Shiny decisions - An R-shiny application for decision frameworks

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ABSTRACT

Taking a drug from development to market is a costly and time-consuming activity for all pharmaceutical companies. Trying with a drug that will not go into market can hence cost billions before it is cancelled. We have developed a R-shiny tool at Novo Nordisk which is built upon the framework developed by Frewer et. al. . This framework is based upon the efficacy seen in literature and/or clinical trials beforehand. This is done by establishing a lower limit of clinical relevance and a value for what clinical relevance that would like to be reached. Then provided the standard deviation of a clinical study, a probability of a stop and a go decision can be calculated using a selected distribution. The tool we have derived is a very user-friendly shiny application that takes this framework and produce both figures and tables. Together with this it takes multiple inputs to tailor to the users needs and updates it in real time. Furthermore, it has multiple unique features like comparing two different scenarios, adding multiple tabs when appropriate and hiding and exchanging inputs based on distribution selection. This application showcases how to build a shiny application which is to be used in a pharmaceutical company and shows some great implemented features. The implementation of this application will serve as an easily understandable, quantitative tool to support decision making and communication of the reasoning of that decision.

INTRODUCTION

As the markets for pharmaceutical products is ever-expanding and the new molecules should be tested, a convenient tool for assessing the viability of the new molecules needs to be created. I have created such a tool using R-shiny and this quick-tip will be regarding the implementation of some of the nifty features that this tool uses.

FIRST MAIN TOPIC

The flexibility and user-friendliness are the main focus areas. It will automatically update the labels for both input and output depending on the chosen probability distribution. It will also change the input methods and units to fit with the most user-friendly approach to this.

The reponsiveness is made up from using a separate wording for each selection – this makes it easier. The axis titles are made up from a reactive function which changes depending on the selection - together with the y-axis units.

As an example the following is an output from the application using the normal distribution:
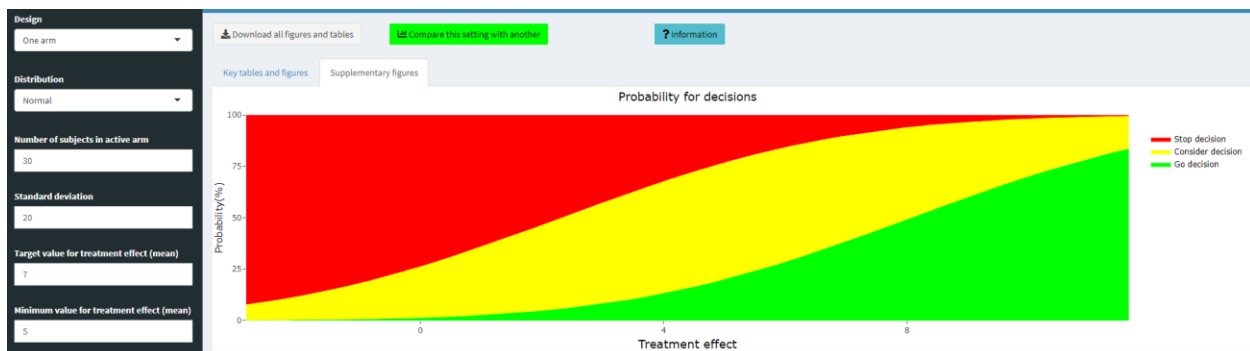
And here is an output from a binomial distribution
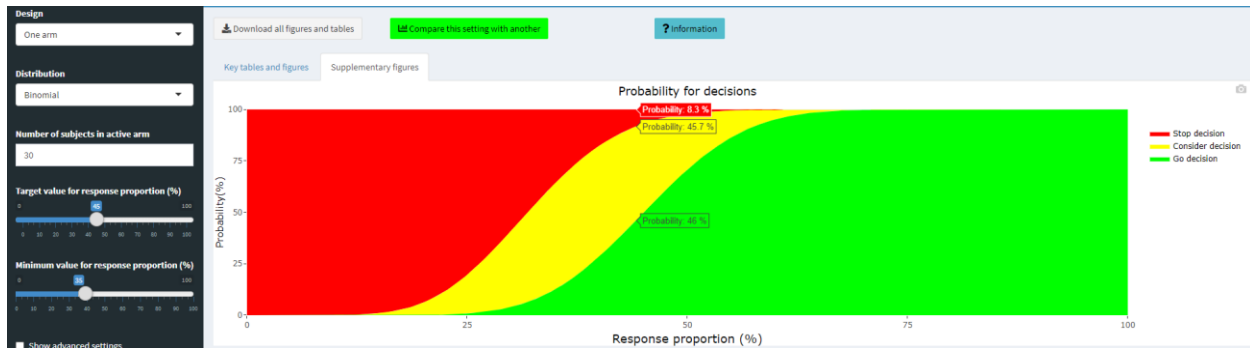
Here you can see how the input methods has changed between the two probabilities and how the axis titles changes.

The responsiveness is made up from if-else statements which can be seen in the following code;

case_when(

input$dist_chosen == "Normal" ~ "Treatment effect",

input$dist_chosen == "Log-normal" & input$design == "One arm" ~ "Treatment effect",

input$dist_chosen == "Log-normal" & input$design == "Two arm" ~ "Treatment ratio",

input$dist_chosen == "Binomial" ~ "Response proportion (%)",

input$dist_chosen == "Difference of proportions" ~ "Difference of proportions (%)",

input$dist_chosen == "Ratio of proportions" ~ "Ratio of proportions",

input$dist_chosen == "Odds ratio of proportions" ~ "Odds-ratio of proportions"

)

```
if(input$design == "One arm"){
    if(input$dist_chosen == "Normal"){
      crit_single_mean(tv = input$tv, lrv = input$lrv, false_go = false_go(), false_stop = false_stop(),
                n_active = input$n_active, sd = stand_dev())
    }
    else if(input$dist_chosen == "Log-normal"){
      crit_single_mean_log(tv = input$tv, lrv = input$lrv, false_go = false_go(), false_stop = false_stop(),
                n_active = input$n_active, sd = stand_dev())
    }
    else if(input$dist_chosen == "Binomial"){
      binom_resp(n_active = input$n_active, lrv = input$lrv/100, tv = input$tv/100, false_go = false_go(),
false_stop = false_stop())
    }
  }
  else if(input$design == "Two arm"){
    if(input$dist_chosen == "Normal"){
```

2

```
        crit_diff_mean(tv = input$tv, lrv = input$lrv, false_go = false_go(), false_stop =
false_stop(),n_control = input$n_comp,

                n_active = input$n_active, sd = stand_dev())

    }

    else if(input$dist_chosen == "Log-normal"){

        crit_ratio_mean(tv = input$tv, lrv = input$lrv, false_go = false_go(), false_stop = false_stop(),
n_active = input$n_active,

                n_control = input$n_comp, sd = stand_dev())

    }

    else if(input$dist_chosen == "Difference of proportions"){

        binom_diff_prop_crit(n_active = input$n_active, tv = input$tv/100, lrv = input$lrv/100, n_control =
input$n_comp, control = control_react(),

                    false_go = false_go(), false_stop = false_stop())

    }

    else if(input$dist_chosen == "Ratio of proportions"){

        binom_ratio_prop_crit(n_active = input$n_active, tv = input$tv/100, lrv = input$lrv/100, n_control =
input$n_comp, control = control_react(),

                    false_go = false_go(), false_stop = false_stop())

    }

    else if(input$dist_chosen == "Odds ratio of proportions"){

        binom_odds_ratio_prop_crit(n_active = input$n_active, tv = input$tv/100, lrv = input$lrv/100,
n_control = input$n_comp, control = control_react(),

                    false_go = false_go(), false_stop = false_stop())

    }
    }
```

CONCLUSION

This application will serve as a ready-to-use, user-friendly and adaptable program. It has been well welcomed in Novo Nordisk.

REFERENCES

Frewer, P and Mitchell, P and Watkins, C and Matcham, J. "Decision-making in early clinical drug development." https://onlinelibrary.wiley.com/doi/full/10.1002/pst.1746

CONTACT INFORMATION

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BASIC INSTRUCTIONS

WRITING GUIDELINES

Writing style

- Use active voice. (Use passive voice only if the recipient of the action needs to be emphasized.) For example:

  The product creates reports. (active)
  Reports are created by the product. (passive)

- Use second person and present tense as much as possible. For example:

  You get accurate results from this product. (second person, present tense)
  The user will get accurate results from this product. (future tense)

- Run spellcheck, and fix errors in grammar and punctuation.

Citing references

All published work that is cited in your paper must be listed in the REFERENCES section.

If you include text or visuals that were written or developed by someone other than yourself, you must use the following guidelines to cite the sources:

- If you use material that is copyrighted, you must mention that you have permission from the copyright holder or the publisher, who might also require you to include a copyright notice. For example: "Reprinted with permission of SAS Institute Inc. from *SAS® Risk Dimensions®: Examples and Exercises*. Copyright 2004. SAS Institute Inc."

- If you use information from a previously printed source from which you haven't requested copyright permission, you must cite the source in parentheses after the paraphrased text. For example: "The minimum variance defines the distance between cluster (Ward 1984, p. 23)

TIPS FOR USING WORD

These instructions are written for MS Word 2007 and MS Word 2010. The steps are similar for MS Word 2003.

To select a paragraph style

1. Click the HOME tab. The most common styles in your document are displayed in the top right area of the Microsoft ribbon. If you don't see a style that you want, click the slanted down arrow at the bottom right corner of the Styles area, and scroll through the list. The main styles for this template are headings 1 through 4, PaperBody, and Caption. Avoid using other styles.

2. To change a paragraph style, click the paragraph to which you want to apply a style, and then click the style that you want in the ribbon.

3. PaperBody (used for most text) is automatically applied when you press Enter at the end of any heading style or the Caption style.

To insert a caption

1. Click **REFERENCES** on the main Word menu.

2. Click **Insert Caption**.

3. Select the **Label** type that you want.

4. Click **OK**.

To insert a cross-reference

1. Click **REFERENCES** on the main Word menu.

2. Click **Cross-reference**.

3. In the **Reference type** list box, select Heading, Figure, Table, Display, or Output.

4. For a heading:

   a. In the **For which heading** list, select the heading that you want.

       b.   From the **Insert reference to** list, select **Heading text.**

5.   For a figure, table, display, or output:

       a.   In the **For which caption** list, select the caption that you want.

       b.   From the **Insert reference to** list, select **Only label and number**.

To insert a graphic from a file

1.   Click **INSERT** on the main Word menu.

2.   Click **Picture**.

3.   In the Insert Picture dialog box, navigate to the file that you want to insert.

4.   When the name of the file that you want to insert is displayed in the **File name** box, click **Insert**.