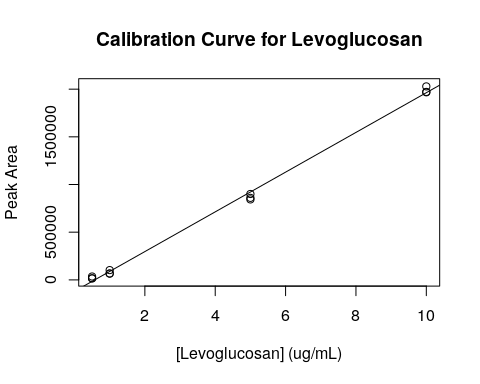
chem313\_LCMSlab

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X <- lm(calibration$signal~calibration$conc)  
plot(calibration$signal~calibration$conc,  
 xlab="[Levoglucosan] (ug/mL)",  
 ylab="Peak Area",  
 main="Calibration Curve for Levoglucosan")  
abline(X)



summary(X)

##   
## Call:  
## lm(formula = calibration$signal ~ calibration$conc)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -78140 -21718 5998 31208 65807   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -119530 19252 -6.209 1e-04 \*\*\*  
## calibration$conc 208247 3427 60.768 3.54e-14 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 45280 on 10 degrees of freedom  
## Multiple R-squared: 0.9973, Adjusted R-squared: 0.997   
## F-statistic: 3693 on 1 and 10 DF, p-value: 3.54e-14

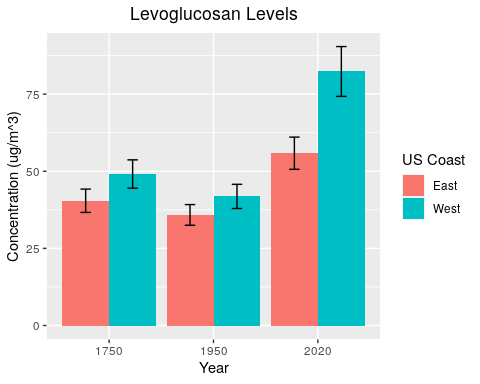
## sorting by coast and year - West  
  
lev\_conc\_solution <- (data$signal+119530)/208247 #x = (y - b)/m  
  
lev\_conc <- lev\_conc\_solution\*4\*70/24 ##unit conversion   
  
error <- sqrt((3427/208247)^2 + (19252/119530)^2) \* lev\_conc  
  
graph\_data <- data.frame(lev\_conc, error, data$coast, data$year)  
  
West\_lev <- graph\_data %>%  
 filter(data.coast=="W")   
  
West\_lev\_1750 <- West\_lev %>%   
 filter(data.year==1750)  
West\_lev\_1950 <- West\_lev %>%   
 filter(data.year==1950)  
West\_lev\_2020 <- West\_lev %>%   
 filter(data.year==2020)  
  
West\_lev\_1750

## lev\_conc error data.coast data.year  
## 1 47.86775 7.749917 W 1750  
## 2 48.93437 7.922607 W 1750  
## 3 50.54213 8.182906 W 1750

W\_1750 <- mean(West\_lev\_1750$lev\_conc)  
W\_1950 <- mean(West\_lev\_1950$lev\_conc)  
W\_2020 <- mean(West\_lev\_2020$lev\_conc)  
  
W\_errors\_sq\_17 <- (West\_lev\_1750$error)^2  
W\_errors\_sum\_17 <- sum(W\_errors\_sq\_17)  
W\_errors\_17 <- (sqrt(W\_errors\_sum\_17)/sum(West\_lev\_1750$lev\_conc))\*W\_1750  
  
W\_errors\_sq\_19 <- (West\_lev\_1950$error)^2  
W\_errors\_sum\_19 <- sum(W\_errors\_sq\_19)  
W\_errors\_19 <- (sqrt(W\_errors\_sum\_19)/sum(West\_lev\_1950$lev\_conc))\*W\_1950  
  
W\_errors\_sq\_20 <- (West\_lev\_2020$error)^2  
W\_errors\_sum\_20 <- sum(W\_errors\_sq\_20)  
W\_errors\_20 <- (sqrt(W\_errors\_sum\_20)/sum(West\_lev\_2020$lev\_conc))\*W\_2020  
  
  
west\_averages <- c(W\_1750, W\_1950, W\_2020)  
west\_errors <- c(W\_errors\_17, W\_errors\_19, W\_errors\_20)

## sorting by coast and year - West  
  
East\_lev <- graph\_data %>%  
 filter(data$coast=="E")   
  
East\_lev\_1750 <- East\_lev %>%   
 filter(data.year==1750)  
East\_lev\_1950 <- East\_lev %>%   
 filter(data.year==1950)  
East\_lev\_2020 <- East\_lev %>%   
 filter(data.year==2020)  
  
E\_1750 <- mean(East\_lev\_1750$lev\_conc)  
E\_1950 <- mean(East\_lev\_1950$lev\_conc)  
E\_2020 <- mean(East\_lev\_2020$lev\_conc)  
  
east\_averages <- c(E\_1750, E\_1950, E\_2020)  
  
E\_errors\_sq\_17 <- (East\_lev\_1750$error)^2  
E\_errors\_sum\_17 <- sum(E\_errors\_sq\_17)  
E\_errors\_17 <- (sqrt(E\_errors\_sum\_17)/sum(East\_lev\_1750$lev\_conc))\*E\_1750  
  
E\_errors\_sq\_19 <- (East\_lev\_1950$error)^2  
E\_errors\_sum\_19 <- sum(E\_errors\_sq\_19)  
E\_errors\_19 <- (sqrt(E\_errors\_sum\_19)/sum(East\_lev\_1950$lev\_conc))\*E\_1950  
  
E\_errors\_sq\_20 <- (East\_lev\_2020$error)^2  
E\_errors\_sum\_20 <- sum(E\_errors\_sq\_20)  
E\_errors\_20 <- (sqrt(E\_errors\_sum\_20)/sum(East\_lev\_2020$lev\_conc))\*E\_2020  
  
east\_errors <- c(E\_errors\_17, E\_errors\_19, E\_errors\_20)  
  
west\_averages <- c(W\_1750, W\_1950, W\_2020)  
west\_errors <- c(W\_errors\_17, W\_errors\_19, W\_errors\_20)

average\_conc <- c(E\_1750, E\_1950, E\_2020, W\_1750, W\_1950, W\_2020)  
average\_errors <- c(E\_errors\_17, E\_errors\_19, E\_errors\_20, W\_errors\_17, W\_errors\_19, W\_errors\_20)  
average\_coast <- c("E", "E", "E", "W", "W", "W")  
average\_year <- c("1750", "1950", "2020", "1750", "1950", "2020")  
  
graph\_data\_averages <- data.frame(average\_conc, average\_errors, average\_coast, average\_year)  
  
ggplot(data=graph\_data\_averages, aes(x=average\_year, y=average\_conc, fill=average\_coast)) +  
 geom\_bar(stat="identity", position=position\_dodge()) +  
 geom\_errorbar(aes(ymin=average\_conc-average\_errors, ymax=average\_conc+average\_errors), width=0.2, position=position\_dodge(0.9)) +  
 xlab("Year") +  
 ylab("Concentration (ug/m^3)") +  
 ggtitle("Levoglucosan Levels") +  
 scale\_fill\_discrete(name="US Coast", labels=c("East", "West")) +  
 theme(plot.title = element\_text(hjust = 0.5))



#statistics  
  
var.test(East\_lev\_2020$lev\_conc, West\_lev\_2020$lev\_conc)

##   
## F test to compare two variances  
##   
## data: East\_lev\_2020$lev\_conc and West\_lev\_2020$lev\_conc  
## F = 0.00037247, num df = 2, denom df = 2, p-value = 0.0007447  
## alternative hypothesis: true ratio of variances is not equal to 1  
## 95 percent confidence interval:  
## 9.550556e-06 1.452640e-02  
## sample estimates:  
## ratio of variances   
## 0.0003724717

t.test(West\_lev\_2020$lev\_conc, East\_lev\_2020$lev\_conc, mu=0, paired=FALSE, var.equal=FALSE)

##   
## Welch Two Sample t-test  
##   
## data: West\_lev\_2020$lev\_conc and East\_lev\_2020$lev\_conc  
## t = 1.445, df = 2.0015, p-value = 0.2852  
## alternative hypothesis: true difference in means is not equal to 0  
## 95 percent confidence interval:  
## -52.36633 105.38039  
## sample estimates:  
## mean of x mean of y   
## 82.36755 55.86052

var.test(East\_lev\_1950$lev\_conc, West\_lev\_1950$lev\_conc)

##   
## F test to compare two variances  
##   
## data: East\_lev\_1950$lev\_conc and West\_lev\_1950$lev\_conc  
## F = 0.16317, num df = 2, denom df = 2, p-value = 0.2806  
## alternative hypothesis: true ratio of variances is not equal to 1  
## 95 percent confidence interval:  
## 0.004183938 6.363769138  
## sample estimates:  
## ratio of variances   
## 0.1631736

t.test(West\_lev\_1950$lev\_conc, East\_lev\_1950$lev\_conc, mu=0, paired=TRUE, var.equal=FALSE)

##   
## Paired t-test  
##   
## data: West\_lev\_1950$lev\_conc and East\_lev\_1950$lev\_conc  
## t = 8.3602, df = 2, p-value = 0.01401  
## alternative hypothesis: true difference in means is not equal to 0  
## 95 percent confidence interval:  
## 2.910520 9.083154  
## sample estimates:  
## mean of the differences   
## 5.996837

var.test(East\_lev\_1750$lev\_conc, West\_lev\_1750$lev\_conc)

##   
## F test to compare two variances  
##   
## data: East\_lev\_1750$lev\_conc and West\_lev\_1750$lev\_conc  
## F = 0.032769, num df = 2, denom df = 2, p-value = 0.06346  
## alternative hypothesis: true ratio of variances is not equal to 1  
## 95 percent confidence interval:  
## 0.0008402221 1.2779778167  
## sample estimates:  
## ratio of variances   
## 0.03276866

t.test(West\_lev\_1750$lev\_conc, East\_lev\_1750$lev\_conc, mu=0, paired=TRUE, var.equal=FALSE)

##   
## Paired t-test  
##   
## data: West\_lev\_1750$lev\_conc and East\_lev\_1750$lev\_conc  
## t = 10.609, df = 2, p-value = 0.008769  
## alternative hypothesis: true difference in means is not equal to 0  
## 95 percent confidence interval:  
## 5.151838 12.182305  
## sample estimates:  
## mean of the differences   
## 8.667072

east\_averages

## [1] 40.44768 35.85727 55.86052

east\_errors

## [1] 3.780875 3.352308 5.221748

west\_averages

## [1] 49.11475 41.85410 82.36755

west\_errors

## [1] 4.592129 3.915261 8.072002