Zooming in on 2019 Performace

The key areas recommended to be looked at in this test are the following:

1) Using data collected in Ghana at the end of Y2019 cropping season, calculate summary metrics that can inform our Research Team about product performance.
2) Present this information in a synthetic and visual manner (you might be asked to go over some of these findings orally during our final interview) Some sample questions that are of particular interest:

1. Do crop yields (in kg/acre) vary significantly from region to region, from district to district, from farmer to farmer? What seems to be a normal, vs. low, vs. high yield for maize in Ghana?
2. Do other factors seem to influence crop yields, such as a farmer's gender, literacy, phone ownership, farm size, use of fertilizer, proximity to a larger town, etc.?
3. Out of the survey sample (cryield table), what is the proportion of farmers who reported bad/good crop yields and received (or did not receive) an insurance payout?
4. At the district level, can we say that districts with poorer (or better) harvests received higher (or lower) insurance payout amounts?
5. Can we trust the quality of our Y2019 sampled data?

We first have to install and load the libraries that we are going to need for this analysis.

```
## Loading required package: tidyverse
```

```
## -- Attaching packages ----------------------------------------------------------------------------
```

```
## v ggplot2 3.1.1       v purrr   0.3.2
## v tibble  2.1.1       v dplyr   0.8.0.1
## v tidyr   0.8.3       v stringr 1.4.0
## v readr   1.3.1       v forcats 0.4.0
```

```
## -- Conflicts ------------------------------------------------------------------------------- tidy
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

Next step is to read all the data into R using the read_csv function from the read_r package.

We then merge the data into one big dataset so that we can start to explore the data. We discover this relationships by looking at the variables that are shared across the tables.

The resulting table has the following features.

```
## Classes 'spec_tbl_df', 'tbl_df', 'tbl' and 'data.frame': 328 obs. of  60 variables:
##  $ cust_id.x       : num  202802 206328 206340 206378 205665 ...
##  $ cntr_id         : num  50339 49794 49809 49919 47411 ...
##  $ weight          : num  0.5 0.153 0.153 0.153 0.153 ...
##  $ strata          : num  1 2 2 2 2 2 2 2 2 2 ...
##  $ treatment       : chr  "grp_msg" "grp_none" "grp_none" "grp_none" ...
##  $ caller          : chr  "Hurmat" "Hurmat" "Hurmat" "Hurmat" ...
##  $ date_called     : Date, format: "2019-12-31" "2019-12-31" ...
##  $ call_status     : chr  "connected" "connected" "failed" "connected" ...
##  $ planted_acres   : num  3 3 NA NA 2 3 4 2.5 NA NA ...
##  $ yield_bags      : num  6 NA NA 1.5 8 4.5 12 9 NA NA ...
##  $ fert_bags       : num  8 0 NA 0 0 9 7 3 NA NA ...
##  $ yield_rate      : chr  "very poor" "good" NA "good" ...
##  $ yield_lost      : chr  "3/4" "none" NA "none" ...
##  $ reason          : chr  "drought before flowering" "other" NA "other" ...
##  $ yield_max_bags  : num  45 20 NA 6 18 45 64 20 NA NA ...
##  $ sold_bags       : num  6 0 NA 0 5 2 10 9 NA NA ...
```

```
##  $ sold_price      : num  130 0 NA 0 110 120 100 150 NA NA ...
##  $ notes           : chr  "Four days after the fertilizer application, the rain stopped  , so the ma
##  $ call_count      : num  216 95 11 1 2 NA NA NA NA NA ...
##  $ date_reg.x      : Date, format: "2018-09-06" "2019-03-22" ...
##  $ gender          : chr  "F" "M" NA "M" ...
##  $ literacy        : chr  NA NA NA NA ...
##  $ farm_size       : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ num_parcels     : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ cht_season      : chr  "Y2018S2" "Y2019S2" "Y2019S1" "Y2019S1" ...
##  $ cht_channel     : chr  "CALL CENTER" "CALL CENTER" "CALL CENTER" "CALL CENTER" ...
##  $ cht_phone       : logi  TRUE TRUE TRUE TRUE TRUE TRUE ...
##  $ has_mobile_money: logi  TRUE TRUE NA TRUE TRUE TRUE ...
##  $ ussd_created    : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
##  $ type            : chr  "Ambassador" "Ambassador" "Customer" "Customer" ...
##  $ amount_usd.x    : num  7.554 3.777 3.777 3.777 0.944 ...
##  $ cust_id.y       : num  202802 206328 206340 206378 205665 ...
##  $ status          : chr  "pending" "expired" "pending" "expired" ...
##  $ season          : chr  "Y2019S2" "Y2019S2" "Y2019S1" "Y2019S1" ...
##  $ product_code    : chr  "MAIZ-GHA-20-ST01" "MAIZ-GHA-20-ST01" "MAIZ-GHA-20-ST01" "MAIZ-GHA-20-ST01"
##  $ date_issued     : Date, format: "2019-06-19" "2019-03-22" ...
##  $ amount          : num  0 20 20 20 5 40 60 30 20 20 ...
##  $ amount_usd.y    : num  0 3.777 3.777 3.777 0.944 ...
##  $ date_planted    : Date, format: NA "2019-09-10" ...
##  $ date_planted_imp: Date, format: NA "2019-09-10" ...
##  $ date_planted_in : Date, format: NA "2019-09-30" ...
##  $ loc_id          : num  4266 1437 1437 1437 4047 ...
##  $ payout          : num  NA 0 NA 0 0 0 0 0 0 0 ...
##  $ payout_usd      : num  NA 0 NA 0 0 0 0 0 0 0 ...
##  $ mm_paid         : logi  NA NA NA NA NA NA ...
##  $ loc_nm          : chr  "Atonsuagya-Grumaline" "Mankranso" "Mankranso" "Mankranso" ...
##  $ date_reg.y      : POSIXct, format: "1970-01-01 04:59:58" "1970-01-01 05:00:25" ...
##  $ cust_N          : logi  NA NA NA NA NA NA ...
##  $ visit_N         : logi  NA NA NA NA NA NA ...
##  $ is_female       : logi  NA NA NA NA NA NA ...
##  $ channel_zm      : logi  NA NA NA NA NA NA ...
##  $ amount_usd      : num  143.5 121.8 121.8 121.8 23.6 ...
##  $ ca_nm           : logi  NA NA NA NA NA NA ...
##  $ iso3            : chr  "GH(S)" "GH(S)" "GH(S)" "GH(S)" ...
##  $ country         : chr  "Ghana" "Ghana" "Ghana" "Ghana" ...
##  $ reg_nm          : chr  "GH-AH" "GH-AH" "GH-AH" "GH-AH" ...
##  $ dist_id         : num  3936 4559 4559 4559 3936 ...
##  $ dist_nm         : chr  "Ejura-Sekyedumase" "Ahafo Ano South" "Ahafo Ano South" "Ahafo Ano South"
##  $ X               : num  -1.42 -1.86 -1.86 -1.86 -1.34 ...
##  $ Y               : num  7.26 6.82 6.82 6.82 7.41 ...
```

The readme file shared additional information on the weight of bags of different products that we can now use to standardize the measurements of the harvests.

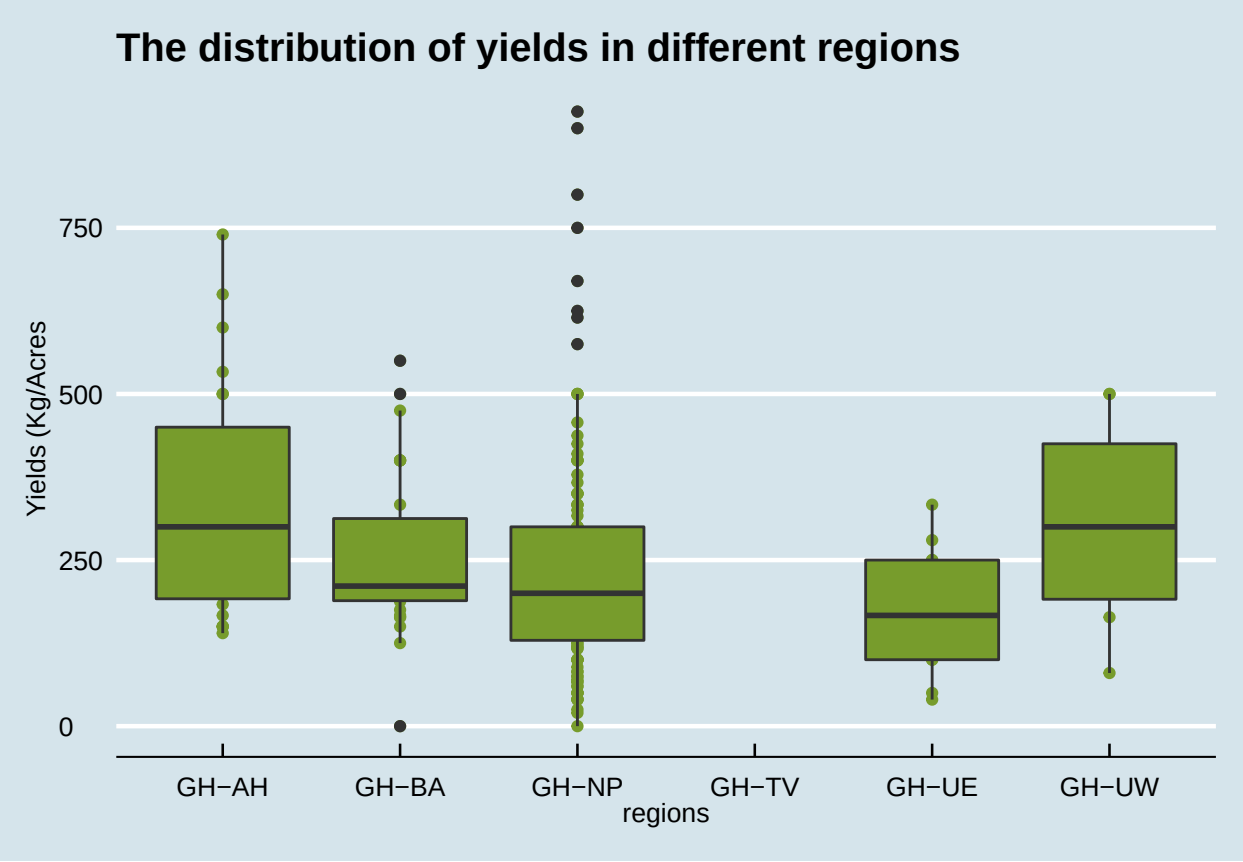
```
## [1] "MAIZ-GHA-20-ST01" "RICE-GHA-20-ST01" "GROU-GHA-20-ST01"
## [4] "SORG-GHA-20-ST01"
```

Below is a computation of the kg values of the bags harvested. This should assist in calculating the yield per hactare.

```
## # A tibble: 10 x 5
##    product_code     yield_bags yield_kgs planted_acres kg_acres
```

```
##    <chr>                <dbl>     <dbl>         <dbl>    <dbl>
##  1 MAIZ-GHA-20-ST01        10      1000             4      250
##  2 MAIZ-GHA-20-ST01        NA        NA            NA       NA
##  3 MAIZ-GHA-20-ST01        NA        NA            NA       NA
##  4 RICE-GHA-20-ST01        NA        NA            NA       NA
##  5 RICE-GHA-20-ST01        NA        NA            NA       NA
##  6 GROU-GHA-20-ST01        NA        NA            NA       NA
##  7 MAIZ-GHA-20-ST01         6       600             2      300
##  8 MAIZ-GHA-20-ST01        37      3700             5      740
##  9 RICE-GHA-20-ST01        NA        NA            NA       NA
## 10 MAIZ-GHA-20-ST01        11      1100             2      550
```

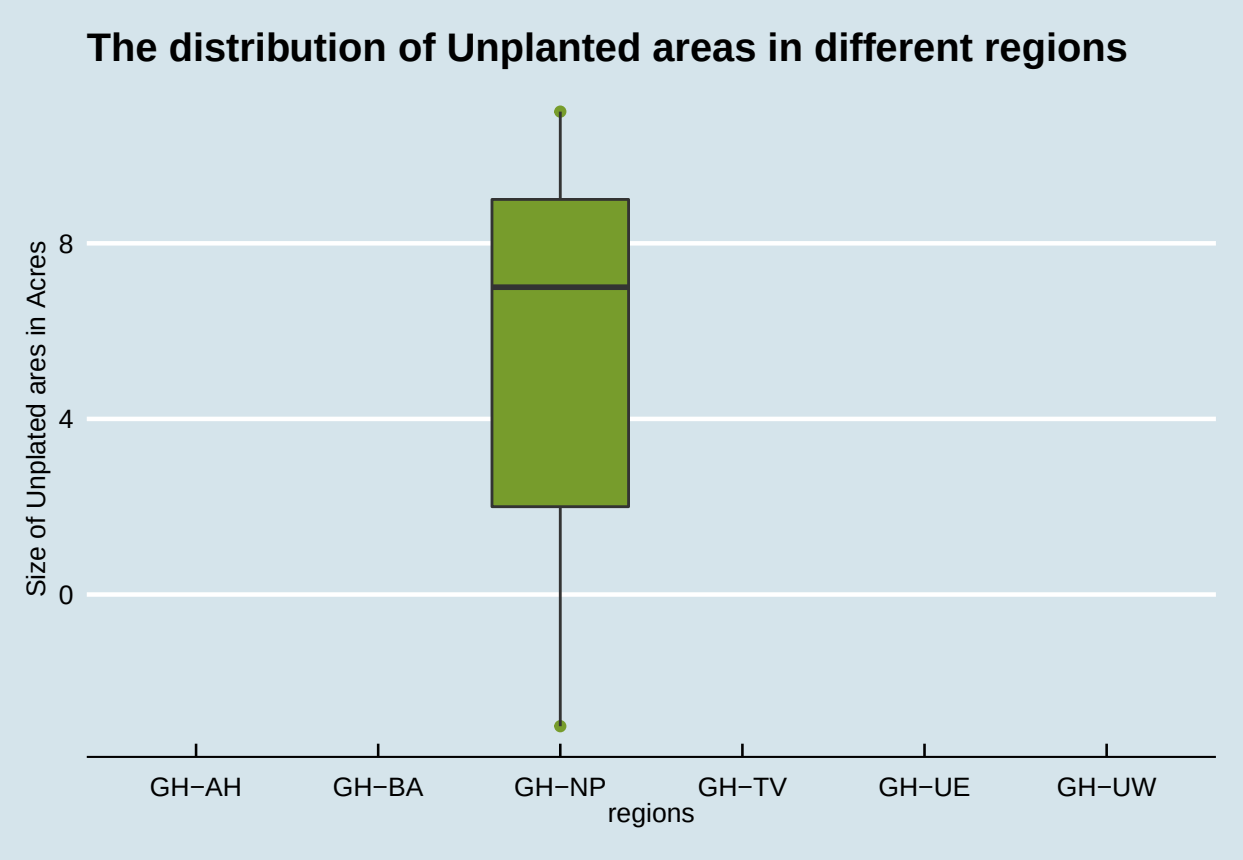
Let's Explore




```
## # A tibble: 6 x 4
##   region district          cust_id.x kg_acres
##   <fct>  <fct>                 <dbl>    <dbl>
## 1 GH-AH  Ejura-Sekyedumase    202802      200
## 2 GH-AH  Ahafo Ano South      206328       NA
## 3 GH-AH  Ahafo Ano South      206340       NA
## 4 GH-AH  Ahafo Ano South      206378       NA
## 5 GH-AH  Ejura-Sekyedumase    205665      400
## 6 GH-AH  Ejura-Sekyedumase    205154      150
```

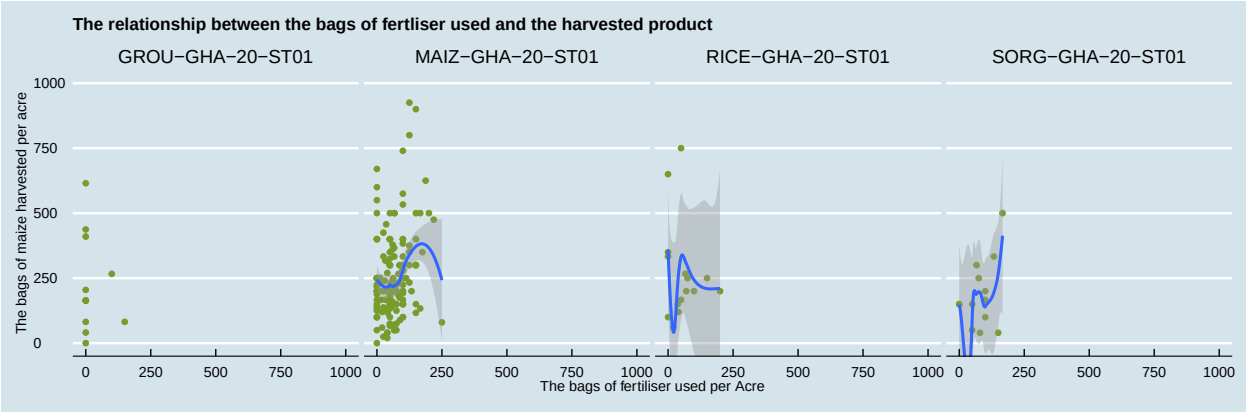
The harvests (in yields/kg) shows that GH-AH and GH-UW are the best with GH-UW having a better harvest distribution as shown by the boxplot above. Additionally, GH-NP seems to have the greatest number

of outliers. GH-UE has the worst harvest of all the other regions that were surveyed.

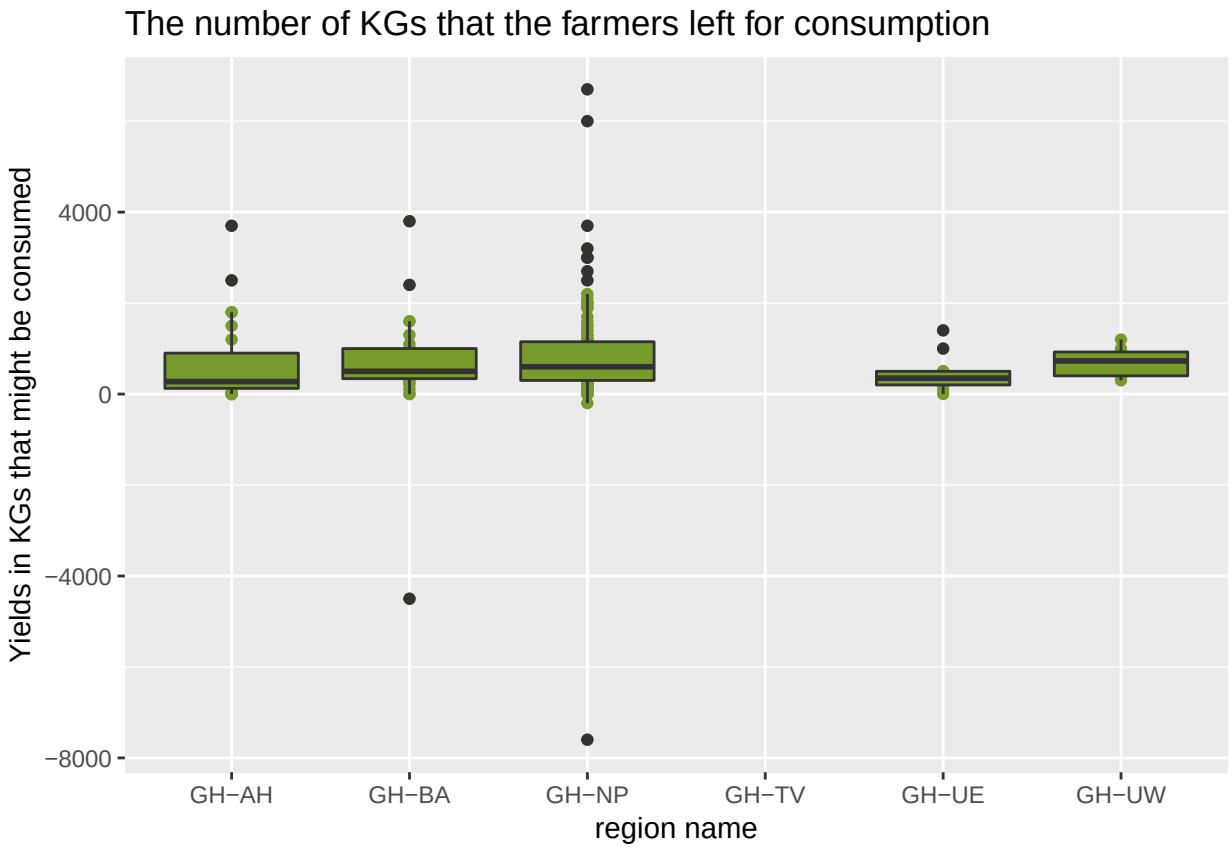


GH-NP is the only region where some farmers did not plant on the full farm with the median farm size left unplanted being 7 Acres. Additionally, there are is a farmer who underreported their farm size. This could be a case of data intergrity and is worthy of a closer look to determine the scale across WC database.

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```



Fertiliser use (assuming 50kg is the standard bag of fertiliser) seems to influence the harvest proportion with the maximum rate being about 200kgs/acre. Of all the crops, Sorghum seems to respond the best to fertiliser application.



In GH-BA and GH-NP there are some farmers who seem to have misrepresented their harvest data. Investigation should reveal whether this deserves more attention or not.

Now that we have a better understanding of the harvest performace we can start to look at answering the questions posed.

1. Do crop yields (in kg/acre) vary significantly from region to region, from district to district, from farmer to farmer? What seems to be a normal, vs. low, vs. high yield for maize in Ghana?

Region to Region

```
##
## Call:
## lm(formula = kg_acres ~ region, data = surveysubset)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -256.00 -102.49  -35.83   69.81  689.17
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   338.33      33.87   9.988  < 2e-16 ***
## regionGH-BA   -82.33      45.02  -1.829  0.06896 .
## regionGH-NP  -102.51      36.73  -2.791  0.00577 **
## regionGH-UE  -163.79      59.55  -2.750  0.00651 **
## regionGH-UW   -32.83      66.68  -0.492  0.62299
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 162.5 on 198 degrees of freedom
##   (125 observations deleted due to missingness)
## Multiple R-squared:  0.05329,    Adjusted R-squared:  0.03416
## F-statistic: 2.786 on 4 and 198 DF,  p-value: 0.02775
```

There's some evidence of varying yields in all regions except GH-UW and across regions with a p-value of 0.02 we can assume variation of yields across regions. Our F-score at 2.7 confirms this as shown below.

```
## Analysis of Variance Table
##
## Response: kg_acres
##            Df  Sum Sq Mean Sq F value  Pr(>F)
## region      4  294127   73532  2.7862 0.02775 *
## Residuals 198 5225586   26392
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The anova test confirms this significant variation between groups in different regions.

District to District

```
##
## Call:
## lm(formula = kg_acres ~ district, data = surveysubset)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -237.92 -103.75  -16.67   56.95  726.11
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                    291.204     55.292   5.267 4.13e-07 ***
## districtBongo                 -194.537    110.584  -1.759   0.0803 .
## districtBunkpurugu Yonyo       -38.870     76.215  -0.510   0.6107
## districtCentral Gonja          -92.316     74.556  -1.238   0.2173
## districtChereponi               58.796    174.849   0.336   0.7371
## districtEast Gonja             -18.426     87.424  -0.211   0.8333
## districtEast Mamprusi          -73.426    110.584  -0.664   0.5076
## districtEjura-Sekyedumase       47.130     65.219   0.723   0.4709
## districtGushegu                -59.870     68.379  -0.876   0.3825
## districtKaraga                 -76.442     87.424  -0.874   0.3831
## districtKassena Nankana West   -87.454     80.601  -1.085   0.2794
## districtKpandai               -174.537    129.671  -1.346   0.1801
## districtKumbungu               -66.918     83.594  -0.801   0.4245
## districtMamprugo Moaduri       -41.204    110.584  -0.373   0.7099
## districtMion                    21.225     92.521   0.229   0.8188
## districtNandom                  21.596     92.521   0.233   0.8157
## districtNanumba North         -149.870    110.584  -1.355   0.1771
## districtNanumba South         -191.204    174.849  -1.094   0.2757
## districtPru                    -74.537    110.584  -0.674   0.5012
## districtSagnarigu              108.796    129.671   0.839   0.4026
## districtSavelugu-Nanton        -28.288     63.293  -0.447   0.6555
## districtSawla-Tuna-Kalba      -124.870     99.679  -1.253   0.2120
```

```
## districtSene East             -80.815     73.144  -1.105   0.2708
## districtSene West              22.884     87.424   0.262   0.7938
## districtSissala West         -211.204    174.849  -1.208   0.2287
## districtTamale Metropolitan    12.963     80.601   0.161   0.8724
## districtTolon                -112.037     99.679  -1.124   0.2626
## districtWa East               208.796    174.849   1.194   0.2341
## districtWa West                 8.796    174.849   0.050   0.9599
## districtWest Mamprusi        -141.204    174.849  -0.808   0.4205
## districtYendi Municipal      -141.204     92.521  -1.526   0.1288
## districtZabzugu              -110.704    110.584  -1.001   0.3182
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 165.9 on 171 degrees of freedom
##   (125 observations deleted due to missingness)
## Multiple R-squared:  0.1476, Adjusted R-squared:  -0.006938
## F-statistic: 0.9551 on 31 and 171 DF,  p-value: 0.5402
```

```
## Analysis of Variance Table
##
## Response: kg_acres
##            Df  Sum Sq Mean Sq F value Pr(>F)
## district   31  814668   26280  0.9551 0.5402
## Residuals 171 4705044   27515
```

There's little to no evidence in this data that confirm variation between the yields from one district to another. This is because we have an F-score less than 1 and a p-value greater than 0.05

Customer to Customer

```
##
## Call:
## lm(formula = kg_acres ~ cust_id.x, data = surveysubset)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -257.09 -110.22  -46.99   87.02  686.92
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 2.107e+02  2.868e+01   7.347 4.98e-12 ***
## cust_id.x   2.461e-04  1.652e-04   1.490    0.138
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 164.8 on 201 degrees of freedom
##   (125 observations deleted due to missingness)
## Multiple R-squared:  0.01092,    Adjusted R-squared:  0.006004
## F-statistic:  2.22 on 1 and 201 DF,  p-value: 0.1378
```

```
## Analysis of Variance Table
##
## Response: kg_acres
##            Df  Sum Sq Mean Sq F value Pr(>F)
## cust_id.x   1   60303   60303  2.2202 0.1378
```

```
## Residuals 201 5459410   27161
```

There's no evidence of variation of yields from customer to customer that can be confirmed with this survey.

Normal vs High Yield vs Low Yield

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = kg_acres ~ region, data = surveysubset)
##
## $region
##                    diff        lwr         upr     p adj
## GH-BA-GH-AH  -82.33254 -206.28839  41.6233152 0.3600739
## GH-NP-GH-AH -102.50734 -203.62207  -1.3925998 0.0451625
## GH-UE-GH-AH -163.78788 -327.74597   0.1702123 0.0503819
## GH-UW-GH-AH  -32.83333 -216.41343 150.7467619 0.9880011
## GH-NP-GH-BA  -20.17480 -110.70017  70.3505764 0.9728159
## GH-UE-GH-BA  -81.45534 -239.10339  76.1927148 0.6139183
## GH-UW-GH-BA   49.49921 -128.46794 227.4663512 0.9400952
## GH-UE-GH-NP  -61.28054 -201.68013  79.1190458 0.7504448
## GH-UW-GH-NP   69.67400  -93.21074 232.5587478 0.7641701
## GH-UW-GH-UE  130.95455  -76.86631 338.7753969 0.4150850
```

2. Do other factors seem to influence crop yields, such as a farmer's gender, literacy, phone ownership, farm size, use of fertilizer, proximity to a larger town, etc.?

```
##
## Call:
## lm(formula = kg_acres ~ ., data = yieldfactors)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -511.84  -88.77  -31.83   80.36  663.58
##
## Coefficients: (1 not defined because of singularities)
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)             1.068e+03  9.281e+02   1.151 0.251970
## cust_id.x               1.675e-04  3.842e-04   0.436 0.663676
## fert_bags               8.087e+00  2.077e+00   3.895 0.000163 ***
## genderM                 6.070e+00  3.479e+01   0.174 0.861777
## literacynone            2.429e+01  8.770e+01   0.277 0.782268
## farm_size              -5.099e-01  2.209e+01  -0.023 0.981619
## num_parcels            -3.072e+01  1.375e+02  -0.223 0.823578
## cht_seasonY2017S1       1.995e+00  9.801e+01   0.020 0.983791
## cht_seasonY2018S1      -2.019e+01  1.060e+02  -0.190 0.849285
## cht_seasonY2018S2       1.412e+02  1.428e+02   0.989 0.324837
## cht_seasonY2019S1      -6.789e+00  1.365e+02  -0.050 0.960420
## cht_seasonY2019S2       1.606e+02  1.608e+02   0.999 0.319774
## cht_seasonY2020S1      -1.258e+02  2.872e+02  -0.438 0.662144
## cht_channelUSSD        -5.823e+01  1.813e+02  -0.321 0.748601
## cht_channelUSSD (CA)   -8.605e+01  7.968e+01  -1.080 0.282383
## cht_channelVISIT       -3.613e+01  7.681e+01  -0.470 0.638946
## cht_channelZM/CA       -7.009e+01  9.977e+01  -0.703 0.483703
```

```
## seasonY2019S2        -6.784e+01  6.829e+01  -0.993 0.322498
## seasonY2020S1                NA         NA      NA       NA
## typeCustomer         -8.258e+01  3.931e+01  -2.101 0.037745 *
## loc_id               -9.564e-04  1.593e-02  -0.060 0.952216
## has_mobile_moneyTRUE  2.996e+01  4.500e+01   0.666 0.506859
## reg_nmGH-BA          -2.936e+02  2.808e+02  -1.046 0.297866
## reg_nmGH-NP          -8.898e+02  9.175e+02  -0.970 0.334107
## reg_nmGH-TV          -1.310e+02  1.894e+02  -0.692 0.490502
## reg_nmGH-UE          -7.342e+02  9.230e+02  -0.795 0.427916
## reg_nmGH-UW          -8.807e+02  9.112e+02  -0.967 0.335750
## dist_id              -2.566e-01  2.267e-01  -1.132 0.260106
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 171.4 on 119 degrees of freedom
##   (182 observations deleted due to missingness)
## Multiple R-squared:  0.2549, Adjusted R-squared:  0.09206
## F-statistic: 1.565 on 26 and 119 DF,  p-value: 0.0557
```

The linear regression model above shoes that fertiliser bags and type have the most significance to the yields per kgs. Other factors have very low influence if any at all.

3. Out of the survey sample (cryield table), what is the proportion of farmers who reported bad/good crop yields and received (or did not receive) an insurance payout?

```
## Warning in chisq.test(payoutsselect): Chi-squared approximation may be
## incorrect
```

```
##
##  Pearson's Chi-squared test
##
## data:  payoutsselect
## X-squared = 2935700, df = 654, p-value < 2.2e-16
```

We can thus see an apparent association between crop yields and payouts. The test results show that relying on the distribution of the test statistic might lead to some inaccuracies so i have included the code that removes this reliance. It takes a little bit of time to run.

4. At the district level, can we say that districts with poorer (or better) harvests received higher (or lower) insurance payout amounts?

```
## Warning in chisq.test(districtpayouts): Chi-squared approximation may be
## incorrect
```

```
##
##  Pearson's Chi-squared test
##
## data:  districtpayouts
## X-squared = 380280, df = 654, p-value < 2.2e-16
```

The payouts across districts seem to have a correlation to the yields.

5. Can we trust the quality of our Y2019 sampled data?

```
##
##  Two Sample t-test
##
## data:  cryield$planted_acres and customers$farm_size
## t = -11.653, df = 233, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -9.323538 -6.626783
## sample estimates:
## mean of x mean of y
##  4.358173 12.333333
```

As we have a p-value that's less than 0.05 we can estimate that the survey is a proper representation of the population.

```
sessionInfo()
```

```
## R version 3.5.3 (2019-03-11)
## Platform: x86_64-pc-linux-gnu (64-bit)
## Running under: Ubuntu 16.04.6 LTS
##
## Matrix products: default
## BLAS: /opt/microsoft/ropen/3.5.3/lib64/R/lib/libRblas.so
## LAPACK: /opt/microsoft/ropen/3.5.3/lib64/R/lib/libRlapack.so
##
## locale:
##  [1] LC_CTYPE=en_US.UTF-8       LC_NUMERIC=C
##  [3] LC_TIME=en_US.UTF-8        LC_COLLATE=en_US.UTF-8
##  [5] LC_MONETARY=en_US.UTF-8    LC_MESSAGES=en_US.UTF-8
##  [7] LC_PAPER=en_US.UTF-8       LC_NAME=C
##  [9] LC_ADDRESS=C               LC_TELEPHONE=C
## [11] LC_MEASUREMENT=en_US.UTF-8 LC_IDENTIFICATION=C
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] forcats_0.4.0        stringr_1.4.0        dplyr_0.8.0.1
##  [4] purrr_0.3.2          readr_1.3.1          tidyr_0.8.3
##  [7] tibble_2.1.1         ggplot2_3.1.1        tidyverse_1.2.1
## [10] RevoUtils_11.0.3     RevoUtilsMath_11.0.0
##
## loaded via a namespace (and not attached):
##  [1] tidyselect_0.2.5 xfun_0.6         reshape2_1.4.3   ggthemes_4.1.1
##  [5] haven_2.1.0      lattice_0.20-38  colorspace_1.4-1 generics_0.0.2
##  [9] htmltools_0.3.6  yaml_2.2.0       utf8_1.1.4       rlang_0.3.4
## [13] pillar_1.3.1     glue_1.3.1       withr_2.1.2      modelr_0.1.4
## [17] readxl_1.3.1     plyr_1.8.4       munsell_0.5.0    gtable_0.3.0
## [21] cellranger_1.1.0 rvest_0.3.3      evaluate_0.13    labeling_0.3
## [25] knitr_1.22       fansi_0.4.0      broom_0.5.2      Rcpp_1.0.1
## [29] scales_1.0.0     backports_1.1.4  jsonlite_1.5     hms_0.4.2
## [33] digest_0.6.18    stringi_1.4.3    grid_3.5.3       cli_1.1.0
## [37] tools_3.5.3      magrittr_1.5     lazyeval_0.2.2   crayon_1.3.4
```

```
## [41] pkgconfig_2.0.2  xml2_1.2.0       lubridate_1.7.4  assertthat_0.2.1
## [45] rmarkdown_1.12   httr_1.4.0       rstudioapi_0.10  R6_2.3.0
## [49] nlme_3.1-137     compiler_3.5.3
```