

# Offensive Statistical Analysis of the 2010 MLB Season

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# Chapter 1 - Summary



This dataset depicts all of the main statistical categories for baseball offensive production for each of the 30 teams in the major leagues. The information is ranked, starting with teams in the American League, by runs scored for the entire team. They are ranked highest to lowest by league with the 14 American League teams listed first followed by the 16 National League teams. There are 13 different statistical categories collected through ESPN to demonstrate the overall offensive production of the entire team compared to that of other teams within both their own league and throughout Major League Baseball.



# Chapter 2 - Charts & Graphs

## Wins

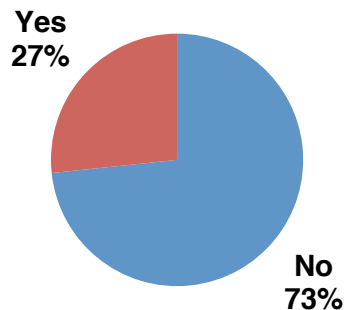
Stem  
unit: 10

| Statistics     |         |
|----------------|---------|
| Sample Size    | 30      |
| Mean           | 81      |
| Median         | 81      |
| Std. Deviation | 11.0047 |
| Minimum        | 57      |
| Maximum        | 97      |

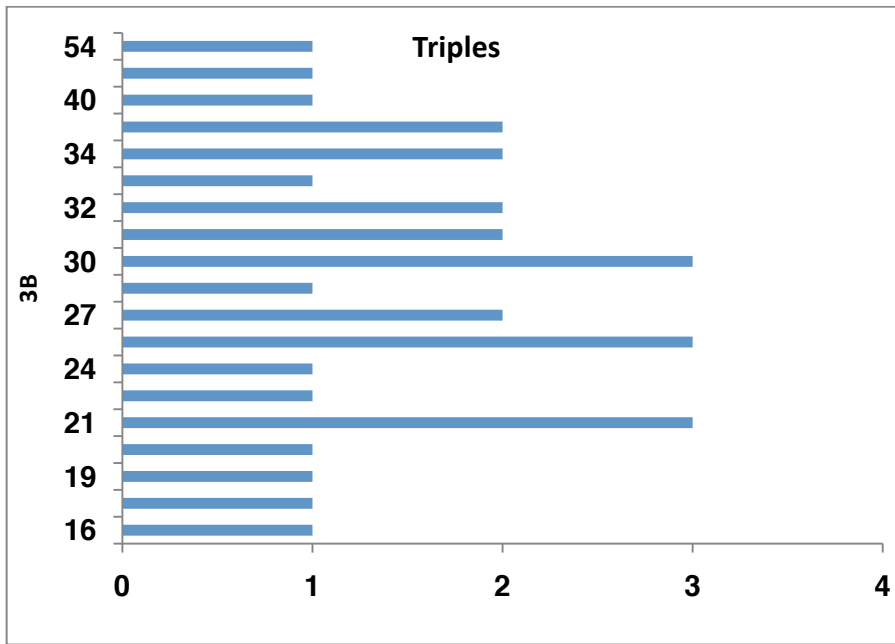
|   |                            |
|---|----------------------------|
| 5 | 7                          |
| 6 | 1 5 6 7 9 9                |
| 7 | 5 6 7 9<br>0 0 0 1 1 3 5 6 |
| 8 | 8 9<br>0 0 1 1 2 4 5 6     |
| 9 | 7                          |

This stem and leaf plot depicts total team wins for the 2010 season with a range of 40 between the Pittsburgh Pirates 57 wins on the low end and the Philadelphia Phillies 97 wins on the high end.

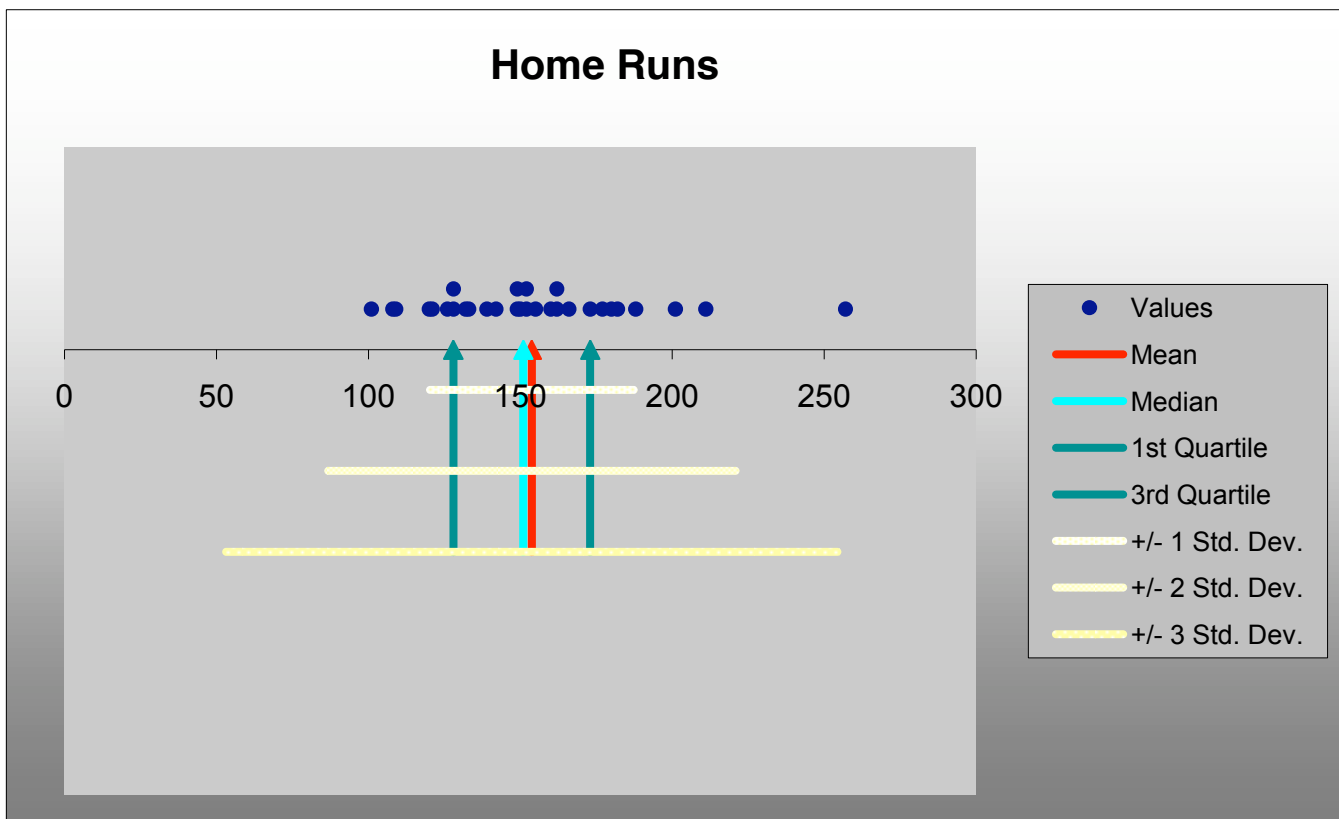
## Playoff Berths



This pie chart shows the percentages of how many teams out of the entire major leagues makes the playoff each season.



This bar chart shows how triples has an almost normal distribution despite being a statistic that just counts the frequencies of one of the games rarest events.



This dot scale diagram contains an abundance of information about home run totals from the 2010 season. It shows how all but 1 team hit within 2 standard deviations of the mean as well as giving a visual version of the five number summary for this data set.

### Batting Average

| Count of<br>BA |       |            |
|----------------|-------|------------|
| BA             | Total | Percentage |
| 0.236          | 1     | 3.33%      |
| 0.242          | 1     | 3.33%      |
| 0.246          | 1     | 3.33%      |
| 0.247          | 2     | 6.67%      |
| 0.248          | 3     | 10.00%     |
| 0.249          | 1     | 3.33%      |
| 0.25           | 2     | 6.67%      |
| 0.252          | 1     | 3.33%      |
| 0.254          | 1     | 3.33%      |
| 0.256          | 1     | 3.33%      |
| 0.257          | 2     | 6.67%      |
| 0.258          | 1     | 3.33%      |
| 0.259          | 1     | 3.33%      |
| 0.26           | 1     | 3.33%      |
| 0.262          | 1     | 3.33%      |
| 0.263          | 2     | 6.67%      |
| 0.267          | 1     | 3.33%      |
| 0.268          | 3     | 10.00%     |
| 0.272          | 1     | 3.33%      |
| 0.273          | 1     | 3.33%      |
| 0.274          | 1     | 3.33%      |
| 0.276          | 1     | 3.33%      |
| Grand<br>Total | 30    |            |

This percentage column shows the different frequencies of team batting averages throughout the major leagues. The chart displays how .248 and .268 were the most common team batting averages with 3 teams having each average.

# Chapter 3 - Statistical Variables

|                               | GP  | AB       | R        | H        | 2B       | 3B       | HR       | TB       | RBI      | BA       | OBP      | SLG      | OPS      |
|-------------------------------|-----|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <a href="#">Mean</a>          | 162 | 5511.767 | 710.2667 | 1418.467 | 282.8667 | 28.86667 | 153.7667 | 2220.367 | 676.2667 | 0.257267 | 0.3253   | 0.402567 | 0.7278   |
| <a href="#">Median</a>        | 162 | 5491.5   | 716      | 1411     | 281.5    | 29.5     | 151      | 2227     | 687.5    | 0.257    | 0.3245   | 0.4025   | 0.7315   |
| <a href="#">Variance</a>      | 0   | 5417.633 | 5786.892 | 5436.189 | 688.3954 | 65.70575 | 1123.426 | 27163.83 | 5589.444 | 0.000108 | 0.000158 | 0.000687 | 0.001303 |
| <a href="#">Std Deviation</a> | 0   | 73.60457 | 76.07162 | 73.73051 | 26.23729 | 8.105908 | 33.51755 | 164.8145 | 74.76258 | 0.010389 | 0.012576 | 0.026212 | 0.03609  |
| <a href="#">CV</a>            | 0%  | 1%       | 11%      | 5%       | 9%       | 28%      | 22%      | 7%       | 11%      | 4%       | 4%       | 7%       | 5%       |
| <a href="#">1st Quartile</a>  | 162 | 5454.75  | 663.5    | 1362.25  | 268.5    | 22.5     | 129      | 2096.75  | 626.25   | 0.24825  | 0.31725  | 0.38375  | 0.702    |
| <a href="#">3rd Quartile</a>  | 162 | 5567.75  | 766.25   | 1470     | 294.75   | 32.75    | 171.25   | 2346     | 735      | 0.266    | 0.335    | 0.41975  | 0.75575  |
| <a href="#">IQR</a>           | 0   | 113      | 102.75   | 107.75   | 26.25    | 10.25    | 42.25    | 249.25   | 108.75   | 0.01775  | 0.01775  | 0.036    | 0.05375  |

This chart takes 13 different offensive statistical categories of the 30 major league baseball teams and takes their season totals and analyzes the data into 8 different inferential statistics: mean, median, variance, coefficient of variation, standard deviation, 1<sup>st</sup> quartile, 3<sup>rd</sup> quartile, and interquartile range. From this chart we get an overview of the performance of all major league teams offenses. This chart tells us that the average MLB batting average is .257 through a few minor calculations we can then use the standard deviation to determine that 95% of players will hit between .237 and .278 in any given season. From this chart we can use the IQR to determine that the middle 50 percent of MLB teams are within 42 home runs, 108 RBIs, and 17 thousandths of a batting average point of each other. That's the difference of one key free agent signing to go from 20<sup>th</sup> in the league to 10<sup>th</sup> in the league. This is just a few of the many interpretations about one MLB season that can be made from this data.

# Chapter 4 - Contingency Tables

## Probabilities Calculations

| Sample Space |          | Play-off Birth |    | Totals |
|--------------|----------|----------------|----|--------|
|              |          | Yes            | No |        |
| League       | American | 4              | 11 | 15     |
|              | National | 4              | 11 | 15     |
|              | Totals   | 8              | 22 | 30     |

| Simple Probabilities |      |
|----------------------|------|
| P(American)          | 0.50 |
| P(National)          | 0.50 |
| P(Yes)               | 0.27 |
| P(No)                | 0.73 |

| Joint Probabilities |      |
|---------------------|------|
| P(American and Yes) | 0.13 |
| P(American and No)  | 0.37 |
| P(National and Yes) | 0.13 |
| P(National and No)  | 0.37 |

| Addition Rule      |      |
|--------------------|------|
| P(American or Yes) | 0.63 |
| P(American or No)  | 0.87 |
| P(National or Yes) | 0.63 |
| P(National or No)  | 0.87 |

This contingency table shows the probabilities of any one team making the playoffs for each league.



**Probabilities  
Calculations**

9

| Sample Space |          | Home Runs |       | Totals |
|--------------|----------|-----------|-------|--------|
|              |          | >150      | <=150 |        |
| League       | American | 8         | 7     | 15     |
|              | National | 7         | 8     | 15     |
|              | Totals   | 15        | 15    | 30     |

| Simple Probabilities |      |
|----------------------|------|
| P(American)          | 0.50 |
| P(National)          | 0.50 |
| P(>150)              | 0.50 |
| P(<151)              | 0.50 |

| Joint Probabilities  |      |
|----------------------|------|
| P(American and >150) | 0.27 |
| P(American and <151) | 0.23 |
| P(National and >150) | 0.23 |
| P(National and <151) | 0.27 |

| Addition Rule       |      |
|---------------------|------|
| P(American or >150) | 0.73 |
| P(American or <151) | 0.77 |
| P(National or >150) | 0.77 |
| P(National or <151) | 0.73 |

This contingency table demonstrates the probabilities of a team from the American League hitting more than 150 home runs versus the probability of a team from the National League hitting more than 150 home runs.

**Probabilities  
Calculations**

| Sample Space   |        | Batting Average |         | Totals |
|----------------|--------|-----------------|---------|--------|
|                |        | >.257           | <= .257 |        |
| Play-off Berth | Yes    | 6               | 2       | 8      |
|                | No     | 9               | 13      | 22     |
|                | Totals | 15              | 15      | 30     |

| Simple Probabilities |      |
|----------------------|------|
| P(Yes)               | 0.27 |
| P(No)                | 0.73 |
| P(>.257)             | 0.50 |
| P(<= .257)           | 0.50 |

| Joint Probabilities |      |
|---------------------|------|
| P(Yes and >.257)    | 0.20 |
| P(Yes and <= .257)  | 0.07 |
| P(No and >.257)     | 0.30 |
| P(No and <= .257)   | 0.43 |

| Addition Rule     |      |
|-------------------|------|
| P(Yes or >.257)   | 0.57 |
| P(Yes or <= .257) | 0.70 |
| P(No or >.257)    | 0.93 |
| P(No or <= .257)  | 0.80 |

This table depicts the probability of a team reaching the playoffs if they hit over the 2010 league average of .257 as a team.

**Probabilities  
Calculations**

| Sample Space   |        | OPS     |             | Totals |
|----------------|--------|---------|-------------|--------|
|                |        | $>.727$ | $\leq .727$ |        |
| Play-off Berth | Yes    | 8       | 0           | 8      |
|                | No     | 10      | 20          | 30     |
|                | Totals | 18      | 20          | 38     |

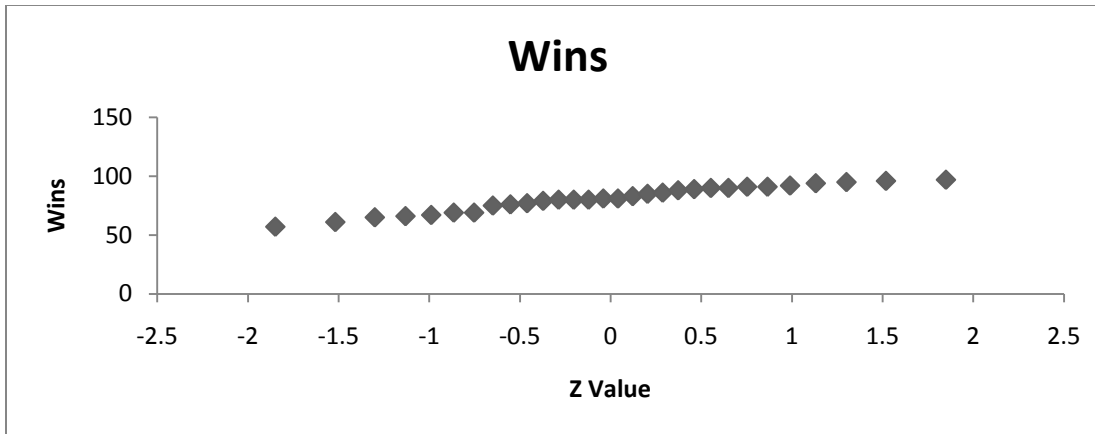
| Simple Probabilities |      |
|----------------------|------|
| P(Yes)               | 0.21 |
| P(No)                | 0.79 |
| P( $>.727$ )         | 0.47 |
| P( $\leq .727$ )     | 0.53 |

| Joint Probabilities     |      |
|-------------------------|------|
| P(Yes and $>.727$ )     | 0.21 |
| P(Yes and $\leq .727$ ) | 0.00 |
| P(No and $>.727$ )      | 0.26 |
| P(No and $\leq .727$ )  | 0.53 |

| Addition Rule          |      |
|------------------------|------|
| P(Yes or $>.727$ )     | 0.47 |
| P(Yes or $\leq .727$ ) | 0.74 |
| P(No or $>.727$ )      | 1.00 |
| P(No or $\leq .727$ )  | 0.79 |

This table exhibits the probability of making the playoffs if your team has an OPS greater than the league average from 2010 of .727.

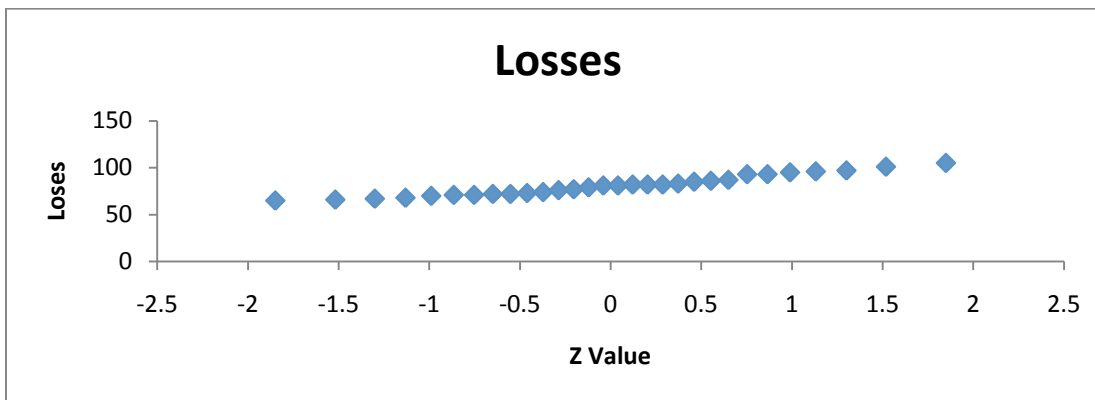
# Chapter 6 - Normal Probability Plots



Median = 81

Mean = 81

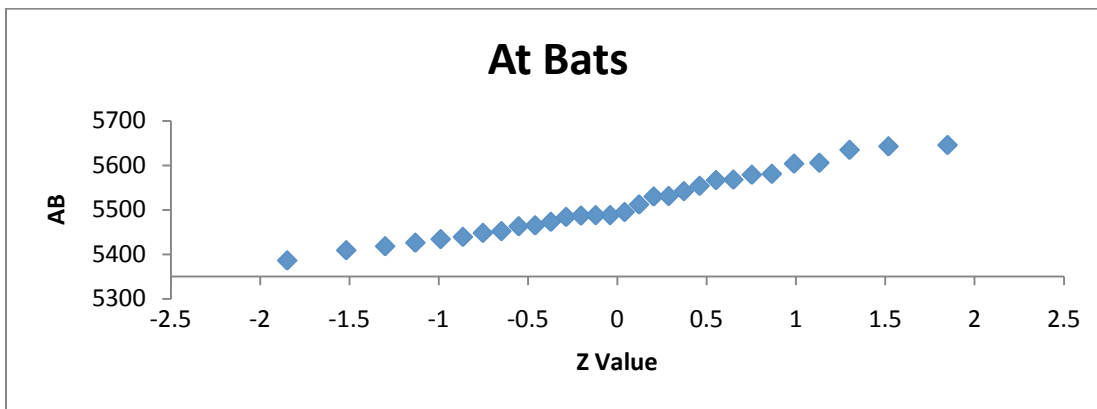
Wins is a normal variable due to its linear relationship between z value and win total along with the exact same mean and median with them both equaling 81.



Median = 81

Mean = 81

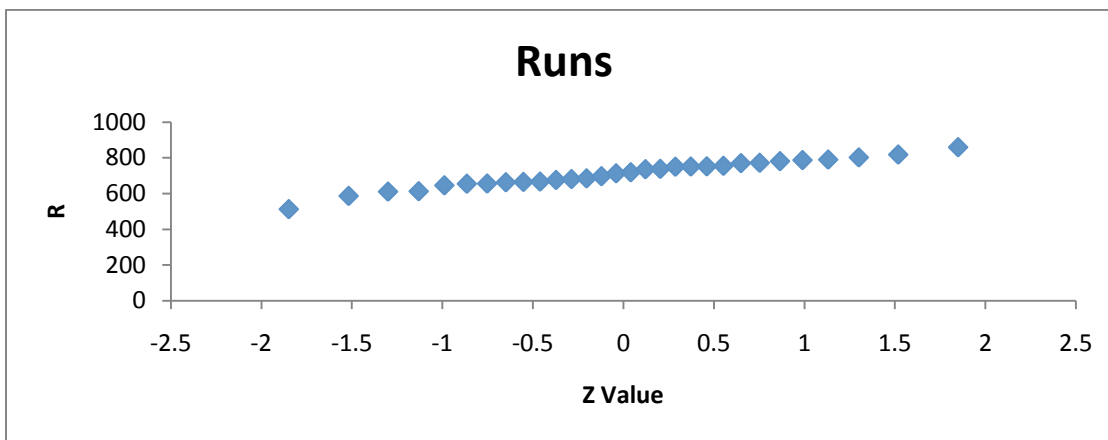
Losses are very similar to wins due to the similarity of the statistic and it too shares the same mean and median, once again 81.



Median = 5491.5

Mean = 5511.767

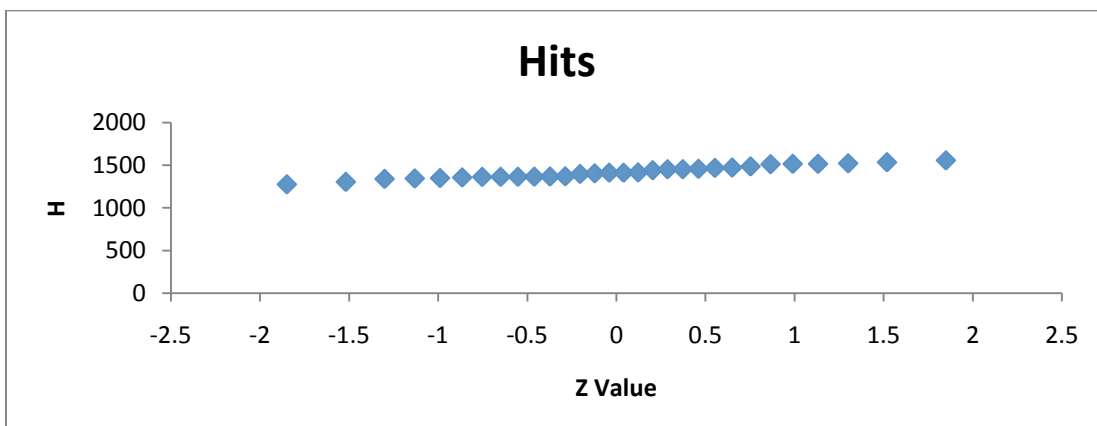
At bats has a bit more variation than the first two variables but it too holds a very strong positive linear relationship and holds a mean and median very similar to each other.



Median = 716

Mean = 710.2667

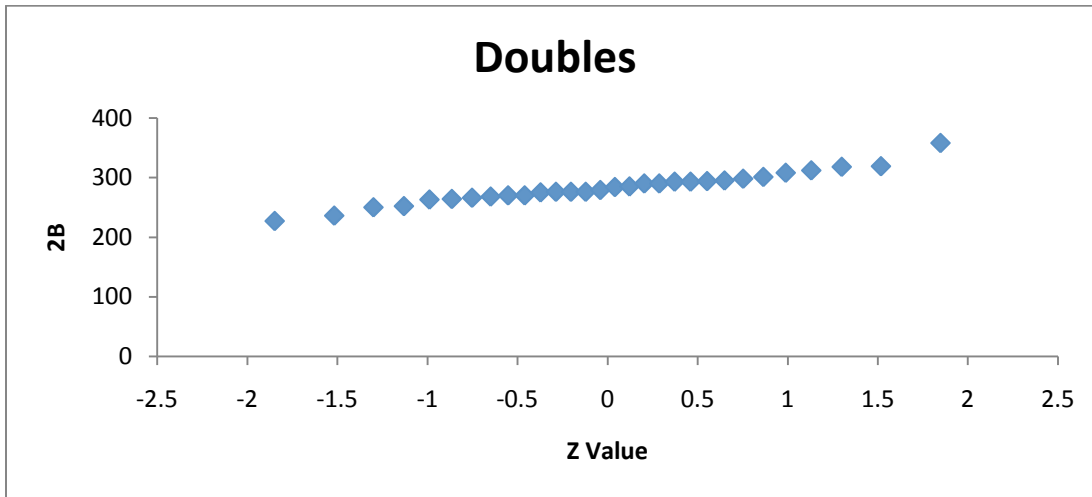
Runs do not have much variation between the teams as most teams are all near the middle of the data set and provides a normal data set with little variation in the mean and median.



Median = 1411

Mean = 1418.467

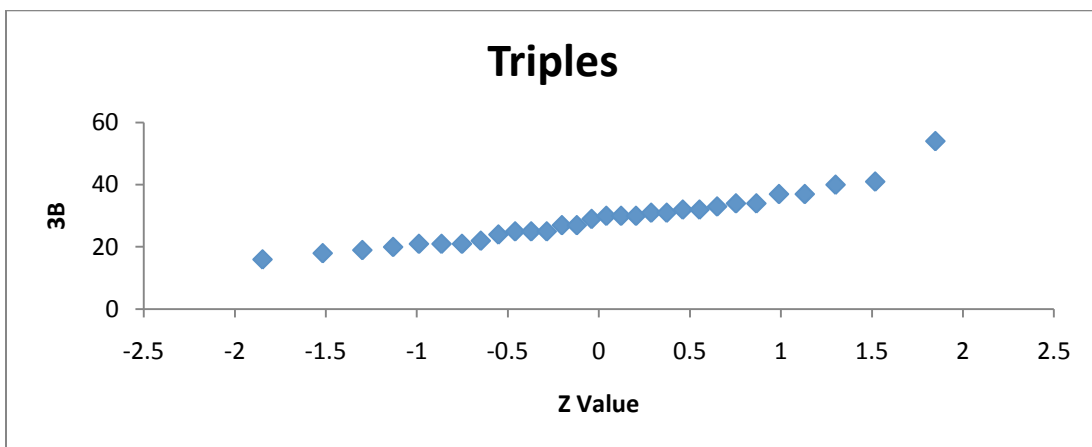
Hits data set is similar to that of runs with a near horizontal relationship and most of the teams bunched together in the middle.



Median = 281.5

Mean = 282.8667

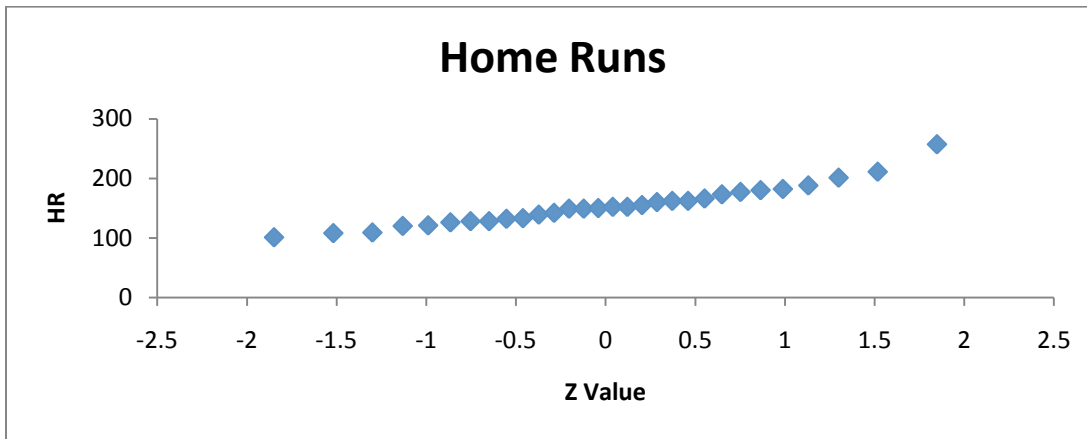
Doubles' mean and median are very close and demonstrate a tight data set with only 2 values straying from the rest of the group.



Median = 29.5

Mean = 28.86667

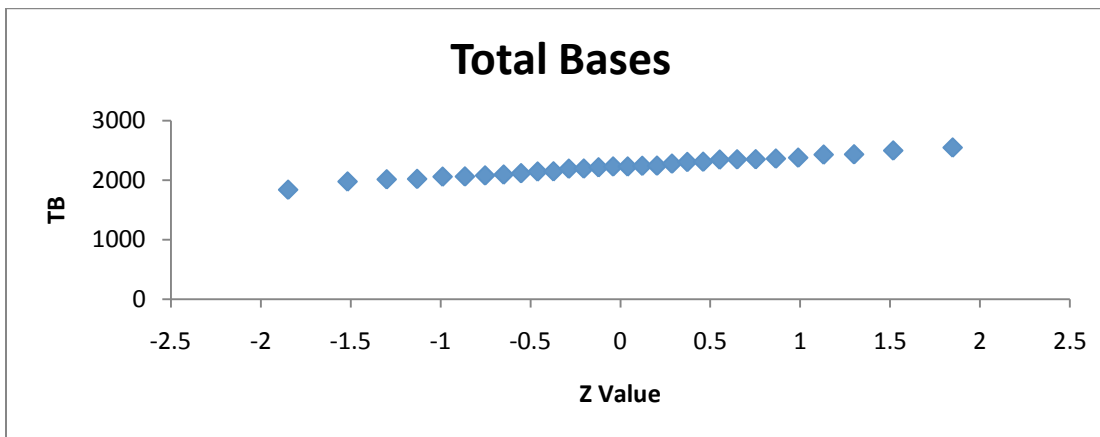
Triples show the most irregular data set to this point due to the possible outlier of the Colorado Rockies having 54 triples during the course of their 2010 season. Many factors could have contributed to this large number whether it be their stadium, the light air playing thousands of feet above sea level or other on field reasons.



Median = 153.7667

Mean = 151

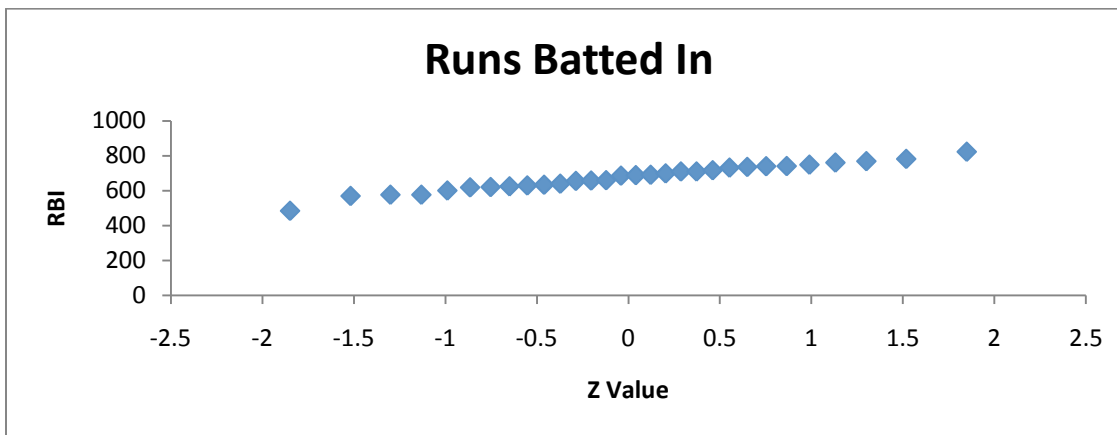
Home Runs, like triples, remain a normal variable with one clear possible outlier, the Toronto Blue Jays 257 outburst fueled by the breakthrough of Jose Bautista as a legitimate power hitter.



Median = 2220.367

Mean = 2227

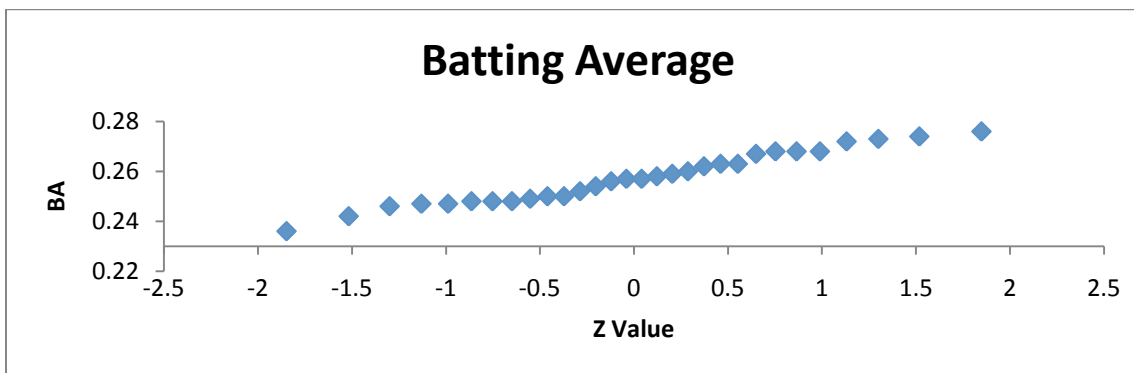
Total bases is a normal variable with no substantial rarities in the data set and a small difference between mean and median.



Median = 676.2667

Mean = 687.5

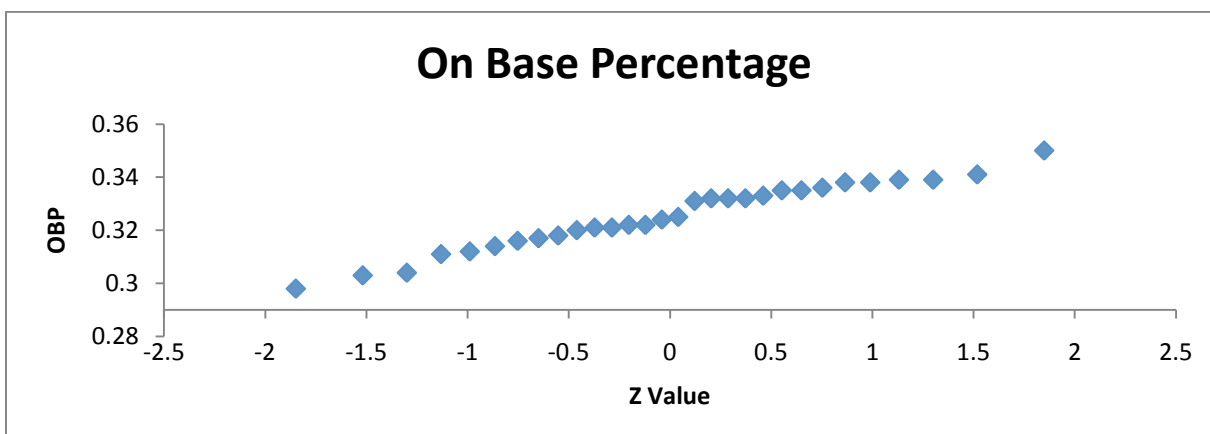
RBI is the first variable we see to have a large gap between median and mode with over a 10 point spread between the two. The graph shows a couple of possible outliers at both ends that could be the main reason for the large differential in mean and median.



Median = .257

Mean = .257267

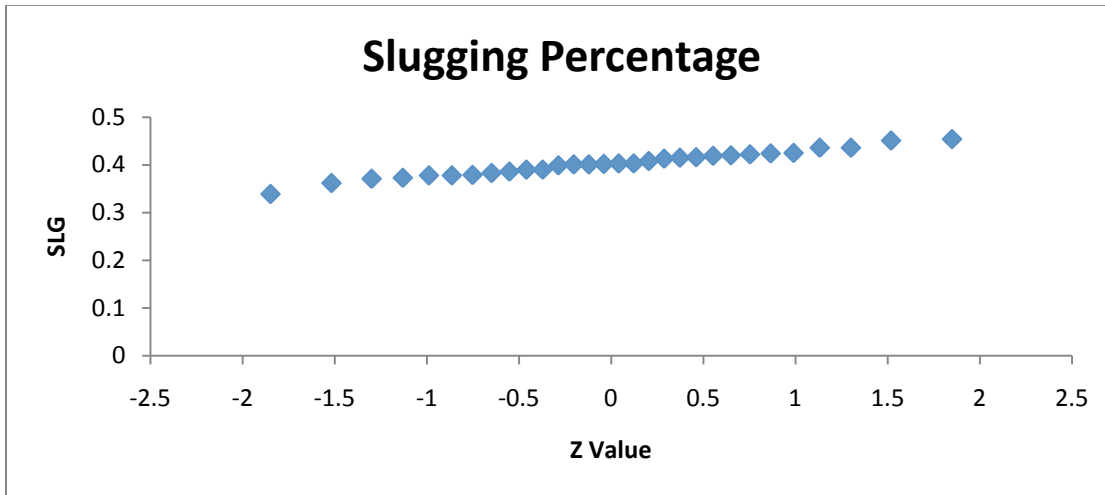
Batting Average has the most interesting graph to this point with a steep slope and a positive linear relationship without a tight cluster containing most of the values in the middle. Conversely most of the values in this variable are spread out.



Median = .3245

Mean = .3253

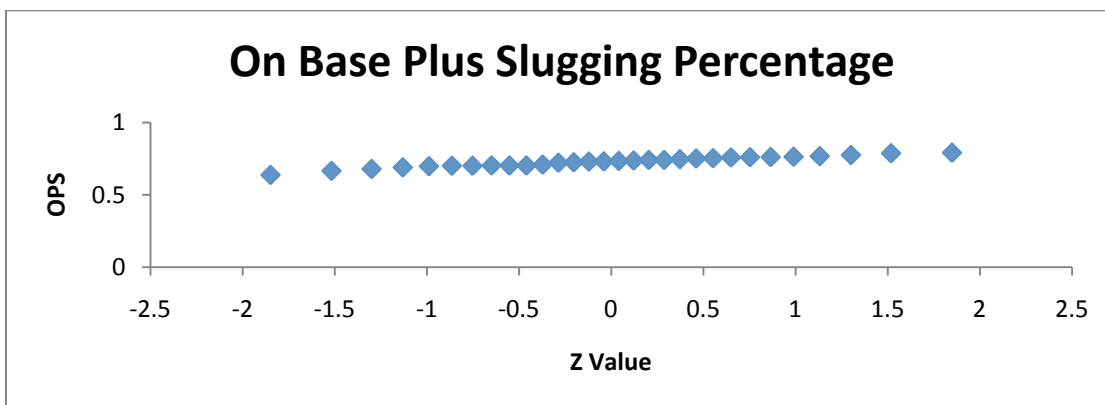
On Base Percentage shows a graph very similar to that of batting average as expected due to the similarity between the two statistics. There is a small differentiation between the median and mode along with a few possible outliers.



Median = .4025

Mean = .402567

Slugging percentage depicts a normal variable with a near identical mean and median and little of interest in the graph.



Median = .7315

Mean = .7278

OPS seems to be a mostly normal variable with most of the data clustered tight in the middle with the values on the ends spreading away from the pack causing the difference in median and mean.



# Chapter 7 - Sampling and Surveys

In order to obtain the samples used to do this statistical analysis every single statistic had to be documented for every team throughout the entire season. Therefore, this data isn't necessarily a sample; it would likely be classified as a population since it takes into account each individual event. Due to this available resource there was no need to take a sample to obtain this data set. However had this information not been available the sampling method that would have worked the best for this data would have been stratified sampling for each individual variable. Stratified sampling would allow the data collector to group players by team before randomly selecting  $x$  amount of players from each team and then recording their offensive statistics. Your sample size would have to be approximately 150 players allowing for 5 players from each team to be selected.

There is very little error in the data set used in this analysis due to the fact that there was no sampling involved. The only possible error is human error when recording the data or human error copying the data from source to source. However, had a stratified sample been used as suggested had this information not been available, there could have been 2 sources of error. Selection bias could have occurred by randomly selecting samples that do not accurately represent the population. Random sampling error could have occurred due to random variation in the results because of the players in the sample being selected at random. In either situation it is hard to imagine any non-sampling errors would occur due to the fact that we are dealing with actual events rather than human recollection of events.

# Chapter 8 - Confidence Intervals

## 90% CI for Batting Average

| Data                      |             |
|---------------------------|-------------|
| Sample Standard Deviation | 0.010388765 |
| Sample Mean               | 0.257266667 |
| Sample Size               | 30          |
| Confidence Level          | 90%         |

| Intermediate Calculations  |             |
|----------------------------|-------------|
| Standard Error of the Mean | 0.00189672  |
| Degrees of Freedom         | 29          |
| t Value                    | 1.699126996 |
| Interval Half Width        | 0.003222769 |

| Confidence Interval  |      |
|----------------------|------|
| Interval Lower Limit | 0.25 |
| Interval Upper Limit | 0.26 |

## 95% CI of Runs Scored

| Data                      |             |
|---------------------------|-------------|
| Sample Standard Deviation | 76.07162384 |
| Sample Mean               | 710.2666667 |
| Sample Size               | 30          |
| Confidence Level          | 95%         |

| Intermediate Calculations  |             |
|----------------------------|-------------|
| Standard Error of the Mean | 13.88871479 |
| Degrees of Freedom         | 29          |
| t Value                    | 2.045229611 |
| Interval Half Width        | 28.40561075 |

| Confidence Interval  |        |
|----------------------|--------|
| Interval Lower Limit | 681.86 |
| Interval Upper Limit | 738.67 |

## 99% CI for Total Home Runs

| Data                      |             |
|---------------------------|-------------|
| Sample Standard Deviation | 33.51755416 |
| Sample Mean               | 153.7666667 |
| Sample Size               | 30          |
| Confidence Level          | 99%         |

| Intermediate Calculations  |             |
|----------------------------|-------------|
| Standard Error of the Mean | 6.119440162 |
| Degrees of Freedom         | 29          |
| t Value                    | 2.756385902 |
| Interval Half Width        | 16.86753859 |

| Confidence Interval  |        |
|----------------------|--------|
| Interval Lower Limit | 136.90 |
| Interval Upper Limit | 170.63 |

Summary: As the numbers depict we can be 90% confident that in any given season most teams will have batting averages between .250 and .260 for the season, we can be 95% confident most teams will score between 681 and 739 runs, and we can be 99% confident most teams will hit between 136 and 171 home runs.

# Chapter 9 - Hypothesis Testing

**T-Test for Runs Scored**

| Data                      |             |
|---------------------------|-------------|
| Null Hypothesis $\mu=$    | 700         |
| Level of Significance     | 0.05        |
| Sample Size               | 30          |
| Sample Mean               | 710.2666667 |
| Sample Standard Deviation | 76.07162384 |

| Intermediate Calculations  |                    |
|----------------------------|--------------------|
| Standard Error of the Mean | 13.88871479        |
| Degrees of Freedom         | 29                 |
| <b>t Test Statistic</b>    | <b>0.739209266</b> |

| Two-Tail Test                     |             |
|-----------------------------------|-------------|
|                                   | -           |
| Lower Critical Value              | 2.045229611 |
| Upper Critical Value              | 2.045229611 |
| p-Value                           | 0.465721604 |
| Do not reject the null hypothesis |             |

**T-Test for Team Runs Batted In**

| Data                      |             |
|---------------------------|-------------|
| Null Hypothesis $\mu=$    | 625         |
| Level of Significance     | 0.05        |
| Sample Size               | 30          |
| Sample Mean               | 676.2666667 |
| Sample Standard Deviation | 74.76258207 |

| Intermediate Calculations  |                    |
|----------------------------|--------------------|
| Standard Error of the Mean | 13.64971755        |
| Degrees of Freedom         | 29                 |
| <b>t Test Statistic</b>    | <b>3.755877473</b> |

| Two-Tail Test              |             |
|----------------------------|-------------|
|                            | -           |
| Lower Critical Value       | 2.045229611 |
| Upper Critical Value       | 2.045229611 |
| p-Value                    | 0.000772939 |
| Reject the null hypothesis |             |

**T-Test for Team Hits**

| Data                      |             |
|---------------------------|-------------|
| Null Hypothesis $\mu=$    | 1400        |
| Level of Significance     | 0.01        |
| Sample Size               | 30          |
| Sample Mean               | 1418.466667 |
| Sample Standard Deviation | 73.73051272 |

| Intermediate Calculations  |                    |
|----------------------------|--------------------|
| Standard Error of the Mean | 13.46128833        |
| Degrees of Freedom         | 29                 |
| <b>t Test Statistic</b>    | <b>1.371835014</b> |

| Two-Tail Test                     |             |
|-----------------------------------|-------------|
|                                   | -           |
| Lower Critical Value              | 2.756385902 |
| Upper Critical Value              | 2.756385902 |
| p-Value                           | 0.180635224 |
| Do not reject the null hypothesis |             |

**T-Test for Team On Base Plus Slugging Percentage**

| Data                      |             |
|---------------------------|-------------|
| Null Hypothesis $\mu=$    | 0.7         |
| Level of Significance     | 0.01        |
| Sample Size               | 30          |
| Sample Mean               | 0.7278      |
| Sample Standard Deviation | 0.036090308 |

| Intermediate Calculations  |                    |
|----------------------------|--------------------|
| Standard Error of the Mean | 0.006589159        |
| Degrees of Freedom         | 29                 |
| <b>t Test Statistic</b>    | <b>4.219051558</b> |

| Two-Tail Test              |             |
|----------------------------|-------------|
|                            | -           |
| Lower Critical Value       | 2.756385902 |
| Upper Critical Value       | 2.756385902 |
| p-Value                    | 0.000220055 |
| Reject the null hypothesis |             |

**Runs Vs. Wins**

(assumes equal population variances)

| Data                      |          |
|---------------------------|----------|
| Hypothesized Difference   | 525      |
| Level of Significance     | 0.01     |
| Population 1 Sample       |          |
| Sample Size               | 30       |
| Sample Mean               | 688.3226 |
| Sample Standard Deviation | 143.2544 |
| Population 2 Sample       |          |
| Sample Size               | 30       |
| Sample Mean               | 81       |
| Sample Standard Deviation | 11.0047  |

| Intermediate Calculations              |                 |
|--|-----------------|
| Population 1 Sample Degrees of Freedom | 29              |
| Population 2 Sample Degrees of Freedom | 29              |
| Total Degrees of Freedom               | 58              |
| Pooled Variance                        | 10321.46        |
| Difference in Sample Means             | 607.3226        |
| <b>t Test Statistic</b>                | <b>3.138297</b> |

| Two-Tail Test              |          |
|----------------------------|----------|
| Lower Critical Value       | -2.66329 |
| Upper Critical Value       | 2.663287 |
| p-Value                    | 0.002671 |
| Reject the null hypothesis |          |

| RBI vs. HR                           |          |
|--------------------------------------|----------|
| (assumes equal population variances) |          |
| Data                                 |          |
| Hypothesized Difference              | 500      |
| Level of Significance                | 0.05     |
| Population 1 Sample                  |          |
| Sample Size                          | 30       |
| Sample Mean                          | 676.2667 |
| Sample Standard Deviation            | 74.76258 |
| Population 2 Sample                  |          |
| Sample Size                          | 30       |
| Sample Mean                          | 149.7742 |
| Sample Standard Deviation            | 39.75065 |

| Intermediate Calculations              |                |
|--|----------------|
| Population 1 Sample Degrees of Freedom | 29             |
| Population 2 Sample Degrees of Freedom | 29             |
| Total Degrees of Freedom               | 58             |
| Pooled Variance                        | 3584.779       |
| Difference in Sample Means             | 526.4925       |
| <b>t Test Statistic</b>                | <b>1.71371</b> |

| Two-Tail Test                     |          |
|-----------------------------------|----------|
| Lower Critical Value              | -2.00172 |
| Upper Critical Value              | 2.001717 |
| p-Value                           | 0.091922 |
| Do not reject the null hypothesis |          |

T-Test for Runs Scored – Accept the null hypothesis because of the high p-value and we can assume that the average Major League team will score 700 runs in a season.

T-Test for Team hits – Accept the null hypothesis because of the high p-value and we can assume that the average Major League team will have 1400 hits in a season.

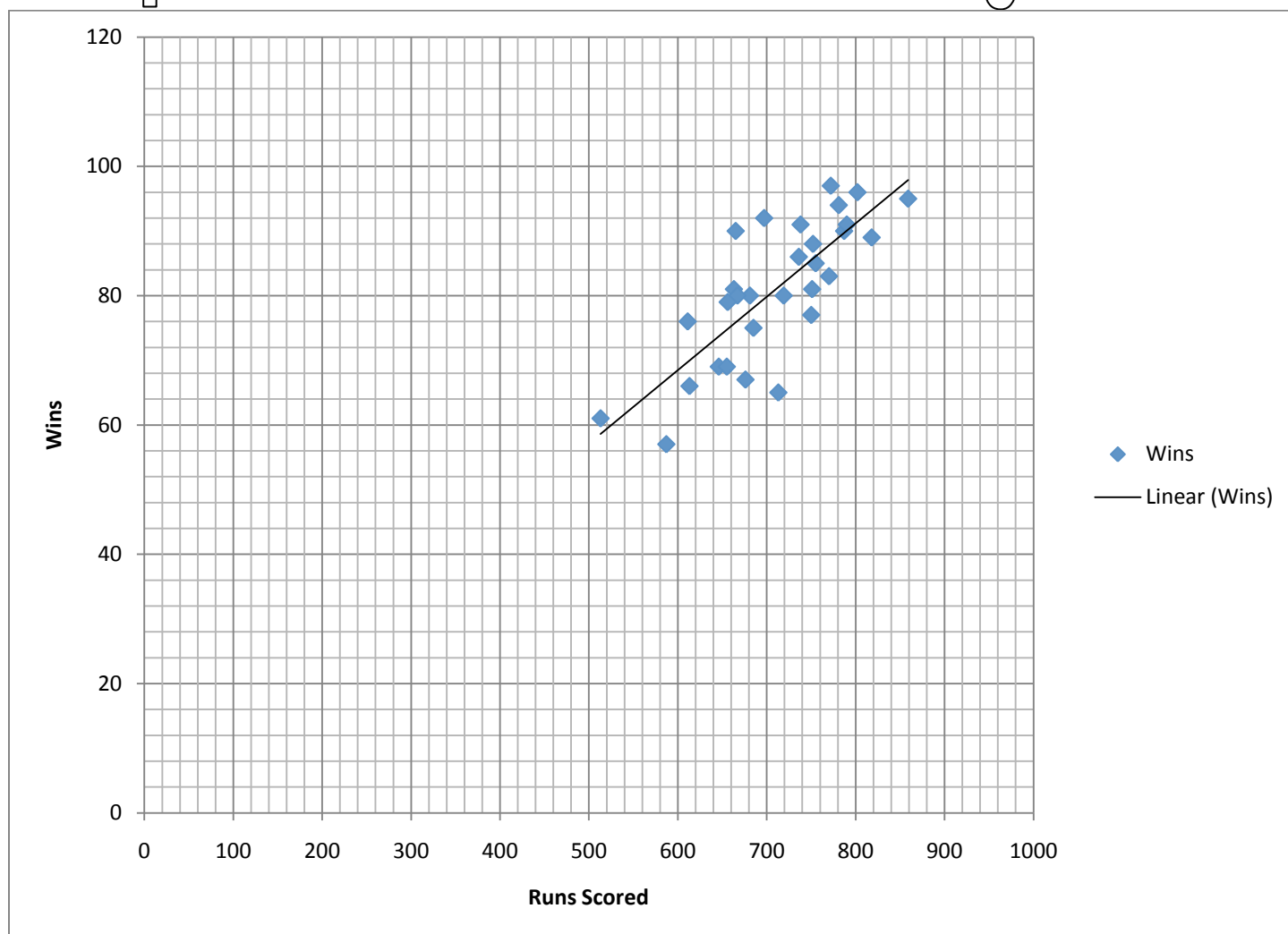
T-Test for Team RBIs – Reject the null hypothesis because of the very low p-value and we can state that there is significant statistical evidence to prove that the average Major League team will drive in more than 625 runs in a season.

T-Test for Team OPS – Reject the null hypothesis because of the very low p-value and we believe there is significant statistical evidence to prove that the average Major League team will have an OPS above .700.

Pooled Variance T-Test for Runs and Wins – Reject the null hypothesis because of the very low p-value due to significant statistical evidence that proves that the average team will have a greater difference in runs and wins than 525

Pooled Variance T-Test for RBIs and HRs – Accept the null because of the high p-value and we can assume that our hypothesized difference between RBIs and HRs of 500 in a season is accurate.

# Chapter 12 & 13 - Linear Regression



Regression Equation –  $Y = .362 + .114x$

Coefficients

$Y$  = Wins

$X$  = Runs

$B_0$  = y-intercept

$B_1$  = correlation

Predictions

1. If a team scores 800 runs in a season they will win 91.5 games.  $[91.5 = .362 + .114(800)]$
2. If a team scores 600 runs in a season they will win 68.8 games.  $[68.8 = .362 + .114(600)]$
3. If a team scores 700 runs in a season they will win 79.8 games.  $[79.8 = .362 + .114(700)]$