```
   time        dose variable  n  mean    sd
1   t12   Basic_2.5    value 36 0.003 0.002
2   t13   Basic_2.5    value 36 0.004 0.003
3   t14   Basic_2.5    value 36 0.005 0.003
4   t15   Basic_2.5    value 36 0.005 0.003
5   t12     Basic_5    value 36 0.005 0.004
6   t13     Basic_5    value 36 0.008 0.005
7   t14     Basic_5    value 36 0.010 0.005
8   t15     Basic_5    value 36 0.011 0.005
9   t12 Complex_2.5    value 36 0.002 0.002
10  t13 Complex_2.5    value 36 0.003 0.003
11  t14 Complex_2.5    value 36 0.004 0.003
12  t15 Complex_2.5    value 36 0.005 0.004
13  t12   Complex_5    value 34 0.004 0.003
14  t13   Complex_5    value 34 0.006 0.003
15  t14   Complex_5    value 34 0.008 0.004
16  t15   Complex_5    value 34 0.009 0.005



   time        dose variable statistic           p
1   t12   Basic_2.5    value 0.9325947 0.0300201181
2   t13   Basic_2.5    value 0.9260434 0.0190186691
3   t14   Basic_2.5    value 0.8868862 0.0015234500
4   t15   Basic_2.5    value 0.8724259 0.0006533080
5   t12     Basic_5    value 0.9393097 0.0483501466
6   t13     Basic_5    value 0.9543458 0.1432631899
7   t14     Basic_5    value 0.9363760 0.0392228510
8   t15     Basic_5    value 0.9247492 0.0173978232
9   t12 Complex_2.5    value 0.8550399 0.0002491432
10  t13 Complex_2.5    value 0.8933568 0.0022571427
11  t14 Complex_2.5    value 0.8779249 0.0008969462
12  t15 Complex_2.5    value 0.8795457 0.0009859208
13  t12   Complex_5    value 0.9579483 0.2117357638
14  t13   Complex_5    value 0.9182365 0.0144093681
15  t14   Complex_5    value 0.9085509 0.0077766139
16  t15   Complex_5    value 0.9391353 0.0581046878

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 383, p-value = 0.002866
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction
```

```
data:  rad51_tb$value and rad51_tb2$value
W = 763, p-value = 0.1931
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 432.5, p-value = 0.03497
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 331, p-value = 0.0003631
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 751, p-value = 0.2452
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 345, p-value = 0.001712
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0
```

```
[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 281, p-value = 3.647e-05
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 718, p-value = 0.4307
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 301.5, p-value = 0.0002642
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 212, p-value = 9.249e-07
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 681.5, p-value = 0.7082
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Complex_5"
```

```
        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 315, p-value = 0.0004828
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 684.5, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 361, p-value = 0.0006997
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 594, p-value = 0.4218
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 444, p-value = 0.01367
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 684.5, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 314, p-value = 9.119e-05
```

```
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 573, p-value = 0.2998
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 407, p-value = 0.0041
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 684.5, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 272.5, p-value = 1.248e-05
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 620, p-value = 0.61
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 390, p-value = 0.00222
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
```

```
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 684.5, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 256, p-value = 5.298e-06
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 633, p-value = 0.7155
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 381, p-value = 0.001581
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 533, p-value = 0.1931
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 317, p-value = 0.0001871
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction
```

```
data:  rad51_tb$value and rad51_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 359, p-value = 0.002803
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 545, p-value = 0.2452
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 264, p-value = 1.513e-05
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 291.5, p-value = 0.0001575
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 578, p-value = 0.4307
alternative hypothesis: true location shift is not equal to 0
```

```
[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 231, p-value = 2.614e-06
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 258.5, p-value = 3.065e-05
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 614.5, p-value = 0.7082
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 205.5, p-value = 6.112e-07
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Complex_5"
```

```
        Wilcoxon rank sum test with continuity correction

data:  rad51_tb$value and rad51_tb2$value
W = 297, p-value = 0.0002032
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 738, p-value = 0.4218
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 383, p-value = 0.002712
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t12"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 492, p-value = 0.07792
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 759, p-value = 0.2998
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 352, p-value = 0.0008188
```

```
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t13"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 460, p-value = 0.03405
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 712, p-value = 0.61
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 297, p-value = 7.33e-05
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t14"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 416, p-value = 0.008876
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
```

```
[1] "Basic_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 699, p-value = 0.7155
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Basic_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 282, p-value = 3.544e-05
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Complex_2.5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 648, p-value = 1
alternative hypothesis: true location shift is not equal to 0

[1] "STARTING TEST FOR >>>>"
[1] "t15"
[1] "Complex_5"

        Wilcoxon rank sum test with continuity correction

data:  WT_tb$value and WT_tb2$value
W = 403, p-value = 0.005705
alternative hypothesis: true location shift is not equal to 0

Analysis of Deviance Table (Type II tests)

Response: valueranked
          LR Chisq Df Pr(>Chisq)
dose       100.560  3     <2e-16 ***
time        82.502  3     <2e-16 ***
dose:time    6.062  9     0.7337
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

contrast                           estimate   SE  df z.ratio p.value
 Basic_2.5 t12 - Basic_5 t12         -7.3023 2.91 Inf  -2.506  0.4668
 Basic_2.5 t12 - Complex_2.5 t12      2.6717 2.60 Inf   1.028  0.9997
 Basic_2.5 t12 - Complex_5 t12       -4.2530 2.77 Inf  -1.538  0.9782
 Basic_2.5 t12 - Basic_2.5 t13       -5.7148 2.83 Inf  -2.022  0.8131
 Basic_2.5 t12 - Basic_5 t13        -16.3279 4.12 Inf  -3.958  0.0075
 Basic_2.5 t12 - Complex_2.5 t13     -2.5391 2.67 Inf  -0.951  0.9999
 Basic_2.5 t12 - Complex_5 t13      -11.7943 3.41 Inf  -3.464  0.0443
 Basic_2.5 t12 - Basic_2.5 t14       -8.3956 3.00 Inf  -2.795  0.2717
 Basic_2.5 t12 - Basic_5 t14        -18.3962 4.43 Inf  -4.149  0.0035
 Basic_2.5 t12 - Complex_2.5 t14     -6.1061 2.84 Inf  -2.150  0.7326
 Basic_2.5 t12 - Complex_5 t14      -17.6241 4.40 Inf  -4.004  0.0063
 Basic_2.5 t12 - Basic_2.5 t15       -9.2232 3.09 Inf  -2.981  0.1770
 Basic_2.5 t12 - Basic_5 t15        -16.4038 4.11 Inf  -3.989  0.0066
 Basic_2.5 t12 - Complex_2.5 t15     -7.3945 2.92 Inf  -2.533  0.4473
 Basic_2.5 t12 - Complex_5 t15      -18.3427 4.45 Inf  -4.119  0.0039
```

Basic_5 t12 - Complex_2.5 t12	9.9740	3.05	Inf	3.266	0.0817	
Basic_5 t12 - Complex_5 t12	3.0493	2.64	Inf	1.157	0.9989	
Basic_5 t12 - Basic_2.5 t13	1.5875	2.52	Inf	0.629	1.0000	
Basic_5 t12 - Basic_5 t13	-9.0256	3.11	Inf	-2.904	0.2128	
Basic_5 t12 - Complex_2.5 t13	4.7632	2.76	Inf	1.724	0.9409	
Basic_5 t12 - Complex_5 t13	-4.4921	2.67	Inf	-1.685	0.9511	
Basic_5 t12 - Basic_2.5 t14	-1.0933	2.50	Inf	-0.438	1.0000	
Basic_5 t12 - Basic_5 t14	-11.0939	3.35	Inf	-3.313	0.0710	
Basic_5 t12 - Complex_2.5 t14	1.1962	2.53	Inf	0.473	1.0000	
Basic_5 t12 - Complex_5 t14	-10.3219	3.34	Inf	-3.090	0.1338	
Basic_5 t12 - Basic_2.5 t15	-1.9209	2.51	Inf	-0.764	1.0000	
Basic_5 t12 - Basic_5 t15	-9.1015	3.09	Inf	-2.943	0.1941	
Basic_5 t12 - Complex_2.5 t15	-0.0922	2.51	Inf	-0.037	1.0000	
Basic_5 t12 - Complex_5 t15	-11.0404	3.38	Inf	-3.268	0.0811	
Complex_2.5 t12 - Complex_5 t12	-6.9248	2.86	Inf	-2.421	0.5314	
Complex_2.5 t12 - Basic_2.5 t13	-8.3865	2.95	Inf	-2.841	0.2457	
Complex_2.5 t12 - Basic_5 t13	-18.9996	4.34	Inf	-4.374	0.0013	
Complex_2.5 t12 - Complex_2.5 t13	-5.2109	2.73	Inf	-1.911	0.8713	
Complex_2.5 t12 - Complex_5 t13	-14.4661	3.59	Inf	-4.030	0.0057	
Complex_2.5 t12 - Basic_2.5 t14	-11.0673	3.16	Inf	-3.503	0.0390	
Complex_2.5 t12 - Basic_5 t14	-21.0679	4.66	Inf	-4.520	0.0007	
Complex_2.5 t12 - Complex_2.5 t14	-8.7778	2.97	Inf	-2.958	0.1870	
Complex_2.5 t12 - Complex_5 t14	-20.2959	4.63	Inf	-4.388	0.0012	
Complex_2.5 t12 - Basic_2.5 t15	-11.8949	3.26	Inf	-3.647	0.0239	
Complex_2.5 t12 - Basic_5 t15	-19.0755	4.33	Inf	-4.405	0.0012	
Complex_2.5 t12 - Complex_2.5 t15	-10.0662	3.06	Inf	-3.290	0.0760	
Complex_2.5 t12 - Complex_5 t15	-21.0144	4.68	Inf	-4.491	0.0008	
Complex_5 t12 - Basic_2.5 t13	-1.4617	2.61	Inf	-0.561	1.0000	
Complex_5 t12 - Basic_5 t13	-12.0749	3.50	Inf	-3.447	0.0467	
Complex_5 t12 - Complex_2.5 t13	1.7139	2.69	Inf	0.636	1.0000	
Complex_5 t12 - Complex_5 t13	-7.5413	2.94	Inf	-2.567	0.4220	
Complex_5 t12 - Basic_2.5 t14	-4.1425	2.67	Inf	-1.554	0.9759	
Complex_5 t12 - Basic_5 t14	-14.1432	3.77	Inf	-3.748	0.0166	
Complex_5 t12 - Complex_2.5 t14	-1.8531	2.62	Inf	-0.708	1.0000	
Complex_5 t12 - Complex_5 t14	-13.3711	3.76	Inf	-3.560	0.0322	
Complex_5 t12 - Basic_2.5 t15	-4.9701	2.71	Inf	-1.832	0.9053	
Complex_5 t12 - Basic_5 t15	-12.1508	3.49	Inf	-3.483	0.0416	
Complex_5 t12 - Complex_2.5 t15	-3.1415	2.64	Inf	-1.190	0.9985	
Complex_5 t12 - Complex_5 t15	-14.0897	3.80	Inf	-3.708	0.0192	
Basic_2.5 t13 - Basic_5 t13	-10.6131	3.24	Inf	-3.277	0.0789	
Basic_2.5 t13 - Complex_2.5 t13	3.1756	2.70	Inf	1.175	0.9987	
Basic_2.5 t13 - Complex_5 t13	-6.0796	2.74	Inf	-2.218	0.6842	
Basic_2.5 t13 - Basic_2.5 t14	-2.6808	2.52	Inf	-1.062	0.9996	
Basic_2.5 t13 - Basic_5 t14	-12.6814	3.49	Inf	-3.630	0.0253	
Basic_2.5 t13 - Complex_2.5 t14	-0.3913	2.52	Inf	-0.155	1.0000	
Basic_2.5 t13 - Complex_5 t14	-11.9094	3.48	Inf	-3.420	0.0510	
Basic_2.5 t13 - Basic_2.5 t15	-3.5084	2.55	Inf	-1.374	0.9928	
Basic_2.5 t13 - Basic_5 t15	-10.6891	3.22	Inf	-3.316	0.0704	
Basic_2.5 t13 - Complex_2.5 t15	-1.6797	2.52	Inf	-0.665	1.0000	
Basic_2.5 t13 - Complex_5 t15	-12.6279	3.52	Inf	-3.585	0.0296	
Basic_5 t13 - Complex_2.5 t13	13.7888	3.81	Inf	3.621	0.0262	
Basic_5 t13 - Complex_5 t13	4.5335	2.74	Inf	1.653	0.9585	
Basic_5 t13 - Basic_2.5 t14	7.9323	2.97	Inf	2.667	0.3519	
Basic_5 t13 - Basic_5 t14	-2.0683	2.51	Inf	-0.824	1.0000	
Basic_5 t13 - Complex_2.5 t14	10.2218	3.23	Inf	3.161	0.1103	
Basic_5 t13 - Complex_5 t14	-1.2963	2.57	Inf	-0.504	1.0000	
Basic_5 t13 - Basic_2.5 t15	7.1047	2.88	Inf	2.465	0.4977	
Basic_5 t13 - Basic_5 t15	-0.0759	2.48	Inf	-0.031	1.0000	
Basic_5 t13 - Complex_2.5 t15	8.9334	3.11	Inf	2.872	0.2290	
Basic_5 t13 - Complex_5 t15	-2.0148	2.56	Inf	-0.788	1.0000	
Complex_2.5 t13 - Complex_5 t13	-9.2552	3.16	Inf	-2.927	0.2016	
Complex_2.5 t13 - Basic_2.5 t14	-5.8564	2.82	Inf	-2.074	0.7818	
Complex_2.5 t13 - Basic_5 t14	-15.8571	4.10	Inf	-3.869	0.0106	
Complex_2.5 t13 - Complex_2.5 t14	-3.5670	2.72	Inf	-1.314	0.9955	

```
 Complex_2.5 t13 - Complex_5 t14   -15.0850 4.07 Inf  -3.704  0.0195
 Complex_2.5 t13 - Basic_2.5 t15    -6.6840 2.89 Inf  -2.310  0.6166
 Complex_2.5 t13 - Basic_5 t15     -13.8647 3.79 Inf  -3.653  0.0233
 Complex_2.5 t13 - Complex_2.5 t15  -4.8554 2.77 Inf  -1.755  0.9319
 Complex_2.5 t13 - Complex_5 t15   -15.8036 4.12 Inf  -3.835  0.0121
 Complex_5 t13 - Basic_2.5 t14       3.3988 2.59 Inf   1.311  0.9956
 Complex_5 t13 - Basic_5 t14        -6.6018 2.91 Inf  -2.271  0.6458
 Complex_5 t13 - Complex_2.5 t14     5.6883 2.74 Inf   2.075  0.7811
 Complex_5 t13 - Complex_5 t14      -5.8298 2.92 Inf  -1.996  0.8282
 Complex_5 t13 - Basic_2.5 t15       2.5712 2.55 Inf   1.007  0.9998
 Complex_5 t13 - Basic_5 t15        -4.6095 2.73 Inf  -1.690  0.9498
 Complex_5 t13 - Complex_2.5 t15     4.3999 2.67 Inf   1.648  0.9594
 Complex_5 t13 - Complex_5 t15      -6.5483 2.94 Inf  -2.225  0.6797
 Basic_2.5 t14 - Basic_5 t14       -10.0006 3.20 Inf  -3.125  0.1218
 Basic_2.5 t14 - Complex_2.5 t14     2.2895 2.53 Inf   0.905  0.9999
 Basic_2.5 t14 - Complex_5 t14      -9.2286 3.20 Inf  -2.885  0.2226
 Basic_2.5 t14 - Basic_2.5 t15      -0.8276 2.47 Inf  -0.336  1.0000
 Basic_2.5 t14 - Basic_5 t15        -8.0082 2.96 Inf  -2.706  0.3264
 Basic_2.5 t14 - Complex_2.5 t15     1.0011 2.50 Inf   0.401  1.0000
 Basic_2.5 t14 - Complex_5 t15      -9.9471 3.23 Inf  -3.077  0.1382
 Basic_5 t14 - Complex_2.5 t14      12.2901 3.49 Inf   3.524  0.0364
 Basic_5 t14 - Complex_5 t14         0.7721 2.55 Inf   0.303  1.0000
 Basic_5 t14 - Basic_2.5 t15         9.1730 3.09 Inf   2.965  0.1840
 Basic_5 t14 - Basic_5 t15           1.9924 2.50 Inf   0.796  1.0000
 Basic_5 t14 - Complex_2.5 t15      11.0017 3.35 Inf   3.283  0.0777
 Basic_5 t14 - Complex_5 t15         0.0535 2.52 Inf   0.021  1.0000
 Complex_2.5 t14 - Complex_5 t14   -11.5181 3.48 Inf  -3.314  0.0709
 Complex_2.5 t14 - Basic_2.5 t15    -3.1171 2.56 Inf  -1.219  0.9980
 Complex_2.5 t14 - Basic_5 t15     -10.2977 3.22 Inf  -3.199  0.0991
 Complex_2.5 t14 - Complex_2.5 t15  -1.2884 2.53 Inf  -0.509  1.0000
 Complex_2.5 t14 - Complex_5 t15   -12.2366 3.52 Inf  -3.480  0.0420
 Complex_5 t14 - Basic_2.5 t15       8.4010 3.10 Inf   2.713  0.3221
 Complex_5 t14 - Basic_5 t15         1.2203 2.56 Inf   0.477  1.0000
 Complex_5 t14 - Complex_2.5 t15    10.2296 3.34 Inf   3.060  0.1447
 Complex_5 t14 - Complex_5 t15      -0.7185 2.59 Inf  -0.278  1.0000
 Basic_2.5 t15 - Basic_5 t15        -7.1807 2.87 Inf  -2.505  0.4681
 Basic_2.5 t15 - Complex_2.5 t15     1.8287 2.51 Inf   0.727  1.0000
 Basic_2.5 t15 - Complex_5 t15      -9.1195 3.13 Inf  -2.916  0.2068
 Basic_5 t15 - Complex_2.5 t15       9.0093 3.10 Inf   2.911  0.2094
 Basic_5 t15 - Complex_5 t15        -1.9389 2.55 Inf  -0.762  1.0000
 Complex_2.5 t15 - Complex_5 t15   -10.9482 3.38 Inf  -3.239  0.0883

P value adjustment: tukey method for comparing a family of 16 estimates

dose        time emmean   SE  df asymp.LCL asymp.UCL .group
 Complex_2.5 t12  -16.39 3.50 Inf  -23.2472    -9.539  a
 Basic_2.5   t12  -13.72 3.27 Inf  -20.1295    -7.314  ab
 Complex_2.5 t13  -11.18 2.95 Inf  -16.9565    -5.408  abc
 Complex_5   t12   -9.47 2.63 Inf  -14.6200    -4.317  abc
 Basic_2.5   t13   -8.01 2.34 Inf  -12.6001    -3.414  abcd
 Complex_2.5 t14   -7.62 2.34 Inf  -12.2049    -3.026  abcd
 Basic_5     t12   -6.42 2.21 Inf  -10.7492    -2.089  abcde
 Complex_2.5 t15   -6.33 2.21 Inf  -10.6678    -1.986  abcde
 Basic_2.5   t14   -5.33 2.07 Inf   -9.3924    -1.260   bcde
 Basic_2.5   t15   -4.50 1.99 Inf   -8.3942    -0.603   bcde
 Complex_5   t13   -1.93 1.91 Inf   -5.6636     1.809    cde
 Basic_5     t13    2.61 1.85 Inf   -1.0107     6.223     de
 Basic_5     t15    2.68 1.83 Inf   -0.9045     6.269     de
 Complex_5   t14    3.90 2.04 Inf   -0.0926     7.898     de
 Complex_5   t15    4.62 2.04 Inf    0.6313     8.611      e
 Basic_5     t14    4.67 1.98 Inf    0.7895     8.560      e

Confidence level used: 0.95
P value adjustment: tukey method for comparing a family of 16 estimates
```

```
significance level used: alpha = 0.05
NOTE: If two or more means share the same grouping symbol,
      then we cannot show them to be different.
      But we also did not show them to be the same.

Code:

setwd("C:/Users/danie/Desktop/Daniel_Master_Directory/AMMPER/AMMPER_NEW/AMMPE
R/StatisticsBulk")

if(!require('stats')) {
  install.packages('stats')
  library('stats')
}
library(readr)
library(dendsort)
library(tidyverse)
library(dplyr)
library(pheatmap)
library(grid)
library(iClusterPlus)
library(iCluster2)
library(GenomicRanges)
library(gplots)
library(lattice)
library(maftools)
library(CopyNumberPlots)
library(rstatix)

test <- read_tsv(file="Complex_vs_Basic_RM2ANOVA.tsv")

test <- as.data.frame(test)

test <- subset(test, select = -1 )

colnames(test)[1] <- "time"
test$dose <- paste(test$ROS_model, test$dose, sep="_")
test$dose <- as.factor(test$dose)
test$variable <- as.factor(test$variable)
test$ROS_model <- NULL
rad51 <- test %>% filter(Treatment == "rad51")
rad51$Treatment <- NULL
WT <- test %>% filter(Treatment == "WT")
WT$Treatment <- NULL

summary<-rad51 %>%
  group_by(dose,time) %>%
  get_summary_stats(value, type = "mean_sd")
data.frame(summary)

View(rad51)

#### PLOTS
color1 = "#d31e25"
color2 = "#d7a32e"
color3 = "#369e4b"
color4 = "#5db5b7"
color5 = "#31407b"
color6 = "#d1c02b"
color7 = "#8a3f64"
color8 = "#4f2e39"

library(hrbrthemes)
```

```
rad51t14 <- rad51 %>% filter(time == "t14")
a <- rad51t14 %>% ggplot( aes(x=value, fill=dose)) +
  geom_histogram( color="#e9ecef", alpha=0.6, position = 'identity') +
  scale_fill_manual(values=c("#d31e25", "#d7a32e", "#369e4b","#5db5b7")) +
  theme_ipsum() +
  labs(fill="")

a
# Shapiro

normality<-rad51 %>%
  group_by(dose,time) %>%
  shapiro_test(value)
data.frame(normality)


rad51 <- rownames_to_column(rad51)
colnames(rad51)[1] <- "id"

# PAIRWISE WILCOXONS >>>>>>>>>>>>>>>>>>>>>>>>>>
coli = c("t12", "t13", "t14", "t15")
colj = c("Basic_2.5", "Basic_5", "Complex_2.5", "Complex_5")

for (x in coli) {

  for (y in colj) {
    rad51_t <- rad51 %>% filter(time == x)

    rad51_tb <- rad51_t %>% filter(dose == "Basic_2.5")

    rad51_tb2 <- rad51_t %>% filter(dose == y)

    res <- wilcox.test(rad51_tb$value, rad51_tb2$value, paired = FALSE)
    print("STARTING TEST FOR >>>>")
    print(x)
    print(y)
    print(res)

  }


}

WT <- rownames_to_column(WT)
colnames(WT)[1] <- "id"

for (x in coli) {

  for (y in colj) {
    WT_t <- WT %>% filter(time == x)

    WT_tb <- WT_t %>% filter(dose == "Basic_2.5")

    WT_tb2 <- WT_t %>% filter(dose == y)

    res <- wilcox.test(WT_tb$value, WT_tb2$value, paired = FALSE)
    print("STARTING TEST FOR >>>>")
    print(x)
    print(y)
    print(res)

  }
```

```
}

################## Basic 5

for (x in coli) {

  for (y in colj) {
    rad51_t <- rad51 %>% filter(time == x)

    rad51_tb <- rad51_t %>% filter(dose == "Complex_2.5")

    rad51_tb2 <- rad51_t %>% filter(dose == y)

    res <- wilcox.test(rad51_tb$value, rad51_tb2$value, paired = FALSE)
    print("STARTING TEST FOR >>>>")
    print(x)
    print(y)
    print(res)

  }


}

for (x in coli) {

  for (y in colj) {
    WT_t <- WT %>% filter(time == x)

    WT_tb <- WT_t %>% filter(dose == "Complex_2.5")

    WT_tb2 <- WT_t %>% filter(dose == y)

    res <- wilcox.test(WT_tb$value, WT_tb2$value, paired = FALSE)
    print("STARTING TEST FOR >>>>")
    print(x)
    print(y)
    print(res)

  }


}


###################### CLMM ############
#
library(ordinal)

rad51 <- within(rad51, {
  valueranked <- NA # need to initialize variable
  valueranked[value < 0.002] <- "1"
  valueranked[value >= 0.002 & value < 0.004] <- "2"
  valueranked[value >= 0.004 & value < 0.006] <- "3"
  valueranked[value >= 0.006 & value < 0.008] <- "4"
  valueranked[value >= 0.008 & value < 0.010] <- "5"
  valueranked[value >= 0.010 & value < 0.012] <- "6"
  valueranked[value >= 0.012 & value < 0.014] <- "7"
  valueranked[value >= 0.014 & value < 0.016] <- "8"
  valueranked[value >= 0.016 & value < 0.018] <- "9"
  valueranked[value >= 0.018 & value < 0.020] <- "10"
  valueranked[value >= 0.020 & value < 0.022] <- "11"
  valueranked[value >= 0.022] <- "12"
} )
```

```
View(rad51)
rad51$valueranked <-as.factor(rad51$valueranked)
mod = clmm(valueranked~dose*time+(1|id), data=rad51, Hess=T, nAGQ=17)

library(car)

library(RVAideMemoire)

Anova.clmm(mod,
           type = "II")

# PAIRED MEDIANS
install.packages("emmeans")
install.packages("multcomp")
library(emmeans)

marginal = emmeans(mod,
                   ~ dose + time)
pairs(marginal,
      adjust="tukey")


library(multcomp)

cld(marginal, Letters=letters)

################### Half life
> ### Use Kruskal wallis
> # Load necessary library
> library(dplyr)
> # Read the data from a CSV file
> data <- read.delim("Half_lives_RM2ANOVA.tsv")
> # Ensure the 'Half_life' column is a factor
> data$Half_life <- as.factor(data$Half_life)
> # Perform the Kruskal-Wallis test
> kruskal_test <- kruskal.test(value ~ Half_life, data = data)
> # Print the result of the Kruskal-Wallis test
> print(kruskal_test)

        Kruskal-Wallis rank sum test

data:  value by Half_life
Kruskal-Wallis chi-squared = 4.9566, df = 3, p-value = 0.175

> # If significant, perform pairwise comparisons using Wilcoxon rank-sum test
s with Holm correction
> if (kruskal_test$p.value < 0.05) {
+   pairwise_results <- pairwise.wilcox.test(data$value, data$Half_life, p.ad
just.method = "holm")
+   print(pairwise_results)
+ }
```