APPLICATIONS OF MATHEMATICS IN FINANCE

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1. Introduction. It has been well established by The United States Environmental Protection Agency and other independent organizations that average temperature is increasing across the country. This study examines monthly temperature data from two stations: Rye Patch Dam, Nevada, and Salt Lake City International Airport, Utah. These stations were chosen because they are roughly at the same latitude, $40.498°N$ and $40.790°N$, roughly at the same elevation, 1260.3m and 1287.8m, relatively close longitudes, 118.316°W and 111.980°W, for Rye Patch and Salt Lake City respectively. The goal of the first hypothesis is to examine whether the effects of climate change statistically differ between these two locations; if they do, we can infer the climate change is predominantly man-made.

2. First Hypothesis. abc

3. Hypothesis 1. def

```r
library(ggpubr);
library(ggplot2);
library(latex2exp);

# Disable pdf generation:
pdf(NULL);

data_Salt_Lake = read.csv("GSOY/GSOM_Salt_Lake.csv"); #1287.8m elevation
data_rye_patch = read.csv("GSOY/GSOM_rye_patch.csv"); #1260.3m elevation

Salt_Lake_Temp_Data = data_Salt_Lake$TAVG;
rye_patch_Temp_Data = data_rye_patch$TAVG;

# Calculate means: (must round to first decimal place because this is the precision of our data:
Salt_Lake_mean = round(10 * mean(Salt_Lake_Temp_Data[1:258], na.rm=TRUE)) / 10;
rye_patch_mean = round(10 * mean(rye_patch_Temp_Data[151:415], na.rm=TRUE)) / 10;

Salt_Lake_Diff = Salt_Lake_Temp_Data[259:length(Salt_Lake_Temp_Data)] - Salt_Lake_mean;
rye_patch_Diff = rye_patch_Temp_Data[416:length(rye_patch_Temp_Data)] - rye_patch_mean;

# Remove missing data (values of NA) here:
Salt_Lake_Diff = Salt_Lake_Diff[!is.na(Salt_Lake_Diff)];
rye_patch_Diff = rye_patch_Diff[!is.na(rye_patch_Diff)];

# Print mean, variance, and sample size for each dataset:
print("Salt_Lake");
print(paste("\U03BC", "=", mean(Salt_Lake_Diff, na.rm=TRUE)));
print(paste("\U03C3", "=", sqrt(var(Salt_Lake_Diff, na.rm=TRUE))));
print(paste("n =",length(Salt_Lake_Diff)));
# New line:
cat("\n");

print("rye_patch");
print(paste("\U03BC", "=", mean(rye_patch_Diff, na.rm=TRUE)));
print(paste("\U03C3", "=", sqrt(var(rye_patch_Diff, na.rm=TRUE))));
print(paste("n =",length(rye_patch_Diff)));
# New line:
cat("\n");

# Perform the Shapiro Tests:
shapiro.test(Salt_Lake_Diff);
shapiro.test(rye_patch_Diff);

# Visualize with QQ plots:
png(file = "Salt_Lake_Diff_QQ_Plot.png");
qqplot(y=Salt_Lake_Diff, x=1:length(Salt_Lake_Diff), xlab="x index", ylab="Data value",
main=TeX("Salt Lake City Temperature Increases: $p \\approx 1.084 \\times 10^{-12}$"));
abline(a = min(Salt_Lake_Diff), b = (max(Salt_Lake_Diff) - min(Salt_Lake_Diff)) / length(Salt_Lake_Diff));
dev.off();

png(file = "Rye_Patch_Diff_QQ_Plot.png");
qqplot(y=rye_patch_Diff, x=1:length(rye_patch_Diff), xlab="x index", ylab="Data value",
main=TeX("Rye Patch Temperature Increases: $p \\approx 5.759 \\times 10^{-11}$"));

abline(a = min(rye_patch_Diff), b = (max(rye_patch_Diff) - min(rye_patch_Diff)) / length(rye_patch_Diff));
dev.off();

#Perform two sided t-test with unequal variances:
t.test(rye_patch_Diff, Salt_Lake_Diff);
```

REFERENCES