

Lab 8 Report

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Section 1: Hypothesis

The goal of this research paper is to determine if regular prayer has any correlation to religious service attendance. Also examined is the affect sex and prayer has in relation to service attendance. The following are the hypothesizes examined:

Null: There is no significant correlation between prayer frequency, gender, and attendance of religious services.

Research₁: There will be a significant increase in attendance with an increase in prayer frequency

Research₂: Women will attend religious services more with higher levels of prayer when compared to men.

H₀: Higher prayer frequency + gender \neq More religious attendance

H₁: Higher prayer frequency = More religious attendance

H₂: Women = More religious attendance

Section 2: Data

The data used for this report is from the Baylor Survey of Religious Life. The data records three different metrics of each respondent: frequency of prayer, gender, and attendance of religious services. Data is encoded as ordinal for frequency and attendance, while gender is nominal.

Section 3: Method

Using RStudio, data was first packaged within a `data.frame` to make for easier coding, as the `data.frame` it came prepackaged in had an excessively long name.

```
betterList <- data.frame(prayerFrequency = Module_8_Lab_Data$PrayerFreq,  
                        attendance = Module_8_Lab_Data$Attendance,  
                        gender = Module_8_Lab_Data$Gender)
```

Section 3.1: Prayer Frequency

An ANOVA (`aov()`) was performed with respects to prayer frequency and religious service attendance. A `TukeyHSD()` was performed to determine where variance might be resulting from.

```
# Prayer and Attendance  
  
storedVal <- aov(betterList$attendance~betterList$prayerFrequency,  
                betterList)
```

```
summary(storedVal)

TukeyHSD(aov(betterList$attendance~as.factor(betterList$prayerFrequency),
            betterList))
```

Section 3.2: Prayer and Gender Frequency

`lm()` was used to perform an analysis (factorial ANOVA) of the interaction between gender and prayer frequency and how both affect attendance of religious services. An ANOVA was used to perform a `TukeyHSD()` test. Note that results of the `aov()` and `lm()` are similar and within margin of error; thus it seems reasonable to use `aov()` to construct a `TukeyHSD`, as there is no applicable method within `TukeyHSD` to run the test with `lm()` as the input. Furthermore, documentation within the *stats* package reveals that `aov()` is a wrapper for `lm()` with differing output methods; therefore, results should be near identical no matter the scenario.

```
# Gender, Prayer, and Attendance

storedVal <- lm(betterList$attendance~betterList$prayerFrequency*betterList$gender,
               data = betterList)
summary(storedVal)

TukeyHSD(aov(betterList$attendance~as.factor(betterList$prayerFrequency)*as.factor(betterList$gender),
            data = betterList))
```

Lastly, *ggplot2* was used to create a interaction plot between service attendance in relation to gender and prayer frequency.

```
# ggplot2 `interaction.plot()`

listInt <- ddply(betterList,.(prayerFrequency,gender),summarise, val = mean(attendance))

ggplot() +
  geom_point(data = betterList, aes(x = prayerFrequency, y = attendance, colour = gender)) +
  geom_point(data = listInt, aes(x = prayerFrequency, y = val, colour = gender)) +
  geom_line(data = listInt, aes(x = prayerFrequency, y = val, group = gender, colour = gender)) +
  ylim(1, 5) +
  theme_bw() +
  labs(title = "Interaction Plot", x = "Prayer Frequency", y = "Mean of Attendance")
```

Section 4: Results

From these tests, a number of discoveries emerge. The data is as follows:

Section 4.1: Attendance in Relation to Prayer

1. ANOVA analysis ~

```
##                Df Sum Sq Mean Sq F value Pr(>F)
## betterList$prayerFrequency    1    3166    3166   733.2 <2e-16 ***
## Residuals                1398    6037         4
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

2. TukeyHSD() ~

```
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = betterList$attendance ~ as.factor(betterList$prayerFrequency), data = betterList)
##
## $'as.factor(betterList$prayerFrequency)'
```

	diff	lwr	upr	p adj
2-1	2.092259	1.7262206	2.458298	0
3-1	3.414845	3.1210036	3.708687	0
3-2	1.322586	0.9742448	1.670927	0

Section 4.2: Attendance in Relation to Sex and Prayer:

1. lm() analysis ~

```
##
## Call:
## lm(formula = betterList$attendance ~ betterList$prayerFrequency *
## betterList$gender, data = betterList)
##
## Residuals:
```

	Min	1Q	Median	3Q	Max
	-4.9336	-1.4931	0.2078	1.2078	5.6051

```
##
## Coefficients:
```

	Estimate	Std. Error	t value
(Intercept)	-0.15057	0.45677	-0.330
betterList\$prayerFrequency	1.74187	0.21001	8.294
betterList\$gender	-0.07657	0.28942	-0.265
betterList\$prayerFrequency:betterList\$gender	-0.02161	0.12832	-0.168

```
## Pr(>|t|)
## (Intercept) 0.742
## betterList$prayerFrequency 2.54e-16 ***
## betterList$gender 0.791
## betterList$prayerFrequency:betterList$gender 0.866
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.079 on 1396 degrees of freedom
## Multiple R-squared: 0.3446, Adjusted R-squared: 0.3432
## F-statistic: 244.6 on 3 and 1396 DF, p-value: < 2.2e-16
```

2. TukeyHSD() using AOV() ~

```
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = betterList$attendance ~ as.factor(betterList$prayerFrequency) * as.factor(betterL
##
```

```
## $'as.factor(betterList$prayerFrequency)'
##      diff      lwr      upr p adj
## 2-1 2.092259 1.7270694 2.457449    0
## 3-1 3.414845 3.1216850 3.708005    0
## 3-2 1.322586 0.9750525 1.670119    0
##
## $'as.factor(betterList$gender)'
##      diff      lwr      upr      p adj
## 2-1 -0.1238114 -0.3435646 0.09594176 0.2692526
##
## $'as.factor(betterList$prayerFrequency):as.factor(betterList$gender)'
##      diff      lwr      upr      p adj
## 2:1-1:1 2.56582643 1.9036532 3.22799962 0.0000000
## 3:1-1:1 3.41031581 2.8648082 3.95582342 0.0000000
## 1:2-1:1 0.04156910 -0.4998915 0.58302969 0.9999310
## 2:2-1:1 1.79481193 1.2060180 2.38360583 0.0000000
## 3:2-1:1 3.44602192 2.9800463 3.91199751 0.0000000
## 3:1-2:1 0.84448938 0.1626149 1.52636385 0.0056378
## 1:2-2:1 -2.52425733 -3.2028985 -1.84561618 0.0000000
## 2:2-2:1 -0.77101449 -1.4879890 -0.05403996 0.0265907
## 3:2-2:1 0.88019550 0.2601088 1.50028217 0.0007638
## 1:2-3:1 -3.36874671 -3.9341307 -2.80336275 0.0000000
## 2:2-3:1 -1.61550388 -2.2263702 -1.00463752 0.0000000
## 3:2-3:1 0.03570612 -0.4578652 0.52927748 0.9999486
## 2:2-1:2 1.75324284 1.1459878 2.36049791 0.0000000
## 3:2-1:2 3.40445283 2.9153580 3.89354762 0.0000000
## 3:2-2:2 1.65120999 1.1101810 2.19223900 0.0000000
```

3. Interaction plot: See Section 6, Fig. 1.

Section 4.3: Key Values

Taking what is most important for prayer frequency, there is a statistically significant link between prayer and attendance. With an f-statistic of 733.6, there is no possible combinations of degrees of freedom in which the results, according to the critical f-value, are not significant (Fig. 2). The p-value for this test is $2E-16$, or 0.0000000000000002. *Fig. 1* represents this graphically by way of mean of attendance based on prayer rates. The Tukey Post Hoc test (`TukeyHSD()`) reveals that the interaction of each level between both factors is significant, with p-values listed as 0.

For attendance in relation to gender and prayer, we see a mix of statistical significance in interaction between genders and prayer frequency. Overall, the findings within the `lm()` analysis shows prayer frequency has a statistically significant effect on service attendance. However, gender does not have this effect. The individual interactions displayed in the Tukey Post Hoc test corroborate this.

Section 5: Discussion and Conclusion

From these results, it's clear that prayer frequency has a direct and measurable impact on attendance of religious services. Gender, however has no significant impact, and any seen is likely due to error. This is further confirmed by *fig. 1*, in which we can see that the attendance results for each gender according to prayer frequency show similar trends.

It stands to reason the null is rejected and H_1 is accepted. However, H_2 is rejected on the grounds of not possessing statistical significance.

Section 6: Graphics and Visuals

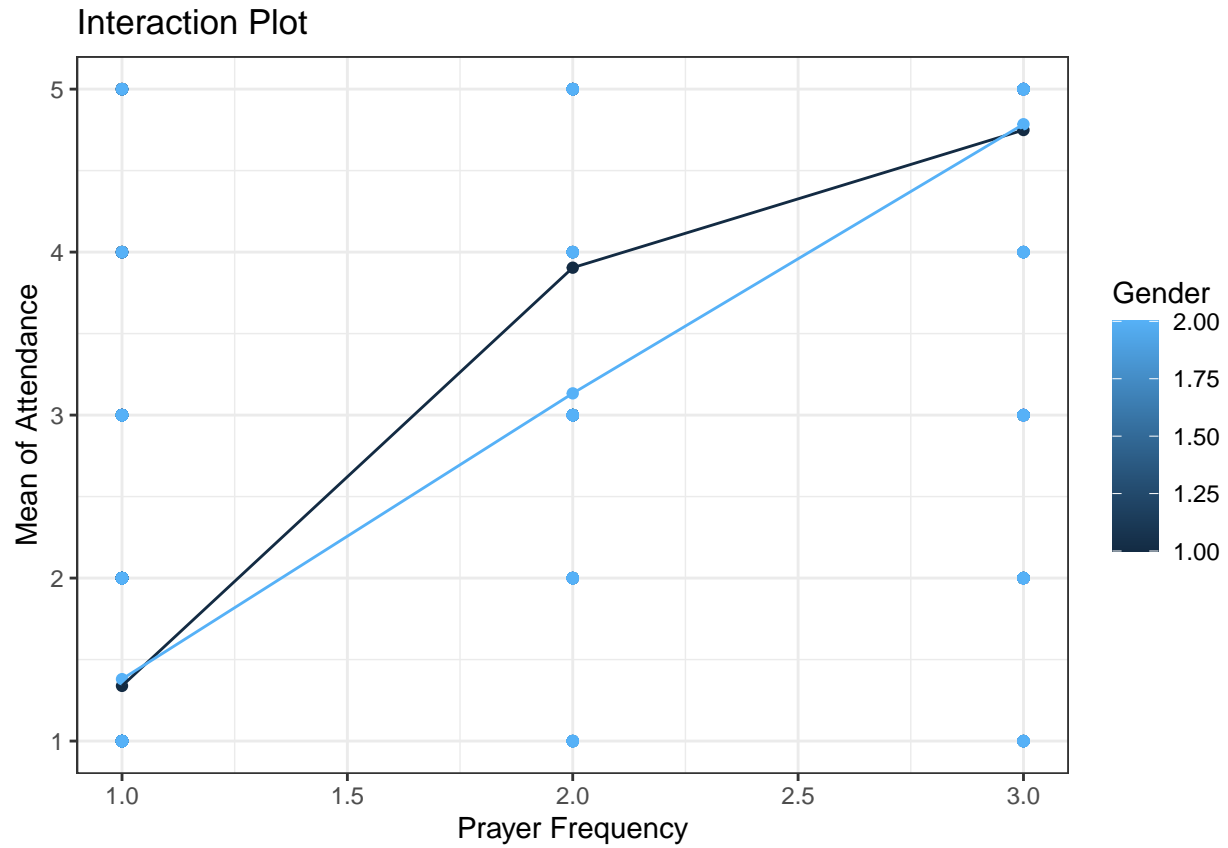


Figure 1: Fig. 1. Line plot. Effect of gender and prayer frequency on mean of attendance.

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Prayer Frequency	1	3166	3166	733.2	<2e-16 ***
Residuals	1398	6037	4	4	

Fig. 2. F table for Prayer Frequency.

F-statistic:	Df _{denom} :	Df _{num} :	p-value:
244.6	3	1396	< 2.2e-16

Fig. 3. Linear Model table for Prayer and Gender.