AUTOMATING DATA ANALYSIS AND REPORTING WITH QUARTO

Leveraging Quarto and R for Dynamic Document Generation, Data Visualization, and Advanced Statistical Analysis Using the Setif Template

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1 Introduction

This document aims at demonstrating the capabilities of Quarto's document automation. The document is based on the simplereport template.

2 Code blocks using R

2.1 Tables

```
mtcars |>
  knitr::kable()
```

Table 1: mtcars R dataset

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
Cadillac Fleetwood	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4
Lincoln Continental	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
Chrysler Imperial	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4
Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
AMC Javelin	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
Camaro Z28	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
Ford Pantera L	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
Ferrari Dino	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
Maserati Bora	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2

```
USArrests  |>
  knitr::kable()
```

Table 2: USArrests R dataset from the datasets package

	Murder	Assault	UrbanPop	Rape
Alabama	13.2	236	58	21.2
Alaska	10.0	263	48	44.5
Arizona	8.1	294	80	31.0
Arkansas	8.8	190	50	19.5
California	9.0	276	91	40.6
Colorado	7.9	204	78	38.7
Connecticut	3.3	110	77	11.1
Delaware	5.9	238	72	15.8
Florida	15.4	335	80	31.9
Georgia	17.4	211	60	25.8
Hawaii	5.3	46	83	20.2
Idaho	2.6	120	54	14.2
Illinois	10.4	249	83	24.0
Indiana	7.2	113	65	21.0
Iowa	2.2	56	57	11.3
Kansas	6.0	115	66	18.0
Kentucky	9.7	109	52	16.3
Louisiana	15.4	249	66	22.2
Maine	2.1	83	51	7.8
Maryland	11.3	300	67	27.8
Massachusetts	4.4	149	85	16.3
Michigan	12.1	255	74	35.1

	Murder	Assault	UrbanPop	Rape
Minnesota	2.7	72	66	14.9
Mississippi	16.1	259	44	17.1
Missouri	9.0	178	70	28.2
Montana	6.0	109	53	16.4
Nebraska	4.3	102	62	16.5
Nevada	12.2	252	81	46.0
New Hampshire	2.1	57	56	9.5
New Jersey	7.4	159	89	18.8
New Mexico	11.4	285	70	32.1
New York	11.1	254	86	26.1
North Carolina	13.0	337	45	16.1
North Dakota	0.8	45	44	7.3
Ohio	7.3	120	75	21.4
Oklahoma	6.6	151	68	20.0
Oregon	4.9	159	67	29.3
Pennsylvania	6.3	106	72	14.9
Rhode Island	3.4	174	87	8.3
South Carolina	14.4	279	48	22.5
South Dakota	3.8	86	45	12.8
Tennessee	13.2	188	59	26.9
Texas	12.7	201	80	25.5
Utah	3.2	120	80	22.9
Vermont	2.2	48	32	11.2
Virginia	8.5	156	63	20.7
Washington	4.0	145	73	26.2
West Virginia	5.7	81	39	9.3
Wisconsin	2.6	53	66	10.8
Wyoming	6.8	161	60	15.6

2.2 Raw outputs

```
glm <- glm(mpg ~ disp, data = mtcars)
glm
```

```

Call:  glm(formula = mpg ~ disp, data = mtcars)
```

```
Coefficients:
(Intercept)         disp
   29.59985     -0.04122

Degrees of Freedom: 31 Total (i.e. Null);  30 Residual
Null Deviance:      1126
Residual Deviance: 317.2    AIC: 170.2
```

2.3 Plots

2.3.1 Base R plots

In this example, we plot the relationship between displacement and miles per gallon based on the mtcars dataset using the `plot()` function.

```
glm <- lm(mpg ~ disp, data = mtcars)
plot(mpg ~ disp, data = mtcars) # add general linear model dashed
line
abline(glm, col = "blue", lty = 2)
```

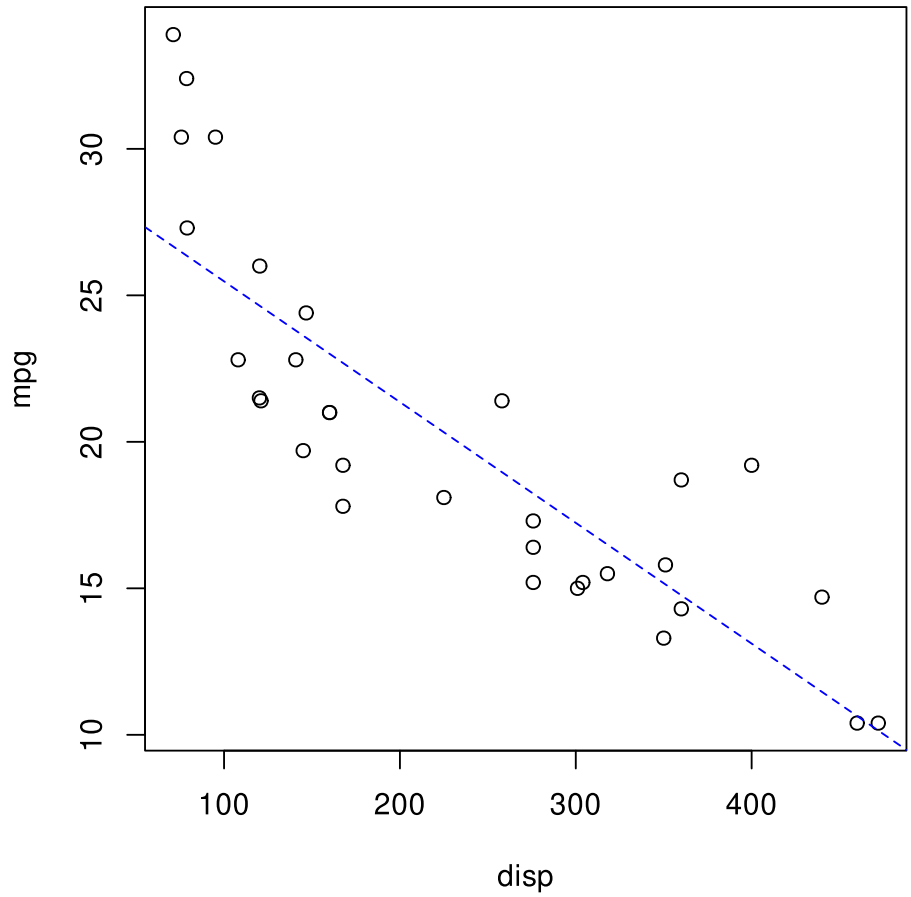

Figure 1: The figure describes the relationship between displacement and miles per gallon based on the mtcars dataset

2.3.2 ggplot2 plots

In this example, we plot the relationship between displacement and miles per gallon based on the mtcars dataset using the `ggpubr` package, a wrapper around the `ggplot2` package.

```
# install ggplot2 package if not already installed
if (!require("ggpubr")) {
  install.packages("ggpubr")
```

```
  library(ggpubr)
}
```

```
Loading required package: ggpubr
```

```
Loading required package: ggplot2
```

```
ggscatter(mtcars, x = "disp", y = "mpg", shape = 1,
          add = "reg.line",
          conf.int = TRUE,
          cor.coef = TRUE,
          cor.method = "pearson",
          xlab = "Displacement", ylab = "Miles per gallon") +
          theme_classic2() +
          theme(
            panel.border = element_rect(colour = "black", fill =
NA),
          )
```

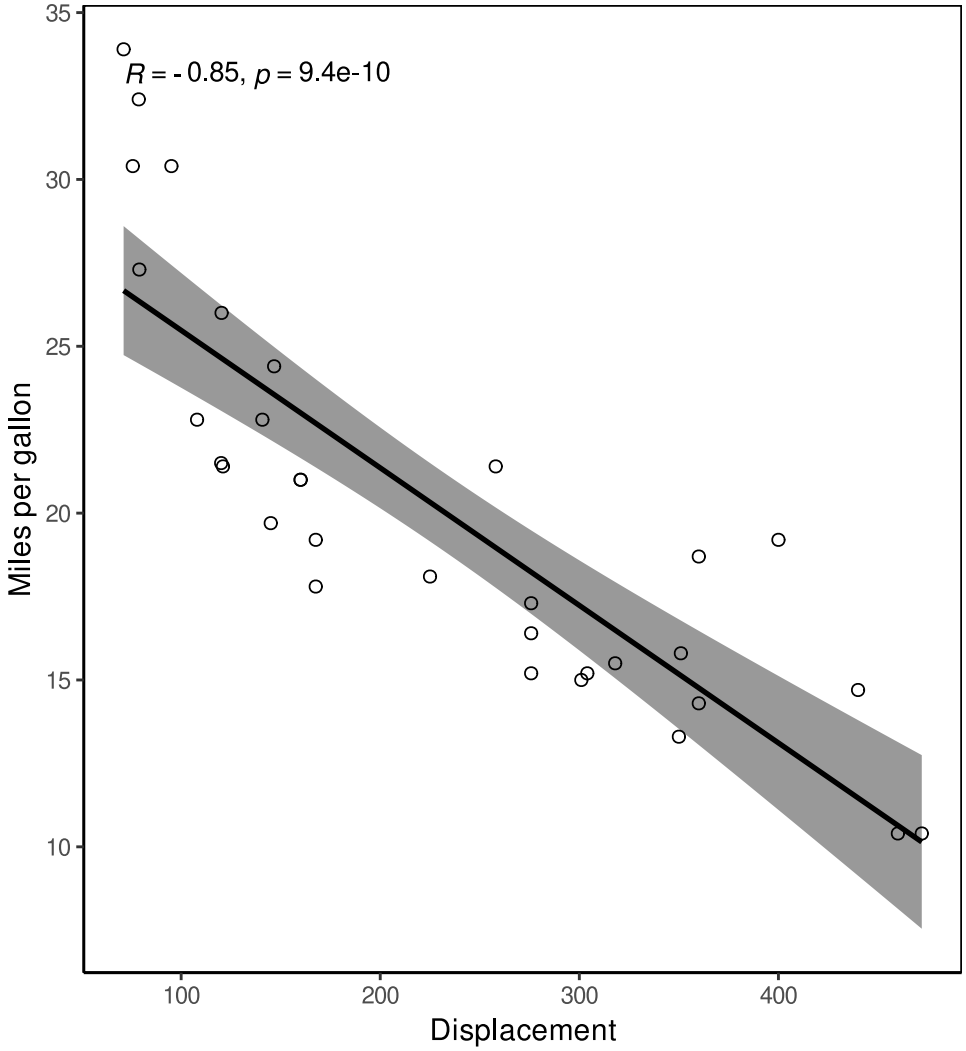

Figure 2: ggpubr figure describes the relationship between displacement and miles per gallon based on the mtcars dataset

3 Cross ref and refs

3.1 Cross references

The code block presented in Section 2.1 uses `R` to generate a table. The `mtcars` dataset is shown in Table 1.

3.2 References using BibTeX

This is how to reference a BibTeX entry A. Hazra and N. Gogtay [1] or like this [1].

4 Inline code blocks for automatic reporting

Here we can present an example of an inline code block. This is very useful for automatic reporting as we can use variables to include them directly in the text. For instance, the mean mpg of cars is shown 20.090625 (i.e. the previous number was generated using the `mean()` function from the `base` package).

4.1 More complex example

Now lets create a new `R` function that summarizes continuous variables by pasting the mean (SD) [min and max].

```
summary_continuous <- function(x, digits = 2) {
  # remove any NA values*
  x <- x[!is.na(x)]
  output <- paste0(
    round(mean(x), digits),
    " (",
    round(sd(x), digits),
    ") [",
    round(min(x), digits),
    " - ",
    round(max(x), digits),
    "]")
  return(output)
}
```

Now using the new function we can summarize the `mpg` variable from the `mtcars` dataset like so **20.09 (6.03) [10.4 - 33.9]**.

Now we can visualize the mean line in the same way as before in Figure 3.

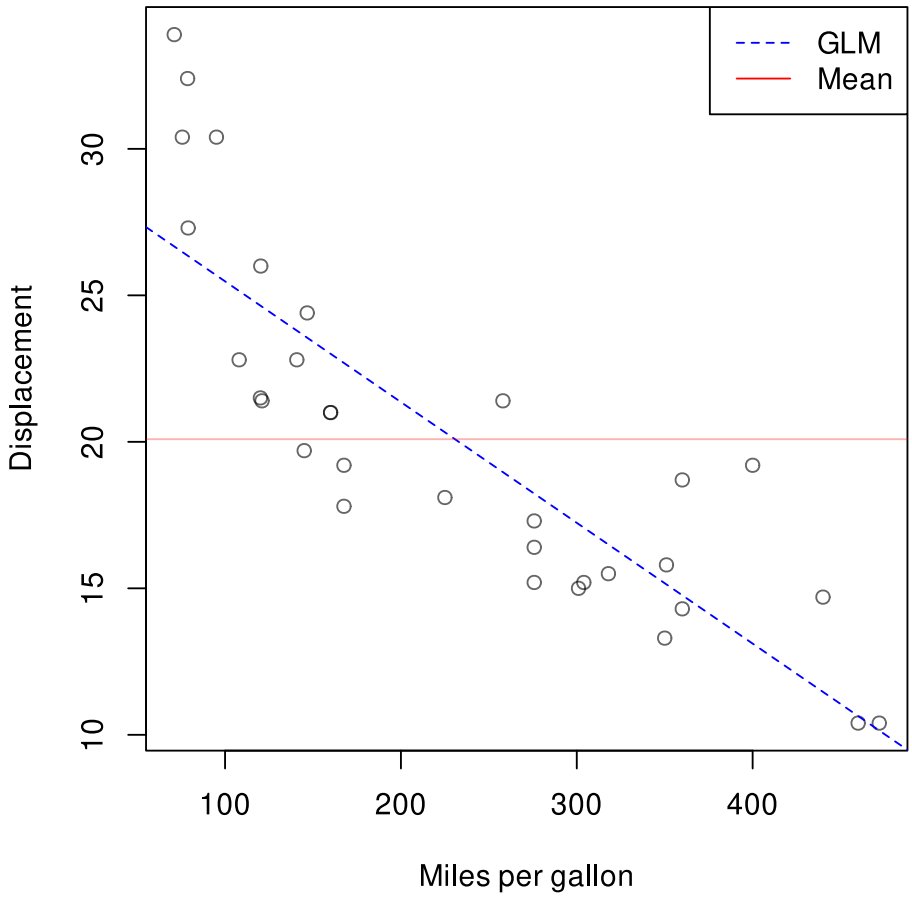

Figure 3: The figure shows the mean mpg of cars based on the mtcars dataset

4.2 Some lorem ipsums to check out the typst template

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5 Conclusion

This extended example document illustrates a wide range of features for creating automated reports with Quarto using the Setif template. We covered code execution, table generation, inline calculations, data visualization, and the use of custom functions to summarize data.

Bibliography

[1] A. Hazra and N. Gogtay, "Biostatistics Series Module 1: Basics of Biostatistics," *Indian Journal of Dermatology*, vol. 61, no. 1, pp. 10–20, 2016, doi: 10.4103/0019-5154.173988.

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