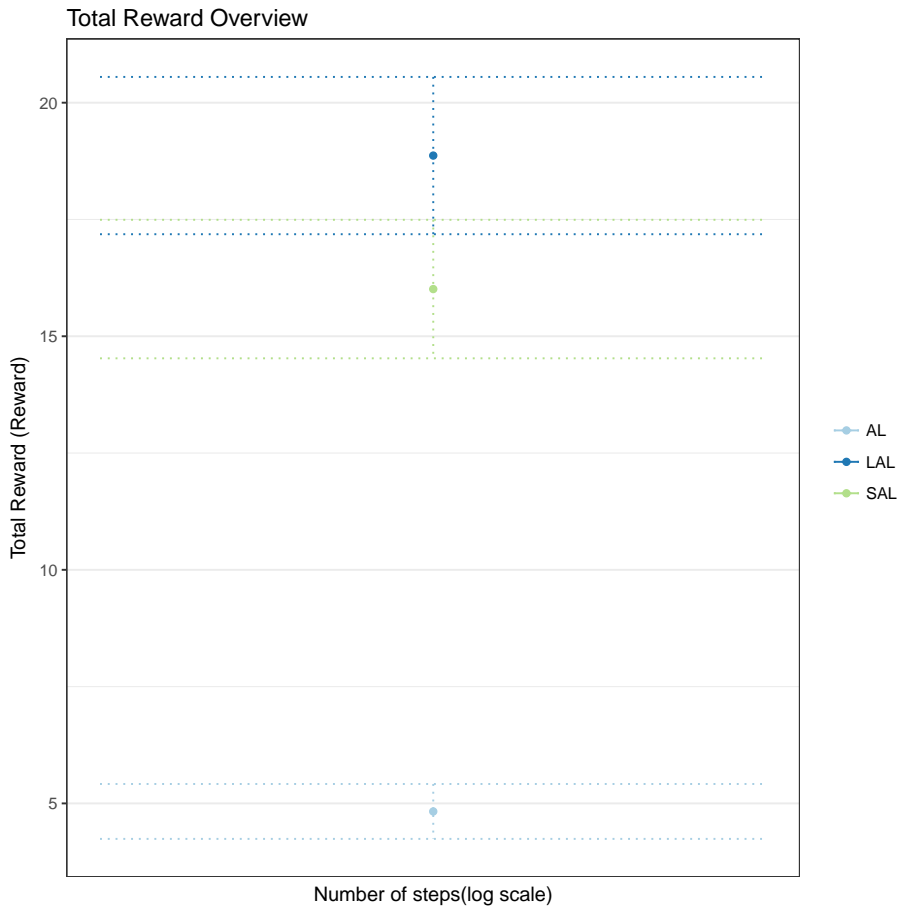December 4, 2019

1 Description

2 Overview

Total Reward Overview

Messsages Overview

Messsages (Messages)

Number of steps(log scale)

AL
LAL
SAL

Completed Tasks Overview

Runtime Overview

AL
LAL
SAL

Runtime (Seconds)

Number of steps(log scale)

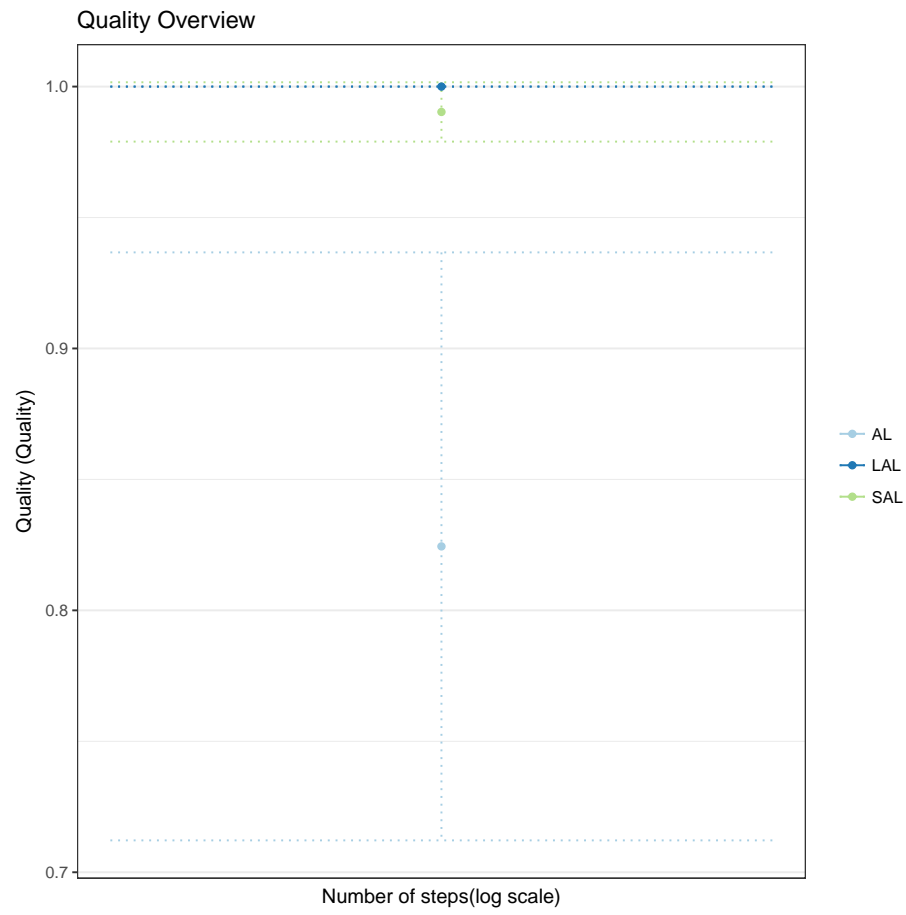Quality Overview
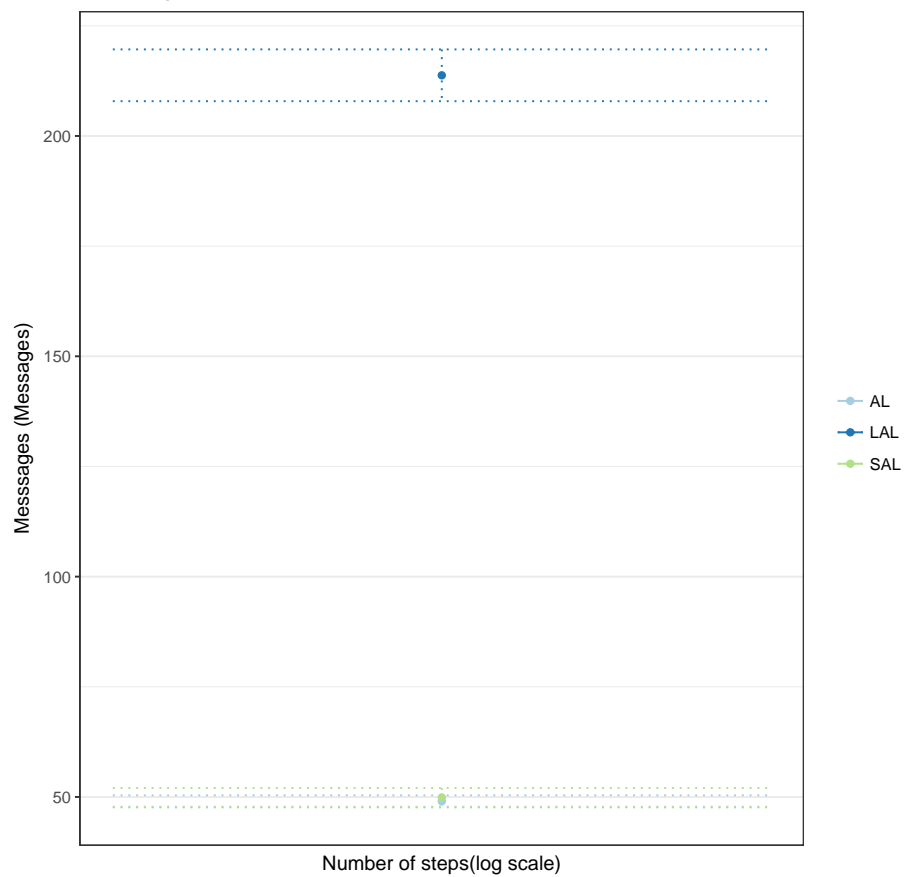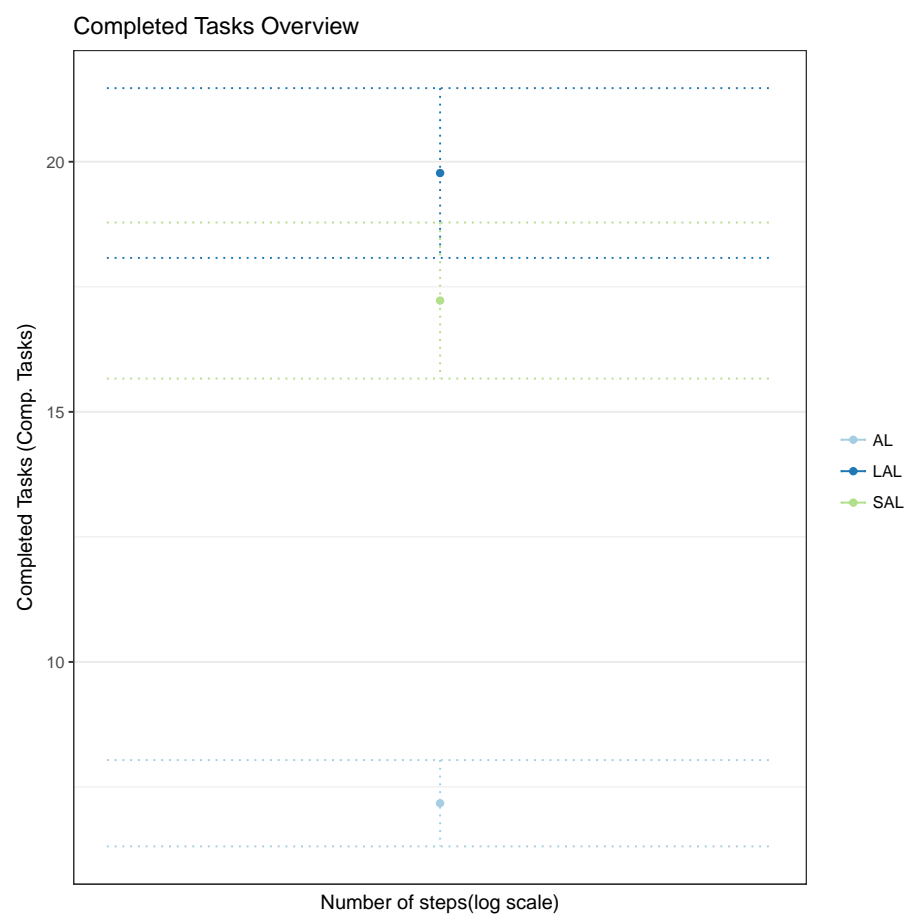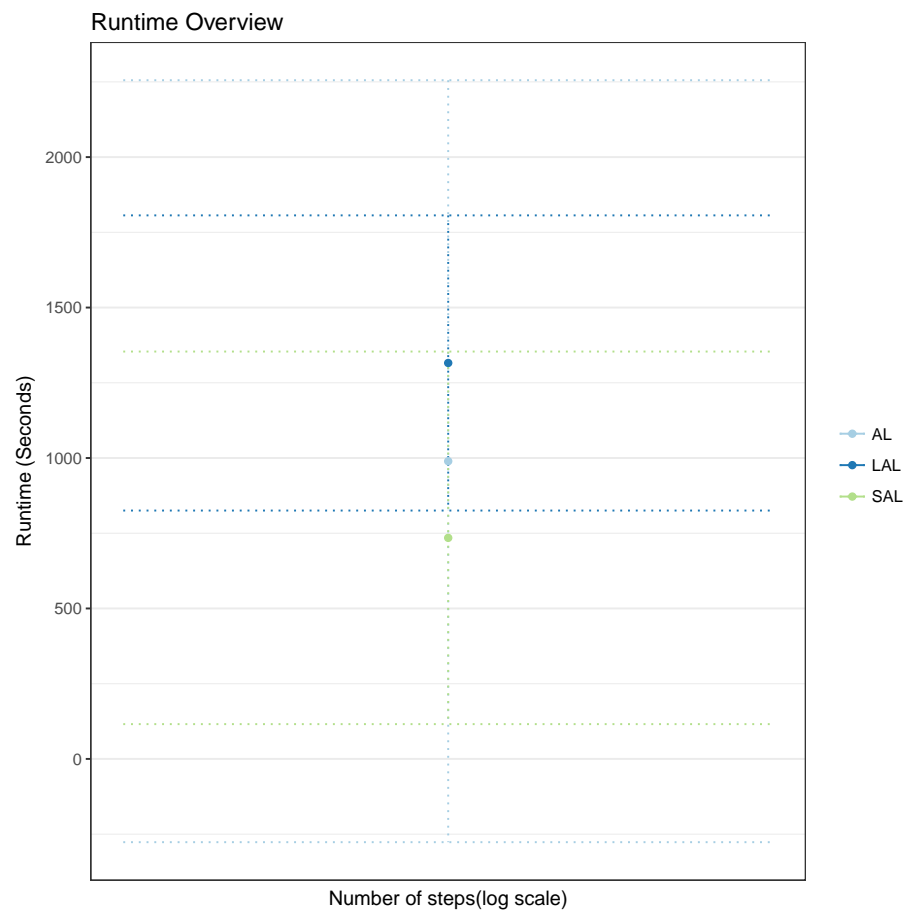
2.1 Objects Overview
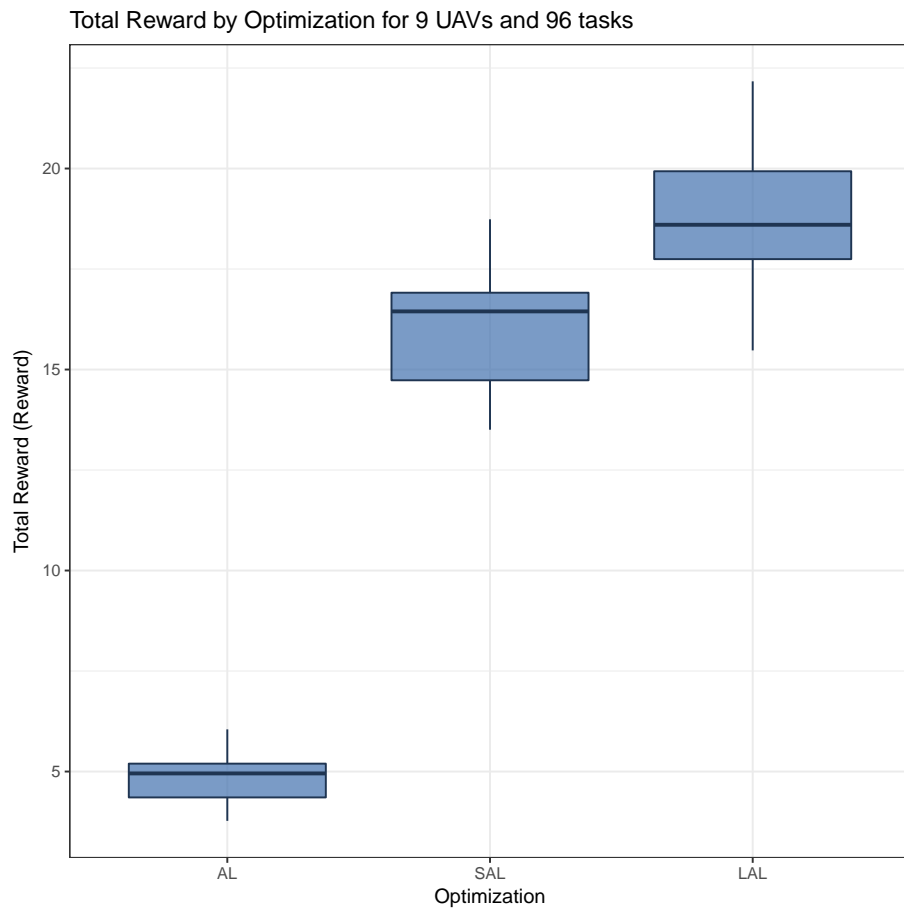
2.1.1 Overview for 9 UAVs and 96 tasks

Total Reward by Optimization for 9 UAVs and 96 tasks

Messsages by Optimization for 9 UAVs and 96 tasks

Completed Tasks by Optimization for 9 UAVs and 96 tasks

Runtime by Optimization for 9 UAVs and 96 tasks
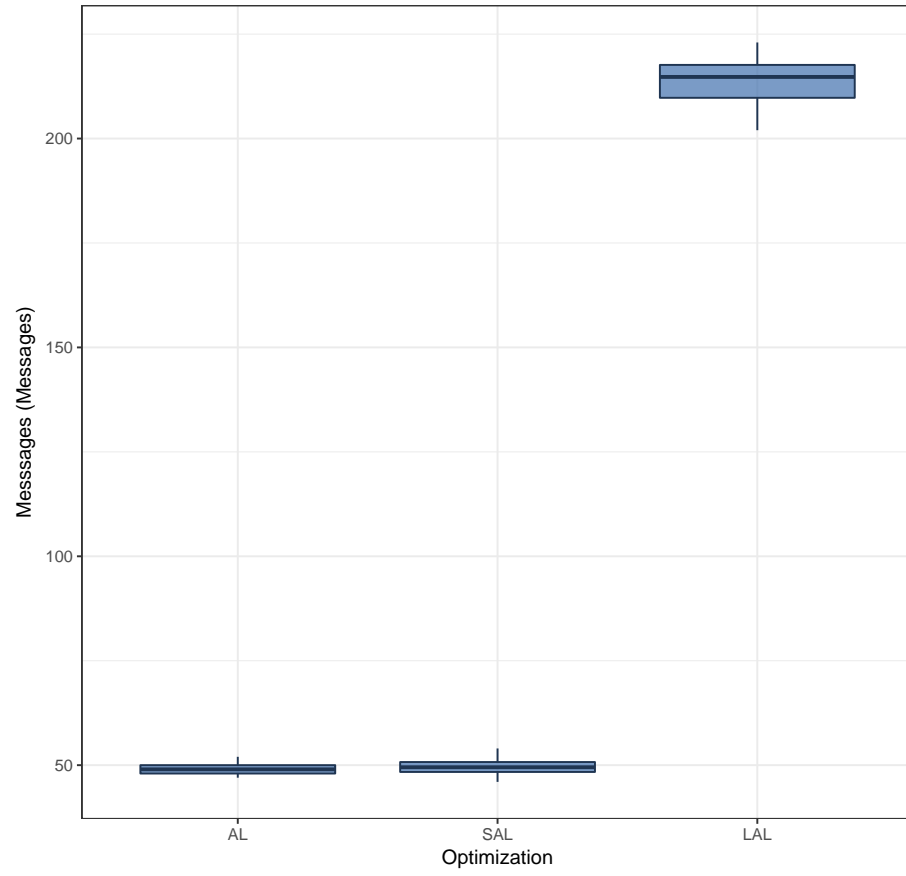
Quality by Optimization for 9 UAVs and 96 tasks
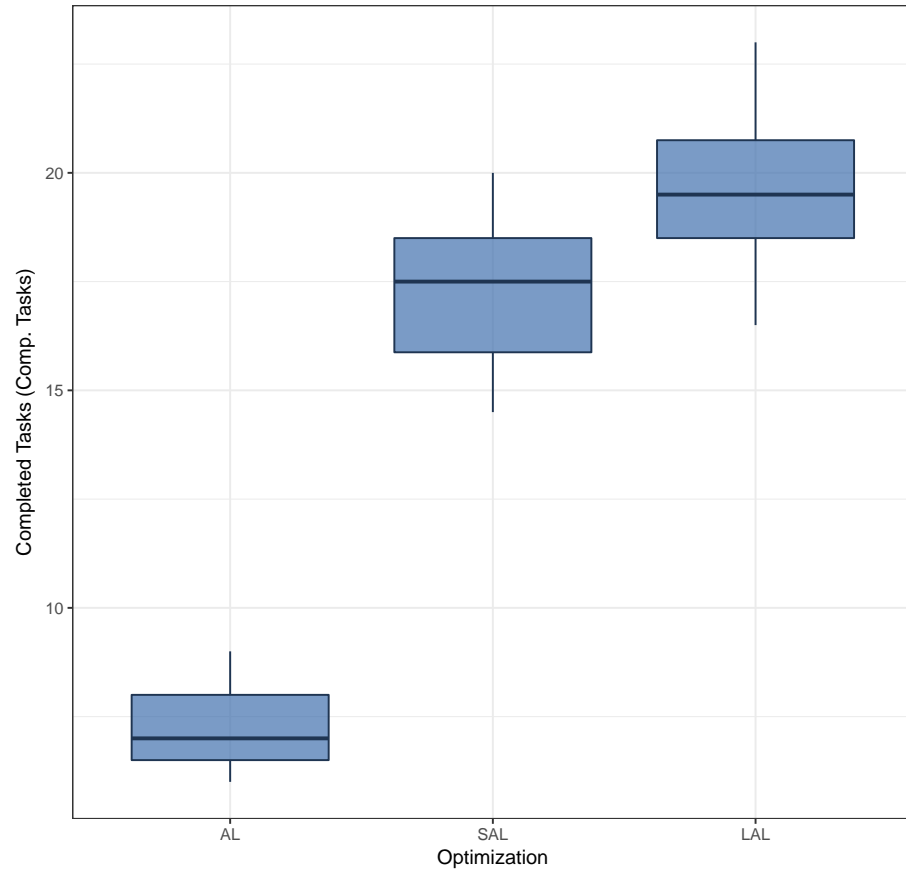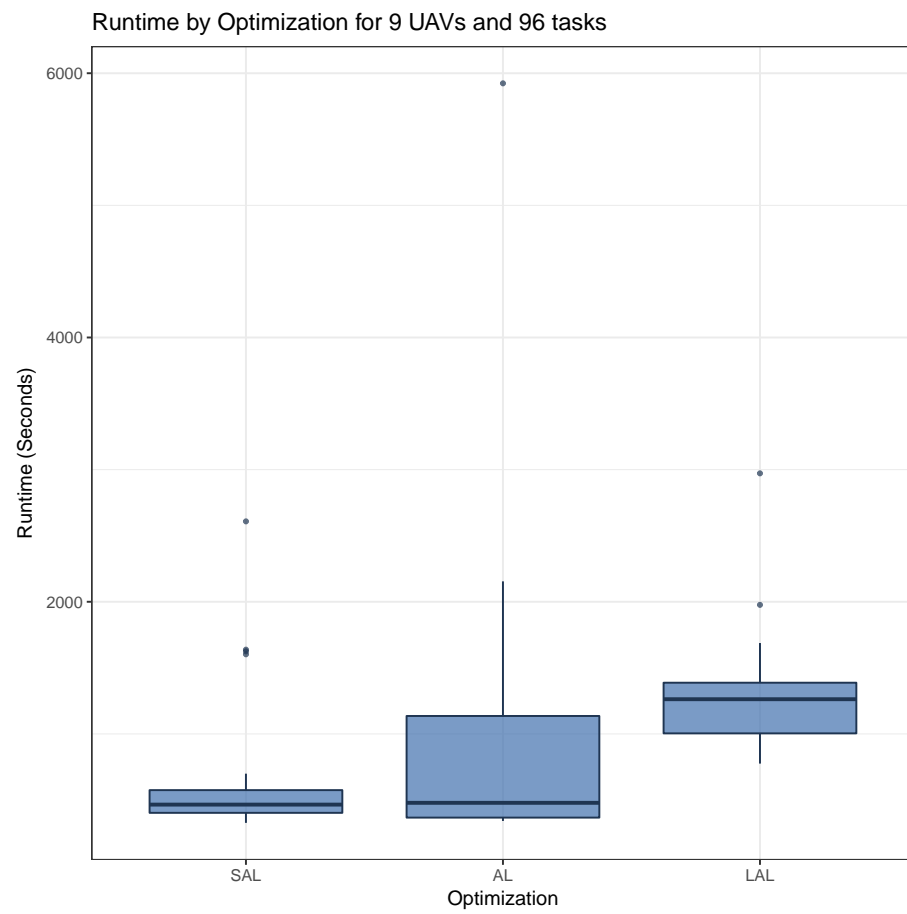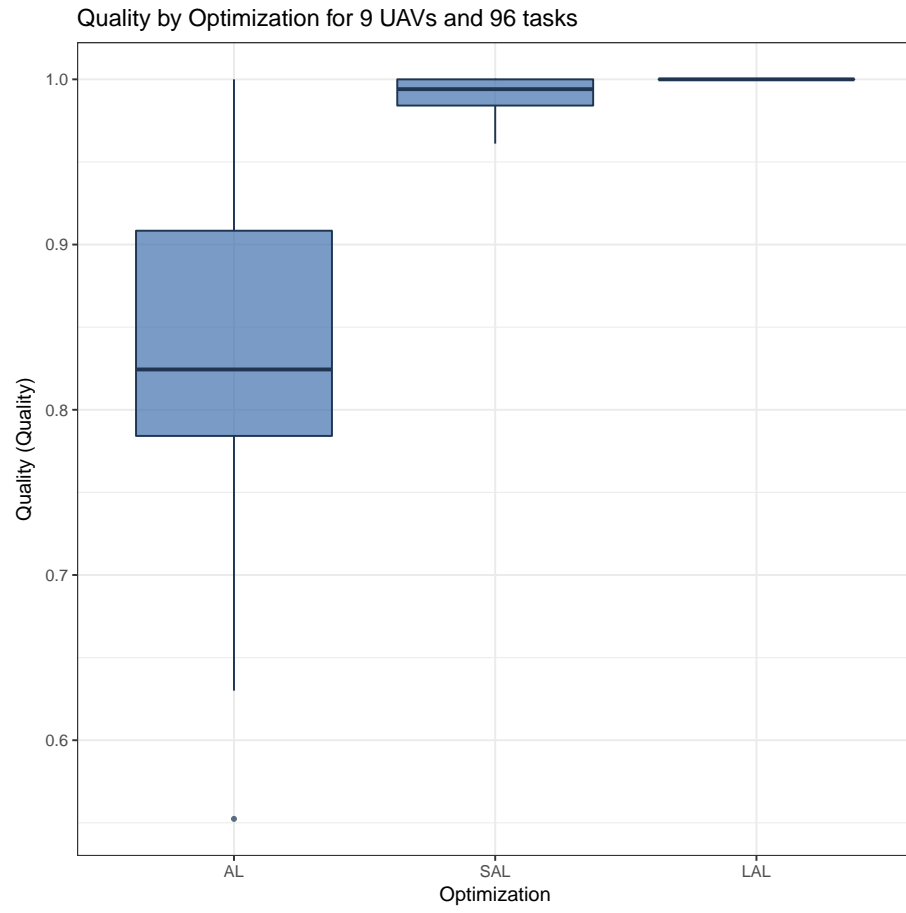
3 Research Hypotheses

3.1 RH1: Reward for LAL is equals than Reward for SAL

Total Reward Overview
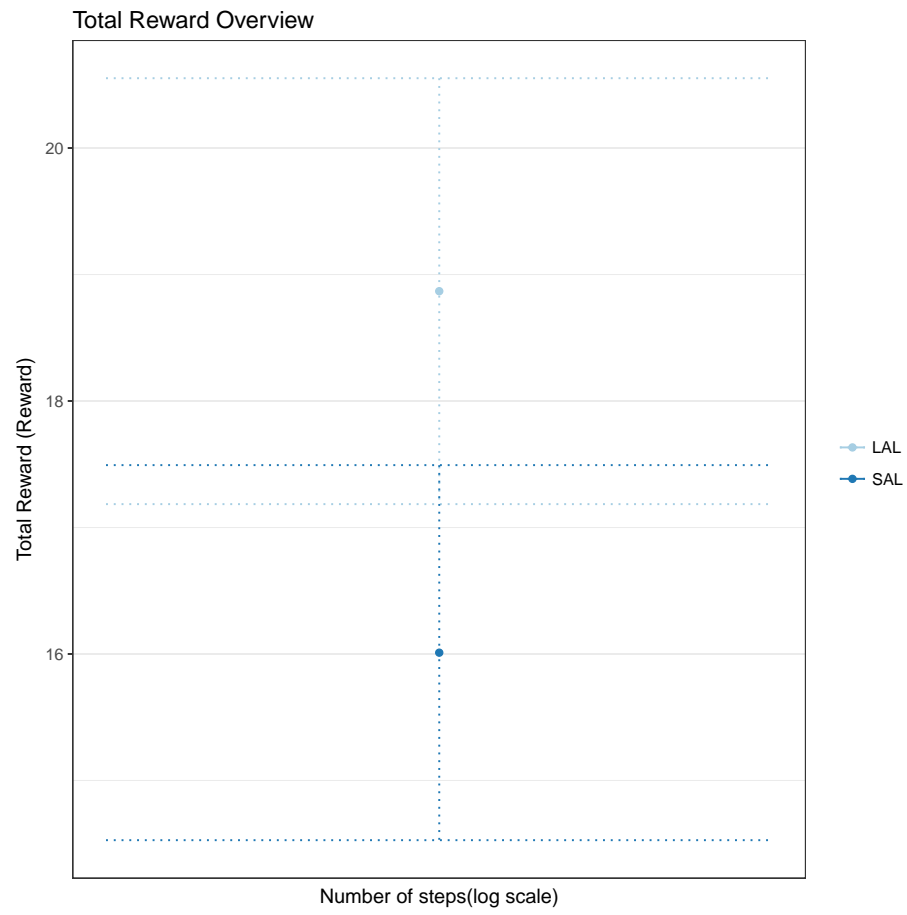
3.1.1 RH1.1: Object 9 UAVs and 96 tasks

Total Reward for LAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   15.48   17.75   18.60   18.87   19.93   22.17
```
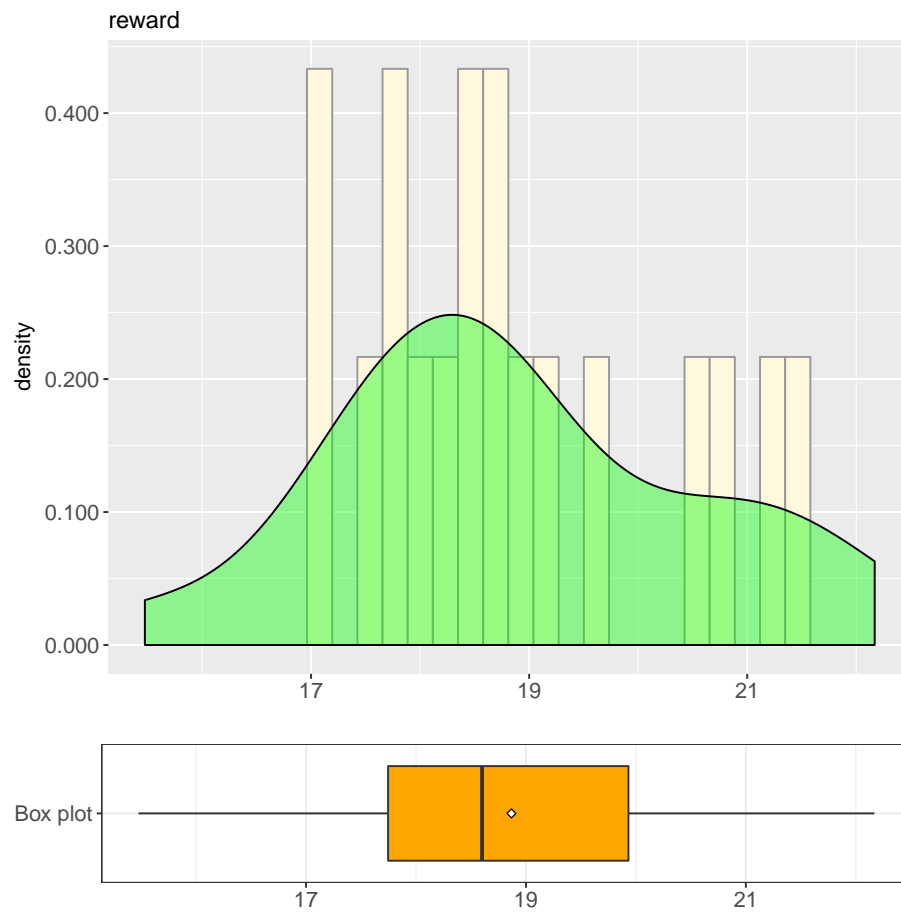
reward


```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$reward
## W = 0.96571, p-value = 0.6629
## 
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.662864621713108"
```

Total Reward for SAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   13.50   14.73   16.45   16.01   16.91   18.74
```
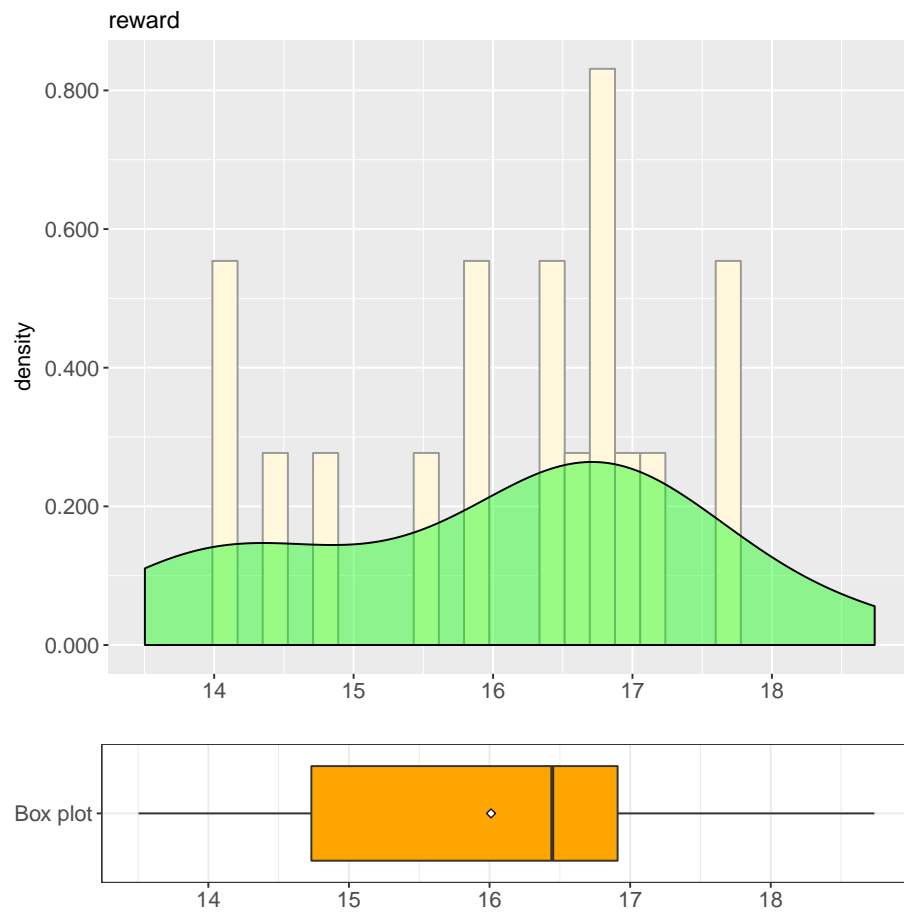
reward

Box plot

```
##
##  Shapiro-Wilk normality test
##
## data:  subset(json_data, treatment == "SAL" & object == "experiment6")$reward
## W = 0.95094, p-value = 0.3816
##
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.381553911695679"
```

Comparison
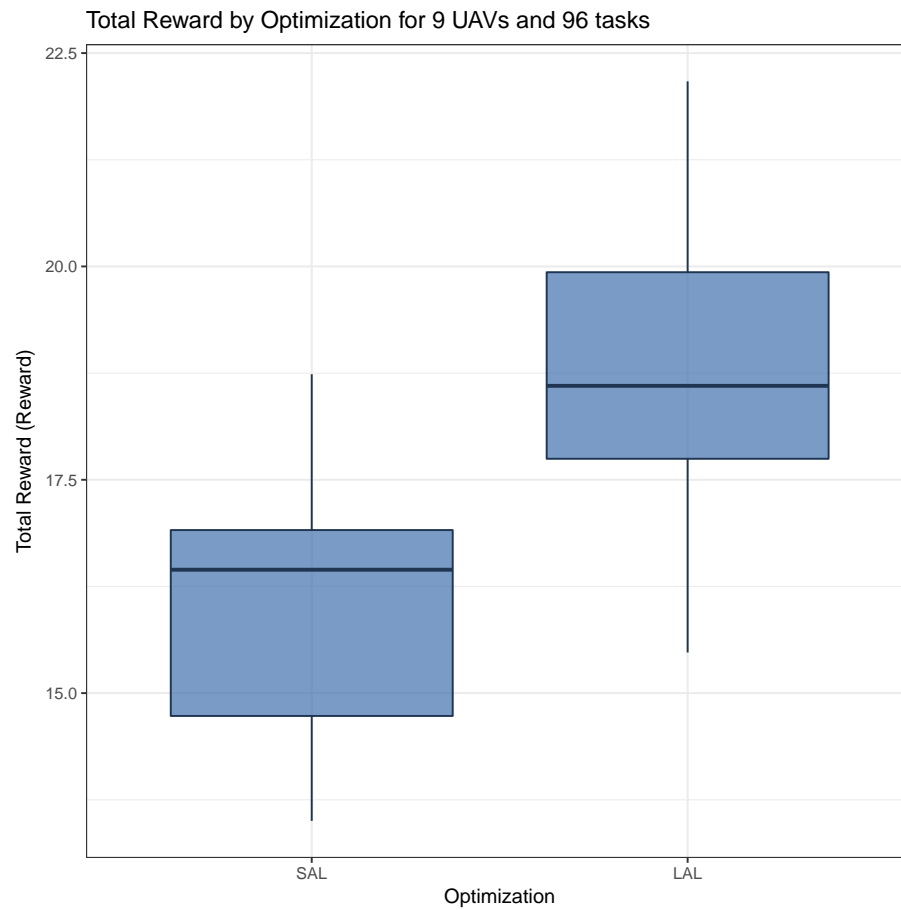
Total Reward by Optimization for 9 UAVs and 96 tasks


```
## [1] "Fisher's F-test to verify the homoskedasticity (homogeneity of variances)"
##
##   F test to compare two variances
##
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$reward and subset(
## F = 1.2896, num df = 19, denom df = 19, p-value = 0.5848
## alternative hypothesis: true ratio of variances is not equal to 1
## 95 percent confidence interval:
##  0.5104483 3.2581682
## sample estimates:
## ratio of variances
##           1.289623
##
## [1] "Homogeneity of variances: TRUE. P-value: 0.584808582792787"
## [1] "Assuming that the two samples are taken from populations that follow a Gaussian dist
##
```

```
##  Two Sample t-test
##
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$reward and subset(
## t = 5.697, df = 38, p-value = 1.483e-06
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  1.842253 3.873187
## sample estimates:
## mean of x mean of y
##  18.86827  16.01055
##
## [1] "T-test: Null Hypothesis rejected. P-value: 1.4825003184035e-06"
## [1] ""
## [1] "Means comparison"
## [1] "Mean Total Reward for LAL:  18.86827"
## [1] "Mean Total Reward for SAL:  16.01055"
## [1] "Absolute difference:  2.85772"
## Total Reward for LAL is  17.8489808282664 % greater than
##  Total Reward for SAL
```

3.1.2 RH1 Results: Total Reward LAL = SAL

Table 1: RH1 Results per Object

9 UAVs and 96 tasks	LAL > SAL

Table 2: RH1 Results Summary

LAL < SAL:	0%
LAL > SAL:	100%
LAL:	0%
SAL:	0%
None:	0%
Inconclusive:	0%

3.2 RH2: Reward for LAL is equals than Reward for AL

Total Reward Overview
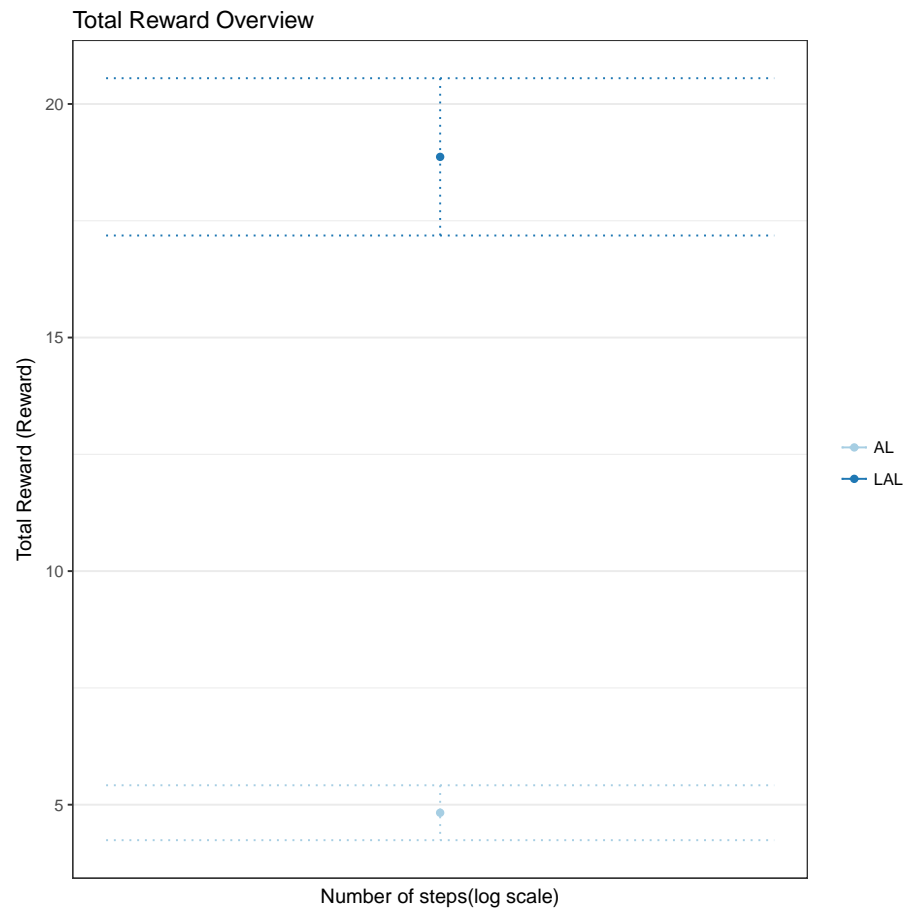
3.2.1 RH2.1: Object 9 UAVs and 96 tasks

Total Reward for AL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   3.773   4.356   4.953   4.828   5.196   6.049
```
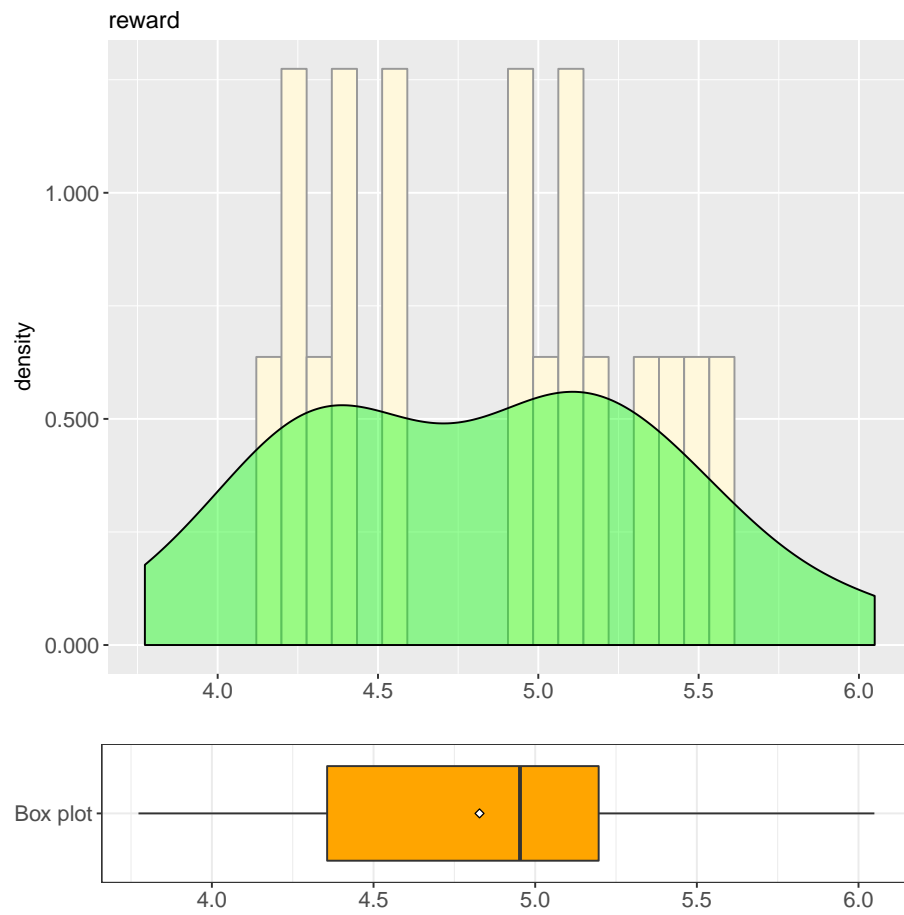
reward


```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "AL" & object == "experiment6")$reward
## W = 0.97059, p-value = 0.7674
## 
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.767368211800189"
```

Total Reward for LAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   15.48   17.75   18.60   18.87   19.93   22.17
```
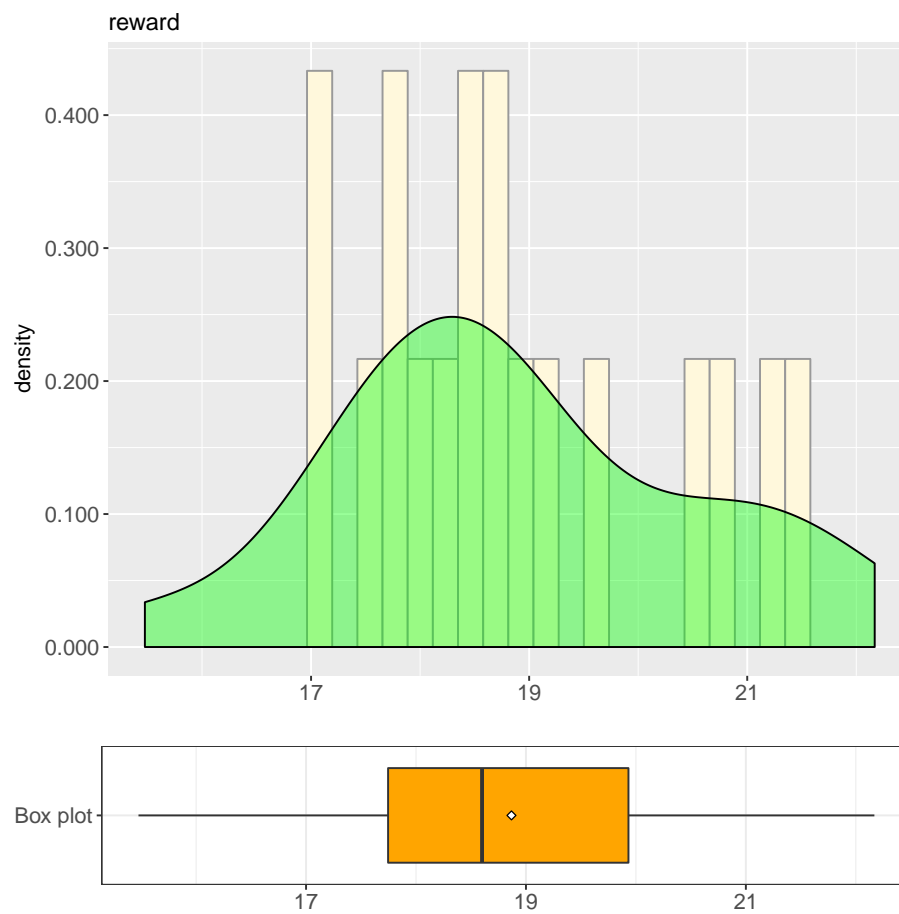
reward

```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$reward
## W = 0.96571, p-value = 0.6629
## 
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.662864621713108"
```

Comparison
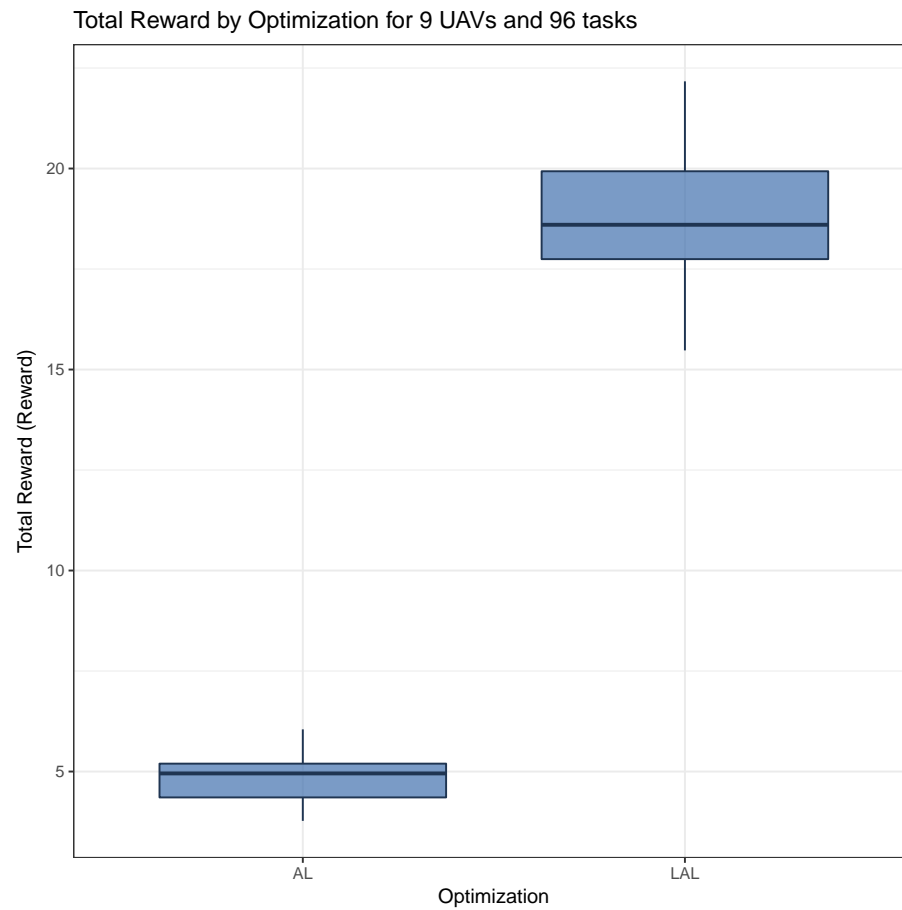
Total Reward by Optimization for 9 UAVs and 96 tasks


```
## [1] "Fisher's F-test to verify the homoskedasticity (homogeneity of variances)"
##
##   F test to compare two variances
##
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$reward and subset(
## F = 8.2069, num df = 19, denom df = 19, p-value = 2.736e-05
## alternative hypothesis: true ratio of variances is not equal to 1
## 95 percent confidence interval:
##   3.248381 20.734271
## sample estimates:
## ratio of variances
##           8.206876
##
## [1] "Homogeneity of variances: FALSE. P-value: 2.73564479011945e-05"
## [1] "Assuming that the two samples are taken from populations that follow a Gaussian dist
##
```

```
##  Welch Two Sample t-test
##
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$reward and subset(
## t = 35.212, df = 23.563, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  13.21670 14.86422
## sample estimates:
## mean of x mean of y
##  18.86827    4.82781
##
## [1] "T-test: Null Hypothesis rejected. P-value: 6.93685672334856e-22"
## [1] ""
## [1] "Means comparison"
## [1] "Mean Total Reward for LAL:  18.86827"
## [1] "Mean Total Reward for AL:  4.82781"
## [1] "Absolute difference:  14.04046"
## Total Reward for LAL is  290.824618201628 % greater than
##  Total Reward for AL
```

3.2.2 RH2 Results: Total Reward LAL = AL

Table 3: RH2 Results per Object
9 UAVs and 96 tasks   LAL > AL

Table 4: RH2 Results Summary

LAL < AL:	0%
LAL > AL:	100%
LAL:	0%
AL:	0%
None:	0%
Inconclusive:	0%

3.3 RH3: Messages from LAL is equals than Messages for SAL

Messsages Overview
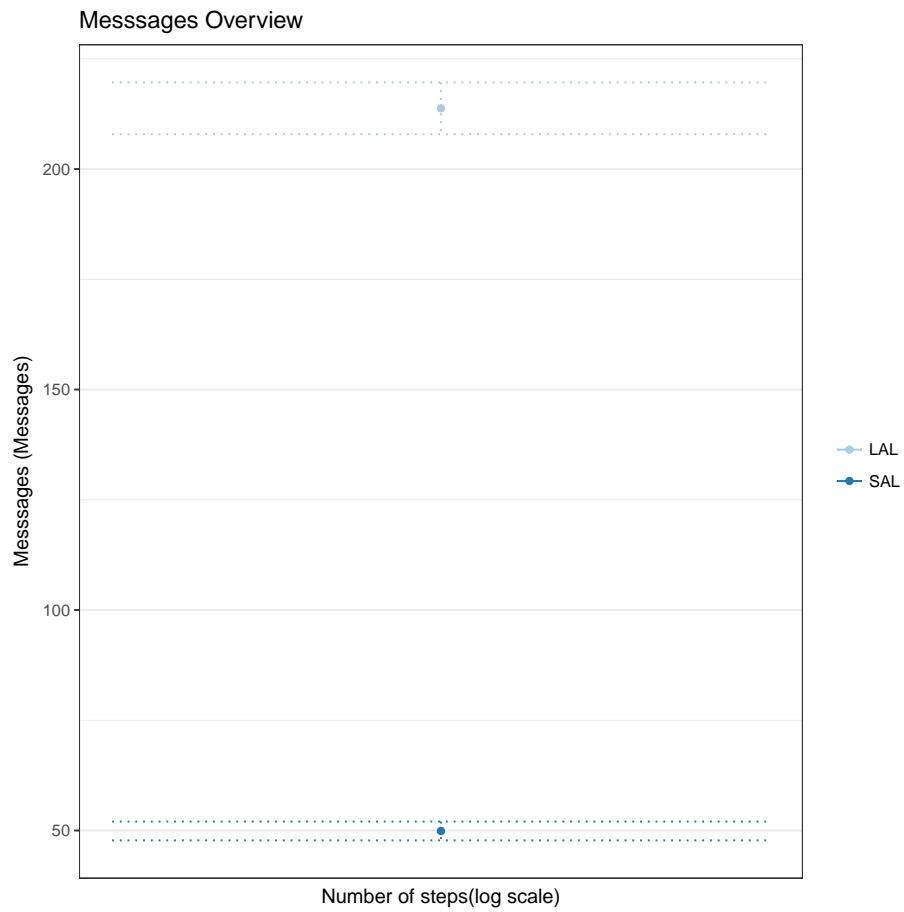
3.3.1 RH3.1: Object 9 UAVs and 96 tasks

Messsages for LAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   202.0   209.8   214.8   213.8   217.6   223.0
```
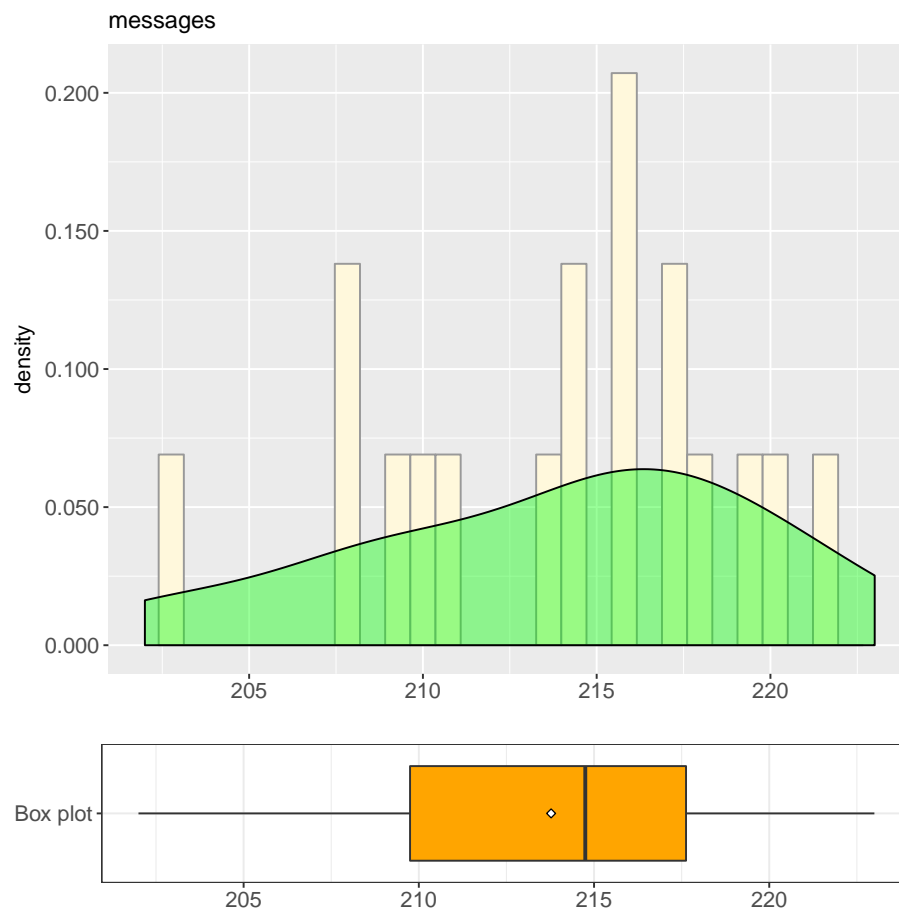
messages


```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$messages
## W = 0.9602, p-value = 0.5479
## 
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.547932125635498"
```

Messsages for SAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   46.00   48.38   49.50   49.90   50.75   54.00
```
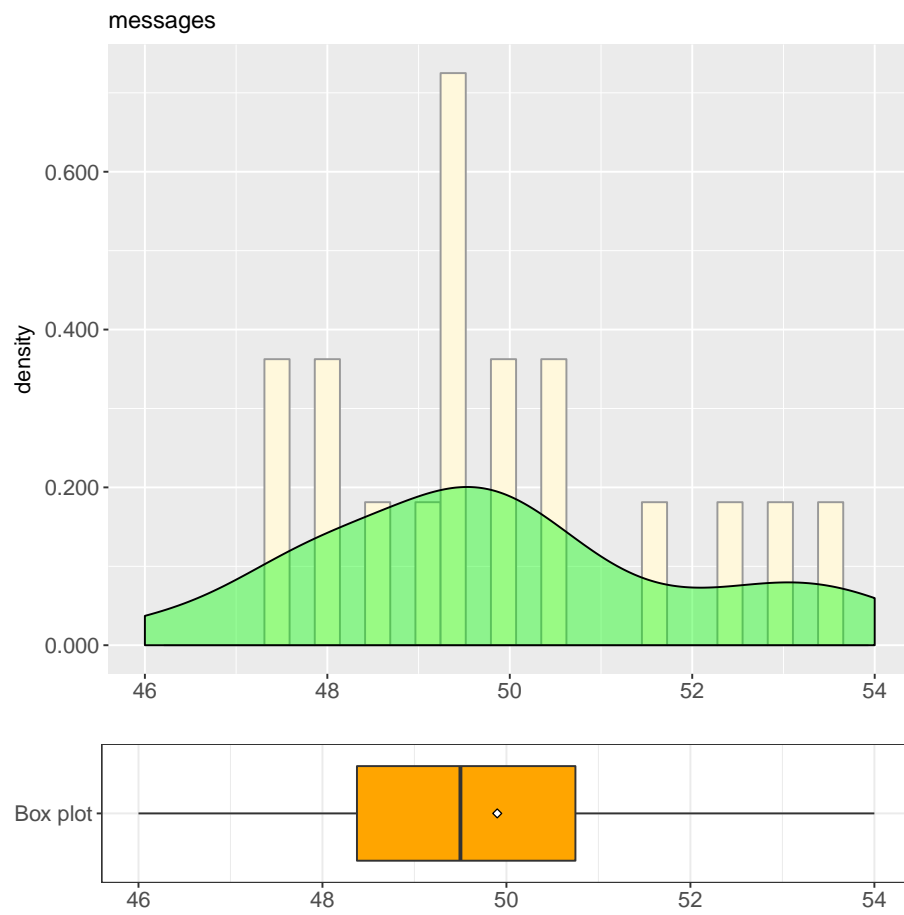
messages


```
## 
##   Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "SAL" & object == "experiment6")$messages
## W = 0.95977, p-value = 0.5393
## 
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.539254623440362"
```

Comparison

Messsages by Optimization for 9 UAVs and 96 tasks
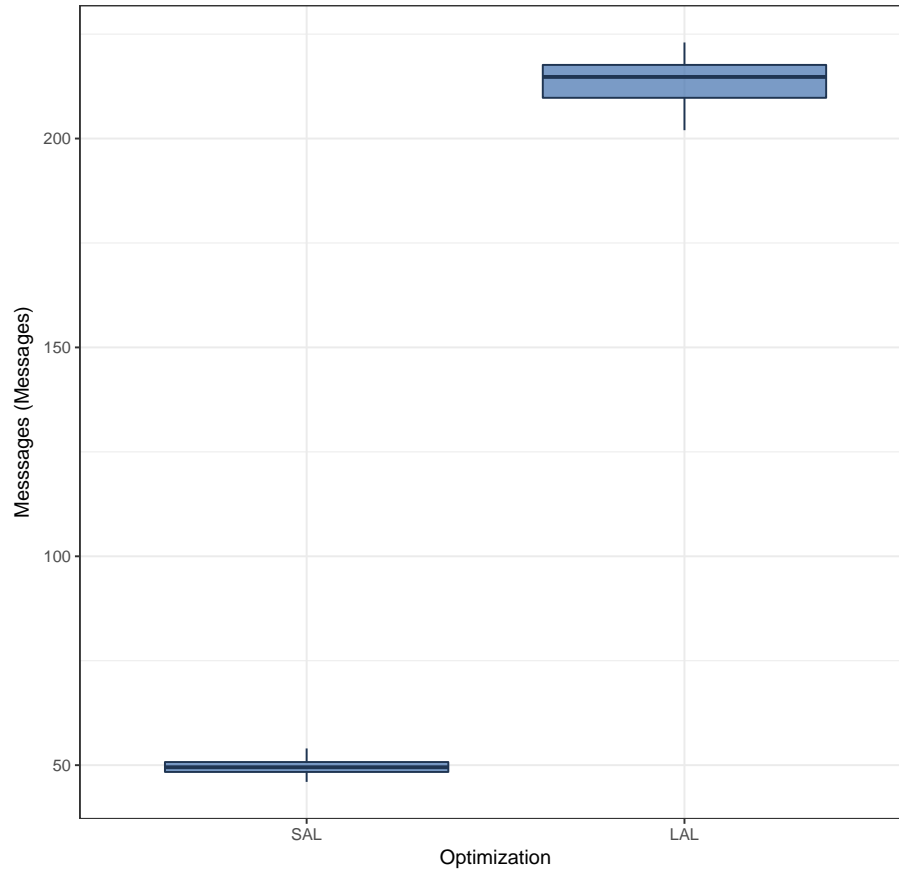

```
## [1] "Fisher's F-test to verify the homoskedasticity (homogeneity of variances)"
##
##  F test to compare two variances
##
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$messages and subse
## F = 7.5603, num df = 19, denom df = 19, p-value = 5.096e-05
## alternative hypothesis: true ratio of variances is not equal to 1
## 95 percent confidence interval:
##   2.992474 19.100828
## sample estimates:
## ratio of variances
##            7.56034
##
## [1] "Homogeneity of variances: FALSE. P-value: 5.09601725871001e-05"
## [1] "Assuming that the two samples are taken from populations that follow a Gaussian dist
##
```

```
##  Welch Two Sample t-test
##
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$messages and subse
## t = 117.19, df = 23.94, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  160.9886 166.7614
## sample estimates:
## mean of x mean of y
##   213.775    49.900
##
## [1] "T-test: Null Hypothesis rejected. P-value: 1.50673486124634e-34"
## [1] ""
## [1] "Means comparison"
## [1] "Mean Messsages for LAL:  213.775"
## [1] "Mean Messsages for SAL:  49.9"
## [1] "Absolute difference:  163.875"
## Messsages for LAL is  328.406813627255 % greater than
##  Messsages for SAL
```

3.3.2 RH3 Results: Messsages LAL = SAL

Table 5: RH3 Results per Object
9 UAVs and 96 tasks   LAL > SAL

Table 6: RH3 Results Summary

LAL < SAL:	0%
LAL > SAL:	100%
LAL:	0%
SAL:	0%
None:	0%
Inconclusive:	0%

3.4 RH4: Messages for LAL is equals than Messages for AL

Messsages Overview
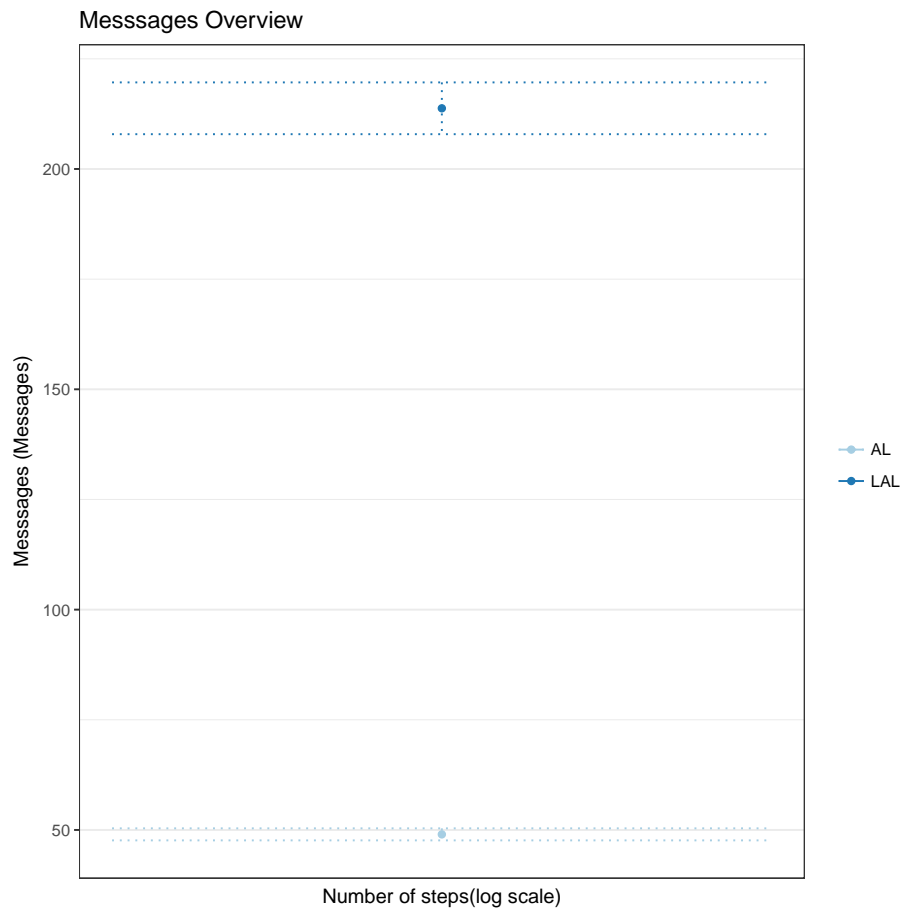
3.4.1 RH4.1: Object 9 UAVs and 96 tasks

Messsages for AL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##      47      48      49      49      50      52
```
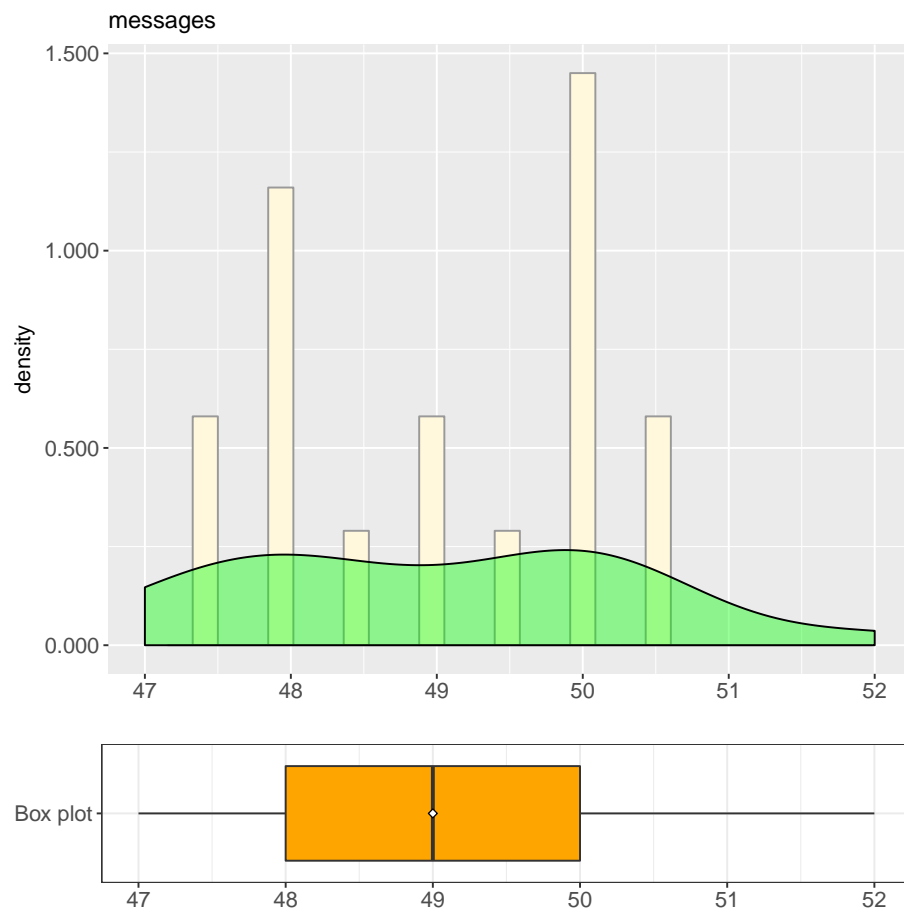
```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "AL" & object == "experiment6")$messages
## W = 0.9388, p-value = 0.2275
## 
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.227521114248871"
```

Messsages for LAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   202.0   209.8   214.8   213.8   217.6   223.0
```
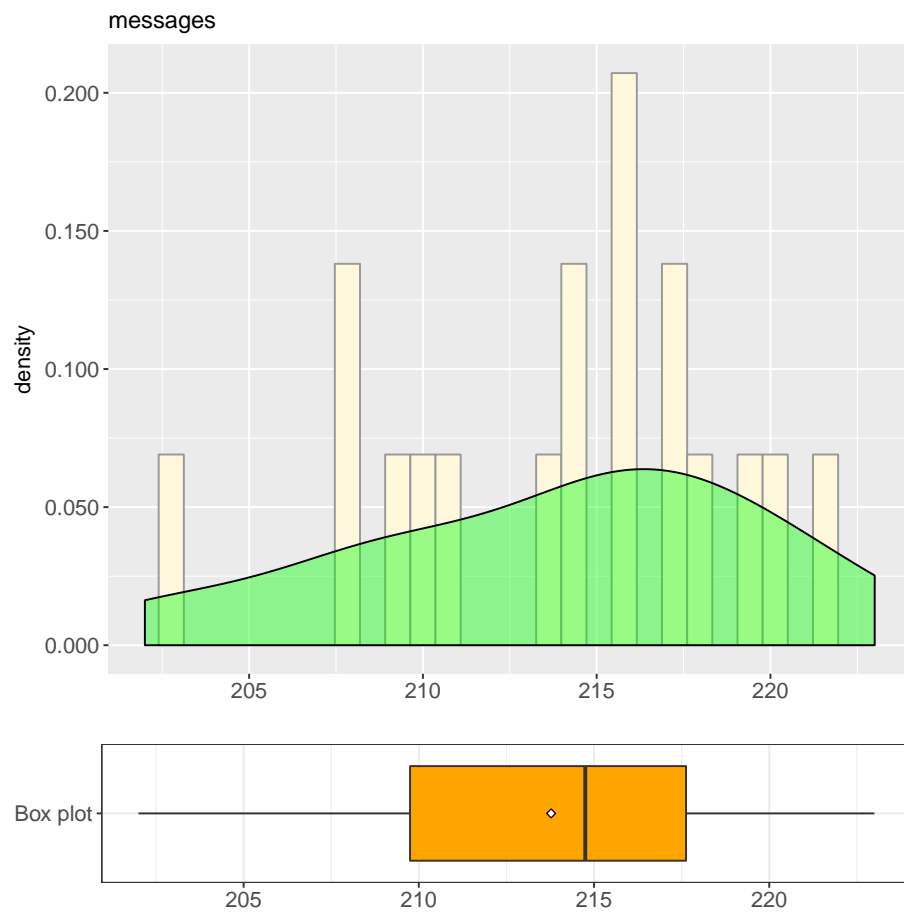
messages

```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$messages
## W = 0.9602, p-value = 0.5479
## 
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.547932125635498"
```

Comparison

Messsages by Optimization for 9 UAVs and 96 tasks
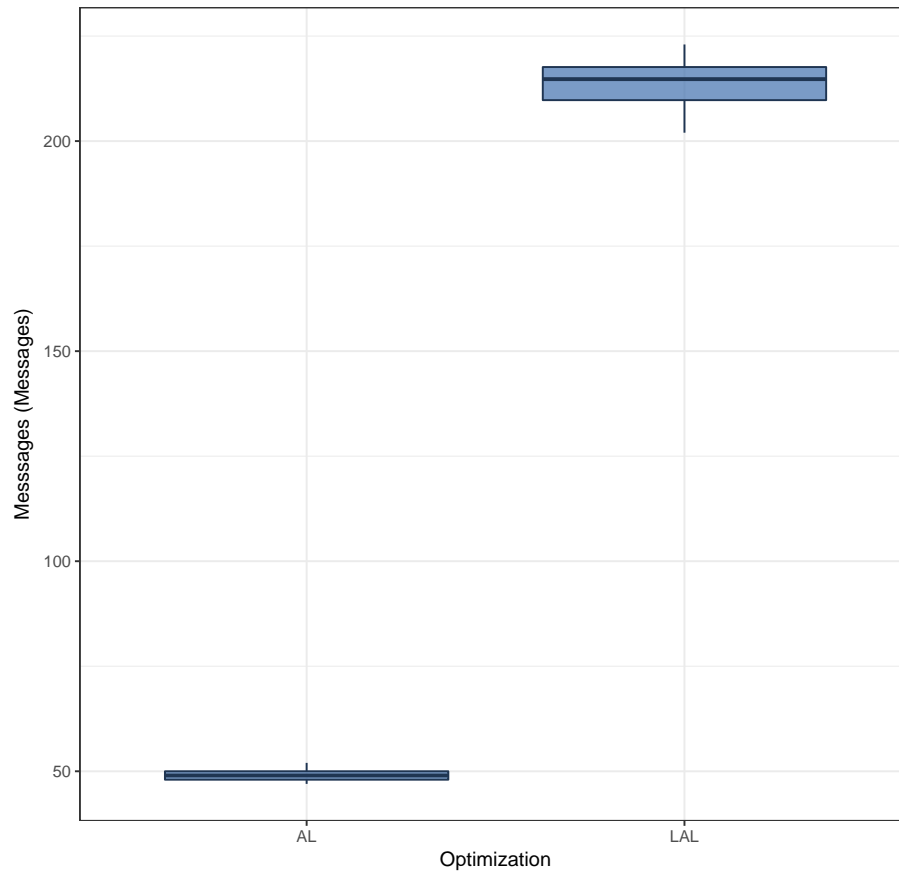

```
## [1] "Fisher's F-test to verify the homoskedasticity (homogeneity of variances)"
##
##  F test to compare two variances
##
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$messages and subse
## F = 18.486, num df = 19, denom df = 19, p-value = 3.539e-08
## alternative hypothesis: true ratio of variances is not equal to 1
## 95 percent confidence interval:
##   7.316811 46.702869
## sample estimates:
## ratio of variances
##          18.48556
##
## [1] "Homogeneity of variances: FALSE. P-value: 3.53949047848801e-08"
## [1] "Assuming that the two samples are taken from populations that follow a Gaussian dist
##
```

```
##  Welch Two Sample t-test
##
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$messages and subse
## t = 122.13, df = 21.05, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  161.9696 167.5804
## sample estimates:
## mean of x mean of y
##   213.775    49.000
##
## [1] "T-test: Null Hypothesis rejected. P-value: 1.69524139783428e-31"
## [1] ""
## [1] "Means comparison"
## [1] "Mean Messsages for LAL:  213.775"
## [1] "Mean Messsages for AL:  49"
## [1] "Absolute difference:  164.775"
## Messsages for LAL is  336.275510204082 % greater than
##  Messsages for AL
```

3.4.2 RH4 Results: Messsages LAL = AL

Table 7: RH4 Results per Object
9 UAVs and 96 tasks   LAL > AL

Table 8: RH4 Results Summary

LAL < AL:	0%
LAL > AL:	100%
LAL:	0%
AL:	0%
None:	0%
Inconclusive:	0%

3.5 RH5: Completed tasks for LAL is equals Completed tasks for SAL

Completed Tasks Overview
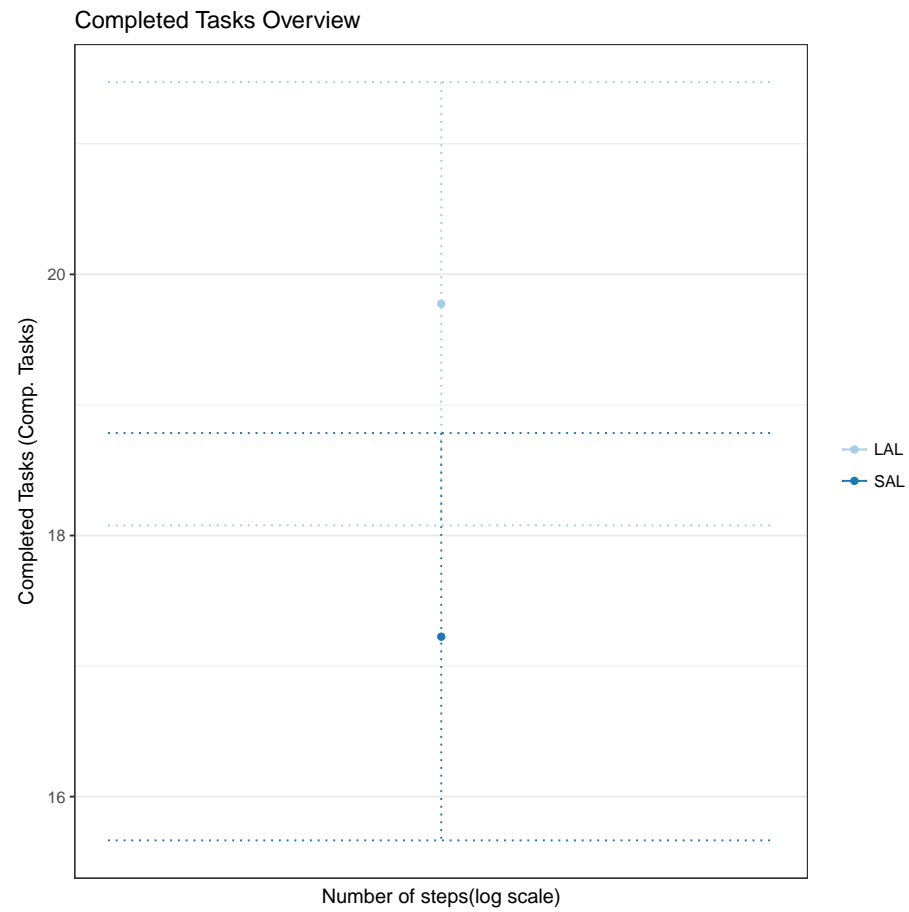
3.5.1 RH5.1: Object 9 UAVs and 96 tasks

Completed Tasks for LAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   16.50   18.50   19.50   19.77   20.75   23.00
```
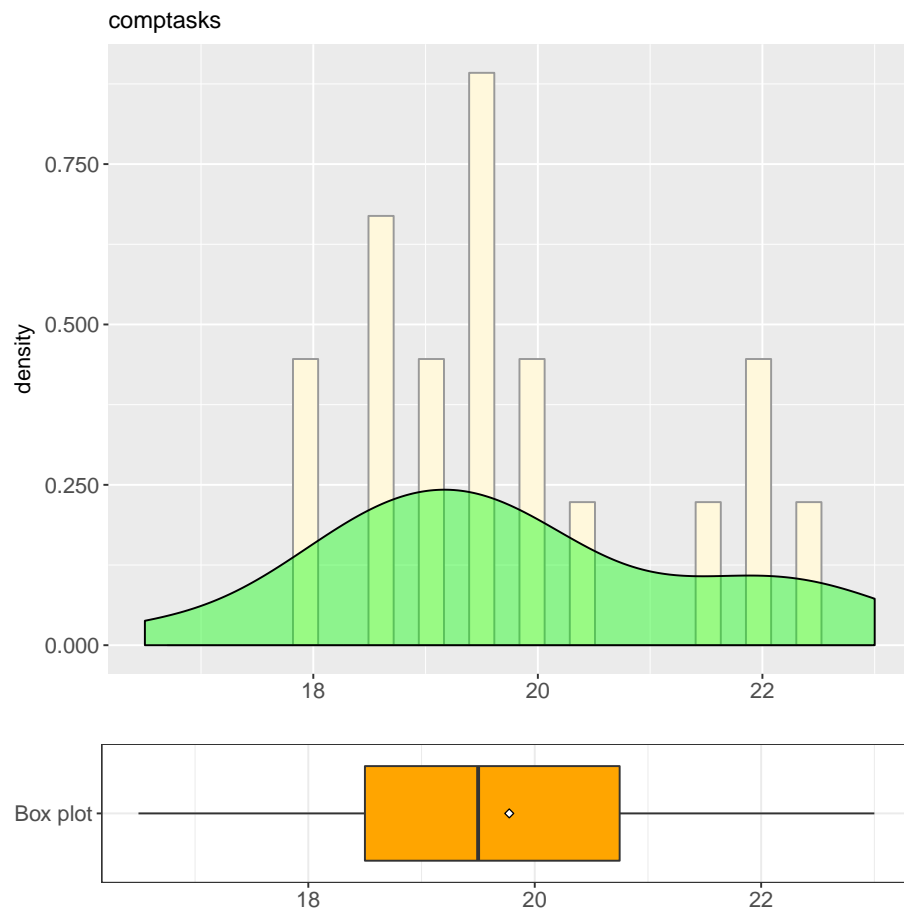
comptasks

```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$comptasks
## W = 0.95294, p-value = 0.4139
## 
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.413898462965162"
```

Completed Tasks for SAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14.50   15.88   17.50   17.23   18.50   20.00
```
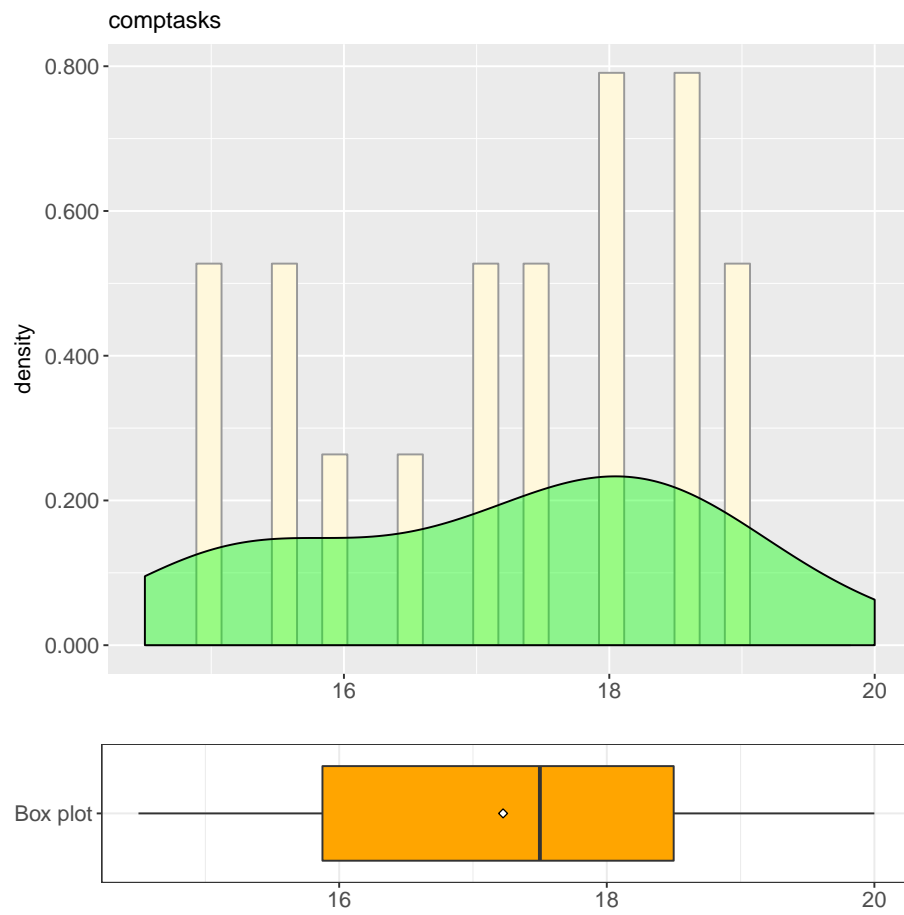
comptasks

```
##
##  Shapiro-Wilk normality test
##
## data:  subset(json_data, treatment == "SAL" & object == "experiment6")$comptasks
## W = 0.95462, p-value = 0.4427
##
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.442747203952692"
```

Comparison
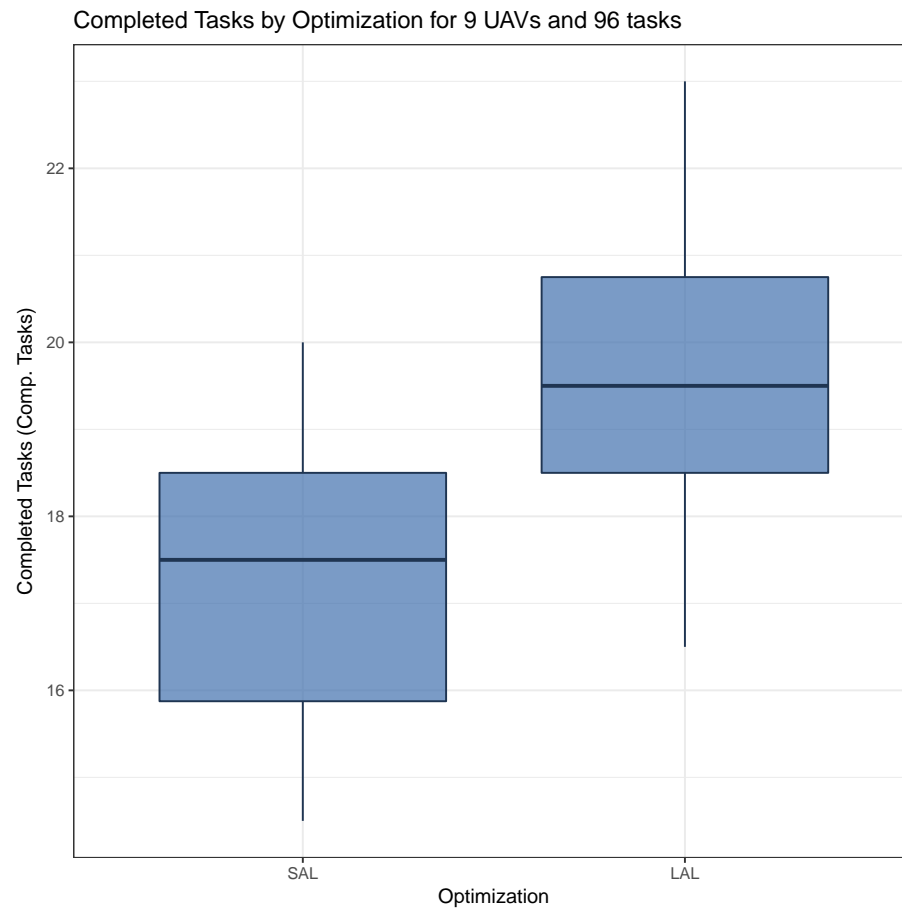
Completed Tasks by Optimization for 9 UAVs and 96 tasks

```
## [1] "Fisher's F-test to verify the homoskedasticity (homogeneity of variances)"
##
##   F test to compare two variances
##
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$comptasks and subs
## F = 1.1838, num df = 19, denom df = 19, p-value = 0.7168
## alternative hypothesis: true ratio of variances is not equal to 1
## 95 percent confidence interval:
##  0.4685757 2.9908972
## sample estimates:
## ratio of variances
##           1.183833
##
## [1] "Homogeneity of variances: TRUE. P-value: 0.716768061006223"
## [1] "Assuming that the two samples are taken from populations that follow a Gaussian dist
##
```

```
##  Two Sample t-test
##
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$comptasks and subs
## t = 4.9468, df = 38, p-value = 1.567e-05
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  1.506457 3.593543
## sample estimates:
## mean of x mean of y
##    19.775    17.225
##
## [1] "T-test: Null Hypothesis rejected. P-value: 1.56740576417201e-05"
## [1] ""
## [1] "Means comparison"
## [1] "Mean Completed Tasks for LAL:  19.775"
## [1] "Mean Completed Tasks for SAL:  17.225"
## [1] "Absolute difference:  2.55"
## Completed Tasks for LAL is  14.8040638606676 % greater than
##  Completed Tasks for SAL
```

3.5.2 RH5 Results: Completed Tasks LAL = SAL

Table 9: RH5 Results per Object
9 UAVs and 96 tasks   LAL > SAL

Table 10: RH5 Results Summary

LAL < SAL:	0%
LAL > SAL:	100%
LAL:	0%
SAL:	0%
None:	0%
Inconclusive:	0%

3.6 RH6: Completed tasks for LAL is equals Completed tasks for AL

Completed Tasks Overview
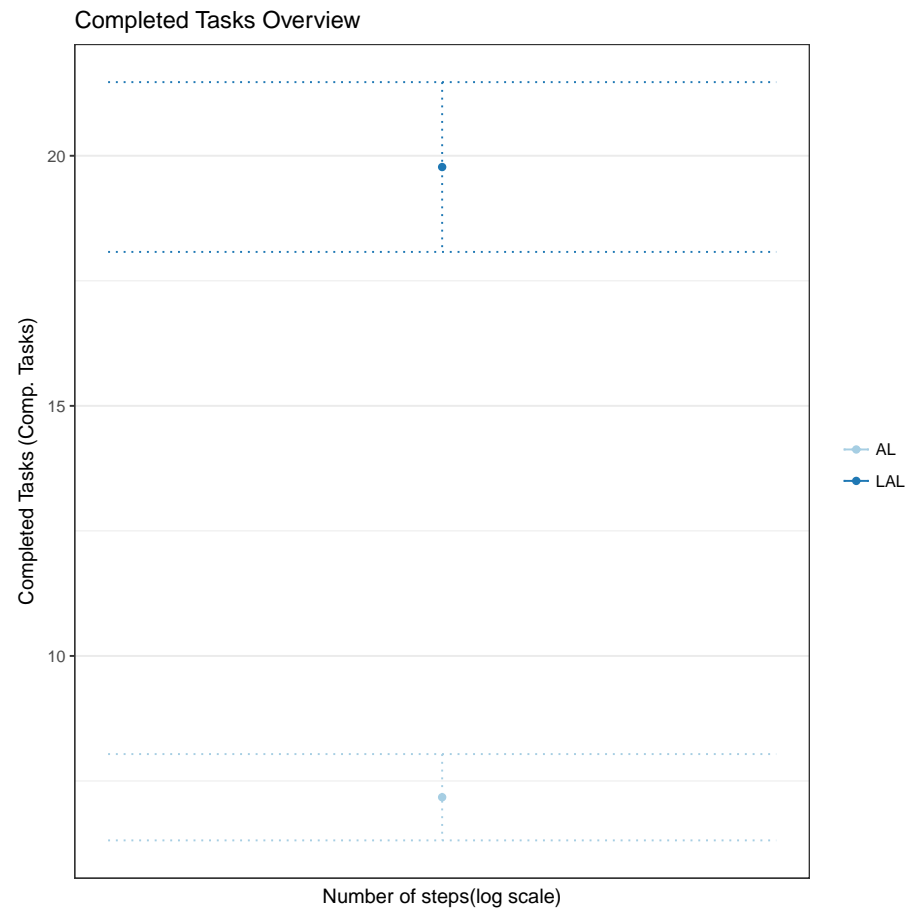
3.6.1 RH6.1: Object 9 UAVs and 96 tasks

Completed Tasks for AL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   6.000   6.500   7.000   7.175   8.000   9.000
```
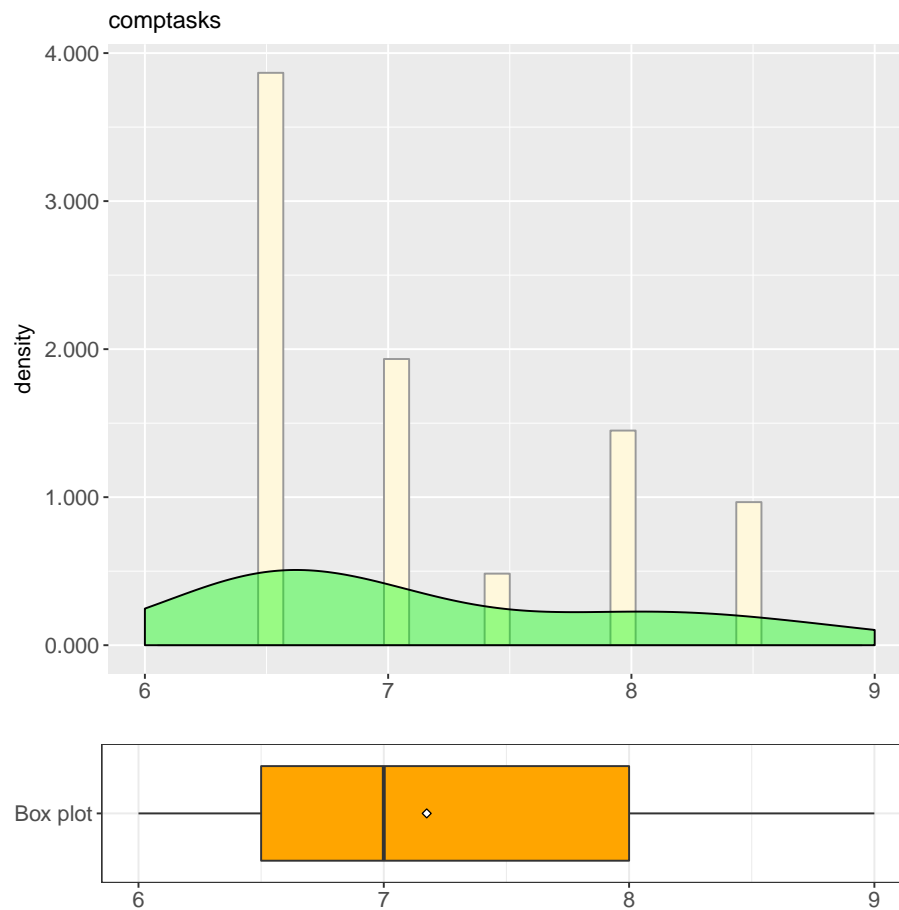
comptasks


```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "AL" & object == "experiment6")$comptasks
## W = 0.86599, p-value = 0.009995
## 
## [1] "Shapiro test: Null Hypothesis (normality) rejected. P-value: 0.00999541128065406"
```

Completed Tasks for LAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   16.50   18.50   19.50   19.77   20.75   23.00
```
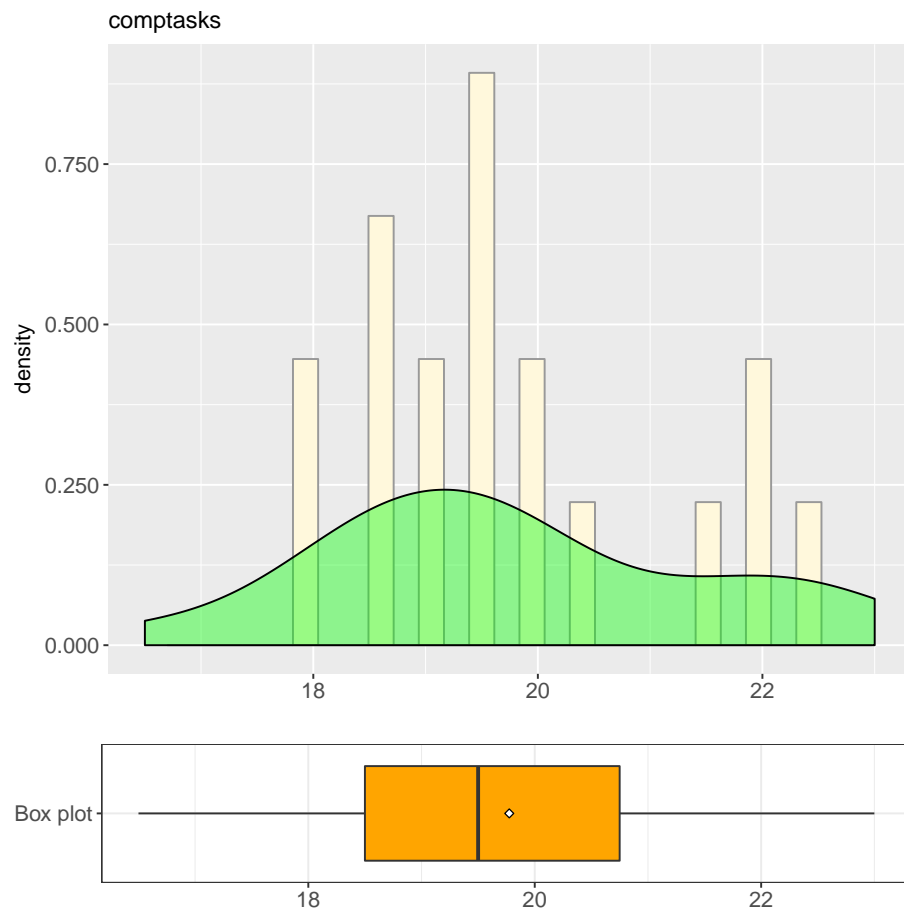
comptasks

```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$comptasks
## W = 0.95294, p-value = 0.4139
## 
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.413898462965162"
```

Comparison

Completed Tasks by Optimization for 9 UAVs and 96 tasks
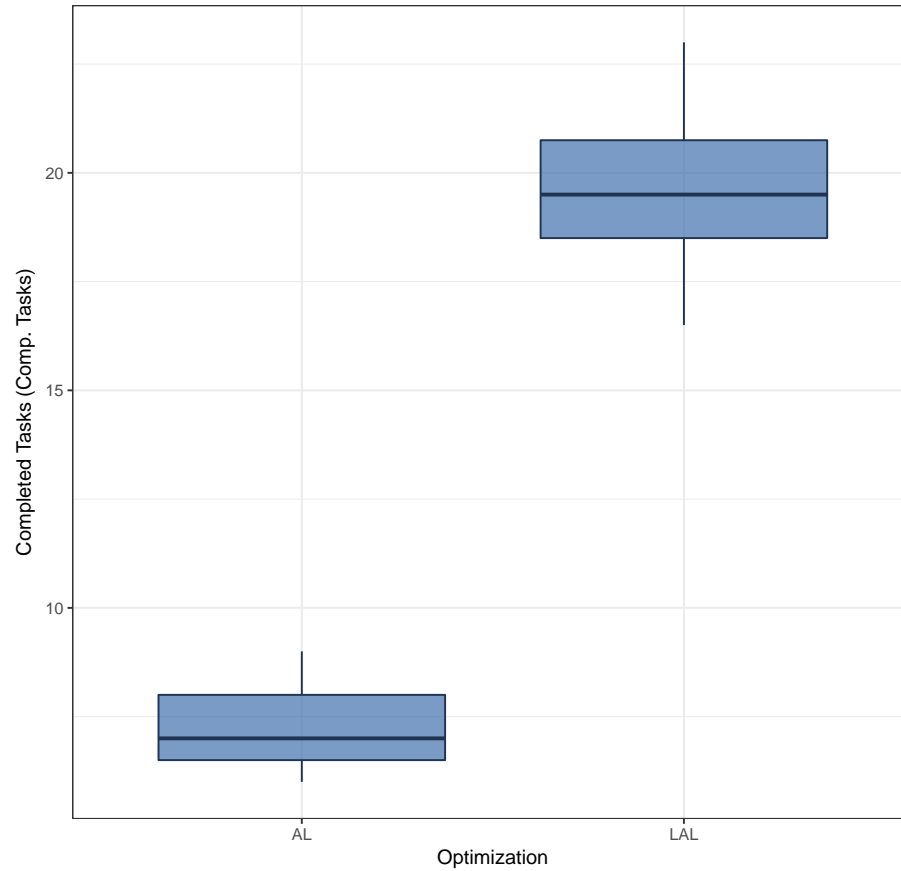

```
## 
##   Wilcoxon rank sum test with continuity correction
## 
## data:  comptasks by treatment
## W = 0, p-value = 5.752e-08
## alternative hypothesis: true location shift is not equal to 0
## 
## [1] "Wilcoxon-Mann-Whitney test: Null Hypothesis rejected. P-value: 5.75169291416295e-08'
## [1] ""
## [1] "Means comparison"
## [1] "Mean Completed Tasks for LAL:  19.775"
## [1] "Mean Completed Tasks for AL:  7.175"
## [1] "Absolute difference:  12.6"
## Completed Tasks for LAL is  175.609756097561 % greater than
##   Completed Tasks for AL
```

3.6.2 RH6 Results: Completed Tasks LAL = AL

Table 11: RH6 Results per Object
9 UAVs and 96 tasks   LAL > AL

Table 12: RH6 Results Summary

LAL < AL:	0%
LAL > AL:	100%
LAL:	0%
AL:	0%
None:	0%
Inconclusive:	0%

3.7 RH7: Time taken by LAL is equals Time taken for SAL

Runtime Overview

Runtime (Seconds)

Number of steps(log scale)

LAL
SAL
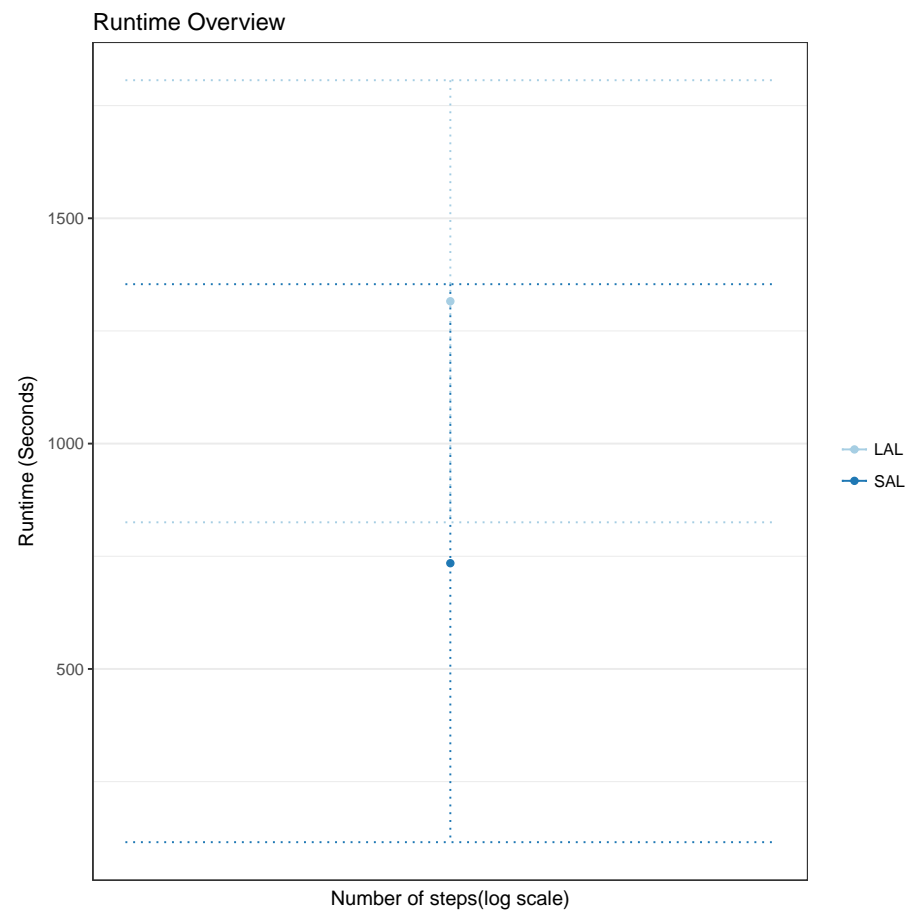
3.7.1 RH7.1: Object 9 UAVs and 96 tasks

Runtime for LAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   775.4  1004.1  1262.6  1315.9  1387.5  2972.0
```
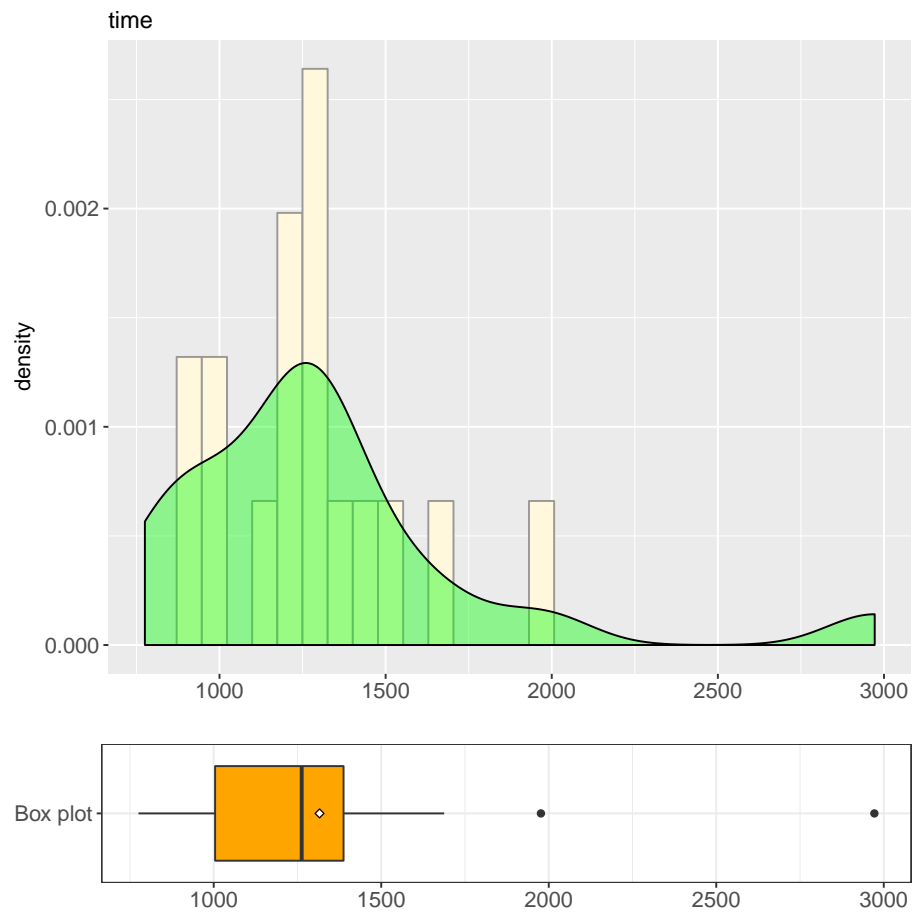
time


```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$time
## W = 0.79897, p-value = 0.0008339
## 
## [1] "Shapiro test: Null Hypothesis (normality) rejected. P-value: 0.000833910544820863"
```

Runtime for SAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   326.9   402.8   465.1   734.7   574.6  2608.5
```
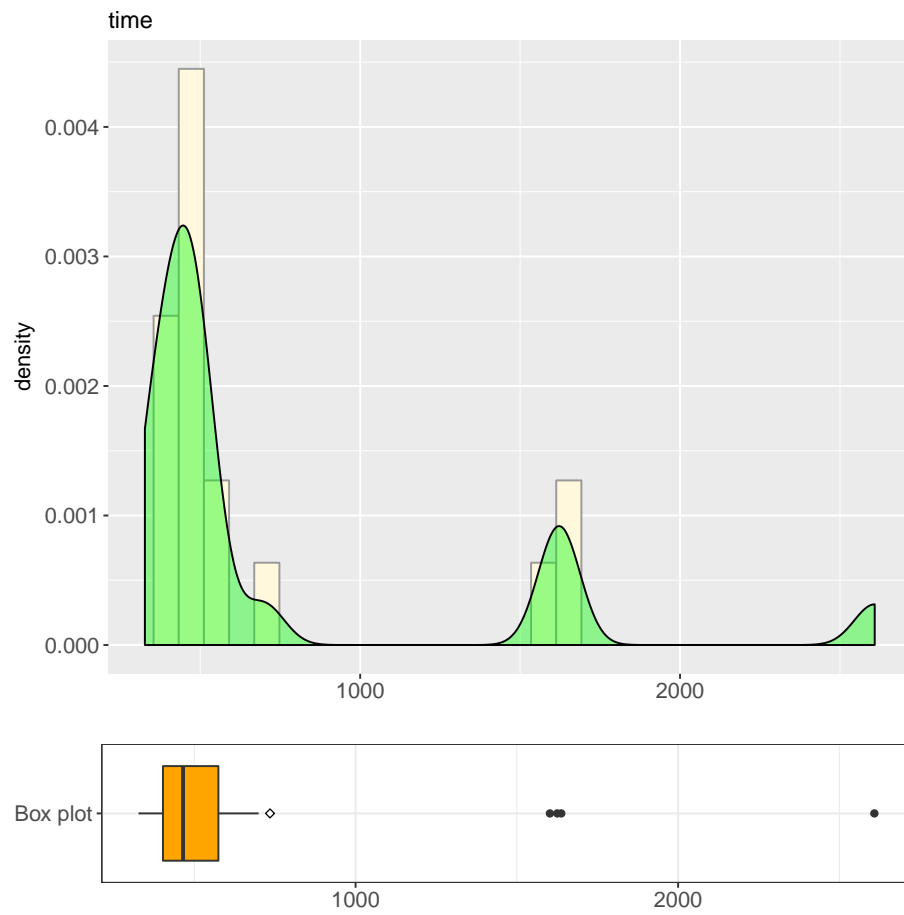
time

density

Box plot

```
##
##  Shapiro-Wilk normality test
##
## data:  subset(json_data, treatment == "SAL" & object == "experiment6")$time
## W = 0.6387, p-value = 7.618e-06
##
## [1] "Shapiro test: Null Hypothesis (normality) rejected. P-value: 7.61843145056985e-06"
```

Comparison

Runtime by Optimization for 9 UAVs and 96 tasks
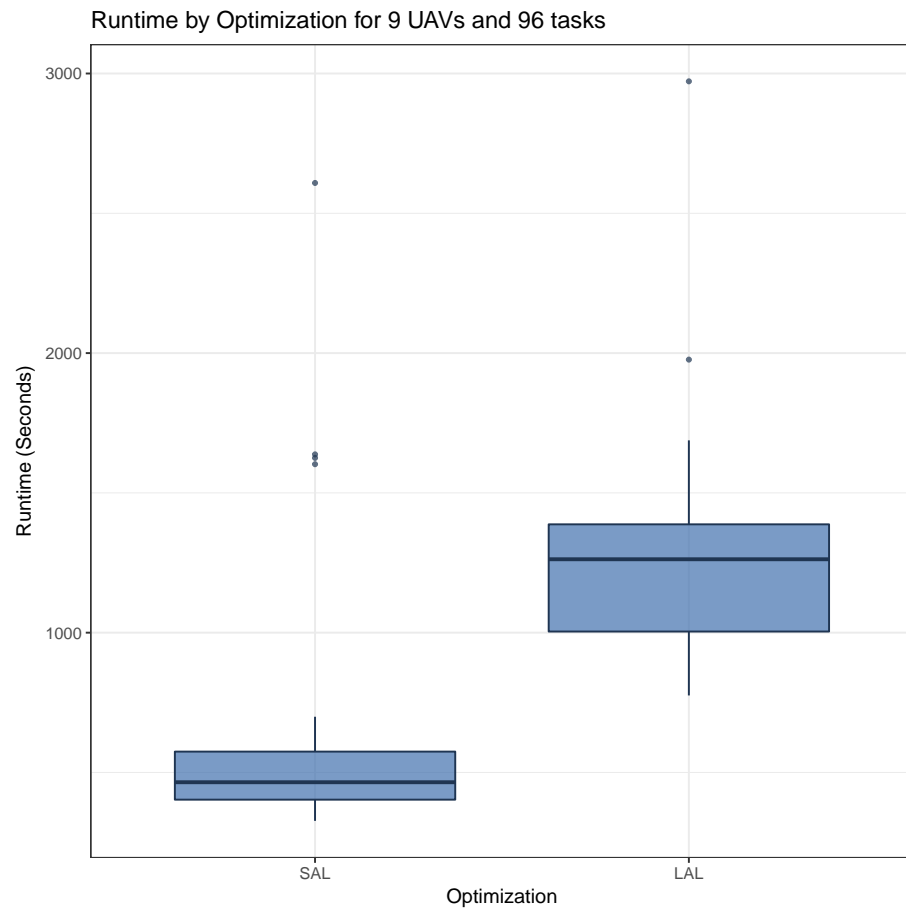

```
##
##   Wilcoxon rank sum test
##
## data:  time by treatment
## W = 330, p-value = 0.000258
## alternative hypothesis: true location shift is not equal to 0
##
## [1] "Wilcoxon-Mann-Whitney test: Null Hypothesis rejected. P-value: 0.000257973808295422"
## [1] ""
## [1] "Means comparison"
## [1] "Mean Runtime for LAL:  1315.895785"
## [1] "Mean Runtime for SAL:  734.690345"
## [1] "Absolute difference:  581.20544"
## Runtime for LAL is  79.1088985931889 % greater than
##   Runtime for SAL
```

3.7.2   RH7 Results: Runtime LAL = SAL

Table 13: RH7 Results per Object
9 UAVs and 96 tasks   LAL > SAL

Table 14: RH7 Results Summary

LAL < SAL:	0%
LAL > SAL:	100%
LAL:	0%
SAL:	0%
None:	0%
Inconclusive:	0%

3.8   RH8: Time taken by LAL is equals Time taken by AL

Runtime Overview
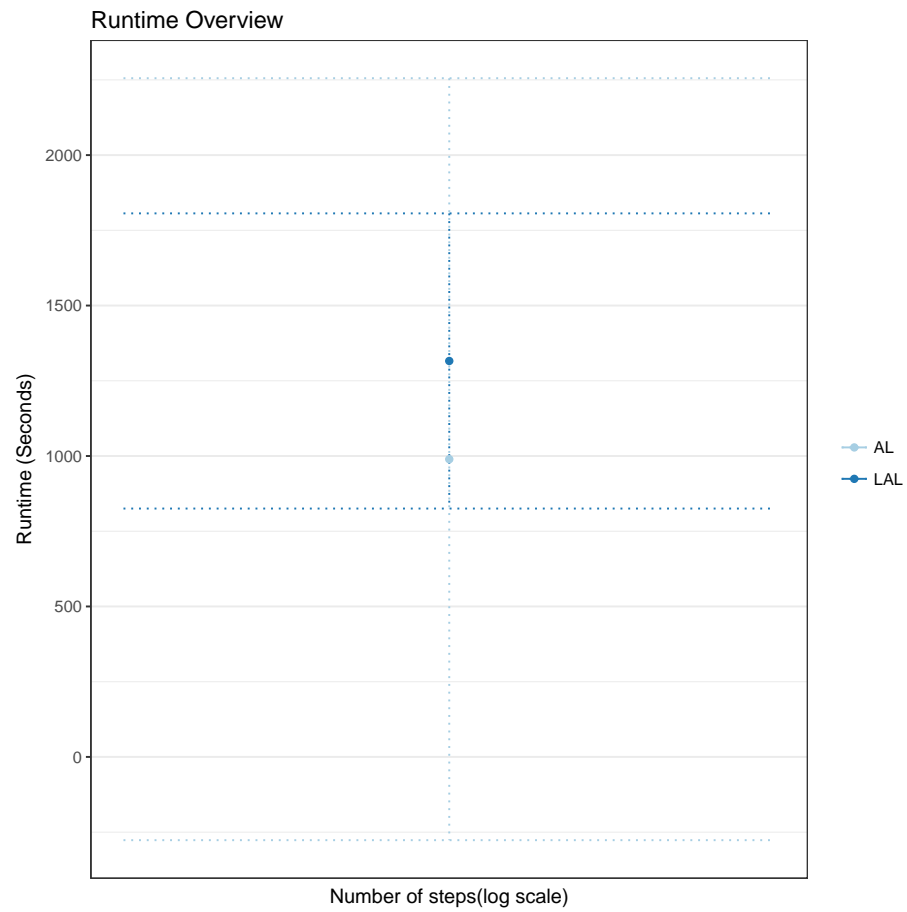
3.8.1 RH8.1: Object 9 UAVs and 96 tasks

Runtime for AL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   341.4   366.7   478.7   989.4  1135.7  5923.4
```
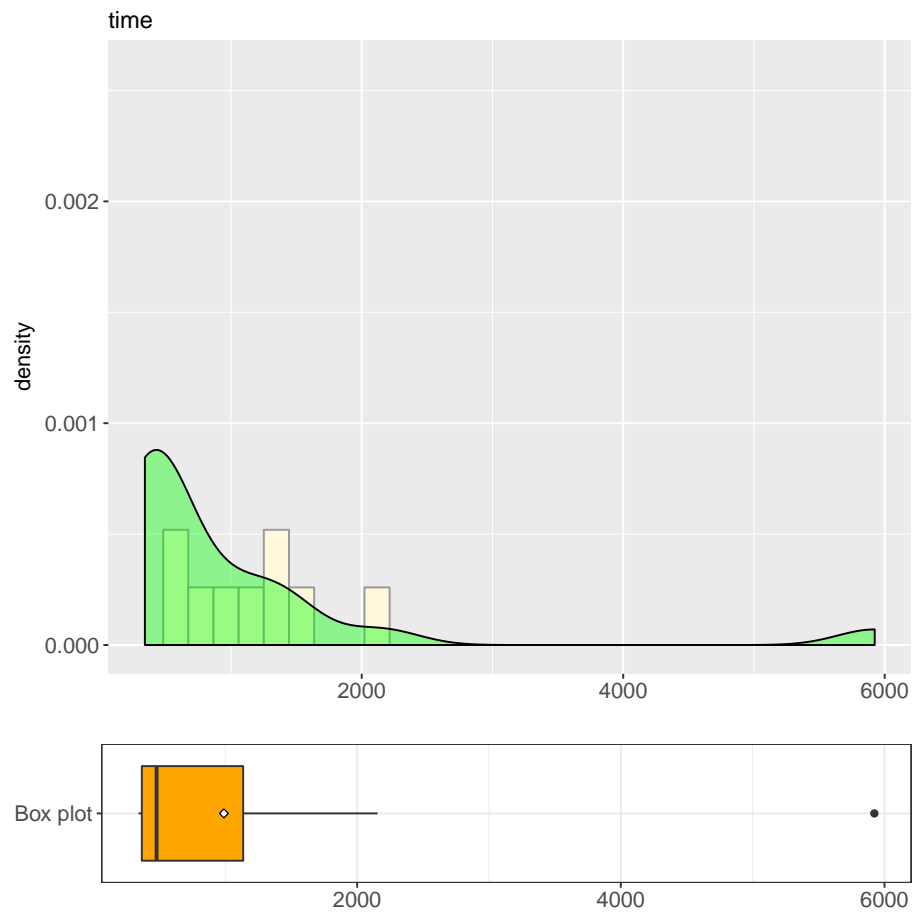
time


```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "AL" & object == "experiment6")$time
## W = 0.54081, p-value = 7.605e-07
## 
## [1] "Shapiro test: Null Hypothesis (normality) rejected. P-value: 7.60511280857568e-07"
```

Runtime for LAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   775.4  1004.1  1262.6  1315.9  1387.5  2972.0
```
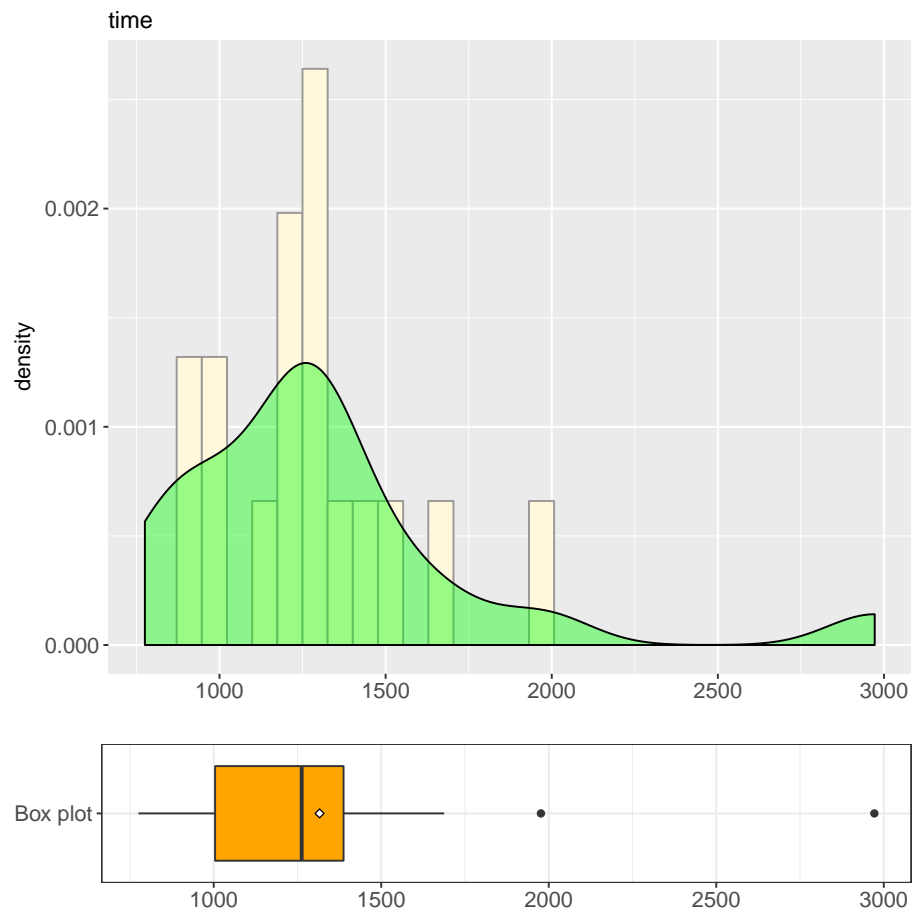
```
##
##   Shapiro-Wilk normality test
##
## data:  subset(json_data, treatment == "LAL" & object == "experiment6")$time
## W = 0.79897, p-value = 0.0008339
##
## [1] "Shapiro test: Null Hypothesis (normality) rejected. P-value: 0.000833910544820863"
```

Comparison

Runtime by Optimization for 9 UAVs and 96 tasks
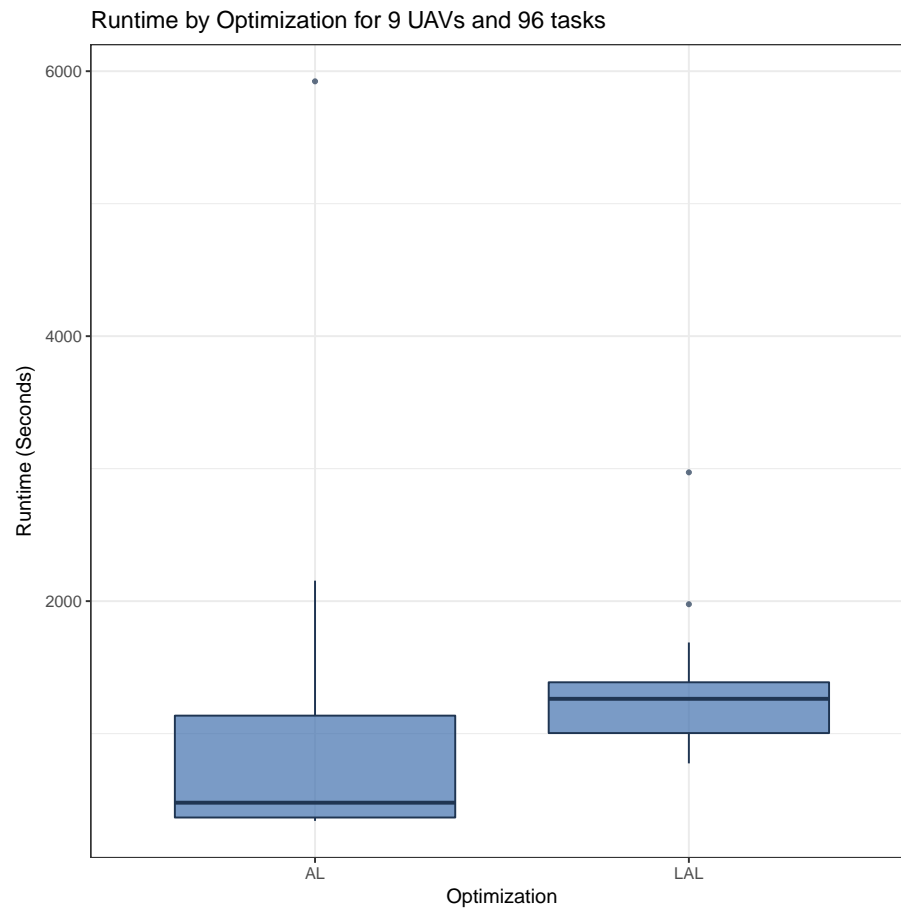

```
##
##   Wilcoxon rank sum test
##
## data:  time by treatment
## W = 93, p-value = 0.003211
## alternative hypothesis: true location shift is not equal to 0
##
## [1] "Wilcoxon-Mann-Whitney test: Null Hypothesis rejected. P-value: 0.00321093063270362"
## [1] ""
## [1] "Means comparison"
## [1] "Mean Runtime for LAL:  1315.895785"
## [1] "Mean Runtime for AL:  989.421425"
## [1] "Absolute difference:  326.47436"
## Runtime for LAL is  32.9964918639194 % greater than
##   Runtime for AL
```

3.8.2　RH8 Results: Runtime LAL = AL

Table 15: RH8 Results per Object
9 UAVs and 96 tasks　　LAL > AL

Table 16: RH8 Results Summary

LAL < AL:	0%
LAL > AL:	100%
LAL:	0%
AL:	0%
None:	0%
Inconclusive:	0%

3.9　RH9: Quality for LAL is equals Quality for SAL

Quality Overview

Quality (Quality)

Number of steps(log scale)

LAL
SAL
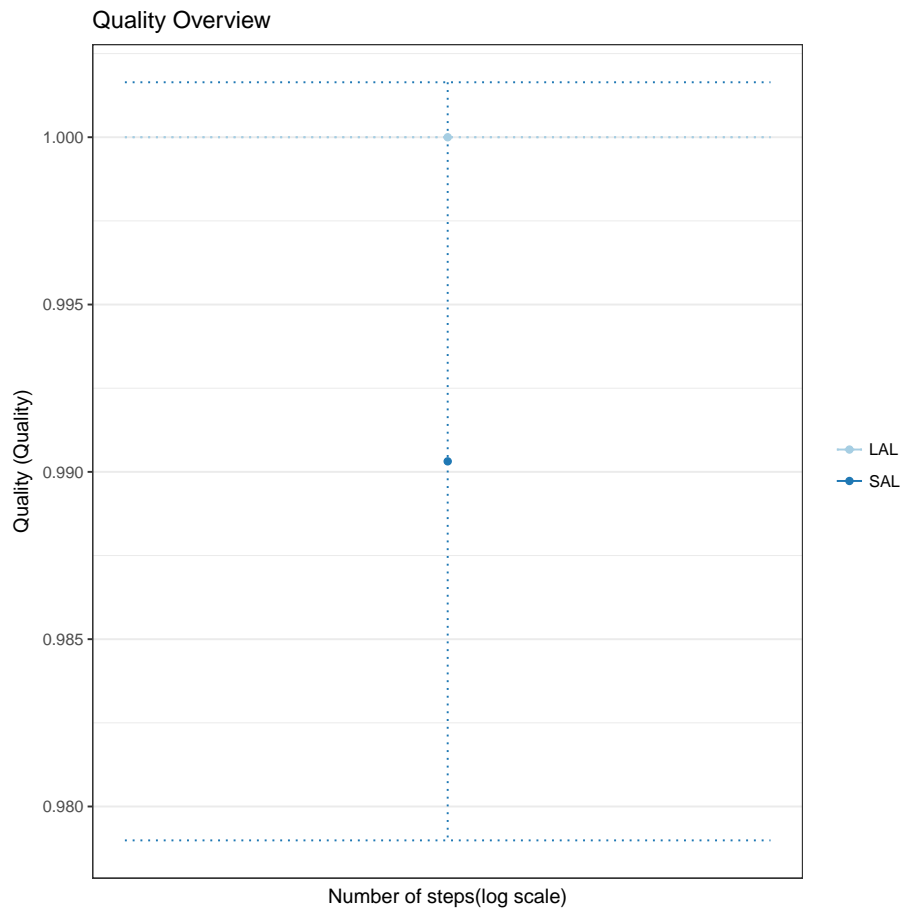
3.9.1 RH9.1: Object 9 UAVs and 96 tasks

Quality for LAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##      1        1       1       1       1       1

## Error in shapiro.test(subset(json_data, treatment == "LAL" & object
== :  all 'x' values are identical
```
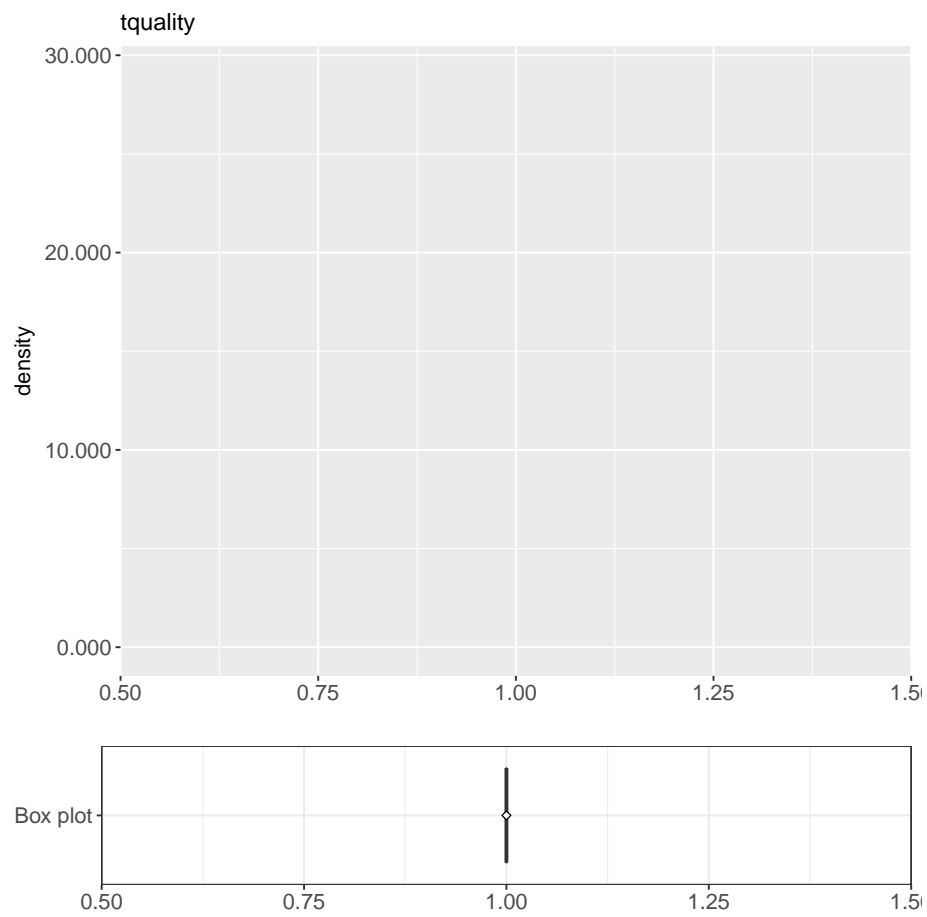
tquality

Quality for SAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.9611  0.9841  0.9940  0.9903  1.0000  1.0000
```
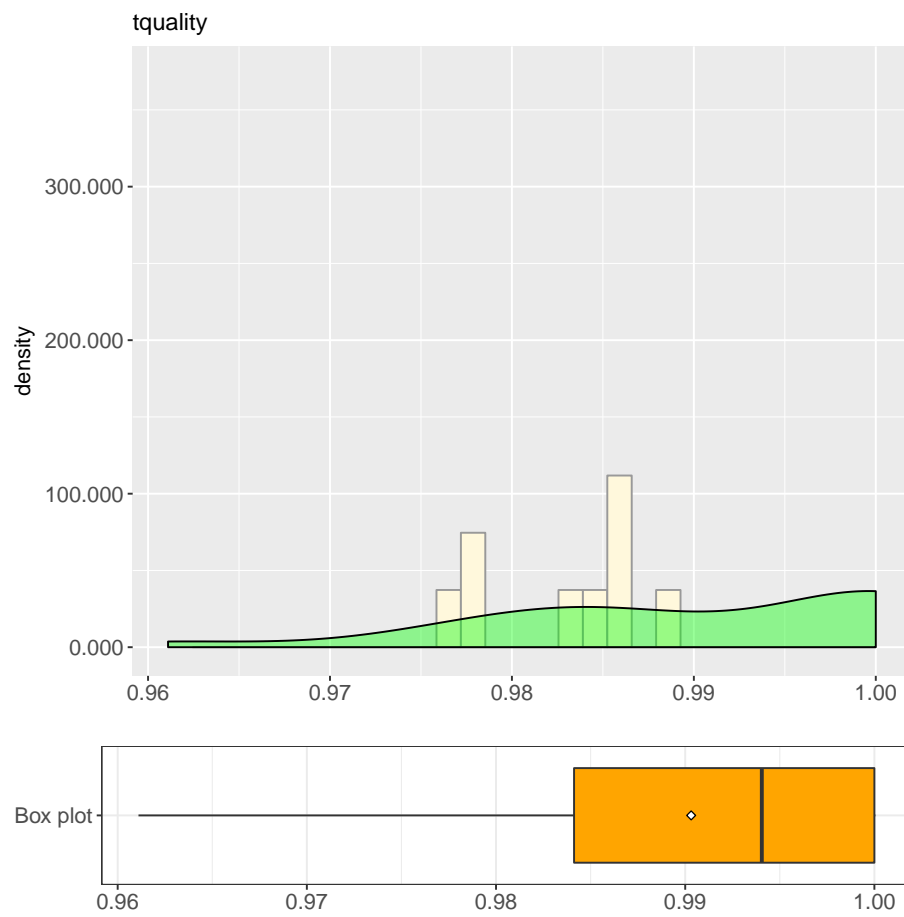
tquality


```
## 
##  Shapiro-Wilk normality test
## 
## data:  subset(json_data, treatment == "SAL" & object == "experiment6")$tquality
## W = 0.8061, p-value = 0.001067
## 
## [1] "Shapiro test: Null Hypothesis (normality) rejected. P-value: 0.00106679511379971"
```

Comparison

Quality by Optimization for 9 UAVs and 96 tasks
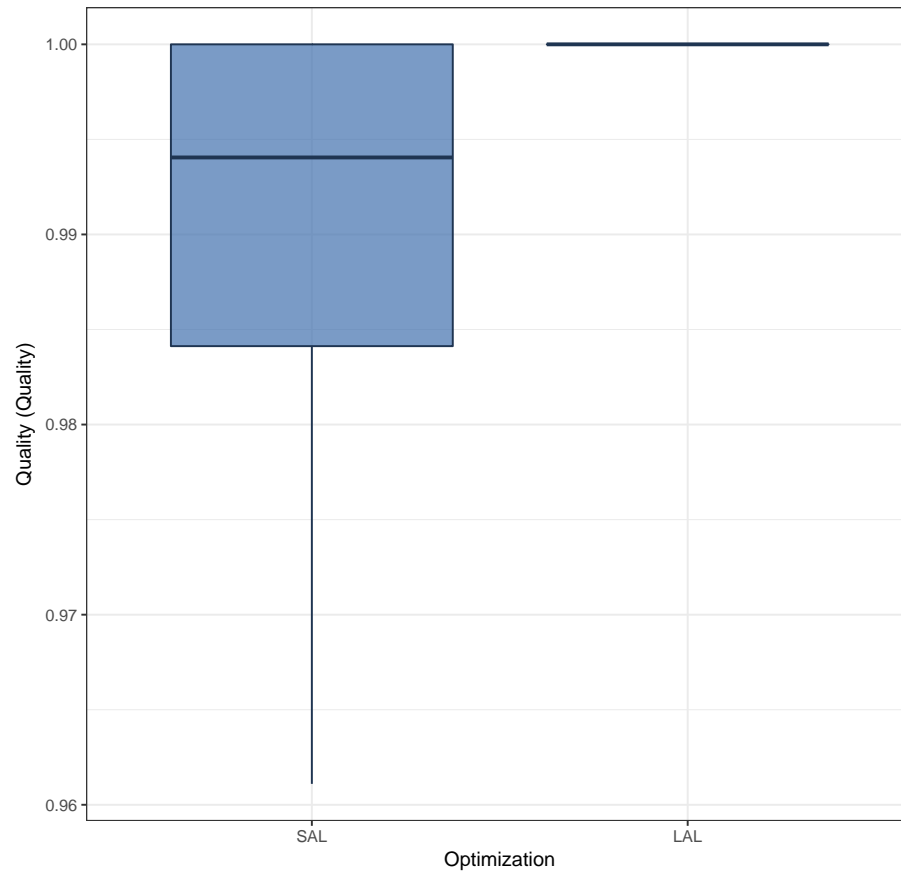

```
##
##   Wilcoxon rank sum test with continuity correction
##
## data:  tquality by treatment
## W = 300, p-value = 0.0004005
## alternative hypothesis: true location shift is not equal to 0
##
## [1] "Wilcoxon-Mann-Whitney test: Null Hypothesis rejected. P-value: 0.000400485111294929'
## [1] ""
## [1] "Means comparison"
## [1] "Mean Quality for LAL:   1"
## [1] "Mean Quality for SAL:   0.990315"
## [1] "Absolute difference:   0.00968500000000005"
## Quality for LAL is   0.977971655483362 % greater than
##   Quality for SAL
```

3.9.2   RH9 Results: Quality LAL = SAL

Table 17: RH9 Results per Object
9 UAVs and 96 tasks   LAL > SAL

Table 18: RH9 Results Summary

LAL < SAL:	0%
LAL > SAL:	100%
LAL:	0%
SAL:	0%
None:	0%
Inconclusive:	0%

3.10   RH10: Quality for LAL is equals Quality for AL

Quality Overview
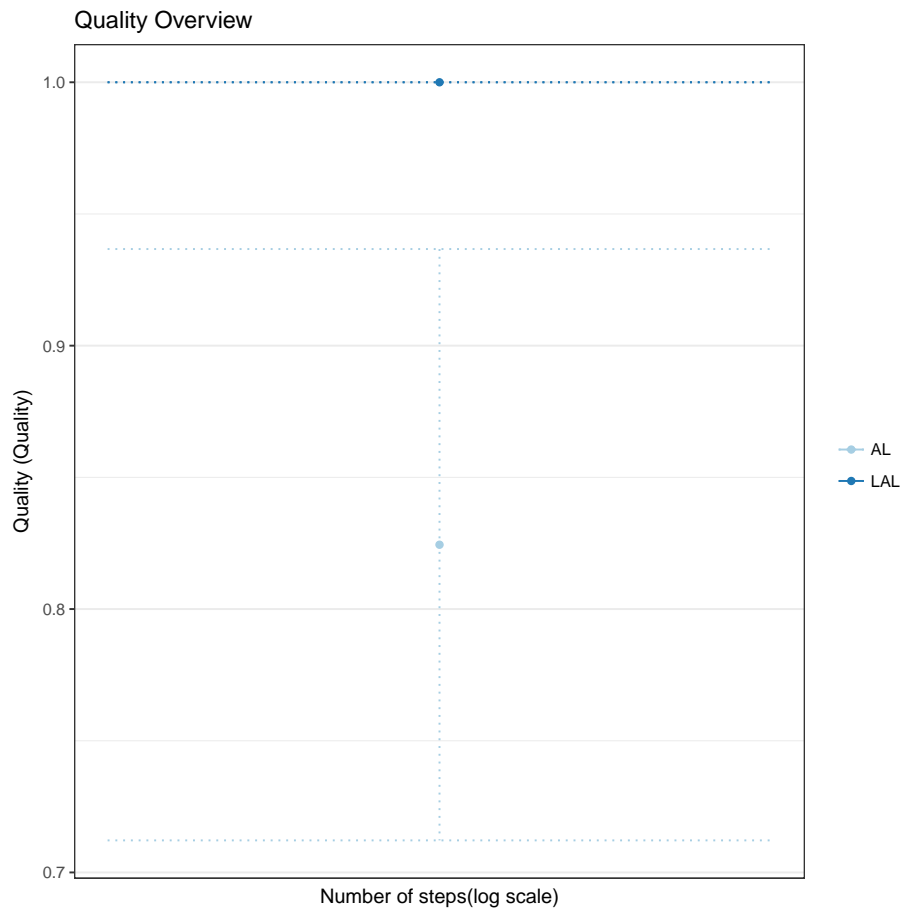
3.10.1   RH10.1: Object 9 UAVs and 96 tasks

Quality for AL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.5524  0.7842  0.8244  0.8244  0.9084  1.0000
```
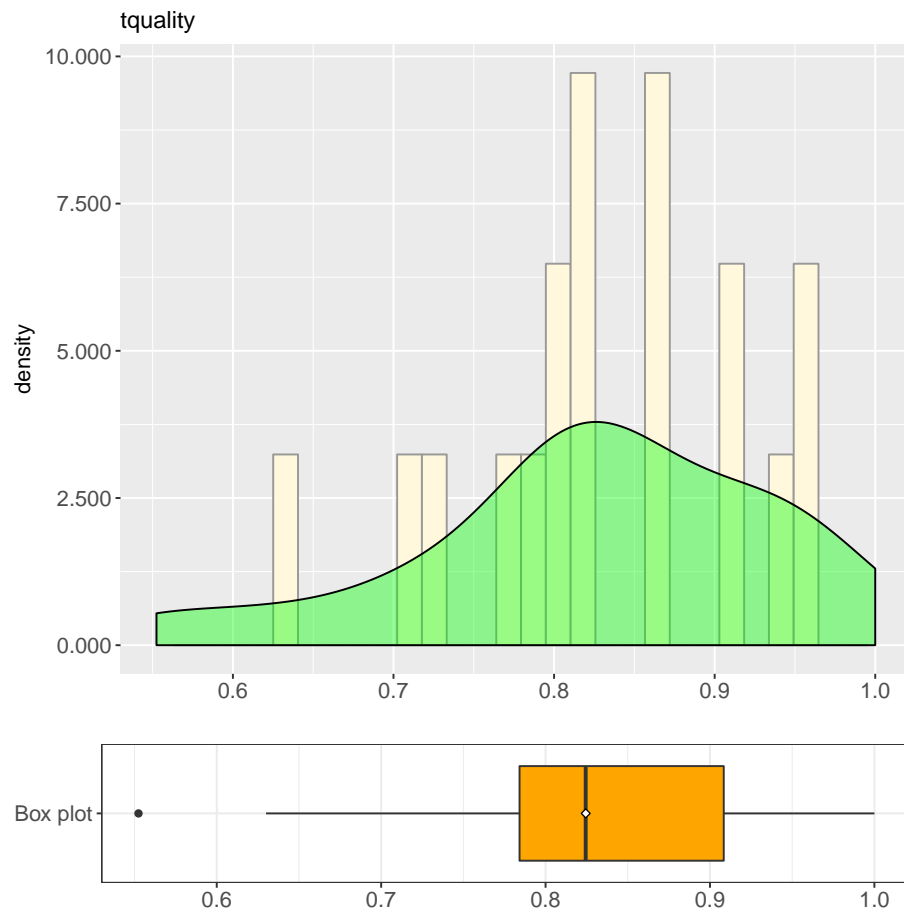
```
##
##  Shapiro-Wilk normality test
##
## data:  subset(json_data, treatment == "AL" & object == "experiment6")$tquality
## W = 0.95665, p-value = 0.4793
##
## [1] "Shapiro test: Null Hypothesis (normality) not rejected. P-value: 0.479308653411073"
```

Quality for LAL

```
## [1] "Sample size:  20"
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##       1       1       1       1       1       1
```

```
## Error in shapiro.test(subset(json_data, treatment == "LAL" & object
== :  all 'x' values are identical
```

tquality

Comparison

Quality by Optimization for 9 UAVs and 96 tasks
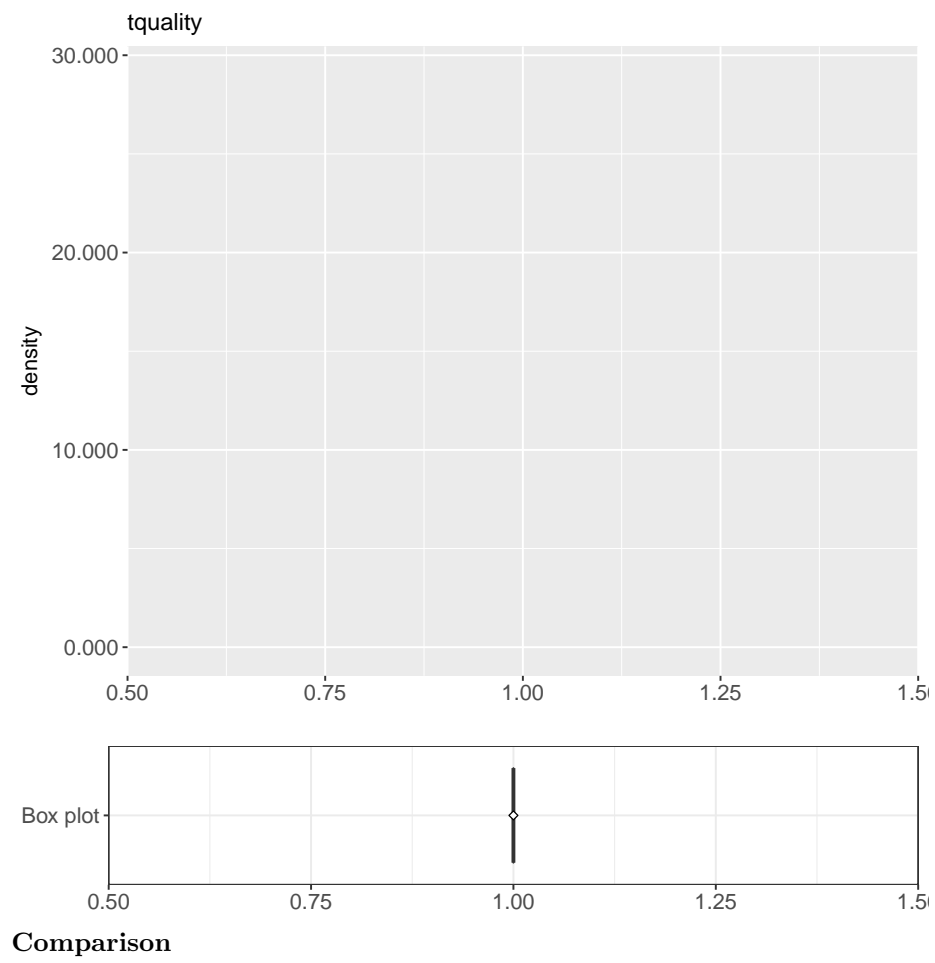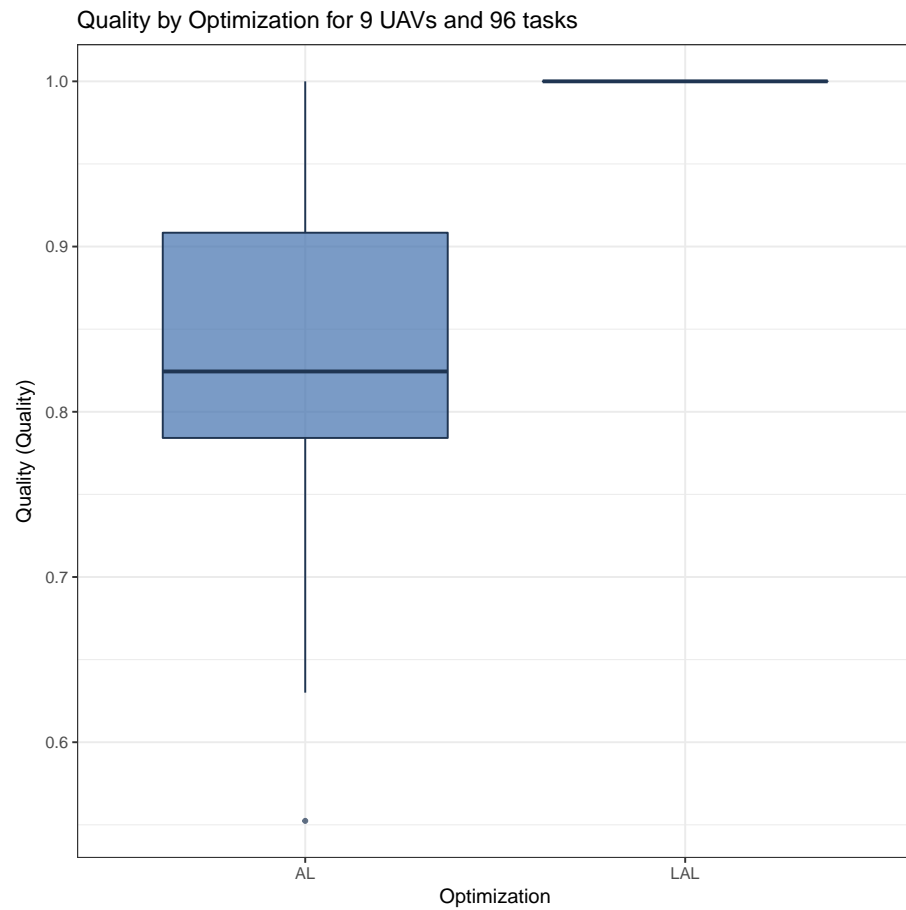

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  tquality by treatment
## W = 10, p-value = 2.992e-08
## alternative hypothesis: true location shift is not equal to 0
##
## [1] "Wilcoxon-Mann-Whitney test: Null Hypothesis rejected. P-value: 2.99198195738904e-08'
## [1] ""
## [1] "Means comparison"
## [1] "Mean Quality for LAL:   1"
## [1] "Mean Quality for AL:  0.82443"
## [1] "Absolute difference:  0.17557"
## Quality for LAL is   21.2959256698568 % greater than
##  Quality for AL
```

3.10.2   RH10 Results: Quality LAL = AL

Table 19: RH10 Results per Object
9 UAVs and 96 tasks   LAL > AL

Table 20: RH10 Results Summary

LAL < AL:	0%
LAL > AL:	100%
LAL:	0%
AL:	0%
None:	0%
Inconclusive:	0%

4   Result Summary

4.1   Research Hypotheses

4.1.1   RH1 Results: Total Reward LAL = SAL

Table 21: RH1 Results per Object
9 UAVs and 96 tasks   LAL > SAL

Table 22: RH1 Results Summary

LAL < SAL:	0%
LAL > SAL:	100%
LAL:	0%
SAL:	0%
None:	0%
Inconclusive:	0%

4.1.2   RH2 Results: Total Reward LAL = AL

Table 23: RH2 Results per Object
9 UAVs and 96 tasks   LAL > AL

Table 24: RH2 Results Summary

LAL < AL:	0%
LAL > AL:	100%
LAL:	0%
AL:	0%
None:	0%
Inconclusive:	0%

4.1.3 RH3 Results: Messsages LAL = SAL

Table 25: RH3 Results per Object

9 UAVs and 96 tasks   LAL > SAL

Table 26: RH3 Results Summary

LAL < SAL:	0%
LAL > SAL:	100%
LAL:	0%
SAL:	0%
None:	0%
Inconclusive:	0%

4.1.4 RH4 Results: Messsages LAL = AL

Table 27: RH4 Results per Object

9 UAVs and 96 tasks   LAL > AL

Table 28: RH4 Results Summary

LAL < AL:	0%
LAL > AL:	100%
LAL:	0%
AL:	0%
None:	0%
Inconclusive:	0%

4.1.5 RH5 Results: Completed Tasks LAL = SAL

Table 29: RH5 Results per Object

9 UAVs and 96 tasks   LAL > SAL

Table 30: RH5 Results Summary

LAL < SAL:	0%
LAL > SAL:	100%
LAL:	0%
SAL:	0%
None:	0%
Inconclusive:	0%

4.1.6   RH6 Results: Completed Tasks LAL = AL

Table 31: RH6 Results per Object

9 UAVs and 96 tasks	LAL > AL

Table 32: RH6 Results Summary

LAL < AL:	0%
LAL > AL:	100%
LAL:	0%
AL:	0%
None:	0%
Inconclusive:	0%

4.1.7   RH7 Results: Runtime LAL = SAL

Table 33: RH7 Results per Object

9 UAVs and 96 tasks	LAL > SAL

Table 34: RH7 Results Summary

LAL < SAL:	0%
LAL > SAL:	100%
LAL:	0%
SAL:	0%
None:	0%
Inconclusive:	0%

4.1.8   RH8 Results: Runtime LAL = AL

Table 35: RH8 Results per Object

9 UAVs and 96 tasks	LAL > AL

Table 36: RH8 Results Summary

LAL < AL:	0%
LAL > AL:	100%
LAL:	0%
AL:	0%
None:	0%
Inconclusive:	0%

4.1.9   RH9 Results: Quality LAL = SAL

Table 37: RH9 Results per Object

9 UAVs and 96 tasks   LAL > SAL

Table 38: RH9 Results Summary

LAL < SAL:	0%
LAL > SAL:	100%
LAL:	0%
SAL:	0%
None:	0%
Inconclusive:	0%

4.1.10   RH10 Results: Quality LAL = AL

Table 39: RH10 Results per Object

9 UAVs and 96 tasks   LAL > AL

Table 40: RH10 Results Summary

LAL < AL:	0%
LAL > AL:	100%
LAL:	0%
AL:	0%
None:	0%
Inconclusive:	0%

A Session Information

```
## R version 3.4.2 (2017-09-28)
## Platform: x86_64-pc-linux-gnu (64-bit)
## Running under: Debian GNU/Linux buster/sid
##
## Matrix products: default
## BLAS: /usr/lib/x86_64-linux-gnu/blas/libblas.so.3.7.1
## LAPACK: /usr/lib/x86_64-linux-gnu/lapack/liblapack.so.3.7.1
##
## locale:
##  [1] LC_CTYPE=en_US.UTF-8       LC_NUMERIC=C
##  [3] LC_TIME=en_US.UTF-8        LC_COLLATE=en_US.UTF-8
##  [5] LC_MONETARY=en_US.UTF-8    LC_MESSAGES=en_US.UTF-8
##  [7] LC_PAPER=en_US.UTF-8       LC_NAME=C
##  [9] LC_ADDRESS=C               LC_TELEPHONE=C
## [11] LC_MEASUREMENT=en_US.UTF-8 LC_IDENTIFICATION=C
##
## attached base packages:
## [1] methods   stats     graphics  grDevices utils     datasets  base
##
## other attached packages:
## [1] plyr_1.8.4      jsonlite_1.5    ggplot2_2.2.1    reproducer_0.1.9
## [5] knitr_1.17
##
## loaded via a namespace (and not attached):
##  [1] Rcpp_0.12.13      digest_0.6.12     grid_3.4.2
##  [4] gtable_0.2.0      magrittr_1.5      evaluate_0.10.1
##  [7] scales_0.5.0      rlang_0.1.2       stringi_1.1.5
## [10] lazyeval_0.2.0    labeling_0.3      RColorBrewer_1.1-2
## [13] tools_3.4.2       stringr_1.2.0     munsell_0.4.3
## [16] compiler_3.4.2    colorspace_1.3-2  gridExtra_2.3
## [19] tibble_1.3.4
```