Visualizing Miller's "Probability of Replication"

Here is Miller's formula for p_{ra}.

In[79]:=
$$p_{ra}[\alpha\_,\ \beta\_,\ \gamma\_] := \frac{\gamma\,(1-\beta)^2 + \frac{1}{2}\,(1-\gamma)\,\alpha^2}{\gamma\,(1-\beta) + (1-\gamma)\,\alpha};$$

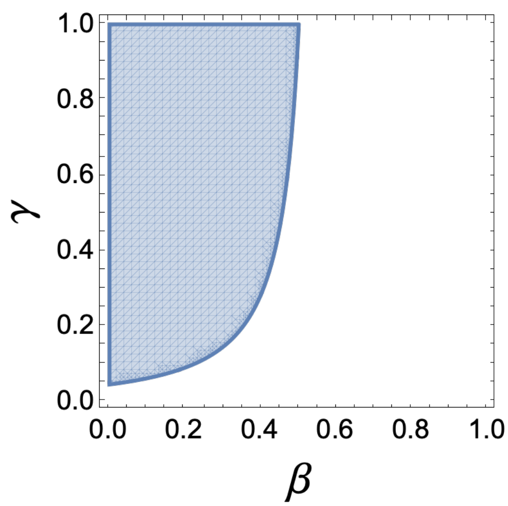
Here is a function which calculates (and visualizes) the region of $\{\beta,\gamma\}$ parameter space in which $p_{ra} > t$ — for a given significance level α, and probability threshold t.

In[80]:=
```
ThresholdPlot[α_, t_] := RegionPlot[pra[α, β, γ] > t, {β, 0, 1},
    {γ, 0, 1}, FrameLabel → {Style["β", 20, FontFamily → "Lucida Bright"],
      Style["γ", 20, FontFamily → "Lucida Bright"]},
    FrameTicksStyle → Directive[FontSize → 14], PlotPoints → 50];
```

Here's what the $\alpha = 0.05$, t = 0.5 case looks like:

In[81]:=
```
ThresholdPlot[0.05, 0.5]
```

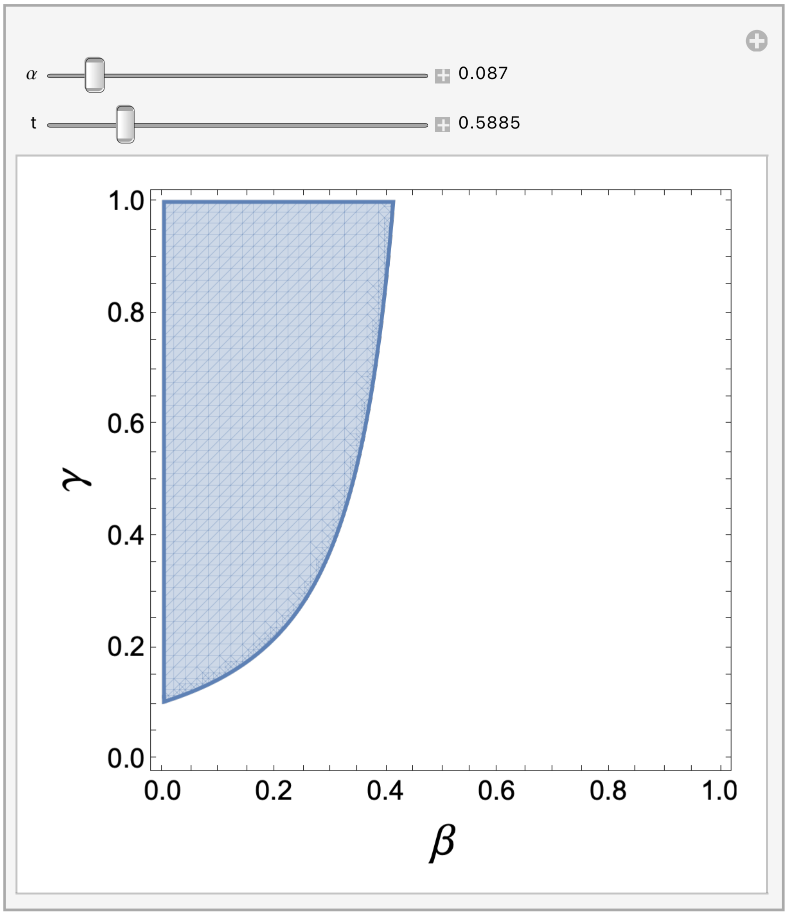
Out[81]=



We can vary the values of the significance level α and the probability threshold t, to see they alter the "*t*-probable replication" region.

In[82]:=
```
Manipulate[ThresholdPlot[α, t], {{α, 0.01}, 0, 1, Appearance → "Labeled"},
  {{t, 0.5}, 0.5, 1, Appearance → "Labeled"}]
```

Out[82]=



Here is a closed-form solution for the "t-probable replication" region.

In[73]:=
```
tRegion[α_, β_, γ_, t_] =
  FullSimplify[Reduce[p_ra[α, β, γ] > t && 0 < α < 1 && 0 < β < 1 && 0 < γ < 1 && 1/2 < t < 1],
   0 < α < 1 && 0 < β < 1 && 0 < γ < 1 && 1/2 < t < 1]
```

Out[73]=

$$t + \beta < 1 \;\&\&\; \frac{(2\,t - \alpha)\,\alpha}{-\alpha^2 + 2\,(-1 + \beta)^2 + 2\,t\,(-1 + \alpha + \beta)} < \gamma$$

In[74]:=
```
RegionPlot[tRegion[0.05, β, γ, 0.5], {β, 0, 1}, {γ, 0, 1}]
```

Out[74]=