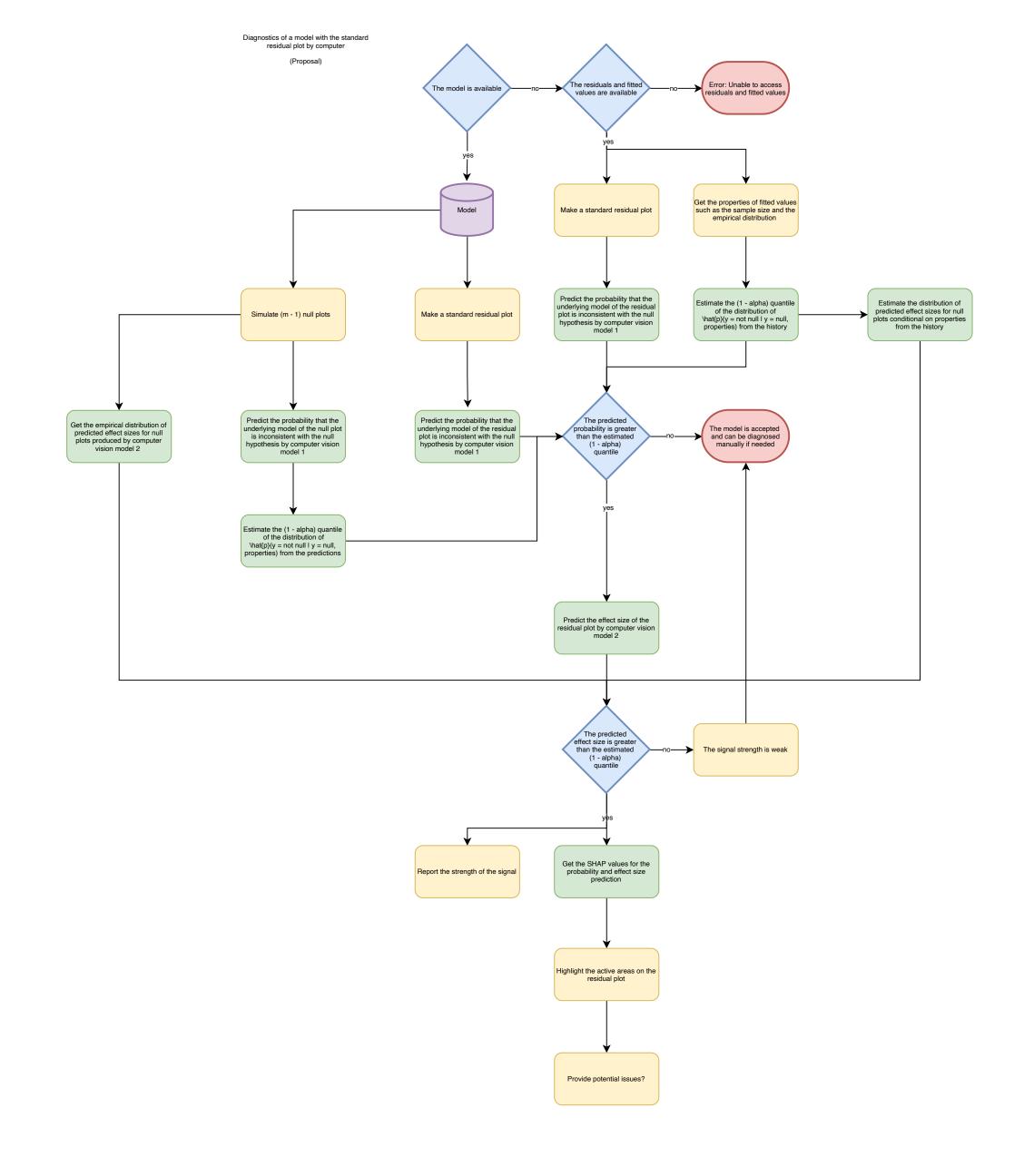What can people potentially gain from residual diagnostics?
1. whether the model is acceptable (a decision)
2. the visual patterns that makes the model unacceptable (an observable reason)
3. the potential violations/issues that cause the visual patterns (a suggestion for solving the problem)

Model

Simulate m null plots

Draw the standard residual plot and conceal it from any observer

Embed the residual plot in a matrix of null plots to run a visual test

There is only one observer

Observers are allowed to select more than one plot

Observers are willing to evaluate null lineups for alpha calculation

Use the binomial model to calculate the p-value

Observer is only allowed to select zero or one plot

Use the beta-binomial model to calculate the p-value

The p-value is less than or equal to the desired significance level

There are less than four observers

There are less than four observers

The data plot is identified with p-value = 1/m

The data plot contains strong visual patterns that are not present in any null plot

The identification is due to week visual patterns

A more rigorous result is needed

Accept the model

visual patterns in the data plot clearly indicates the potential issues

visual patterns are present, but the issue is not immediately discernible

It is possible to seek more observers to run a more accurate visual test

Reject the model and conclude the issues

Use other diagnostic methods such as conventional hypothesis testing to understand the causes of the visual patterns

Use other diagnostic methods such as conventional hypothesis testing to diagnose the model

Other diagnostic methods strongly suggests the model should be rejected

Propose a new model

Reject the model and conclude the issues

The model is available

The residuals and fitted values are available

Error: Unable to access residuals and fitted values

Model

Make a standard residual plot

Get the properties of fitted values such as the sample size and the empirical distribution

Simulate (m - 1) null plots

Make a standard residual plot

Predict the probability that the underlying model of the residual plot is inconsistent with the null hypothesis by computer vision model 1

Estimate the (1 - alpha) quantile of the distribution of \hat{p}(y = not null | y = null, properties) from the history

Estimate the distribution of predicted effect sizes for null plots conditional on properties from the history

Get the empirical distribution of predicted effect sizes for null plots produced by computer vision model 2

Predict the probability that the underlying model of the null plot is inconsistent with the null hypothesis by computer vision model 1

Predict the probability that the underlying model of the residual plot is inconsistent with the null hypothesis by computer vision model 1

The predicted probability is greater than the estimated (1 - alpha) quantile

The model is accepted and can be diagnosed manually if needed

Estimate the (1 - alpha) quantile of the distribution of \hat{p}(y = not null | y = null, properties) from the predictions

Predict the effect size of the residual plot by computer vision model 2

The predicted effect size is greater than the estimated (1 - alpha) quantile

The signal strength is weak

Report the strength of the signal

Get the SHAP values for the probability and effect size prediction

Highlight the active areas on the residual plot

Provide potential issues?

A residual plot in png format

Computer vision model 1

The probability that the underlying model of the residual plot is inconsistent with the null hypothesis

A residual plot in png format

Computer vision model 2

The effect size