STAT100 - ASSIGNMENT 1

RESEARCH QUESTION

In 2023 it was estimated that 30% of all fatal road accidents in Australia were caused by drink driving. Unlike many other countries in the world, Australia has not yet adopted a zero tolerance policy against drink driving. The legal blood alcohol limit for operating an auto vehicle in Australia is 0.05% and the widely known rule of thumb which was handed down from the federal government is 2 standard drinks in the first hour and one every hour after that for men and for women, one standard drink in the first hour and one every hour after. In this research study we will ask the question:

What effects on coordination, cognitive function and attention does following the Australian government's drink driving guidelines have on adults and are these significant enough to suggest revising these guidelines.

The explanatory variable:

- Number of hours passed (numerical - discrete)

For every hour that passes, each participant will be drinking one standard drink (30mls of vodka). We are using hours as our explanatory variable and not drinks due to the fact that our male subjects will be drinking two standard drinks in the first hour and our female subjects are only drinking one, every hour after all participants will be drinking only one standard drink, therefore it has been decided that hours passed is a better explanatory metric for this study to avoid any confusion between the sex's.

The response variable:

- Motor skills score (numerical - discrete)

This will be a score based on the combined test results (see equation in method section below) of an attention test, an IQ test and a balancing test score all to be conducted once an hour after each standard drink. The variable is numerical - discrete as the attention test counts the number of misses made which are whole number integers, the balancing test is calculated in full seconds and the iq test is also an integer score and all of these will be summed together creating an integer.

METHODS

The population of interest for our study are humans of legal drinking age, i.e adults from age 18 and up.

The sampling method implemented for this study was multi-stage. This was achieved by first deciding to take 8 subjects from each of the islands (4 male, 4 female). Next I numbered each town on that island from 1 to however many there were from the top to the bottom of each island. From there I went to only odd numbered towns and chose only odd numbered houses to select from. I started with the lowest number (1) and then alternated between male and female, only taking one from a house at a time. If the subject declined to be a part of the study I would move onto the next odd numbered house in that town. If a subject agreed, I'd move onto the next odd numbered town and started again. This continued until I had 4 male and 4 females from each island, totaling 24 participants for the study.

I then went through the process of testing each participant with three basic tests, an attention, iq, and coordination to get some sober baseline values to compare against. Over the course of the next 5 hours, each participant would take a shot of vodka (two for men in the first hour and one for women in the first hour, one for each every hour after) and then sit the same tests each hour until the end. This was an observational study with hours passed and test scores being recorded for later analysis.

To calculate the ‘Motor skills’ response variable I have used a simple method of summing together each test into a single variable to measure the results. This is a fairly straightforward procedure, but there is one thing to consider and that is what each of the tests are measuring. Since the attention test is measuring the number of misses a participant makes, this score must be subtracted from the score instead of summed as it would make little sense to add a score that when increasing means you are doing worse. Other than this the ‘IQ test’ and the ‘number of seconds balanced’ are very straightforward and can be summed together. The final formula looks like this:

IQ test score + Balancing test - Attention test = Motor skills score.

DATA

Table 1's column variables explained:

at - attention score, number of ques missed in a 10 minute attention test

iq - iq score, the score obtained after a 20 minute iq test

ct - coordination score (seconds), how long a subject could balance on one foot blindfolded

Table 1 - Attention, iq and coordination test scores per hour/standard drink

Names	at_0	at_1	at_2	at_3	at_4	at_5	iq_0	iq_1	iq_2	iq_3	iq_4	iq_5	ct_0	ct_1	ct_2	ct_3	ct_4	ct_5
Paul Blomgren	9	19	33	33	50	47	90	81	84	75	71	74	36	37	25	16	42	20
Sacha Banerjee	9	16	20	30	54	36	98	89	86	81	79	81	38	42	41	31	15	18
Erik Carlsen	9	15	15	21	18	20	112	104	99	101	95	99	28	27	20	28	23	14
Julia Collins	6	13	20	24	27	27	92	93	82	85	86	84	56	31	22	21	28	20
Anika Dhawan	50	60	73	82	90	88	84	77	70	69	66	67	41	47	30	40	13	16
Layak Ganaka	1	1	2	2	2	1	136	130	127	124	121	125	24	34	17	14	11	14
Salvatire Garnier	26	33	38	49	59	45	81	72	71	69	68	74	49	44	26	29	15	29
Amie Hardy	6	8	7	14	12	20	114	102	98	99	94	92	39	13	18	3	6	24
Elin Ibsen	3	5	10	23	35	34	99	95	87	85	83	85	34	28	14	13	15	17
Dylan Jackson	15	27	20	31	33	40	89	79	79	79	77	77	20	22	18	13	19	10
Kirk Jensen	10	13	17	25	38	34	102	93	92	92	89	91	27	17	14	26	36	23
Raunak Krishna	8	18	30	41	36	33	90	82	80	78	75	80	38	48	31	26	36	20
Albert Nagel	6	14	19	28	28	25	98	92	89	85	87	84	22	17	25	26	35	20
Rida Page	4	6	4	17	22	9	114	104	103	97	96	97	54	37	17	32	18	32
Daniele Perrin	22	27	48	59	63	65	81	74	64	68	63	63	36	33	14	7	8	15
Chryselle Sato	3	3	10	5	9	9	119	111	107	103	98	100	20	19	25	16	8	7
Emma Sato	31	45	58	74	74	71	93	89	80	80	76	77	27	25	39	32	25	9
Erik Shibata	12	21	24	34	43	38	111	100	100	100	95	99	54	47	32	30	12	34
Kelda Solberg	4	7	13	15	13	26	109	100	95	98	93	91	62	21	20	17	16	23
Leon Solberg	3	8	13	13	16	14	103	97	93	91	93	91	39	15	21	9	18	33
Galen Sorensen	3	0	6	5	12	6	121	115	107	106	105	105	29	20	23	13	11	11
Kristjana Wilson	5	16	14	21	26	28	97	93	89	90	89	87	20	34	37	10	33	19
Tyr Wolff	3	9	12	10	16	16	128	121	117	117	119	117	10	29	11	12	15	10
Kyle Yamada	7	5	16	20	19	27	100	92	92	87	86	88	51	46	53	45	30	26

The below table contains the values of our response variable which have been calculated from Table 1's values as outlined in the method section above. Going forward we will be analyzing Table 1.1's values and not Table 1's as we are more concerned with the motor test scores and not the raw testing data for this study.

Table 1.1 - Motor Skills Test Scores Per Hour

Name	hour_0	hour_1	hour_2	hour_3	hour_4	hour_5
Paul Blomgren	117	99	76	58	63	47
Sacha Banerjee	127	115	107	82	40	63
Erik Carlsen	131	116	104	108	100	93
Julia Collins	142	111	84	82	87	77
Anika Dhawan	75	64	27	27	-11	-5
Layak Ganaka	159	163	142	136	130	138
Salvatire Garnier	104	83	59	49	24	58
Amie Hardy	147	107	109	88	88	96
Elin Ibsen	130	118	91	75	63	68
Dylan Jackson	94	74	77	61	63	47
Kirk Jensen	119	97	89	93	87	80
Raunak Krishna	120	112	81	63	75	67
Albert Nagel	114	95	95	83	94	79
Rida Page	164	135	116	112	92	120
Daniele Perrin	95	80	30	16	8	13
Chryselle Sato	136	127	122	114	97	98
Emma Sato	89	69	61	38	27	15
Erik Shibata	153	126	108	96	64	95
Kelda Solberg	167	114	102	100	96	88
Leon Solberg	139	104	101	87	95	110
Galen Sorensen	147	135	124	114	104	110
Kristjana Wilson	112	111	112	79	96	78
Tyr Wolff	135	141	116	119	118	111
Kyle Yamada	144	133	129	112	97	87

Table 2 - Motor Skills Test Summary Statistics

A table containing important statistics calculated from the data collected during the study comparing certain motor skills tests against number of hours drinking alcohol

No of Hours	Min	1st Quartile	IQR	3rd Quartile	Median	Mean	Max
0	75	113.5	31.3	144.8	130.5	127.5	167
1	64	96.5	29.7	126.2	111.5	109.5	163
2	27	80	33	113	101.5	94.25	142
3	16	62.5	46.5	109	85	83	136
4	-11	63	33.25	96.25	87.5	74.88	130
5	-5	61.75	34.75	96.5	79.5	76.38	138
Total % change	-106.67	-45.59	11.02	-33.36	-39.08	-40.09	-17.37

Note: Total % change shows the difference from the 0-th hour of the study i.e no drinks consumed, to the fifth or last hour of the study, this number shows total change over the length of the study. We have also included sample statistics for all of the separate tests over each hour in Appendix A below as well as general observations of the plotted data for each test.

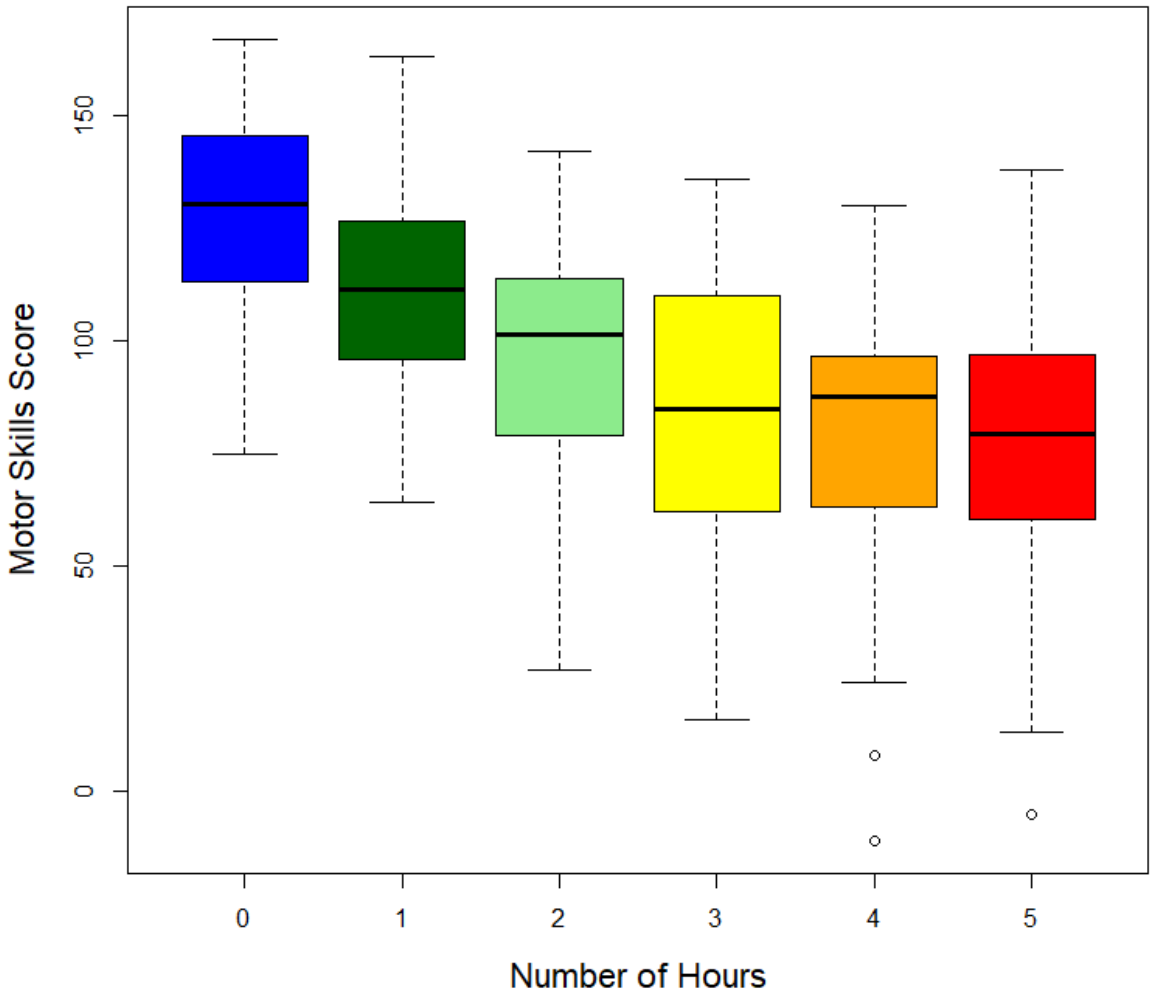

Figure 1 - Motor Skills Test Scores sorted by Number of hours past

As we can see in figure 1 there is a fairly strong downtrend of motor skill scores, the median continues to drop from start to end even though we see a brief period of plateauing at the 3 hour mark. Furthermore we see an increase in variance over the course of the study suggesting that perhaps alcohol affects people differently when performing these tests. Finally we see a small amount of right skew at the beginning of the study which reappears in the second and fourth hour but overall our data looks fairly normal.

SUMMARY AND DISCUSSION

Looking at our Table of statistics for our Motor skills tests, it is very clear that we see a significant change from the beginning of the experiment to the end. A first clear indication of this is to look at our median and mean, both decreased by 40% from the start of the study when no drinks had been consumed, to the end once all participants had consumed one standard drink per hour. This statistic alone is incredibly glaring to look at as to see such a significant drop of our sample population's motor skills when following Australian Government guidelines for drink driving, and has to make you question what thought went into these guidelines. When looking at our Inter quartile range or variance we may see some answers to this question, with an 11% increase from start to end, this suggests to me something that is fairly obvious, alcohol consumption affects everyone differently and the more that is consumed the more that varies. As to how this may answer the question on guidelines, perhaps with this being only a suggested guideline, the government is trying to capture as much of the population in their suggestion of how to drink drive instead of catering to just the worst cases. Adding more to this idea is the min and max values from our study. The maximum saw a 17% decrease with the minimum seeing a 106% decrease, going so low as to enter the negative. This to me further highlights the above claims showing that the worst case is far worse than the best case and that perhaps the government should revise these guidelines to cater more towards the worst case as it is a matter of life and death.

Figure 1 helps visualize this line of thought showing a sharp drop off from hours 0 to 3 and then an increase in variance from hours 3 to 5. The third hour of the study does have the widest Inter quartile range and could be considered to have the most volatile effect on a human's motor skills when drinking. This leads to what could be considered a helpful suggestion of only consuming two standard drinks in total if you are driving later on. One final piece of analysis is that although the medium does continue to drop after 3 hours of drinking, it does seem as though we are reaching a place of diminishing returns, suggesting that the worst is over in terms of loss of skills. That being said, outliers do start to appear after the 3rd hour as well as the gap between max and min whiskers to continue to increase.

Overall our results are telling of what happens to an individual's ability to pay attention, use coordination, not make mistakes, and solve problems after consuming alcohol at a rate that is suggested by the Australian government if that individual will be operating an auto vehicle. One can easily argue that these skills are imperative and central to being able to drive a car safely not only for themselves but for others they share the road with. The results we found today show that all of these skills see a sharp drop off when following the government's guidelines and suggest that perhaps these guidelines should be looked into and reassessed.

One possible confounding variable to be looked into is perhaps fatigue. Possibly we would have seen decreases in a participants abilities to perform these tests regardless of alcohol consumption simply due to 5 hours of repeated testing being very taxing already. In the future if this experiment was to be held with the results affecting governmental considerations, a control group who would not be consuming any alcohol and only water would be a good idea to help measure fatigue levels and help provide a more accurate estimation of the effects of alcohol consumption when following the Australian government guidelines.

RSTUDIO script

```
# Assignment 1 - STAT100

# Read in our data, assign it a variable, and attach it as our working dataset
motor_skills = read.csv("../workshop-datasets/motor_skills_tests.csv")
attach(motor_skills)

# Function for printing summaries of our column data
print_summeries = function(list_of_variables) {

  for (x in list_of_variables) {
    print(summary(x))
  }
}

# Function for plotting a boxplot
boxplot_generator = function(variables, y_label) {

  boxplot(variables, names=label_names, xlab="Number of Hours",
          col=c('blue', 'darkgreen','lightgreen','yellow','orange','red'),
          ylab=y_label)
}

# list of names for our boxplots x axis
label_names = c("0", "1", "2", "3", "4", "5")

# Create a list of our columns variables from our test results
motor_skills_results = list(hour_0,      hour_1,          hour_2, hour_3,          hour_4,
hour_5)

# Call our summaries function to get all useful information for all variables
# to be used in creating information tables for better understanding of the numbers
print_summeries(motor_skills_results)

# Call our boxplot function to display our boxplots & apply a small edit to their display
par(cex.lab='1.35')    # should be placed at the top of the script, keeping here for relevance
boxplot_generator(motor_skills_results, "Motor Skills Score")

detach(motor_skills)
```

```
# ---------- FOR APPENDIX CHARTS ONLY----------

# Read in our data, assign it a variable, and attach it as our working dataset
drinking = read.csv("../workshop-datasets/drink_driving.csv")
attach(drinking)

# three lists for each of our response variables we want to plot results for
attention_variables = list(attention_none,      attention_one, attention_two,
                           attention_three,     attention_four, attention_five)

iq_variables = list(iq_none,    iq_one,         iq_two, iq_three,       iq_four,        iq_five)

coord_variables = list(coord_none,   coord_one,     coord_two,     coord_three,
                       coord_four,     coord_five)

# Call our summaries function to get all useful information for all variables
# to be used in creating information tables for better understanding of the numbers
print_summeries(attention_variables)
print_summeries(iq_variables)
print_summeries(coord_variables)

# Call our boxplot function to display our boxplots
par(cex.lab='1.35')
boxplot_generator(attention_variables, "Attention Mistakes Made (10 min period)")
boxplot_generator(iq_variables, "IQ Scores")
boxplot_generator(coord_variables, "Balance Test Scores (seconds)")
```

APPENDIX A

Table 2.A - A summary of important “Attention Test Score” statistics

No of Drinks	Min	1st Quartile	IQR	3rd Quartile	Median	Mean	Max
0	1	3.75	6.75	10.5	6.5	10.62	50
1	0	6.75	12.75	19.5	13.5	16.21	60
2	2	11.5	14	25.5	16.5	21.75	73
3	2	14.75	18.5	33.25	23.5	28.17	82
4	2	16	28.75	44.75	27.5	33.12	90
5	1	19	19.5	38.5	27.5	31.62	88
Total % change*	0.00	406.67	188.89	266.67	323.08	197.74	76.00

Table 3.A - A summary of important “IQ Test Score” statistics

No of Drinks	Min	1st Quartile	IQR	3rd Quartile	Median	Mean	Max
0	81	91.5	21	112.5	99.5	102.5	136
1	72	87.25	15.25	102.5	93	95.21	130
2	64	81.5	17.75	99.25	90.5	91.29	127
3	68	79.75	19.5	99.25	88.5	89.96	124
4	63	76.75	18.25	95	88	87.67	121
5	63	79.25	18.25	97.5	87.5	88.67	125
Total % change*	-22.22	-13.39	-13.10	-13.33	-12.06	-13.49	-8.09

Table 4.A - A summary of important “Coordination Test” statistics

No of Drinks	Min	1st Quartile	IQR	3rd Quartile	Median	Mean	Max
0	10	26.25	16.75	43	36	35.58	62
1	13	20.75	17.5	38.25	30	30.54	48
2	11	17.75	12.5	30.25	22.5	24.71	53
3	3	13	16.25	29.25	19	21.21	45
4	6	12.75	15.75	28.5	17	20.33	42
5	7	14	9.25	23.25	19.5	19.33	34
Total % change*	-30.00	-46.67	-44.78	-45.93	-45.83	-45.67	-45.16

* “Total % change” refers to the percent difference in the various statistics from no drinks consumed to the 5th drink consumed

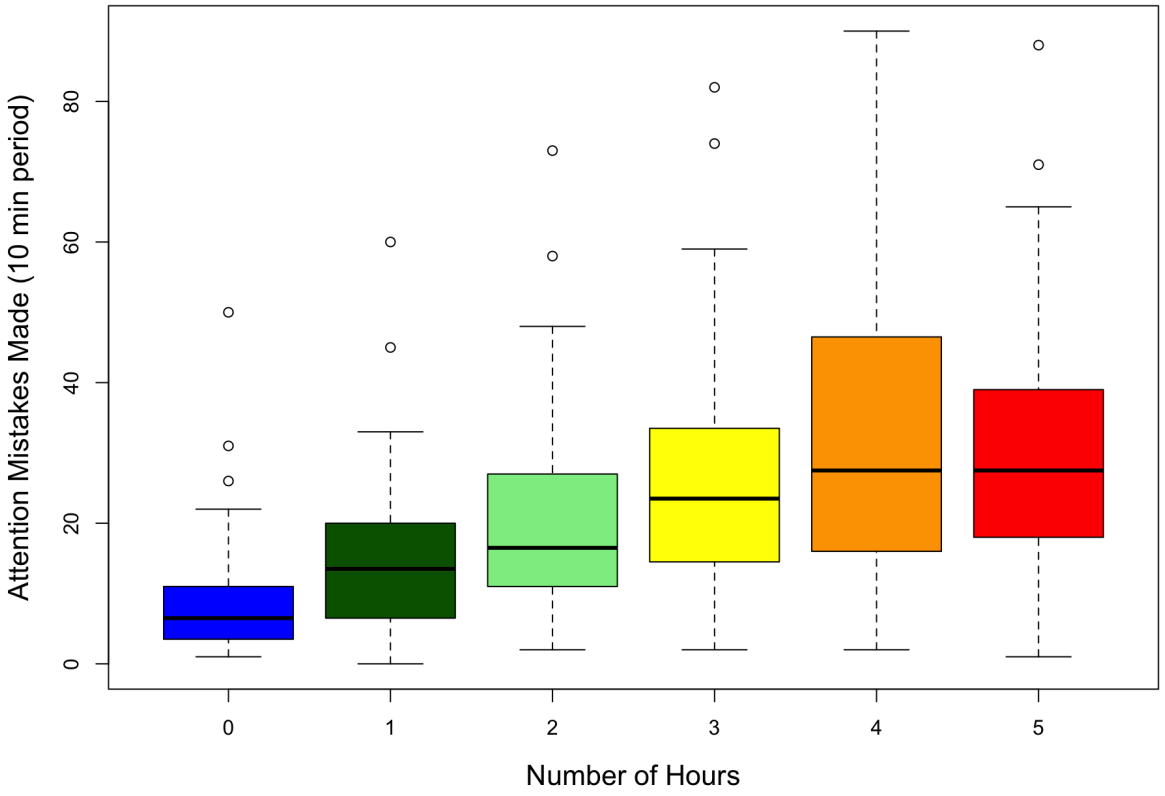

Figure 1.A - Attention scores sorted by number of drinks consumed

Despite the number of drinks consumed, there seems to be a fairly heavy right screw in all of the plots suggesting that in general only a minority of participants score poorly on this test while the majority do “ok” in relative terms. We can also see that the interquartile ranges (IQR) for each plot continuously expands until around the 4th drink mark where the scores seem to taper off.

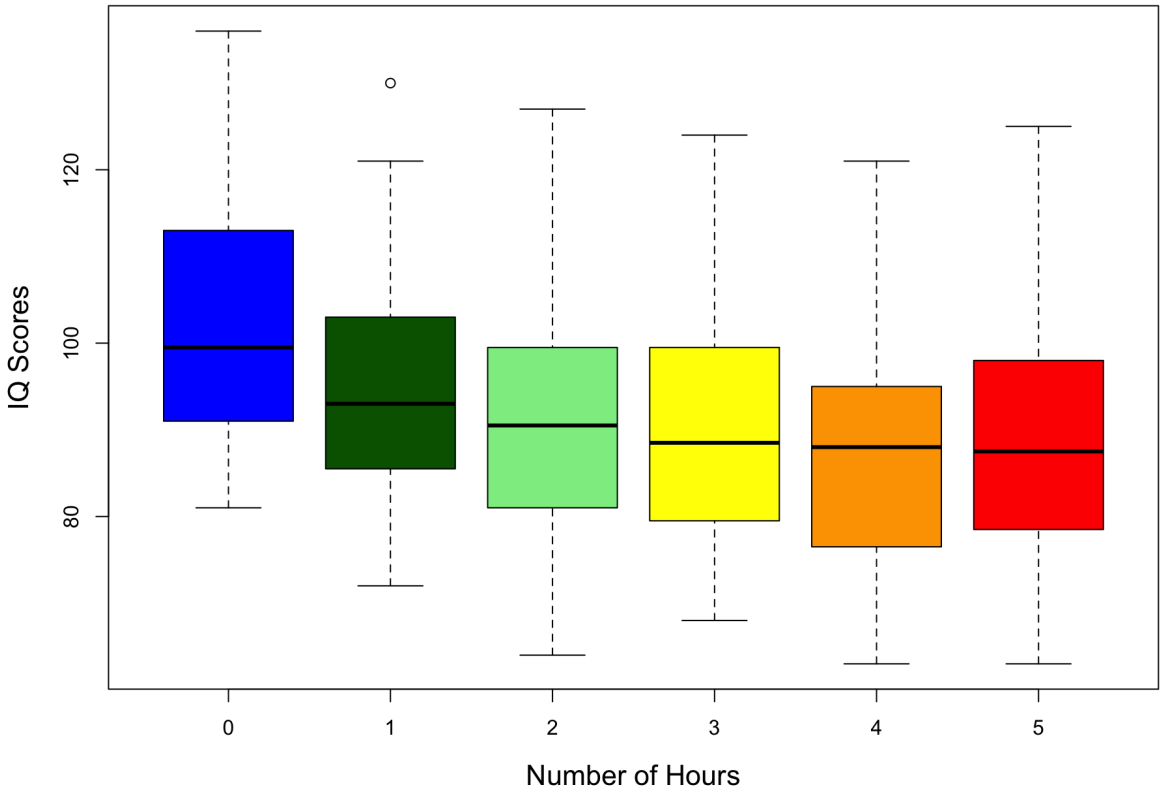

Figure 2.A - IQ scores sorted by number of drinks consumed

There is a little bit of right screw apparent in these plots, but compared to the attention scores above it is significantly reduced. From drink 2 to 5 the low score seems to bottom out suggesting that perhaps there is a limit to how much a person's IQ score can drop when drinking one standard drink each hour. Similarly to the attention score, the IQ does decline but by the 4th drink it does seem to level out though the median does continue to drop.

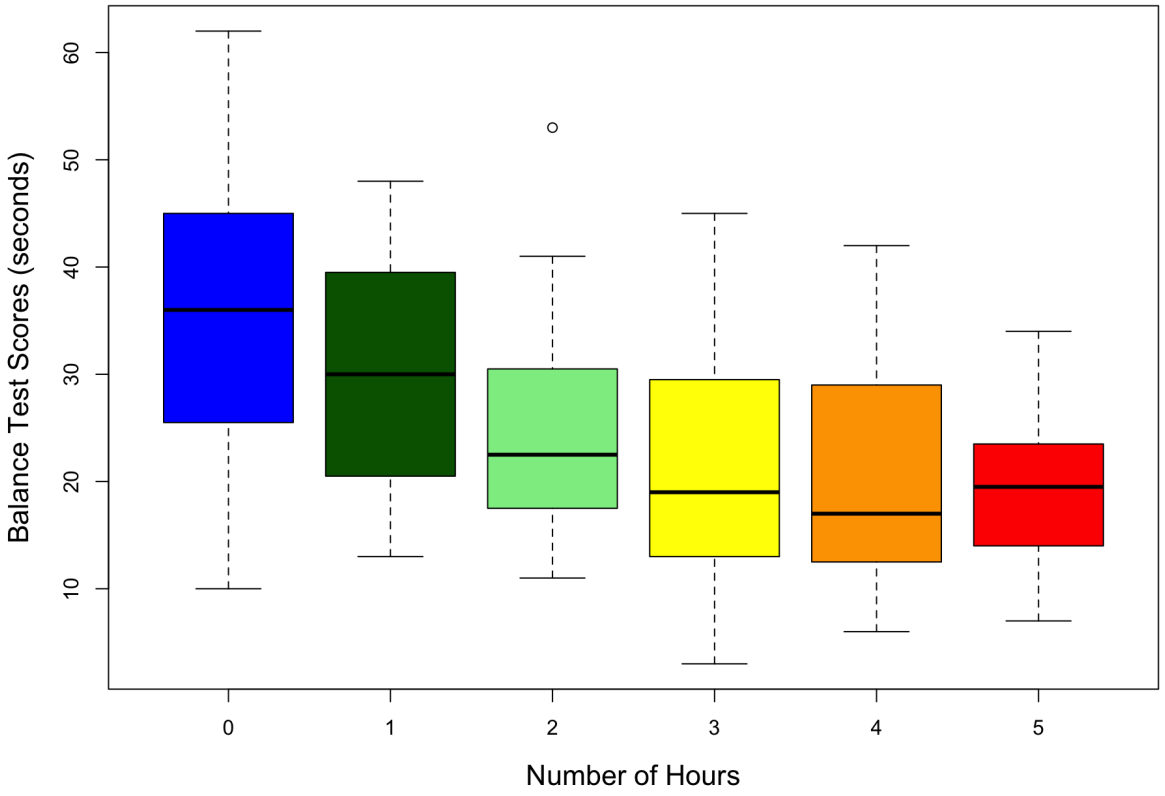

Figure 3.A - Number of seconds a participant can balance blind folded vs the number of drinks consumed.

Once again we have a similar right skew as the IQ scores above and the scores seem to bottom out around the 4th drink mark and bounce slightly for the 5th drink. Although something to note here is despite the 5th drink's median sitting slightly higher than the 4th, its interquartile range is the lowest and tightest of all drinks with the highest score being significantly lower than all others as well.