## Question 1 (Show work to get full points)

Suppose there are 4 levels of a single treatment factor to be compared in a balanced incomplete block design. There are only 6 blocks available each with only 2 experimental units.

(a). Compute the number of times each treatment level appears in the whole design.

4 levels of treatment means a = 4; 6 blocks means b = 6; 2 experimental units means k = 2;

$$N = kb = ra \implies r = kb/a = 2 \times 6 \div 4 = 3$$

(b). Compute the number of times each pair of treatment levels appears in the whole design.

$$\lambda = \frac{r(k-1)}{a-1} = \frac{3(2-1)}{4-1} = 1$$

(c). Provide a random assignment of treatment levels so that columns represent blocks and rows represent treatment levels.

	block1	block2	block3	block4	block5	block6
unit1	1	2	3	4	1	2
unit2	2	3	4	1	3	4

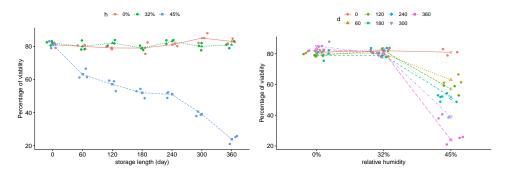
## Question 2 (Use software to analyze the given data)

Big sagebrush is often planted in range restoration projects. An experiment is performed to determine the effects of storage length and relative humidity on the viability of seeds. Sixty-three batches of 300 seeds each are randomly divided into 21 groups of three. These 21 groups each receive a different treatment, namely the combinations of storage length (0, 60, 120, 180, 240, 300, or 360 days) and storage relative humidity (0, 32, or 45). After the storage time, the seeds are planted, and the response is the percentage of seeds that sprout. The data are shown above and given in Sagebrush Excel file.

Part I: Analyze these data for the effects of the factors on viability. Do not report code here. Your analysis should include the following:

(a). Plot of the data (a plot with data and/or means of treatment combinations). Do not report code here.

```
## Classes 'tbl_df', 'tbl' and 'data.frame': 63 obs. of 5 variables:
## $ Humidity: num 0 0 0 0 0 0 0 0 0 0 ...
## $ Days : num 0 0 0 60 60 60 120 120 120 180 ...
## $ Percent : num 82.1 79 81.9 78.6 80.8 80.5 79.8 79.1 78.2 82.3 ...
## $ h : Factor w/ 3 levels "0%", "32%", "45%": 1 1 1 1 1 1 1 1 1 1 1 ...
## $ d : Factor w/ 7 levels "0", "60", "120", ...: 1 1 1 2 2 2 3 3 3 4 ...
```



(b). Description of the observed relationship between two factors based on the graph.

The line plot shows that not all lines are parallel. Difference in average percentage between humidity is not same for different storage length. There could be an interaction effect. The graph also show that,

When relative humidity is 0 or 32%, the average percentage is around 80% and have not obivous difference between different storage length.

When humidity is 45%, the average percentage of viability of seeds have obvious difference between different storage length. The longer storage length have lower average percentage of viability of seeds.

When storage length is 0 day, the average percentage of viability of seeds has not obvious difference between different relative humidity.

When any storage length is applied, the average percentage have not obivous difference between 0 and 32% humidity.

When storage length is 60 to 360 days, the average percentage of viability have significent difference between 45% humidity and other levels of humidity. The higher humidity has lower average percentage of viability of seeds.

(c). Tabular form of the numerical summaries for each treatment combination and factor levels separately.

h	min	Q1	median	Q3	max	mean	sd	n	missing
0%	75.5	79.1	81.1	82.1	87.9	81.13333	2.670268	21	0
32%	77.6	78.9	81.0	83.1	83.8	80.99524	2.128491	21	0
45%	21.0	40.6	52.9	61.2	83.1	52.43333	17.196114	21	0

<sup>\*</sup> h=relative humidity

d	min	Q1	median	Q3	max	mean	sd	n	missing
0	78.9	80.5	81.9	82.4	83.1	81.33333	1.599219	9	0
60	61.2	66.5	78.3	80.5	83.6	74.33333	8.767554	9	0
120	52.9	59.3	79.1	80.4	83.8	72.68889	11.984203	9	0
180	48.7	54.3	77.8	79.1	82.3	69.97778	13.708462	9	0
240	48.8	52.2	81.1	81.7	83.8	71.64444	15.580606	9	0
300	37.9	40.6	80.3	82.1	87.9	68.00000	21.921451	9	0
360	21.0	25.8	81.0	82.7	84.6	62.66667	29.070690	9	0

<sup>\*</sup> d=storage length (days)

h.d	min	Q1	median	Q3	max	mean	sd	n	missing
0%.0	79.0	80.45	81.9	82.00	82.1	81.00000	1.7349352	3	0
32%.0	80.5	81.45	82.4	82.75	83.1	82.00000	1.3453624	3	0
45%.0	78.9	79.95	81.0	82.05	83.1	81.00000	2.1000000	3	0
0%.60	78.6	79.55	80.5	80.65	80.8	79.96667	1.1930353	3	0
32%.60	78.1	78.20	78.3	80.95	83.6	80.00000	3.1192948	3	0
45%.60	61.2	61.30	61.4	63.95	66.5	63.03333	3.0038864	3	0
0%.120	78.2	78.65	79.1	79.45	79.8	79.03333	0.8020806	3	0
32%.120	80.4	81.10	81.8	82.80	83.8	82.00000	1.7088007	3	0
45%.120	52.9	55.90	58.9	59.10	59.3	57.03333	3.5851546	3	0
0%.180	75.5	77.30	79.1	80.70	82.3	78.96667	3.4019602	3	0
32%.180	77.8	78.30	78.8	79.60	80.4	79.00000	1.3114877	3	0
45%.180	48.7	50.80	52.9	53.60	54.3	51.96667	2.9143324	3	0
0%.240	80.1	80.60	81.1	81.40	81.7	80.96667	0.8082904	3	0
32%.240	81.5	82.60	83.7	83.75	83.8	83.00000	1.3000000	3	0
45%.240	48.8	50.35	51.9	52.05	52.2	50.96667	1.8823744	3	0
0%.300	82.1	83.55	85.0	86.45	87.9	85.00000	2.9000000	3	0
32%.300	77.6	78.95	80.3	81.15	82.0	79.96667	2.2188586	3	0
45%.300	37.9	38.25	38.6	39.60	40.6	39.03333	1.4011900	3	0
0%.360	81.7	82.20	82.7	83.65	84.6	83.00000	1.4730920	3	0
32%.360	78.9	79.95	81.0	82.05	83.1	81.00000	2.1000000	3	0
45%.360	21.0	23.10	25.2	25.50	25.8	24.00000	2.6153394	3	0

<sup>\*</sup> h.d=interaction items

(d). The complete (theoretical, not the estimated) linear model and explain the terms for this experiment.

This is a two-factor factionial model with fixed effect.

$$y_{ijk} = \mu + \tau_i + \beta_j + (\tau \beta)_{ij} + \varepsilon_{jik}$$

for i = 1, 2, ..., a represents 0, 32%, and 45% humidity; j = 1, 2, ..., b represents 7 levels of storage length; k = 1, 2..., n represents 3 experimental units.

 $y_{ijk}$  is the the average percentage of viability of seeds for the  $k^{th}$  Exerimental Unit when  $i^{th}$  level of relative humidity and  $j^{th}$  level of storage length are applied.

*a* is the number of levels of relative humidity being compared;

*b* is the number of levels of storage length being compared;

 $\tau_i$  is fixed main effect of  $i^{th}$  level of relative humidity (Treatment effect of relative humidity);

 $\beta_j$  is fixed main effect of  $j^{th}$  level of storage length (Treatment effect of storage length);

 $(\tau \beta)_{ij}$  is fixed interaction effect of  $i^{th}$  level of relative humidity and  $j^{th}$  level of storage length (Interaction effect of relative humidity and storage length)

 $\varepsilon_{jik}$  is random error for the  $k^{th}$  Exerimental Unit when  $i^{th}$  level of relative humidity and  $j^{th}$  level of storage length are applied.

The model includes below assumptions:

$$\varepsilon_{ijk} \sim iidN(0,\sigma^2); \sum_i^a \tau_i = 0; \sum_j^b \beta_j = 0; \sum_i^a (\tau \beta)_{ij} = 0; \sum_j^b (\tau \beta)_{ij} = 0$$

(e). The complete ANOVA table for the fitted model you have in part (d). Do not report code here.

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
humidity	2	11476	5738	1179	1.271e-37
days	6	1789	298.1	61.25	3.504e-19
h:d	12	4154	346.2	71.12	6.511e-24
<b>Residuals</b>	42	204.4	4.867		
Total	62	17623.78			

**(f).** Conclusion from the test of significant interaction effect along with the p value. What do you recommend as the next step in your analysis? (That is, should you test for main effects or simple effects? Why? Explain clearly and provide reasons).

According to ANOVA table, there is a significant interaction effect from relative humidity and storage length on the average percentage at 5% significance level (P-value= $6.511 \times e^{-24}$ ). That means, effect of humidity and effect of storage length on average percentage of viability is not independent. Therefore, simple effects examinations are recommended.

**(g).** According to your answer in part (f), conclusion(s) from the appropriate tests about the effect of factors along with the p-value(s).

The pairwise test adjusted by Tukey method show the simple effects (full table and P-values in Part III):

• In comparisons of storage length Least Squares Means by humidity,

When 0 humidity is applied,  $\mathbf{NONE}$  of comparisons of storage length has significant difference on the

average percentage around 5% significance level (all P-value>0.05).

When 32% humidity is applied, **NONE** of comparisons of storage length has significant difference on the average percentage around 5% significance level (all P-value>0.05).

When 45% humidity applied, **MOST** of comparisons of storage length have significant difference on the average percentage around 5% significance level (P-value<0.05) **EXCEPT** 60 versus 120 days, 120 versus 180 days, 120 versus 240 days, and 180 versus 240 days (P-value=0.0815, 0.2452, 0.0747, 1.0000, respectively)

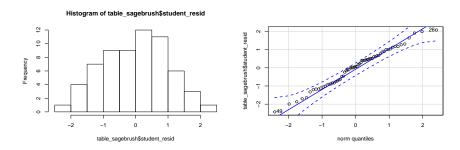
In comparisons of humidity Least Squares Means by storage length,

When 0 day applied, **NONE** of comparisons of humidity have significant difference on the average percentage around 5% significance level (all P-value>0.05).

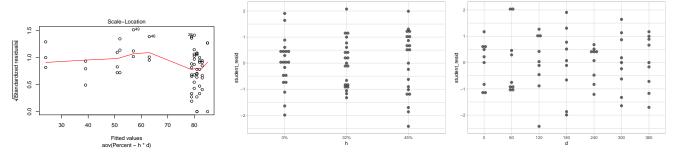
When 60 to 360 day applied, **NONE** of 0 versus 32% have significant difference on the average percentage around 5% significance level (all P-value>0.05). **ALL** of 0 versus 45%, 32% versus 45% have significant difference on the average percentage around 5% significance level (all P-value<0.05).

The overall conclusion is that humidity lower than 45% can keep the average percentage of viability of seeds being aroud 80%. If we cannot control the high humidity, the shorter storage length can give higher average percentage of viability of seeds.

(h). Check the assumptions of the fitted model and if you find any violation of assumptions, recommend solutions to fix them. Clearly explain and provide all the graphs and/or tables used to answer this question here. (Do not provide any code here).



## [1] 49 26



The histogram of residuals shows an acceptable normal distribution. The QQ plot didn't show obvious violation of normality except a few data points are not on the line and flattening at the extremes, which is acceptable.

The plot of studentized residual versus predicted (fitted) value shows that except few outliers, the residuals are evenly distributed about zero at each prededict value (zero mean) and vertical deviations of residuals from zero are about same for each predicted value (constant variance).

The plots of studentized residual versus humanity and storage length levels didn't show obvious violation of zero mean and constant variance.

Part II: The researchers are interested in testing whether the mean percentage of seeds that sprout is significantly different at humidity of 45% compared to average of percentage of seeds that sprout at humidity of 0 and 32% when the storage length is 60 days.

(a). To test this, write a contrast statement in terms of the treatment means.

$$\Gamma: \mu_{32} - \frac{1}{2}(\mu_{12} + \mu_{22}) = 0 \implies \tau_{32} + (\tau\beta)_{32} - \frac{1}{2}(\tau_{12} + (\tau\beta)_{12} + \tau_{22} + (\tau\beta)_{22}) = 0$$

where subscript "32" represents 45% humidity and 60-days storage; "12" represents 0 humidity and 60-days storage; "22" represents 32% humidity and 60-days storage.

The H0 for contrast is  $\mu_{32} - \frac{1}{2}(\mu_{12} + \mu_{22}) = 0$  or  $\tau_{32} + (\tau\beta)_{32} - \frac{1}{2}(\tau_{12} + (\tau\beta)_{12} + \tau_{22} + (\tau\beta)_{22}) = 0$ . The H1 is they don't equal zero.

(b). test your contrast using the software and provide the conclusion along with p value.

The estimated value of the contrast is -16.9 and the adjusted Tukey's p value for testing the above hypotheses for contrast is less than 0.0001, which is small enough. We can reject the *H*0 and conclude that the average percentage of viability of seeds for 60-days storage at 45% humidity versus that at 0 and 32% humidity are different at 5% significance level.

Part III: Provide your full code and/or output (only the ones used to answer above questions) here.

```
## # I(a)
## table_sagebrush <- read_xlsx("Sagebrush.xlsx")
## table_sagebrush$h <- factor(table_sagebrush$Humidity, levels = c(0, 32, 45),
       labels = c("0\%", "32\%", "45\%"))
##
## table_sagebrush\$d \leftarrow factor(table_sagebrush\$Days, levels = c(0, 60, 120, 180, 180)
       240, 300, 360), labels = c("0", "60", "120", "180", "240", "300", "360"))
## str(table_sagebrush)
## gqline(table_sagebrush, "d", "Percent", add = c("mean", "jitter"), shape = "h",
       color = "h", linetype = "h", ylab = "viability of seeds", xlab = "storage length (day)"
## ggline(table_sagebrush, "h", "Percent", add = c("mean", "jitter"), shape = "d",
       color = "d", linetype = "d", ylab = "viability of seeds", xlab = "relative humidity")
## # I(c)
## favstats(Percent ~ h, data = table_sagebrush)
## favstats(Percent ~ d, data = table_sagebrush)
## favstats(Percent ~ h + d, data = table_sagebrush)
## # I(e)
## model_sagebrush <- aov(Percent ~ h * d, data = table_sagebrush)
## summary(model_sagebrush)
## # I(q)
h_d <- pairs(lsmeans(model_sagebrush, ~h | d))</pre>
d_h <- pairs(lsmeans(model_sagebrush, ~d | h))</pre>
kable(test(rbind(d_h, h_d), adjust = "tukey"), format = "latex") %>% kable_styling("condensed"
    full_width = F, font_size = 6) \% row_spec(c(43:63, 68, 69, 71, 72, 74,
    75, 77, 78, 80, 81, 83, 84), bold = T) \% row_spec(c(49, 54, 55, 58), background = "#EAFA
    footnote(symbol = "Adjusted by Tukey's Method")
```

b         d         contrast         estimate         SE         df         t.ratio         pysophet           0%         .         0 - 00         1.033333         1.801352         42         1.0947728         0.9967578           0%         .         0 - 120         1.9666667         1.801352         42         1.11277820         0.9967578           0%         .         0 - 240         0.0333333         1.801352         42         2.1112774         0.9962109           0%         .         0 - 360         - 2.0000000         1.801352         42         - 1.1102774         0.9962109           0%         .         6 0 - 120         0.333333         1.801352         42         0.5551387         0.999976           0%         .         6 0 - 240         - 1.0000000         1.801352         42         0.7551387         0.999976           0%         .         6 0 - 360         - 3.0333333         1.801352         42         0.7551387         0.999976           0%         .         1.20 - 180         0.0666667         1.801352         42         0.1000000         1.901352         42         0.0572681         0.99274           0%         .         1.20 - 240								
0%         0         120         19666667         1801322         22         10917282         0.996758           0%         1         0         180         0.2333333         1801382         22         11127720         0.099976           0%         1         0         300         4.0000000         1801382         22         22.255454         0.099906           0%         1         0         300         4.0000000         1801382         22         2.11102774         0.998209           0%         1         0         300         4.0000000         1801382         22         2.5551387         0.0999976           0%         1         60         300         -30333333         1801382         42         -2.5551387         0.0999976           0%         1         2120         30         -30333333         1801332         42         -2.1689309         0.9999976           0%         1         2120         30         -30333333         1801332         42         -2.189180         0.9527610           0%         1         2120-180         -39666667         1801332         42         -1.110274         0.996210           0%         1         8		d						
0%         0         180         2_0333333         1801352         22         1_1287820         0_075008           0%         0         0         2_0         2_0333333         1801352         22         2_1205846         0_059008           0%         0         0         2_0000000         1801352         22         2_1205848         0_099209           0%         0         0         2_0000000         1801352         22         1_120774         0.992109           0%         0         0         120         1_0000000         1801352         22         1_551347         0.9999976           0%         0         0         10         10         1801353         22         0.555137         0.9999976           0%         0         0         30         0         5.000000         1         0.000000           0%         1         120-180         0.966667         1.801352         22         0.1072681         0.957274           0%         1         120-240         0.3903333         1.801352         22         0.1072691         0.982109           0%         1         120-360         -3666667         1.801352         22         1.1102774								
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0%         0         0         4,0000000         1801352         42         2,2225548         0,599516           0%         .         60 - 120         0,9335333         1801352         42         1,1102774         0,999976           0%         .         60 - 120         0,9335333         1,801352         42         0,5551387         0,9999976           0%         .         60 - 200         -1,0000000         1,801353         42         0,5551387         0,9999976           0%         .         60 - 300         -5,0333333         1,801353         42         2,0551387         0,9999976           0%         .         61 - 300         -5,066667         1,801352         42         0,000000         0,000000           0%         .         1,20 - 400         -5,9666667         1,801352         42         -3,0172681         0,972274           0%         .         1,20 - 400         -5,9666667         1,801352         42         -3,0172681         0,972374           0%         .         1,80 - 300         -6,60333333         1,801352         42         -1,1102774         0,962109           0%         .         1,80 - 300         -6,0333333         1,801352         42 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>								
0%         0         0         2,0000000         18,01352         22         1,1102774         0.9962109           0%         1         66-180         1,0000000         1,801352         22         1,55151294         0.0999976           0%         1         66-180         1,0000000         1,801352         42         0.5551387         0.0999976           0%         1         60-340         -1,0000000         1,801352         42         -2,7941981         0.0557612           0%         1         120-180         0.066667         1,801352         42         -1,689207         0.000000           0%         1         120-140         -1,9333333         1,801352         42         -1,000000         0.000000           0%         1         1,900         -1,9333333         1,801352         42         -1,100000         0.000000         1,0000000         0.000000         1,000000         0.000000         0.000000         0.000000         0.000000         0.000000         0.000000         0.000000         0.000000         0.000000         0.000000         0.000000         0.000000         0.000000         1,0000000         0.0000000         0.000000         0.0000000         0.0000000         0.0000000         0.00								
0%         I.         60 - 120         0.9333333         1.801352         42         0.3551387         0.9999976           0%         I.         60 - 240         1.0000000         1.801352         42         0.3551387         0.9999976           0%         I.         60 - 300         5.0333333         1.801352         42         0.5551387         0.9999076           0%         I.         120 - 180         0.066667         1.801352         42         1.6389207         0.9000001           0%         I.         120 - 300         3.5966667         1.801352         42         -1.0732681         0.9972374           0%         I.         120 - 300         3.5966667         1.801352         42         -3.312276         0.0851541           0%         I.         180 - 301         6.0333333         1.801352         42         1.1012774         0.996219           0%         I.         180 - 301         6.0333333         1.801352         42         1.1112774         0.996219           0%         I.         180 - 301         6.0333333         1.801352         42         1.112274         0.996219           0%         I.         240 - 300         4.0333333         1.801352								
0%         L         60 - 180         1 0000000         1.801352         42         0.5551387         0.9999976           0%         L         60 - 300         5.0333333         1.801352         42         -2.7941931         0.2537612           0%         L         60 - 300         5.03333333         1.801352         42         -1.6734917         0.9000001           0%         L         120 - 180         0.0666667         1.801352         42         -1.0732681         0.9000000           0%         L         120 - 300         5.9666667         1.801352         42         -2.020502         0.6119437           0%         L         120 - 300         5.9666667         1.801352         42         -2.200502         0.6119437           0%         L         180 - 300         4.60333333         1.801352         42         2.230594         0.05870388           0%         L         240 - 500         2.0033333         1.801352         42         1.1102774         0.9962109           32%         L         0.60         2.0000000         1.801352         42         1.1102774         0.9962109           32%         L         0.120         0.0000000         1.801352         4								
0%         I.         60 - 240         -1 0000000         1801352         42         0.5333731         0.999976           0%         I.         60 - 360         3.0333333         1801352         42         1.0839207         0.9000001           0%         I.         120 - 180         0.0666667         1.801352         42         1.073081         0.9000001           0%         I.         120 - 360         3.933333         1.801352         42         1.073081         0.9072274           0%         I.         120 - 360         3.93666667         1.801352         42         2.3212276         0.0851541           0%         I.         180 - 260         4.0333333         1.801352         42         1.1102774         0.9962109           0%         I.         180 - 360         4.0333333         1.801352         42         2.11227800         0.9780810           0%         I.         240 - 360         4.0333333         1.801352         42         1.1122774         0.996210           0%         I.         240 - 360         4.0333333         1.801352         42         1.1122780         0.99896210           0%         I.         240 - 300         3.000000         1.801352								
0%         Image: Color of the color o								
0%         L         60 - 360         -3.03333333         L801352         42         1.0859207         0.900001           0%         L         120 - 180         0.0666667         1.801352         42         1.0732881         0.9972274           0%         L         120 - 300         -3.9666667         1.801352         42         1.073281         0.9972274           0%         L         120 - 300         -3.9666667         1.801352         42         -1.017274         0.9962179           0%         L         180 - 201         -6.0333333         1.801352         42         -1.1102774         0.9962109           0%         L         180 - 360         4.0333333         1.801352         42         2.2309544         0.0870488           0%         L         240 - 360         4.0333333         1.801352         42         1.1102774         0.9962109           32%         L         0.60         2.2000000         1.801352         42         1.1102774         0.9962109           32%         L         0.120         2.0000000         1.801352         42         1.1102774         0.9962109           32%         L         0.180         1.0000000         1.801352         42 </td <td></td> <td>•</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		•						
0%         I.         120 - 180         0.0666667         1.801352         42         0.0370092         1.0000000           0%         I.         120 - 300         -3.9666667         1.801352         42         -3.3122276         0.0851541           0%         I.         120 - 300         -3.9666667         1.801352         42         -2.2020502         0.6511947           0%         I.         180 - 300         4.0333333         1.801352         42         -2.349368         0.0780433           0%         I.         180 - 300         4.0333333         1.801352         42         2.2390594         0.987308           0%         I.         240 - 300         4.0333333         1.801352         42         2.1129780         0.987808           0%         I.         240 - 360         2.20033333         1.801352         42         1.1102774         0.9962109           0%         I.         300 - 60         2.0000000         1.801352         42         1.1102774         0.9962109           2%         I.         0.120         0.0000000         1.801352         42         1.6164161         0.996738           2%         I.         0.120         0.0000000         1.801352								
0%         I.         120-240         I-J9333333         J801352         42         I-J073681         0.997274           0%         I.         120-360         3-5966667         J801352         42         2-2020502         0.6881541           0%         I.         120-360         3-9666667         J801352         42         2-2020502         0.6119477           0%         I.         180-300         6-033333         J801352         42         2-2200904         0.078433           0%         I.         240-300         4-0333333         J801352         42         2-2309044         0.0870368           0%         I.         240-300         4-0333333         J801352         42         1-1287820         0.995209           2%         I.         0.60         2-2030000         J801352         42         1-120774         0.996219           2%         I.         0.180         3.000000         J801352         42         1.6654161         0.9967389           2%         I.         0.120         0.000000         J801352         42         1.6654161         0.9967389           2%         I.         0.120         0.000000         J801352         42         1.6654161 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>								
0%         I.         120-300         5-5966667         I.801352         42         3.3122276         0.081543           0%         I.         120-360         -3-966667         I.801352         42         -1.1102774         0.9962109           0%         I.         180-300         -6.0333333         1.801352         42         -1.1102774         0.9962109           0%         I.         180-300         -6.0333333         1.801352         42         -2.2305944         0.5870368           0%         I.         240-360         2.0333333         1.801352         42         -2.2305944         0.5870368           0%         I.         300-360         2.000000         1.801352         42         1.012774         0.9962109           0%         I.         300-360         2.0000000         1.801352         42         1.0000000         1.000000           22%         I.         0-120         0.0000000         1.801352         42         1.0000000         1.0000000           22%         I.         0-300         2.033333         1.801352         42         1.0553337         0.9999976           22%         I.         0-300         2.0333333         1.801352         42		•						
0%         I.         120-360         -3.9666667         I.801352         42         2.2020502         0.6119457           0%         I.         180-340         -6.0333333         1.801352         42         -2.349364         0.0780433           0%         I.         180-360         -6.0333333         1.801352         42         -2.2390944         0.5870368           0%         I.         240-300         -4.0333333         1.801352         42         -2.2390944         0.5870368           0%         I.         240-300         -4.0333333         1.801352         42         1.1126774         0.9962109           0%         I.         0.60         I.         2.0000000         1.801352         42         1.1126774         0.9962109           22%         I.         0.160         2.0000000         1.801352         42         1.6654161         0.9962109           32%         I.         0.180         3.0000000         1.801352         42         1.6654161         0.9965789           32%         I.         0.300         2.0333333         1.801352         42         1.6554161         0.9969789           32%         I.         0.100         1.000000         1.801352								
0%         I. BISD -240         -2,0000000         1,801352         42         -1,1102774         40,9962109           0%         I. BISD -300         -6,0333333         1,801352         42         -2,2990594         50,570368           0%         I. 240 -300         -4,0333333         1,801352         42         -2,2290594         50,570368           0%         I. 240 -300         -4,0333333         1,801352         42         -1,1287820         0,9955988           0%         I. 300 -360         2,0000000         1,801352         42         -1,112774         0,9962109           2%         I. 0         0-120         0,0000000         1,801352         42         1,000000         1,0000000           32%         I. 0         0-180         3,0000000         1,801352         42         1,6654161         0,9067389           32%         I. 0         0-300         1,0000000         1,801352         42         1,1102774         0,9969109           32%         I. 0         0-300         1,0333333         1,801352         42         0,1551387         0,999975           32%         I. 0         60-180         1,0000000         1,801352         42         0,1551461         0,906667								
189								
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09%         J. 300 - 360         2.0000000         1.801352         42         1.1102774         0.9962109           32%         J. 0 - 120         0.0000000         1.801352         42         1.1102774         0.9962109           32%         J. 0 - 180         3.0000000         1.801352         42         1.0600010         1.0000003           32%         J. 0 - 240         1.0000000         1.801352         42         1.05551387         0.999976           32%         J. 0 - 340         1.0000000         1.801352         42         1.15287820         0.9999976           32%         J. 0 - 360         1.0000000         1.801352         42         1.1102774         0.9962109           32%         J. 60 - 120         - 2.0000000         1.801352         42         1.5551387         0.9999976           32%         J. 60 - 120         - 2.0000000         1.801352         42         1.5551387         0.999978           32%         J. 60 - 360         J. 030033333         1.801352         42         1.05551387         0.9999976           32%         J. 120 - 300         J. 03033333         1.801352         42         1.05551387         0.9999976           32%         J. 120 - 340         J. 0								
1.0   0.60								
32%          0-120         0.000000         1.801352         42         0.000000         1.000000           32%          0-180         3.0000000         1.801352         42         1.0664161         0.9067389           32%          0-300         2.033333         1.801352         42         1.1287820         0.999976           32%          0-360         1.0000000         1.801352         42         1.1102774         0.999976           32%          60-180         1.0000000         1.801352         42         -1.5551387         0.9999976           32%          60-240         3.0000000         1.801352         42         -1.6561461         0.9967389           32%          60-300         0.0333333         1.801352         42         -0.5551387         0.999976           32%          60-360         1.0000000         1.801352         42         -0.5551387         0.99999967           32%          120-140         -1.0000000         1.801352         42         -0.5551387         0.9999963           32%          120-340         -1.0000000         1.801352         42								
32%          0-180         3.000000         1.801352         42         1.6654161         0.909978           32%          0-300         -1.0000000         1.801352         42         -1.1287820         0.999976           32%          0-360         1.0000000         1.801352         42         1.112774         0.999976           32%          60-180         1.0000000         1.801352         42         0.1517774         0.999976           32%          60-180         1.0000000         1.801352         42         0.151774         0.999976           32%          60-300         -1.000000         1.801352         42         0.0185046         1.000000           32%          120-180         3.0000000         1.801352         42         0.0551387         0.999976           32%          120-360         -1.000000         1.801352         42         0.5551387         0.999976           32%          120-240         -1.000000         1.801352         42         0.5551387         0.999978           32%          120-350         1.000000         1.801352         42								
32%   . 0 - 240								
32%         .         0.360         2.0333333         1.801352         42         1.1287820         0.995898           32%         .         0.60-120         1.0000000         1.801352         42         1.1112774         0.9999976           32%         .         60-180         1.0000000         1.801352         42         1.1162774         0.9999976           32%         .         60-240         -3.0000000         1.801352         42         1.6654161         0.99999976           32%         .         60-300         -1.0000000         1.801352         42         -0.5551387         0.9999976           32%         .         120-180         3.0000000         1.801352         42         -0.5551387         0.9999976           32%         .         120-300         2.033333         1.801352         42         -0.5551387         0.9999976           32%         .         120-300         2.0333333         1.801352         42         -0.5551387         0.9999976           32%         .         180-240         -4.0000000         1.801352         42         -0.556141         0.5999986           32%         .         180-366         -2.0000000         1.801352         42<								
32%   .   0-360								
32%          60 - 120         -2.0000000         1.801352         42         1.1102774         0.9962109           32%          60 - 240         1.0000000         1.801352         42         -1.6654161         0.9967389           32%          60 - 300         0.0333333         1.801352         42         -0.5551387         0.9999976           32%          60 - 360         -1.0000000         1.801352         42         -0.5551387         0.9999976           32%          120 - 240         -1.0000000         1.801352         42         -0.5551387         0.9999976           32%          120 - 300         2.0333333         1.801352         42         -0.5551387         0.9999976           32%          120 - 360         1.000000         1.801352         42         -0.556345         0.9999976           32%          180 - 300         -0.966667         1.801352         42         -0.536431         0.9999978           32%          180 - 360         -2.0000000         1.801352         42         1.1102774         0.9962109           32%          180 - 360         -2.0000000         <								
32%         .         60 - 180         1.0000000         1.801352         42         0.5551387         0.999976           32%         .         60 - 240         -3.0000000         1.801352         42         -1.6654161         0.9067389           32%         .         60 - 300         -0.0333333         1.801352         42         -0.5551387         0.9999976           32%         .         120 - 240         -1.0000000         1.801352         42         -0.5551387         0.9999976           32%         .         120 - 240         -1.0000000         1.801352         42         -0.5551387         0.9999976           32%         .         120 - 360         1.0000000         1.801352         42         -0.5551387         0.9999976           32%         .         180 - 360         1.0000000         1.801352         42         -0.5366341         0.9999976           32%         .         180 - 300         -0.9666667         1.801352         42         -1.202749093           32%         .         180 - 360         2.0000000         1.801352         42         1.1102774         0.9962109           32%         .         240 - 360         2.0000000         1.801352         42<								
32%         .         60 - 240         -3.0000000         1.801352         42         -1.6654161         0.9067389           32%         .         60 - 360         0.0333333         1.801352         42         -0.05551387         0.9999976           32%         .         120 - 180         3.0000000         1.801352         42         -1.6551161         0.9967389           32%         .         120 - 240         -1.0000000         1.801352         42         -1.6551187         0.9999976           32%         .         120 - 300         2.0333333         1.801352         42         -1.5551387         0.9999976           32%         .         180 - 240         -4.0000000         1.801352         42         -0.5566311         0.9995984           32%         .         180 - 300         -0.9666667         1.801352         42         -0.5366311         0.9999976           32%         .         180 - 360         -2.0000000         1.801352         42         -1.1102774         0.9962109           32%         .         240 - 360         -2.0000000         1.801352         42         1.1102774         0.9962109           32%         .         300 - 361         -1.0333333 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>								
32%         .         60 - 300         0.0333333         1.801352         42         0.0185046         1.000000           32%         .         60 - 360         -1.0000000         1.801352         42         -0.5551387         0.9999976           32%         .         120 - 120         3.0000000         1.801352         42         -1.664161         0.9967389           32%         .         120 - 240         -1.0000000         1.801352         42         -0.5551387         0.9999976           32%         .         120 - 300         2.0333333         1.801352         42         -0.5563487         0.9999976           32%         .         180 - 300         -0.9666667         1.801352         42         -0.5566341         0.9999984           32%         .         180 - 300         -0.9666667         1.801352         42         -1.102774         0.9962109           32%         .         240 - 300         3.033333         1.801352         42         1.1102774         0.9962109           32%         .         240 - 360         2.000000         1.801352         42         1.1102774         0.9962109           32%         .         0.60         17.9666667         1.801352								
32%         .         60 - 360         -1,0000000         1.801352         42         -0.5551387         0.999976           32%         .         120 - 1240         -1.0000000         1.801352         42         -1.6551187         0.999976           32%         .         120 - 300         2.0333333         1.801352         42         -1.25551387         0.9999976           32%         .         180 - 240         -4.0000000         1.801352         42         -0.5561387         0.9999978           32%         .         180 - 300         -0.9666667         1.801352         42         -0.5366341         0.9999984           32%         .         180 - 300         -2.0000000         1.801352         42         -1.012774         0.9962019           32%         .         240 - 300         2.0000000         1.801352         42         1.163744         0.9962019           32%         .         240 - 300         2.0000000         1.801352         42         1.163744         0.9962109           32%         .         300 - 360         -1.0333333         1.801352         42         1.1102774         0.9962109           45%         .         0 - 120         2.3966667         1.8013								017 001 007
32%         .         120 - 180         3.000000         1.801352         42         1.6654161         0.9067389           32%         .         120 - 240         -1.000000         1.801352         42         -1.1287820         0.9999976           32%         .         120 - 360         1.0000000         1.801352         42         0.12187820         0.9995898           32%         .         180 - 240         -4.0000000         1.801352         42         -0.2566341         0.9999994           32%         .         180 - 300         -0.9666667         1.801352         42         -1.102774         0.9962109           32%         .         240 - 300         3.0333333         1.801352         42         -1.6639207         0.900001           32%         .         240 - 300         3.0333333         1.801352         42         -1.102774         0.9962109           32%         .         300 - 360         -1.0333333         1.801352         42         1.6110274         0.9962109           32%         .         0 - 60         17.9666667         1.801352         42         0.574433         0.999965           45%         .         0 - 120         3.00333333         1.801352 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>								
32%         .         120 - 240         -1.000000         1.801352         42         -0.5551387         0.9999976           32%         .         120 - 300         2.0333333         1.801352         42         1.1287820         0.9995998           32%         .         180 - 240         -4.0000000         1.801352         42         -2.2205548         0.5995036           32%         .         180 - 300         -2.0000000         1.801352         42         -0.5366341         0.9999976           32%         .         180 - 300         -2.0000000         1.801352         42         1.102774         0.9962109           32%         .         240 - 300         3.033333         1.801352         42         1.11102774         0.9902109           32%         .         300 - 360         -1.0333333         1.801352         42         1.1102774         0.9962109           45%         .         0 - 60         17.9666667         1.801352         42         1.67236433         0.999995           45%         .         0 - 120         23.966667         1.801352         42         1.617526655         0.000000           45%         .         0 - 120         3.0333333         1.801352 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>								
32%         .         120 - 360         2.0333333         1.801352         42         1.1287820         0.9955898           32%         .         180 - 240         4.0000000         1.801352         42         0.5551387         0.99999976           32%         .         180 - 300         -0.9666667         1.801352         42         -0.5366341         0.9999984           32%         .         180 - 360         -2.000000         1.801352         42         -1.1102774         0.9962109           32%         .         240 - 360         2.0000000         1.801352         42         1.1102774         0.9962109           32%         .         240 - 360         2.0000000         1.801352         42         1.1102774         0.9962109           32%         .         0.00         300         360         -1.0333333         1.801352         42         1.5746433         0.9999965           45%         .         0 - 120         23.9666667         1.801352         42         1.3348241         0.000000           45%         .         0 - 180         29.0333333         1.801352         42         16.6726655         0.000000           45%         .         0 - 360         57								
32%         .         120 - 360         1.0000000         1.801352         42         0.5551387         0.9999976           32%         .         180 - 240         -4.0000000         1.801352         42         -2.2205548         0.5999984           32%         .         180 - 360         -2.0000000         1.801352         42         -1.1102774         0.9962109           32%         .         240 - 300         3.0333333         1.801352         42         1.1102774         0.9962109           32%         .         240 - 360         2.0000000         1.801352         42         1.1102774         0.9962109           32%         .         300 - 360         -1.0333333         1.801352         42         1.573433         0.999965           45%         .         0 - 60         17.9666667         1.801352         42         16.175268         0.000000           45%         .         0 - 120         23.966667         1.801352         42         16.6726655         0.000000           45%         .         0 - 240         30.0333333         1.801352         42         16.6726655         0.000000           45%         .         0 - 240         30.0333333         1.801352								
32%         .         180 - 240         -4.000000         1.801352         42         -2.2205548         0.5995036           32%         .         180 - 300         -0.9666667         1.801352         42         -0.5366341         0.9992199           32%         .         240 - 300         3.0333333         1.801352         42         1.1102774         0.9962109           32%         .         240 - 360         2.000000         1.801352         42         1.6839207         0.9000001           32%         .         300 - 360         -1.0333333         1.801352         42         1.573433         0.999965           45%         .         0 - 60         17.9666667         1.801352         42         9.9739919         0.0000000           45%         .         0 - 120         23.9666667         1.801352         42         16.6726655         0.0000000           45%         .         0 - 240         30.0333333         1.801352         42         16.6726655         0.0000000           45%         .         0 - 360         57.000000         1.801352         42         3.303322         0.0815323           45%         .         60 - 120         6.0000000         1.801352								
32%         .         180 - 300         -0.9666667         1.801352         42         -0.5366341         0.9999984           32%         .         180 - 360         -2.0000000         1.801352         42         -1.1102774         0.9962109           32%         .         240 - 360         2.0000000         1.801352         42         1.1102774         0.9962109           32%         .         240 - 360         2.0000000         1.801352         42         1.1102774         0.9962109           32%         .         300 - 360         -1.0333333         1.801352         42         1.9734433         0.9999965           45%         .         0 - 180         29.0333333         1.801352         42         15.3048241         0.000000           45%         .         0 - 180         29.0333333         1.801352         42         13.6429057         0.000000           45%         .         0 - 300         41.9666667         1.801352         42         23.2973206         0.000000           45%         .         0 - 360         57.000000         1.801352         42         3.16429057         0.000000           45%         .         60 - 120         6.000000         1.801352								
32%         .         180 - 360         -2.0000000         1.801352         42         -1.1102774         0.9962109           32%         .         240 - 360         2.0000000         1.801352         42         1.6839207         0.9000001           32%         .         300 - 360         -1.0333333         1.801352         42         -0.5736433         0.9999965           45%         .         0 - 60         17.9666667         1.801352         42         9.739919         0.000000           45%         .         0 - 120         23.966667         1.801352         42         16.175268         0.000000           45%         .         0 - 180         29.0333333         1.801352         42         16.175268         0.000000           45%         .         0 - 240         30.0333333         1.801352         42         16.6726655         0.000000           45%         .         0 - 300         41.966667         1.801352         42         33.308322         0.0815323           45%         .         60 - 120         6.000000         1.801352         42         33.3083322         0.0815323           45%         .         60 - 180         11.0666667         1.801352								
32%         .         240 - 360         3.0333333         1.801352         42         1.102774         0.9962109           32%         .         240 - 360         2.0000000         1.801352         42         1.1102774         0.9962109           45%         .         0 - 60         17.9666667         1.801352         42         9.739919         0.0000000           45%         .         0 - 120         23.966667         1.801352         42         13.3048241         0.0000000           45%         .         0 - 180         29.0333333         1.801352         42         16.6726655         0.0000000           45%         .         0 - 300         41.9666667         1.801352         42         23.2973206         0.0000000           45%         .         0 - 300         41.9666667         1.801352         42         31.6429057         0.000000           45%         .         60 - 120         6.0000000         1.801352         42         6.1435349         0.0000187           45%         .         60 - 180         11.0666667         1.801352         42         6.986736         0.000000           45%         .         60 - 360         39.0333333         1.801352								
32%         .         240 - 360         2.0000000         1.801352         42         1.1102774         0.9962109           32%         .         300 - 360         -1.0333333         1.801352         42         -0.5736433         0.9999965           45%         .         0 - 60         17.9666667         1.801352         42         9.9739919         0.0000000           45%         .         0 - 180         29.03333333         1.801352         42         16.6726655         0.0000000           45%         .         0 - 240         30.0333333         1.801352         42         16.6726655         0.0000000           45%         .         0 - 360         57.0000000         1.801352         42         31.6429057         0.0000000           45%         .         60 - 120         6.0000000         1.801352         42         33.308322         0.0815323           45%         .         60 - 120         6.0000000         1.801352         42         3.338322         0.0815323           45%         .         60 - 120         1.0666667         1.801352         42         1.4689138         0.000000           45%         .         60 - 360         39.033333         1.801352								
32%								
45%         .         0 - 60         17.9666667         1.801352         42         9.9739919         0.0000000           45%         .         0 - 120         23.9666667         1.801352         42         13.3048241         0.0000000           45%         .         0 - 240         30.0333333         1.801352         42         16.1775268         0.0000000           45%         .         0 - 300         41.9666667         1.801352         42         23.2973206         0.0000000           45%         .         0 - 360         57.0000000         1.801352         42         3.3308322         0.0815323           45%         .         60 - 180         11.0666667         1.801352         42         3.3308322         0.0815323           45%         .         60 - 180         11.0666667         1.801352         42         6.4353349         0.00000187           45%         .         60 - 360         39.0333333         1.801352         42         1.3223287         0.0000000           45%         .         120 - 180         5.0666667         1.801352         42         2.8127027         0.2451864           45%         .         120 - 240         6.0666667         1.801352								
45%         .         0 - 120         23,9666667         1.801352         42         13.3048241         0.0000000           45%         .         0 - 180         29,0333333         1.801352         42         16.1175268         0.0000000           45%         .         0 - 300         41,9666667         1.801352         42         23,2973206         0.0000000           45%         .         0 - 360         57,000000         1.801352         42         33,308322         0.0010000           45%         .         60 - 120         6,0000000         1.801352         42         33,308322         0.0010313           45%         .         60 - 240         12,0666667         1.801352         42         6,6986736         0.0000031           45%         .         60 - 300         24,000000         1.801352         42         13,3233287         0.0000000           45%         .         60 - 300         39,0333333         1.801352         42         21,6689138         0.0000000           45%         .         120 - 180         5,0666667         1.801352         42         2,8127027         0.2451864           45%         .         120 - 300         18,000000         1.801352			300 - 360	-1.0333333	1 1 801352	1 42	-0.5736433	0.9999965
45%         .         0 - 180         29.0333333         1.801352         42         16.1175268         0.0000000           45%         .         0 - 240         30.0333333         1.801352         42         16.6726655         0.0000000           45%         .         0 - 360         57.0000000         1.801352         42         23.2973206         0.0000000           45%         .         60 - 120         6.0000000         1.801352         42         33.308322         0.0815323           45%         .         60 - 180         11.0666667         1.801352         42         6.1435349         0.0000031           45%         .         60 - 300         24.0000000         1.801352         42         6.6986736         0.0000001           45%         .         60 - 300         24.0000000         1.801352         42         21.6689138         0.0000000           45%         .         120 - 180         5.0666667         1.801352         42         21.6689138         0.0000000           45%         .         120 - 300         18.000000         1.801352         42         2.8127027         0.2451864           45%         .         120 - 300         18.0000000         1.801352 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>								
45%         .         0 - 240         30.0333333         1.801352         42         16.6726655         0.0000000           45%         .         0 - 300         41.9666667         1.801352         42         23.2973206         0.0000000           45%         .         60 - 120         6.0000000         1.801352         42         31.6429057         0.0000001           45%         .         60 - 180         11.0666667         1.801352         42         6.435349         0.0000187           45%         .         60 - 240         12.0666667         1.801352         42         6.6986736         0.0000031           45%         .         60 - 360         39.0333333         1.801352         42         15.323327         0.000000           45%         .         120 - 180         5.0666667         1.801352         42         2.8127027         0.2431864           45%         .         120 - 180         5.0666667         1.801352         42         2.8127027         0.2431864           45%         .         120 - 300         18.0000000         1.801352         42         3.3678414         0.0746835           45%         .         180 - 300         18.0000000         1.801352 <td>45%</td> <td></td> <td></td> <td></td> <td>1.801352</td> <td>42</td> <td>9.9739919</td> <td></td>	45%				1.801352	42	9.9739919	
45%         .         0 - 300         41,9666667         1.801352         42         23,2973206         0.0000000           45%         .         0 - 360         57,0000000         1.801352         42         31,6429057         0.0000000           45%         .         60 - 180         11.0666667         1.801352         42         3.3308322         0.0013187           45%         .         60 - 240         12.0666667         1.801352         42         6.6986736         0.00000131           45%         .         60 - 300         24.000000         1.801352         42         13.3233287         0.0000000           45%         .         60 - 300         39.0333333         1.801352         42         21.6689138         0.0000000           45%         .         120 - 180         5.0666667         1.801352         42         2.8127027         0.2451864           45%         .         120 - 300         18.000000         1.801352         42         3.3678414         0.0746835           45%         .         120 - 300         18.000000         1.801352         42         18.38616         0.000000           45%         .         180 - 300         12.9333333         1.801352 <td>45% 45%</td> <td></td> <td>0 - 120</td> <td>23.9666667</td> <td>1.801352 1.801352</td> <td>42 42</td> <td>9.9739919 13.3048241</td> <td>0.0000000</td>	45% 45%		0 - 120	23.9666667	1.801352 1.801352	42 42	9.9739919 13.3048241	0.0000000
45%         .         0 - 360         57.000000         1.801352         42         31.6429057         0.000000           45%         .         60 - 120         6.000000         1.801352         42         3.3308322         0.0815323           45%         .         60 - 180         11.0666667         1.801352         42         6.6986736         0.0000031           45%         .         60 - 300         24.0000000         1.801352         42         13.3233287         0.0000000           45%         .         60 - 360         39.033333         1.801352         42         21.6689138         0.0000000           45%         .         120 - 180         5.0666667         1.801352         42         2.8127027         0.2451864           45%         .         120 - 300         18.000000         1.801352         42         3.3678414         0.07468656           45%         .         120 - 360         33.033333         1.801352         42         3.3678414         0.0746836           45%         .         180 - 300         18.000000         1.801352         42         0.5551387         0.9999976           45%         .         180 - 300         12.9333333         1.801352	45% 45% 45%		0 - 120 0 - 180	23.9666667 29.0333333	1.801352 1.801352 1.801352	42 42 42	9.9739919 13.3048241 16.1175268	0.0000000 0.0000000
45%         .         60 - 120         6.000000         1.801352         42         3.3308322         0.0815323           45%         .         60 - 180         11.0666667         1.801352         42         6.1435349         0.0000187           45%         .         60 - 240         12.0666667         1.801352         42         6.6986736         0.0000001           45%         .         60 - 360         24.000000         1.801352         42         21.6689138         0.0000000           45%         .         120 - 180         5.0666667         1.801352         42         2.16689138         0.0000000           45%         .         120 - 240         6.0666667         1.801352         42         2.8127027         0.2451864           45%         .         120 - 300         18.000000         1.801352         42         9.9924965         0.0000000           45%         .         120 - 300         18.000000         1.801352         42         18.3380816         0.0000000           45%         .         180 - 340         1.0000000         1.801352         42         7.1797938         0.0000000           45%         .         180 - 360         27.9666667         1.801352 <td>45% 45% 45% 45%</td> <td></td> <td>0 - 120 0 - 180 0 - 240</td> <td>23.9666667 29.0333333 30.0333333</td> <td>1.801352 1.801352 1.801352 1.801352</td> <td>42 42 42 42</td> <td>9.9739919 13.3048241 16.1175268 16.6726655</td> <td>0.0000000 0.0000000 0.0000000</td>	45% 45% 45% 45%		0 - 120 0 - 180 0 - 240	23.9666667 29.0333333 30.0333333	1.801352 1.801352 1.801352 1.801352	42 42 42 42	9.9739919 13.3048241 16.1175268 16.6726655	0.0000000 0.0000000 0.0000000
45%         .         60 - 180         11.0666667         1.801352         42         6.1435349         0.0000187           45%         .         60 - 240         12.0666667         1.801352         42         6.6986736         0.0000031           45%         .         60 - 300         24.000000         1.801352         42         1.3233287         0.0000000           45%         .         60 - 360         39.0333333         1.801352         42         21.6689138         0.0000000           45%         .         120 - 240         6.0666667         1.801352         42         2.8127027         0.2451864           45%         .         120 - 300         18.000000         1.801352         42         2.8127027         0.2451864           45%         .         120 - 300         18.000000         1.801352         42         9.9924965         0.000000           45%         .         180 - 300         12.9333333         1.801352         42         0.5551387         0.999976           45%         .         180 - 360         27.9666667         1.801352         42         1.5253789         0.000000           45%         .         240 - 300         11.9333333         1.801352 <td>45% 45% 45% 45% 45%</td> <td>•</td> <td>0 - 120 0 - 180 0 - 240 0 - 300</td> <td>23.9666667 29.0333333 30.0333333 41.9666667</td> <td>1.801352 1.801352 1.801352 1.801352 1.801352</td> <td>42 42 42 42 42 42</td> <td>9.9739919 13.3048241 16.1175268 16.6726655 23.2973206</td> <td>0.0000000 0.0000000 0.0000000 0.0000000</td>	45% 45% 45% 45% 45%	•	0 - 120 0 - 180 0 - 240 0 - 300	23.9666667 29.0333333 30.0333333 41.9666667	1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42	9.9739919 13.3048241 16.1175268 16.6726655 23.2973206	0.0000000 0.0000000 0.0000000 0.0000000
45%         .         60 - 240         12.0666667         1.801352         42         6.6986736         0.0000001           45%         .         60 - 300         24.0000000         1.801352         42         13.3233287         0.0000000           45%         .         60 - 360         39.0333333         1.801352         42         21.6689138         0.0000000           45%         .         120 - 240         6.0666667         1.801352         42         3.3678414         0.0746835           45%         .         120 - 300         18.000000         1.801352         42         9.9924965         0.0000000           45%         .         120 - 360         33.0333333         1.801352         42         9.9924965         0.0000000           45%         .         180 - 240         1.0000000         1.801352         42         18.380816         0.0000000           45%         .         180 - 300         12.9333333         1.801352         42         15.5253789         0.0000000           45%         .         180 - 300         21.9333333         1.801352         42         15.5253789         0.0000000           45%         .         240 - 300         11.93333333         1.8	45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360	23.9666667 29.0333333 30.0333333 41.9666667 57.0000000	1.801352 1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42 42	9.9739919 13.3048241 16.1175268 16.6726655 23.2973206 31.6429057	0.0000000 0.0000000 0.0000000 0.0000000 0.000000
45%         .         60 - 300         24.000000         1.801352         42         13.3233287         0.0000000           45%         .         60 - 360         39.0333333         1.801352         42         21.6689138         0.0000000           45%         .         120 - 180         5.0666667         1.801352         42         2.8127027         0.2451864           45%         .         120 - 240         6.0666667         1.801352         42         9.924965         0.0000000           45%         .         120 - 360         33.0333333         1.801352         42         18.3380816         0.0000000           45%         .         180 - 240         1.0000000         1.801352         42         18.3380816         0.0000000           45%         .         180 - 300         12.9333333         1.801352         42         15.5253789         0.0000000           45%         .         180 - 360         27.9666667         1.801352         42         15.5253789         0.0000009           45%         .         240 - 300         11.9333333         1.801352         42         16.246551         0.000009           45%         .         240 - 366         26,9666667         1.80	45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120	23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.00000000	1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42 42 42	9,9739919 13,3048241 16,1175268 16,6726655 23,2973206 31,6429057 3,3308322	0.0000000 0.0000000 0.0000000 0.0000000 0.000000
45%         .         60 - 360         39.0333333         1.801352         42         21.6689138         0.0000000           45%         .         120 - 180         5.0666667         1.801352         42         2.8127027         0.2451864           45%         .         120 - 240         6.0666667         1.801352         42         3.92465         0.0000000           45%         .         120 - 360         33.0333333         1.801352         42         9.9924965         0.0000000           45%         .         120 - 360         33.0333333         1.801352         42         0.5551387         0.9999976           45%         .         180 - 300         12.9333333         1.801352         42         0.5551387         0.9999976           45%         .         180 - 360         27.9666667         1.801352         42         15.5253789         0.000000           45%         .         240 - 360         26.9666667         1.801352         42         15.5253789         0.0000000           45%         .         240 - 360         26.9666667         1.801352         42         14.9702402         0.0000000           45%         .         300 - 360         15.0333333         1.80	45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180	23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667	1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42 42 42 42	9,9739919 13,3048241 16,1175268 16,6726655 23,2973206 31,6429057 3,3308322 6,1435349	0.0000000 0.0000000 0.0000000 0.0000000 0.000000
45%         .         120-180         5.0666667         1.801352         42         2.8127027         0.2451864           45%         .         120-240         6.0666667         1.801352         42         3.3678414         0.0746835           45%         .         120-300         18.0000000         1.801352         42         9.9924965         0.0000000           45%         .         180-240         1.0000000         1.801352         42         18.3380816         0.0000000           45%         .         180-300         12.9333333         1.801352         42         7.1797938         0.0000006           45%         .         180-360         27.9666667         1.801352         42         15.5253789         0.0000000           45%         .         240-300         11.9333333         1.801352         42         15.5253789         0.0000003           45%         .         240-306         26.9666667         1.801352         42         14.9702402         0.0000000           45%         .         240-306         26.9666667         1.801352         42         14.9702402         0.0000000           45%         .         300 -360         15.0333333         1.801352	45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 240	23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667 12.0666667	1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42 42 42 42	9,9739919 13,3048241 16,1175268 16,6726655 23,2973206 31,6429057 3,3308322 6,1435349 6,6986736	0.0000000 0.0000000 0.0000000 0.0000000 0.000000
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	45% 45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 240 60 - 300	23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667 12.0666667 24.0000000	1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42 42 42 42 42	9,9739919 13.3048241 16.1175268 16.6726655 23.2973206 31.6429057 3.3308322 6.1435349 6.6986736 13.3233287	0.0000000 0.0000000 0.0000000 0.0000000 0.000000
45%         .         120 - 300         18.000000         1.801352         42         9.9924965         0.000000           45%         .         120 - 360         33.0333333         1.801352         42         18.3380816         0.000000           45%         .         180 - 240         1.0000000         1.801352         42         0.5551387         0.9999976           45%         .         180 - 360         27.9666667         1.801352         42         7.1797938         0.000000           45%         .         240 - 360         27.9666667         1.801352         42         15.5253789         0.0000003           45%         .         240 - 360         26.9666667         1.801352         42         14.9702402         0.000000           45%         .         240 - 360         15.0333333         1.801352         42         14.9702402         0.000000           45%         .         300 - 360         15.03333333         1.801352         42         8.3455851         0.0000000           .         0         0% - 45%         0.0000000         1.801352         42         0.5551387         0.999976           .         60         0% - 45%         1.0000000         1.801352 <td>45% 45% 45% 45% 45% 45% 45% 45% 45% 45%</td> <td></td> <td>0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 240 60 - 300 60 - 360</td> <td>23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667 12.0666667 24.0000000 39.03333333</td> <td>1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352</td> <td>42 42 42 42 42 42 42 42 42 42 42</td> <td>9,9739919 13.3048241 16.1175268 16.6726655 23.2973206 31.6429057 3.3308322 6.1435349 6.6986736 13.3233287 21.6689138</td> <td>0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0815323 0.000187 0.0000031 0.0000000 0.0000000</td>	45% 45% 45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 240 60 - 300 60 - 360	23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667 12.0666667 24.0000000 39.03333333	1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42 42 42 42 42 42	9,9739919 13.3048241 16.1175268 16.6726655 23.2973206 31.6429057 3.3308322 6.1435349 6.6986736 13.3233287 21.6689138	0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0815323 0.000187 0.0000031 0.0000000 0.0000000
45%         .         120 - 360         33.0333333         1.801352         42         18.3380816         0.0000000           45%         .         180 - 240         1.0000000         1.801352         42         0.5551387         0.9999976           45%         .         180 - 300         12.9333333         1.801352         42         7.1797938         0.0000000           45%         .         180 - 360         27.9666667         1.801352         42         15.5253789         0.0000000           45%         .         240 - 300         11.9333333         1.801352         42         14.9702402         0.0000000           45%         .         240 - 360         26.9666667         1.801352         42         14.9702402         0.0000000           45%         .         300 - 360         15.0333333         1.801352         42         8.3455851         0.0000000           .         0         0% - 32%         -1.0000000         1.801352         42         0.5551387         0.9999976           .         0         0% - 45%         1.0000000         1.801352         42         0.000000         1.000000           .         60         0% - 45%         16.9333333         1.801352 </td <td>45% 45% 45% 45% 45% 45% 45% 45% 45% 45%</td> <td></td> <td>0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 240 60 - 300 60 - 360 120 - 180</td> <td>23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667 12.0666667 24.0000000 39.0333333 5.0666667</td> <td>1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352</td> <td>42 42 42 42 42 42 42 42 42 42 42 42 42</td> <td>9.9739919 13.3048241 16.1175268 16.6726655 23.2973206 31.6429057 3.3308322 6.1435349 6.6986736 13.3233287 21.6689138 2.8127027</td> <td>0.000000 0.000000 0.000000 0.000000 0.000000 0.0815323 0.000187 0.0000031 0.000000 0.2451864</td>	45% 45% 45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 240 60 - 300 60 - 360 120 - 180	23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667 12.0666667 24.0000000 39.0333333 5.0666667	1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42 42 42 42 42 42 42 42	9.9739919 13.3048241 16.1175268 16.6726655 23.2973206 31.6429057 3.3308322 6.1435349 6.6986736 13.3233287 21.6689138 2.8127027	0.000000 0.000000 0.000000 0.000000 0.000000 0.0815323 0.000187 0.0000031 0.000000 0.2451864
45%         .         180 - 240         1.0000000         1.801352         42         0.5551387         0.999976           45%         .         180 - 300         12.9333333         1.801352         42         7.1797938         0.0000006           45%         .         180 - 360         27.96666667         1.801352         42         15.5253789         0.0000000           45%         .         240 - 360         26.9666667         1.801352         42         6.6246551         0.000000           45%         .         240 - 360         26.9666667         1.801352         42         14.9702402         0.000000           45%         .         300 - 360         15.0333333         1.801352         42         8.3455851         0.0000000           .         0         0% - 45%         0.000000         1.801352         42         -0.5551387         0.9999976           .         0         0% - 45%         0.0000000         1.801352         42         0.5551387         0.9999976           .         0         0% - 45%         1.0000000         1.801352         42         0.5551387         0.9999976           .         0         0% - 45%         16.9333333         1.801352	45% 45% 45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 240 60 - 300 60 - 360 120 - 180 120 - 180	23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667 24.000000 39.0333333 5.0666667	1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42 42 42 42 42 42 42 42 4	9.9739919 13.3048241 16.1175268 16.6726655 23.2973206 31.6429057 3.3308322 6.1435349 6.6986736 13.323287 21.6689138 2.8127027 3.3678414	0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0815323 0.000187 0.00000031 0.0000000 0.2451864 0.0746835
45%         .         180 - 300         12.9333333         1.801352         42         7.1797938         0.000006           45%         .         180 - 360         27.9666667         1.801352         42         15.5253789         0.0000000           45%         .         240 - 300         11.9333333         1.801352         42         15.5253789         0.0000000           45%         .         240 - 360         26.9666667         1.801352         42         14.9702402         0.0000000           45%         .         300 - 360         15.0333333         1.801352         42         14.9702402         0.0000000           .         0         0% - 32%         -1.0000000         1.801352         42         -0.5551387         0.9999976           .         0         0% - 45%         0.0000000         1.801352         42         0.5551387         0.9999976           .         60         0% - 45%         10.0000000         1.801352         42         0.0185046         1.0000000           .         60         32% - 45%         16.9333333         1.801352         42         9.403486         0.0000000           .         120         0% - 32%         -2.9666667         1.801352 </td <td>45% 45% 45% 45% 45% 45% 45% 45% 45% 45%</td> <td></td> <td>0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 240 60 - 300 60 - 360 120 - 180 120 - 240 120 - 300</td> <td>23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667 24.0000000 39.033333 5.06666667 6.0666667 18.0000000</td> <td>1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352</td> <td>42 42 42 42 42 42 42 42 42 42 42 42 42 4</td> <td>9.9739919 13.3048241 16.1175268 16.6726655 23.2973206 33.6429087 3.3308322 6.1435349 6.6986736 13.323287 21.6689138 2.8127027 3.3678414 9.9924965</td> <td>0.000000 0.000000 0.000000 0.000000 0.000000 0.0015323 0.000187 0.000000 0.000000 0.2451864 0.0746835 0.000000</td>	45% 45% 45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 240 60 - 300 60 - 360 120 - 180 120 - 240 120 - 300	23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667 24.0000000 39.033333 5.06666667 6.0666667 18.0000000	1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42 42 42 42 42 42 42 42 4	9.9739919 13.3048241 16.1175268 16.6726655 23.2973206 33.6429087 3.3308322 6.1435349 6.6986736 13.323287 21.6689138 2.8127027 3.3678414 9.9924965	0.000000 0.000000 0.000000 0.000000 0.000000 0.0015323 0.000187 0.000000 0.000000 0.2451864 0.0746835 0.000000
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.         0         0% - 32%         -1.000000         1.801352         42         -0.5551387         0.9999976           .         0         0% - 45%         0.000000         1.801352         42         0.000000         1.000000           .         0         32% - 45%         1.000000         1.801352         42         0.0551387         0.9999976           60         0% - 32%         -0.0333333         1.801352         42         -0.0185046         1.0000000           .         60         0% - 45%         16.9333333         1.801352         42         9.4083486         0.0000000           .         60         32% - 45%         16.966667         1.801352         42         9.4188532         0.000000           .         120         0% - 32%         -2.9666667         1.801352         42         9.4188532         0.000000           .         120         0% - 35%         22.9666667         1.801352         42         1.2469115         0.9131836           .         120         32% - 45%         24.9666667         1.801352         42         13.859628         0.000000           .         180         0% - 45%         27.000000         1.801352         42	45% 45% 45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 240 60 - 300 60 - 360 120 - 180 120 - 240 120 - 360 180 - 240 180 - 240 180 - 360 240 - 300	23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667 24.000000 39.0333333 5.0666667 18.000000 33.0333333 1.000000 12.9333333 27.9666667 11.9333333	1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42 42 42 42 42 42 42 42 4	9.9739919 13.3048241 16.1175268 16.6726655 23.2973206 31.6429057 3.3308322 6.1435349 6.6986736 13.323287 21.6689138 2.8127027 3.3678414 9.9924965 18.3380816 0.5551387 7.1797938 15.5253789 6.6246551	0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0815323 0.0000187 0.0000003 0.0000000 0.2451864 0.0746835 0.0000000 0.9999976 0.0000000 0.0000000 0.0000000 0.0000000 0.00000000
.         0         0% - 45%         0.0000000         1.801352         42         0.0000000         1.0000000           .         0         32% - 45%         1.0000000         1.801352         42         0.05551387         0.9999976           .         60         0% - 32%         -0.0333333         1.801352         42         -0.0185046         1.0000000           .         60         32% - 45%         16.966667         1.801352         42         9.4003486         0.0000000           .         60         32% - 45%         16.966667         1.801352         42         9.4188532         0.0000000           .         120         0% - 32%         -2.9666667         1.801352         42         9.4188532         0.0000000           .         120         0% - 45%         22.000000         1.801352         42         12.469115         0.913180         0.000000           .         120         32% - 45%         24.9666667         1.801352         42         13.8599628         0.0000000           .         180         0% - 32%         -0.0333333         1.801352         42         14.9887448         0.0000000           .         180         0% - 45%         27.0333333	45% 45% 45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 360 60 - 120 60 - 180 60 - 240 60 - 300 60 - 360 120 - 360 120 - 300 120 - 300 120 - 300 180 - 300 180 - 300 180 - 300 240 - 300 240 - 300 240 - 300	23.9666667 29.033333 30.033333 41.9666667 57.0000000 6.0000000 11.0666667 24.0000000 39.033333 5.0666667 18.000000 33.0333333 1.0000000 12.9333333 27.9666667	1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352 1.801352	42 42 42 42 42 42 42 42 42 42 42 42 42 4	9.9739919 13.3048241 16.1175268 16.672655 23.2973206 33.6429057 3.3308322 6.1435349 6.6986736 13.323287 21.6689138 2.8127027 3.3678414 9.9924965 18.3380816 0.5551387 7.177938 15.5253789 6.6246551 14.9702402	0.000000 0.000000 0.000000 0.000000 0.000000 0.0015323 0.000187 0.000003 0.000000 0.2451864 0.0746835 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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.         120         0% - 32%         -2.9666667         1.801352         42         -1.6469115         0.9131836           .         120         0% - 45%         22.0000000         1.801352         42         12.2130513         0.0000000           .         120         32% - 45%         24.9666667         1.801352         42         13.8599628         0.0000000           .         180         0% - 32%         -0.0333333         1.801352         42         -0.0185046         1.0000000           .         180         32% - 45%         27.0333333         1.801352         42         15.0072494         0.0000000           .         240         0% - 32%         -2.0333333         1.801352         42         15.0072494         0.0000000           .         240         0% - 32%         -2.0333333         1.801352         42         15.0072494         0.0000000           .         240         0% - 32%         -2.0333333         1.801352         42         11.287820         0.9955898           .         240         0% - 45%         30.000000         1.801352         42         17.7829429         0.000000           .         300         0% - 32%         5.0333333         1.801	45% 45% 45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 240 60 - 300 60 - 360 120 - 180 120 - 240 120 - 300 120 - 360 180 - 300 180 - 360 240 - 300 240 - 300	23.9666667 29.0333333 30.0333333 41.9666667 57.0000000 6.0000000 11.0666667 24.0000000 39.0333333 5.0666667 18.0000000 33.0333333 27.9666667 11.9333333 27.9666667 15.0333333 -1.0000000 1.000000000000000000000000000	1.801352 1.801352	42 42 42 42 42 42 42 42 42 42 42 42 42 4	9.9739919 13.3048241 16.1175268 16.6726655 23.2973206 31.6429057 3.3308322 6.1435349 6.6986736 13.3233287 21.6689138 2.8127027 3.3678414 9.9924965 18.3380816 0.5551387 6.6246551 14.9702402 8.3455851 -0.5551387 -0.0000000 0.5551387 -0.0185046	0.0000000 0.0000000 0.0000000 0.0000000 0.000000
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.     360     0% - 32%     2.0000000     1.801352     42     1.1102774     0.9962109       .     360     0% - 45%     59.0000000     1.801352     42     32.7531831     0.0000000       .     360     32% - 45%     57.0000000     1.801352     42     31.6429057     0.0000000	45% 45% 45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 120 60 - 180 60 - 240 60 - 300 60 - 360 120 - 180 120 - 360 120 - 360 120 - 360 120 - 360 120 - 360 120 - 360 120 - 360 180 - 300 180 - 360 0% - 32% 0% - 45% 32% - 45% 0% - 32% 0% - 45% 32% - 45% 0% - 32% 0% - 45% 32% - 45% 0% - 32% 0% - 45% 32% - 45% 0% - 32% 0% - 45% 32% - 45% 0% - 32% 0% - 45% 32% - 45% 0% - 32% 0% - 45% 32% - 45% 0% - 32%	23,9666667 29,0333333 41,9666667 57,000000 6,0000000 11,0666667 12,0666667 12,0666667 18,000000 12,9333333 1,0000000 12,9333333 1,0000000 12,9333333 1,0000000 1,0000000 1,0000000 1,0000000 1,0000000 1,0000000 1,0000000 1,0000000 1,0000000 1,0000000 1,00000000	1.801352 1.801352	42 42 42 42 42 42 42 42 42 42 42 42 42 4	9.9739919 13.3048241 16.175268 16.676268 16.676268 13.6429057 3.3308322 6.1435349 6.6986736 13.3233287 21.6689138 2.8127027 3.3678414 9.9924965 18.3380816 0.5551387 7.1797938 15.5253789 6.624653 14.9702402 8.3458551 -0.5551387 0.0000000 0.5551387 0.0000000 0.5551387 14.9702402 8.3458531 -0.185046 9.41033486 9.4188532 -1.6469115 12.2130513 13.8599628 -0.0185046 14.9887448 15.0072494 -1.1287820 2.7941981	0.0000000 0.0000000 0.0000000 0.0000000 0.000000
.         360         0% - 45%         59.0000000         1.801352         42         32.7531831         0.0000000           .         360         32% - 45%         57.0000000         1.801352         42         31.6429057         0.0000000	45% 45% 45% 45% 45% 45% 45% 45% 45% 45%		0 - 120 0 - 180 0 - 240 0 - 300 0 - 360 60 - 120 60 - 180 60 - 120 60 - 180 60 - 240 60 - 300 120 - 180 120 - 360 120 - 360 120 - 360 120 - 360 120 - 360 120 - 360 120 - 360 120 - 360 180 - 360 080 - 3240 180 - 300 090 - 32% 090 - 45% 32% - 45% 090 - 32% 090 - 45% 32% - 45% 090 - 32% 090 - 32% 090 - 45% 32% - 45% 090 - 32% 090 - 32% 090 - 45% 32% - 45% 090 - 32% 090 - 45% 32% - 45% 090 - 32% 090 - 45% 32% - 45% 090 - 32% 090 - 45%	23,9666667 29,0333333 41,9666667 57,000000 6,0000000 11,0666667 12,0666667 24,0000000 39,0333333 5,0666667 18,0000000 12,9333333 1,0000000 1,0000000 1,0000000 1,0000000 1,0000000 1,0000000 1,0000000 1,0000000 20,0333333 16,9666667 22,0000000 24,9666667 22,0000000 24,9666667 22,0000000 24,9666667 22,0000000 24,9666667 22,00000000 24,9666667 22,00000000 24,9666667 25,00000000 24,9666667 20,00333333 27,00000000 24,9666667 25,000000000 24,9666667	1.801352 1.801352	42 42 42 42 42 42 42 42 42 42 42 42 42 4	9.9739919 13.3048241 16.175268 16.6726655 16.6726655 33.308322 6.1435349 6.6986736 13.3233287 21.6689138 2.8127027 3.3678414 9.9924965 18.3380816 0.5551387 7.1797938 15.5253789 6.6246551 14.9702402 8.345581 -0.5551387 -0.0185046 9.4188532 -1.6469115 12.2130513 13.8599628 15.0072494 -1.1287820 16.6541609 17.7829429 2.7941981 25.5178754	0.0000000 0.0000000 0.0000000 0.0000000 0.000000
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```
## # I(h)
## table_sagebrush$student_resid <- rstudent(model_sagebrush)
## hist(table_sagebrush$student_resid)
## qqPlot(table_sagebrush$student_resid)
## ggplot(table_sagebrush, 3)
## ggplot(table_sagebrush, aes(h, student_resid)) + geom_dotplot(binaxis = "y",
## stackdir = "center", binwidth = 0.1, alpha = 0.6) + theme_light()
## ggplot(table_sagebrush, aes(d, student_resid)) + geom_dotplot(binaxis = "y",
## stackdir = "center", binwidth = 0.1, alpha = 0.6) + theme_light()
## # II(b)
table_sagebrush$hd <- interaction(table_sagebrush$h, table_sagebrush$d)
kable(summary(contrast(lsmeans(lm(Percent ~ hd, table_sagebrush), "hd"), list(c32_12.22 = c(resident), "one of the contrast (lsmeans))
## # II(b)
## II(b)
```

contrast	estimate	SE	df	t.ratio	p.value
c32_12.22	-16.95	1.560016	42	-10.86527	0

## Question 3 (Show main steps of your work to get full points)

Let  $y_{ijk} = \mu + \tau_i + \beta_j + (\tau \beta)_{ij} + \delta_k + \varepsilon_{ijk}$ ;  $\varepsilon_{ijk} \sim iidN(0, \sigma^2)$ ; for i = 1, ..., a; j = 1, ..., b; k = 1, ..., n; Derive the normal equations from the least squares parameter estimation method and estimate the model parameters using the following constraints.  $\sum_i^a \hat{\tau}_i = 0$ ;  $\sum_i^b \hat{\beta}_j = 0$ ;  $\sum_i^a \widehat{(\tau \beta)}_{ij} = 0$ ;  $\sum_j^b \widehat{(\tau \beta)}_{ij} = 0$ ;  $\sum_k^n \hat{\delta}_k = 0$ 

This is a two-factor factorial in RCBD model with fixed effect.

$$SSE = \sum_{i=1}^{a} \sum_{j=1}^{b} \sum_{k=1}^{n} (y_{ijk} - \mu - \tau_i - \beta_j - (\tau \beta)_{ij} - \delta_k)^2$$

$$\frac{\partial SSE}{\partial \mu}\Big|_{\hat{\mu},\hat{\tau}_{i},\hat{\beta}_{i},\widehat{(\tau\beta)}_{ii},\hat{\delta}_{k}} = 2\sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{n}(y_{ijk} - \hat{\mu} - \hat{\tau}_{i} - \hat{\beta}_{j} - \widehat{(\tau\beta)}_{ij} - \hat{\delta}_{k})(-1) = 0$$

For 
$$i = 1, ..., a$$
,

$$\frac{\partial SSE}{\partial \tau_i}\Big|_{\hat{\mu},\hat{\tau}_i,\hat{\beta}_i,\widehat{(\tau\beta)}_{ji},\hat{\delta}_k} = 2\sum_{j=1}^b \sum_{k=1}^n (y_{ijk} - \hat{\mu} - \hat{\tau}_i - \hat{\beta}_j - \widehat{(\tau\beta)}_{ij} - \hat{\delta}_k)(-1) = 0$$

For 
$$j = 1, ..., b$$
,

$$\frac{\partial SSE}{\partial \beta_j}\Big|_{\hat{\mu},\hat{\tau}_i,\hat{\beta}_j,\widehat{(\tau\beta)}_{ij},\hat{\delta}_k} = 2\sum_{i=1}^a \sum_{k=1}^n (y_{ijk} - \hat{\mu} - \hat{\tau}_i - \hat{\beta}_j - \widehat{(\tau\beta)}_{ij} - \hat{\delta}_k)(-1) = 0$$

For 
$$i = 1, ..., a; j = 1, ..., b$$
,

$$\frac{\partial SSE}{\partial (\tau\beta)_{ij}}\Big|_{\hat{\mu},\hat{\tau}_{i},\hat{\beta}_{i},\widehat{(\tau\beta)}_{ij},\hat{\delta}_{k}} = 2\sum_{k=1}^{n}(y_{ijk} - \hat{\mu} - \hat{\tau}_{i} - \hat{\beta}_{j} - \widehat{(\tau\beta)}_{ij} - \hat{\delta}_{k})(-1) = 0$$

For 
$$k = 1, ..., n$$
,

$$\frac{\partial SSE}{\partial \delta_k}\Big|_{\hat{\mu},\hat{\tau}_i,\hat{\beta}_i,\widehat{(\tau\beta)}_{ii},\hat{\delta}_k} = 2\sum_{i=1}^a \sum_{j=1}^b (y_{ijk} - \hat{\mu} - \hat{\tau}_i - \hat{\beta}_j - \widehat{(\tau\beta)}_{ij} - \hat{\delta}_k)(-1) = 0$$

$$\begin{cases} y_{...} = abn\hat{\mu} + bn\sum_{i=1}^{a} \hat{\tau}_{i} + an\sum_{j=1}^{b} \hat{\beta}_{j} + n\sum_{i=1}^{a} \sum_{j=1}^{b} \widehat{(\tau\beta)}_{ij} + ab\sum_{k=1}^{n} \hat{\delta}_{k} \\ y_{i..} = bn\hat{\mu} + bn\hat{\tau}_{i} + n\sum_{j=1}^{b} \hat{\beta}_{j} + n\sum_{j=1}^{b} \widehat{(\tau\beta)}_{ij} + b\sum_{k=1}^{n} \hat{\delta}_{k} \\ y_{.j.} = an\hat{\mu} + n\sum_{i=1}^{a} \hat{\tau}_{i} + an\hat{\beta}_{j} + n\sum_{i=1}^{a} \widehat{(\tau\beta)}_{ij} + a\sum_{k=1}^{n} \hat{\delta}_{k} \\ y_{ij.} = n\hat{\mu} + n\hat{\tau}_{i} + n\hat{\beta}_{j} + n\widehat{(\tau\beta)}_{ij} + \sum_{k=1}^{n} \hat{\delta}_{k} \\ y_{..k} = ab\hat{\mu} + b\sum_{i=1}^{a} \hat{\tau}_{i} + a\sum_{j=1}^{b} \hat{\beta}_{j} + \sum_{i=1}^{a} \sum_{j=1}^{b} \widehat{(\tau\beta)}_{ij} + ab\hat{\delta}_{k} \end{cases}$$

For 
$$\sum_{i=1}^{a} \hat{\tau}_i = 0$$
;  $\sum_{j=1}^{b} \hat{\beta}_j = 0$ ;  $\sum_{i=1}^{a} \widehat{(\tau \beta)}_{ij} = 0$ ;  $\sum_{j=1}^{b} \widehat{(\tau \beta)}_{ij} = 0$ ;  $\sum_{k=1}^{n} \hat{\delta}_k = 0$ ,

and for  $\hat{\mu}$  is constant,  $\hat{\tau}_i$ ,  $\hat{\beta}_j$ ,  $\widehat{(\tau\beta)}_{ij}$ ,  $\hat{\delta}_k$  are constants for summations on other parameters, and for  $y_{...} = abn\bar{y}_{...}$ ,  $y_{i..} = bn\bar{y}_{i..}$ ,  $y_{.j.} = an\bar{y}_{.j.}$ ,  $y_{ij.} = n\bar{y}_{ij.}$ ,  $y_{..k} = ab\bar{y}_{..k}$ , then

$$\begin{cases} abn\bar{y}_{...} = abn\hat{\mu} + 0 + 0 + 0 + 0 \\ bn\bar{y}_{i..} = bn\hat{\mu} + bn\hat{\tau}_{i} + 0 + 0 + 0 \\ an\bar{y}_{.j.} = an\hat{\mu} + 0 + an\hat{\beta}_{j} + 0 + 0 \\ n\bar{y}_{ij.} = n\hat{\mu} + n\hat{\tau}_{i} + n\hat{\beta}_{j} + n\widehat{(\tau\beta)}_{ij} + 0 \\ ab\bar{y}_{..k} = ab\hat{\mu} + 0 + 0 + 0 + ab\hat{\delta}_{k} \end{cases} \implies \begin{cases} \hat{\mu} = \bar{y}_{...} \\ \hat{\tau}_{i} = \bar{y}_{i..} - \bar{y}_{...} \\ \hat{\beta}_{j} = \bar{y}_{.j.} - \bar{y}_{...} \\ \widehat{(\tau\beta)}_{ij} = \bar{y}_{ij.} - \bar{y}_{i..} - \bar{y}_{...} + \bar{y}_{...} \\ \hat{\delta}_{k} = \bar{y}_{..k} - \bar{y}_{...} \end{cases}$$

## Question 4 (Show main steps of your work to get full points)

Consider the two-factor factorial model with fixed effects

$$y_{ijk} = \mu + \tau_i + \beta_j + (\tau \beta)_{ij} + \varepsilon_{ijk}, \text{ for } i = 1, 2, ..., a; j = 1, 2, ..., b; k = 1, 2, ..., n. \quad \varepsilon_{ijk} \sim iidN(0, \sigma^2); \sum_{i=1}^a \tau_i = 0 \text{ and } \sum_{j=1}^b \beta_j = 0; \sum_{i=1}^a (\tau \beta)_{ij} = 0, \sum_{j=1}^b (\tau \beta)_{ij} = 0. \quad \bar{y}_{i..} = \frac{1}{bn} \sum_{j=1}^b \sum_{k=1}^n y_{ijk}; \\ \bar{y}_{.j.} = \frac{1}{an} \sum_{i=1}^a \sum_{k=1}^n y_{ijk}; \quad y_{...} = \sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^n y_{ijk}; \quad \bar{y}_{...} = \frac{y_{...}}{abn}. \quad SS_A = bn \sum_{i=1}^a (\bar{y}_{i..} - \bar{y}_{...})^2; \quad SS_B = an \sum_{j=1}^b (\bar{y}_{.j.} - \bar{y}_{...})^2; \quad SS_{AB} = n \sum_{i=1}^a \sum_{j=1}^b (\bar{y}_{ij.} - \bar{y}_{i..} - \bar{y}_{.j.})^2$$

• Step 1: Expand the sum-of-squares terms

$$n\sum_{i=1}^{a}\sum_{j=1}^{b}(\bar{y}_{ij.}-\bar{y}_{...})^{2}=n\sum_{i=1}^{a}\sum_{j=1}^{b}\left[(\bar{y}_{ij.}-\bar{y}_{i..}-\bar{y}_{.j.}+\bar{y}_{...})+(\bar{y}_{i..}-\bar{y}_{...})+(\bar{y}_{.j.}-\bar{y}_{...})\right]^{2}$$

$$= n \sum_{i=1}^{a} \sum_{j=1}^{b} (\bar{y}_{ij.} - \bar{y}_{i..} - \bar{y}_{.j.} + \bar{y}_{...})^{2} + bn \sum_{i=1}^{a} (\bar{y}_{i..} - \bar{y}_{...})^{2} + an \sum_{j=1}^{b} (\bar{y}_{.j.} - \bar{y}_{...})^{2} + n \sum_{i=1}^{a} \sum_{j=1}^{b} [\text{three cross product terms}]$$

• Step 2: Proof the first cross-product terms equal 0

$$\sum_{i=1}^{a} \sum_{j=1}^{b} (\bar{y}_{i..} - \bar{y}_{...})(\bar{y}_{.j.} - \bar{y}_{...}) = \sum_{i=1}^{a} (\bar{y}_{i..} - \bar{y}_{...}) \sum_{j=1}^{b} (\bar{y}_{.j.} - \bar{y}_{...}) = (a\bar{y}_{...} - a\bar{y}_{...})(b\bar{y}_{...} - b\bar{y}_{...}) = 0$$

• Step 3: Proof the second cross-product terms equal 0

$$\sum_{i=1}^{a} \sum_{j=1}^{b} (\bar{y}_{ij.} - \bar{y}_{i..} - \bar{y}_{.j.} + \bar{y}_{...})(\bar{y}_{i..} - \bar{y}_{...}) = \sum_{i=1}^{a} \sum_{j=1}^{b} \left[ \bar{y}_{ij.} \bar{y}_{i..} - \bar{y}_{i..}^2 - \bar{y}_{i..} \bar{y}_{.j.} + \bar{y}_{i..} \bar{y}_{...} - \bar{y}_{i..} \bar{y}_{...} + \bar{y}_{i..} \bar{y}_{...} + \bar{y}_{i..} \bar{y}_{...} - \bar{y}_{i...}^2 \right]$$

$$=\sum_{i=1}^{a}\bar{y}_{i..}\sum_{j=1}^{b}\bar{y}_{ij.}-\sum_{i=1}^{a}\sum_{j=1}^{b}\bar{y}_{i..}^{2}-\sum_{i=1}^{a}\bar{y}_{i..}\sum_{j=1}^{b}\bar{y}_{i..}+2\bar{y}_{...}\sum_{i=1}^{a}\sum_{j=1}^{b}\bar{y}_{i..}-\bar{y}_{...}\sum_{i=1}^{a}\sum_{j=1}^{b}\bar{y}_{ij.}+\bar{y}_{...}\sum_{i=1}^{a}\sum_{j=1}^{b}\bar{y}_{.j.}-\sum_{i=1}^{a}\sum_{j=1}^{b}\bar{y}_{...}^{2}$$

$$=\sum_{i=1}^{a}\bar{y}_{i..}b\bar{y}_{i..}-\sum_{i=1}^{a}b\bar{y}_{i..}^{2}-a\bar{y}_{...}b\bar{y}_{...}+2\bar{y}_{...}ab\bar{y}_{...}-\bar{y}_{...}ab\bar{y}_{...}+\bar{y}_{...}ab\bar{y}_{...}-ab\bar{y}_{...}^{2}=0$$

• Step 4: Proof the third cross-product terms equal 0

$$\sum_{i=1}^{a} \sum_{j=1}^{b} (\bar{y}_{ij.} - \bar{y}_{i..} - \bar{y}_{.j.} + \bar{y}_{...})(\bar{y}_{.j.} - \bar{y}_{...}) = \sum_{i=1}^{a} \sum_{j=1}^{b} \left[ \bar{y}_{ij.} \bar{y}_{.j.} - \bar{y}_{i..} \bar{y}_{.j.} - \bar{y}_{.j.}^2 + \bar{y}_{.j.} \bar{y}_{...} - \bar{y}_{ij..} \bar{y}_{...} + \bar{y}_{i...} \bar{y}_{...} + \bar{y}_{i...} \bar{y}_{...} - \bar{y}_{...}^2 \right]$$

$$=\sum_{j=1}^{b}\bar{y}_{.j.}\sum_{i=1}^{a}\bar{y}_{ij.}-\sum_{i=1}^{a}\bar{y}_{i..}\sum_{j=1}^{b}\bar{y}_{.j.}-\sum_{i=1}^{a}\sum_{j=1}^{b}\bar{y}_{.j.}^{2}+2\bar{y}_{...}\sum_{i=1}^{a}\sum_{j=1}^{b}\bar{y}_{.j.}-\bar{y}_{...}\sum_{i=1}^{a}\sum_{j=1}^{b}\bar{y}_{ij.}+\bar{y}_{...}\sum_{i=1}^{a}\sum_{j=1}^{b}\bar{y}_{.i.}-\sum_{i=1}^{a}\sum_{j=1}^{b}\bar{y}_{...}^{2}$$

$$=\sum_{i=1}^{b}\bar{y}_{.j.}a\bar{y}_{.j.}-a\bar{y}_{...}b\bar{y}_{...}-\sum_{i=1}^{a}b\bar{y}_{.j.}^{2}+2\bar{y}_{...}ab\bar{y}_{...}-\bar{y}_{...}ab\bar{y}_{...}+\bar{y}_{...}ab\bar{y}_{...}-ab\bar{y}_{...}^{2}=0$$

• Step 5: Cmplete the proof

For  $n \sum_{i=1}^{a} \sum_{j=1}^{b}$  (three cross product terms)= 0, then

$$n\sum_{i=1}^{a}\sum_{j=1}^{b}(\bar{y}_{ij.}-\bar{y}_{...})^{2}=n\sum_{i=1}^{a}\sum_{j=1}^{b}(\bar{y}_{ij.}-\bar{y}_{i..}-\bar{y}_{.j.}+\bar{y}_{...})^{2}+bn\sum_{i=1}^{a}(\bar{y}_{i..}-\bar{y}_{...})^{2}+an\sum_{j=1}^{b}(\bar{y}_{.j.}-\bar{y}_{...})^{2}=SS_{AB}+SS_{A}+SS_{A}+SS_{B}+SS_{A}+SS_{B}+SS_$$

Therefore,

$$SS_{AB} = n \sum_{i=1}^{a} \sum_{j=1}^{b} (\bar{y}_{ij.} - \bar{y}_{...})^2 - SS_A - SS_B$$