = \frac{\sqrt{s+b}}{s} ,$$

and therefore to minimize this quantity we should maximize  $s/\sqrt{s+b}$ . Show that

$$\frac{s}{\sqrt{s+b}} \propto \sqrt{\varepsilon_s p_s} ,$$

where  $\varepsilon_s$  is the signal efficiency and  $p_s$  is the signal purity, and find the constant of proportionality.