# Bellevue College GPA Predictors


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# Introduction

The grade point average (GPA) is used in most educational systems to measure the overall performance of a student. Many colleges and universities use prospective students GPA score, in addition to other metrics, such as the SAT and ACT scores, to predict future performance of students. Students who excel in school have more options available to them when choosing a school to attend. Many aspects of a student's life affect their performance in school, also many of these aspects are difficult to quantify.

This study seeks to find a relationship between common characteristics of students and their GPAs. According to the Bellevue College Student Program, students are encouraged to make their school work a high priority, do homework daily, sit close to the front of class and take notes during lectures. In the course of this study, we will attempt to prove the effectiveness of some of these encouraged practices.

Senghuot, who came up with the idea for this study, is also a full-time college student and a tutor. Seeing as this study affects each and every one of us at Bellevue College, we want to see if there are any correlations between a number of aspects of a student's life and their GPA. For this study, we are taking a closer look at our home school of Bellevue College.

# Data Collection

The data was collected at Bellevue College during the winter quarter of 2012 by Senghuot and Brendan, at multiple on-campus locations. Locations such as the lunch room, the library and various department buildings were selected randomly. The data was collected typically in the afternoon, from Monday through Friday.

The data was collected by polling, using a standard set of questions for each recipient. Ninety-six students were randomly approached and asked the same questions. We were interested in looking at as many independent variables as we could, and gathering as much data as possible, so as to reduce the impact of having to remove extreme samples from the dataset. Furthermore, to remove bias we excluded polling large groups of students sitting or walking together, and focused mainly on individual students who would agree to talk with us. We only polled students who had already taken a minimum of 45 credits or more already at Bellevue College, which excluded very new students from this study.

# Analysis

## *Dataset Variables*

| **Data Collected From Polling** |
|---|
| Sex |
| Age |
| Hours Studied For Classes/Week |
| Credits Taken/Quarter |
| Row Of Desk In Relation To The Front Of Classroom |
| Ethnicity; Collected As White, Asian, and Other |
| Weekly Income |
| Current GPA |

## *Descriptive Analysis of Continuous Variables*

| | *Age* | *Hrs study / week / credit* | *Weekly Income* | *Overall GPA* |
|---|---|---|---|---|
| Mean | 21.23958333 | 0.68826487 | 102.9479167 | 3.4253125 |
| Stand. Error | 0.572150604 | 0.069724283 | 12.82680145 | 0.041117598 |
| Median | 20 | 0.5 | 67.5 | 3.5 |
| Mode | 19 | 0.333333333 | 0 | 3.5 |
| Stand. Dev. | 5.605908146 | 0.683155662 | 125.6764744 | 0.402868538 |
| Sam. Var. | 31.42620614 | 0.466701659 | 15794.57621 | 0.162303059 |
| Kurtosis | 27.37128579 | 6.956806852 | 2.037485041 | 1.308341182 |
| Skewness | 4.65750729 | 2.385070597 | 1.359274251 | -0.99737964 |
| Range | 44 | 3.928571429 | 600 | 2 |
| Minimum | 16 | 0.071428571 | 0 | 2 |
| Maximum | 60 | 4 | 600 | 4 |
| Sum | 2039 | 66.07342751 | 9883 | 328.83 |
| Count | 96 | 96 | 96 | 96 |
| Largest(6) | 26 | 2.083333333 | 300 | 3.9 |
| Smallest(6) | 18 | 0.125 | 0 | 2.9 |

# Correlation Between GPA and Independent Variables.

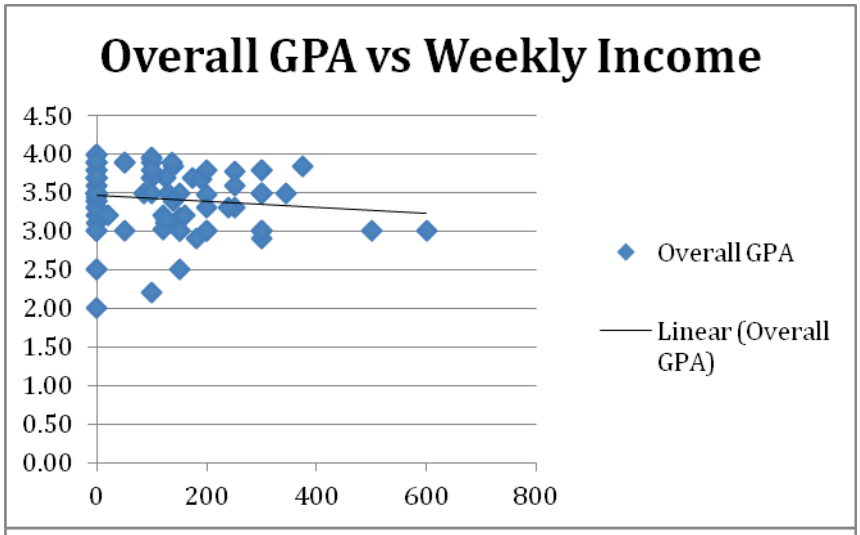
We were disappointed with the results of the correlation coefficients we calculated for our data set. Most of our variables had low scores, which meant low or no relationship to the overall GPA. Despite the low value, the values still told us what effect each independent variable had on the GPA, however tiny.

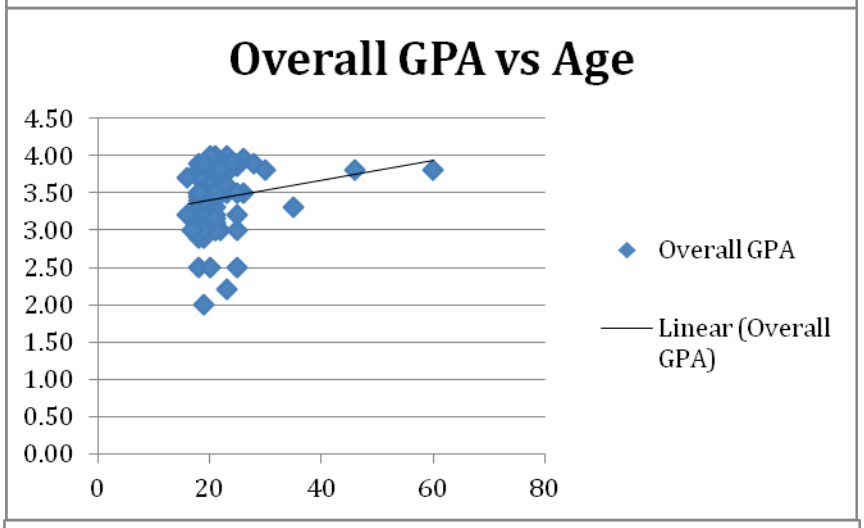
| Field | Overall GPA |
|---|---|
| Age | 0.034442 |
| Sex | 0.009194 |
| White[1] | 0.005877 |
| Asian[1] | 0.112549 |
| Hours studied/week/credit[2] | 0.000305 |
| Row | 0.035163 |
| Weekly Income | 0.015398 |

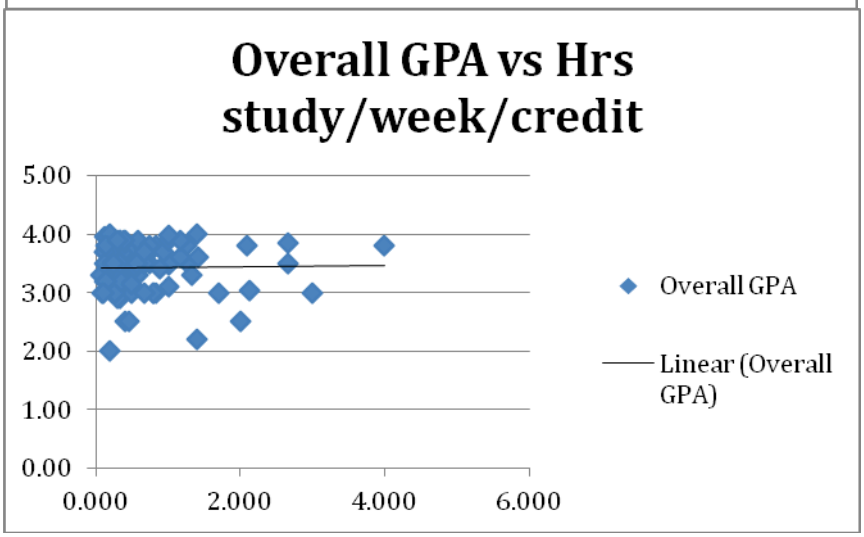
[1] Since the ethnicities gathered from polling fell into 3 basic groups, they were simplified into White, Asian and Other.

[2] Hours studied/week/credit is the combination of two independent variables: Hours studied for classes a week divided by the number of credits taken during the current quarter.

## Scatter Plots Of GPA vs. Independent Variables



# Modeling

We are using multiple regressions to analyze our data. We believe that the overall GPA is influenced by the following variables: age, sex, race, hours-spent-studying weekly-per-credit, row-sat-in, and weekly-income. After running the first analysis, we haven't discovered any extreme values in the data set. However, the P-value of some of the independent variables is very large, which indicates that they are unlikely to tell us anything statistically significant, and will need to be removed when the final model is run.

## *First Model*

| *Regression Statistics* | |
|---|---|
| Multiple R | 0.488909 |
| R Square | 0.239032 |
| Adjusted R Square | 0.178501 |
| Standard Error | 0.365146 |
| Observations | 96 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 7 | 3.685592 | 0.526513 | 3.948893 | 0.000857 |
| Residual | 88 | 11.7332 | 0.133332 | | |
| Total | 95 | 15.41879 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 2.801738 | 0.192398 | 14.56222 | 3.65E-25 | 2.419388 | 3.184088 | 2.419388 | 3.184088 |
| Age | 0.014996 | 0.007271 | 2.062496 | 0.042109 | 0.000547 | 0.029446 | 0.000547 | 0.029446 |
| Sex | -0.03333 | 0.08013 | -0.41597 | 0.678447 | -0.19257 | 0.125911 | -0.19257 | 0.125911 |
| White | 0.23995 | 0.109065 | 2.200075 | 0.030421 | 0.023207 | 0.456693 | 0.023207 | 0.456693 |
| Asian | 0.449945 | 0.11016 | 4.084488 | 9.71E-05 | 0.231026 | 0.668864 | 0.231026 | 0.668864 |
| Hrs study / week / credit | 0.077386 | 0.068586 | 1.128309 | 0.262256 | -0.05891 | 0.213687 | -0.05891 | 0.213687 |
| Row | 0.126867 | 0.080306 | 1.579806 | 0.117739 | -0.03272 | 0.286458 | -0.03272 | 0.286458 |
| Weekly Income | -0.0003 | 0.000321 | -0.93755 | 0.351041 | -0.00094 | 0.000337 | -0.00094 | 0.000337 |

In the First Model, the P-value of Sex, Hours Study/Week/Credit, Row, and Weekly Income are too large, and their t-statistics are under the critical value. These two things tell us that these values don't give us enough evidence to support the alternate hypothesis, that they have any statistically significant impact on the overall GPA. We are left with three coefficients, which are based on two properties from our polling (age, and ethnicity), that will help us construct a mathematical model to guess any students overall GPA based on the given factors (age and ethnicity).

## *Final Model*

| *Regression Statistics* | |
|---|---|
| Multiple R | 0.438309 |
| R Square | 0.192115 |
| Adjusted R Square | 0.165771 |
| Standard Error | 0.367965 |
| Observations | 96 |

ANOVA

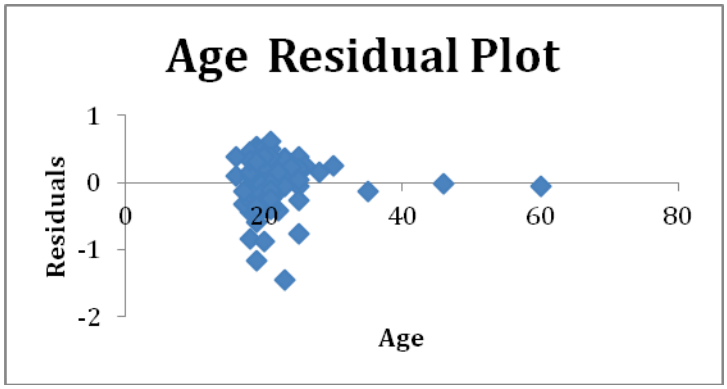
| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 3 | 2.962178 | 0.987393 | 7.292521 | 0.000193 |
| Residual | 92 | 12.45661 | 0.135398 | | |
| Total | 95 | 15.41879 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 2.839513 | 0.174355 | 16.28584 | 7.6E-29 | 2.49323 | 3.185796 | 2.49323 | 3.185796 |
| Age | 0.01689 | 0.006833 | 2.471868 | 0.01528 | 0.003319 | 0.030461 | 0.003319 | 0.030461 |
| White | 0.202701 | 0.096728 | 2.095572 | 0.038867 | 0.01059 | 0.394811 | 0.01059 | 0.394811 |
| Asian | 0.428514 | 0.102252 | 4.190773 | 6.38E-05 | 0.225433 | 0.631595 | 0.225433 | 0.631595 |

# Discussion

To our surprise in the first model, there aren't any observed values with corresponding standard residuals greater than 3.0 or less than -3.0. In our first model, we removed the independent variables with a p-value greater than five percent. When we reanalyzed the modified data set, three independent variables showed statistically significant p-values: Age, Asian, and White.

Sex, Row, White, and Asian residual plots are not shown as they were binary in nature. For example, in the row column of our data, if a student sits in the first row, they get a 1, if they sat in the 2nd, 3rd, or 4th row, they were given a 0. This was done to smooth the data, as there was not enough raw data for this variable to be useful otherwise.




The age residual graph shows what many already know to be true about Bellevue College, there are a lot of young people in their 20s attending. It also shows a wide variance in the levels of achievement of younger people. The residual graph also shows a handful of outliers that seem to show their age not being a major factor affecting their GPA, as represented by them being very close to the 0 on the y-access.

The coefficient of the row the student sits in the class has a slight positive value, although it is statistically insignificant due to its large P-value. The insignificance of the row might be due to the fact that Bellevue College typically only has a few front row desks. Each classroom typically only consists of a handful of rows; therefore we assume that most students are getting similar attention from the instructor. We postulate that our polling method would have had different results at a large university that has huge lecture classes, with much longer rows, and much deeper sets of rows.

For the ethnicity factor, the coefficient value is split into two separate variables, White and Asian. Both variables are positive, with the Asian coefficient being nearly double in both the first and final models. This seems to suggest that being Asian or White means you have a slight boost to your GPA.

# Formula Derived

Based on our study, we have derived the following formula, with which we can, with some loosely based accuracy, predict the GPA of Bellevue College students by only having their age and ethnicity.

$$\mathbf{Y = 2.84 + .017\,X_1 + .203X_2 + .429X_3}$$

- **$X_1$ = Age**
- **$X_2$ = White (Yes = 1, No = 0)**
- **$X_3$= Asian (Yes = 1, No = 0)**

The two characteristics, age and ethnicity can be turned into three varibles that when multiplied by the calculated coefficients, will give us a rough prediction on a student's GPA. With the formula, the Y-intercept is at 2.84, which is our practical "base GPA".

## *Inflation or Base GPA*

We aren't sure what to make of the "base GPA" aspect of the formula we have derived from our data analysis. Considering most students will be at least 17 years old when attending Bellevue College, we figure this starts the average student out with a base 3.129 GPA. Not too shabby a GPA for showing up! A couple purely speculative reasons for this are that the grading system is getting too easy, or all the students who select Bellevue College are simply very bright to begin with. We aren't sure how this reflects on Bellevue College as a whole, but being optimists, we would like to believe that Bellevue College simply has a self-selected set of students who are high achievers in academia, and that this study is simply reflecting that.

## *Testing Formula*

As it turns out, the equation does a relatively good job at predicting students GPA based on age and ethnicity. The equation worked fairly well when we tested it on ourselves, and when we tested it against the dataset itself. It could predict close within .01 of the correct GPA when the independent factors are given. We're confident that the equation can give a quick summary of majority of the students' performance in Bellevue College. This formula is to be used for recreational purposes only, not to be used as a substitute for real scores!

| Formula Testing Results | | | | |
|---|---|---|---|---|
| **Age** | **Asian** | **White** | **Actual GPA** | **Estimate GPA** |
| 24 | 1 | 0 | 3.69 | 3.68 |
| 22 | 1 | 0 | 3.68 | 3.64 |
| 17 | 0 | 1 | 3.42 | 3.32 |
| 19 | 0 | 0 | 3.22 | 3.16 |
| 18 | 0 | 1 | 3.19 | 3.48 |
| 21 | 0 | 0 | 3.02 | 3.19 |
| 25 | 0 | 0 | 3.29 | 3.27 |
| 26 | 0 | 1 | 3.03 | 3.48 |
| 25 | 1 | 0 | 3.72 | 3.69 |

## Outliers

During our study, we have had a couple outlier data points that when added into our models, made them skew the regression. To remedy this, we have removed few outlier data points from the data set when the final model regression was run.

## Conclusion

According to our analysis, we were very surprised that weekly study habits did not seem to have a statistically significant effect on student GPA. The only statistically significant characteristics we found in the end were age and ethnicity. The finding from this study surprised us, as we had a pretty strong idea that sitting closer to the front or studying more would have a positive impact on student GPA. There are many possible explanations why these two obvious scholastic staples did not have strong statistical impact in our study, but most of our thoughts on this would be pure speculation at this point.

Looking back on the initial data gathering, we could have possibly gathered other information that would have helped us narrow down some of our data to remove outliers from our data. Thinking about how we classified our data, it might have been useful if we had tracked what each student had declared as their major; or what area of study they were currently in. This information could have let us boil the study hours down a little more to get into why some people studied a lot for little GPA gain.

What we have gained from this study is the knowledge that there is something to being older and wiser, and that without knowing the deeper cause, genetics can be a boon or a bust to your educational career.

# Appendix

## *Dataset Of Bellevue College Students*

| Subject ID | Age | Sex | White | Asian | Hrs study / week / credit | Row | Weekly Income | Overall GPA |
|---|---|---|---|---|---|---|---|---|
| 1 | 18 | 0 | 0 | 1 | 0.500 | 1 | 100 | 3.70 |
| 2 | 23 | 1 | 1 | 0 | 0.625 | 1 | 300 | 3.50 |
| 3 | 19 | 0 | 1 | 0 | 0.313 | 1 | 0 | 3.50 |
| 4 | 19 | 1 | 0 | 0 | 0.750 | 0 | 130 | 3.50 |
| 5 | 19 | 0 | 1 | 0 | 0.500 | 1 | 150 | 3.50 |
| 6 | 19 | 0 | 0 | 0 | 0.467 | 1 | 175 | 3.70 |
| 7 | 25 | 0 | 1 | 0 | 2.667 | 0 | 375 | 3.85 |
| 8 | 18 | 0 | 1 | 0 | 0.400 | 0 | 0 | 2.50 |
| 9 | 22 | 1 | 1 | 0 | 0.333 | 0 | 600 | 3.00 |
| 10 | 22 | 1 | 0 | 1 | 1.000 | 0 | 0 | 3.50 |
| 11 | 22 | 1 | 0 | 0 | 1.000 | 0 | 200 | 3.48 |
| 12 | 22 | 1 | 1 | 0 | 0.750 | 0 | 125 | 3.70 |
| 13 | 20 | 1 | 1 | 0 | 0.077 | 0 | 150 | 3.00 |
| 14 | 46 | 0 | 1 | 0 | 1.250 | 1 | 300 | 3.80 |
| 15 | 20 | 0 | 1 | 0 | 0.500 | 0 | 0 | 3.40 |
| 16 | 19 | 1 | 1 | 0 | 0.400 | 0 | 140 | 3.85 |
| 17 | 19 | 1 | 0 | 1 | 0.300 | 0 | 150 | 3.18 |
| 18 | 21 | 1 | 0 | 0 | 1.000 | 0 | 0 | 3.10 |
| 19 | 18 | 1 | 1 | 0 | 0.200 | 1 | 0 | 3.20 |
| 20 | 20 | 1 | 0 | 0 | 1.267 | 1 | 0 | 3.50 |
| 21 | 19 | 0 | 1 | 0 | 0.294 | 0 | 250 | 3.30 |
| 22 | 22 | 0 | 1 | 0 | 0.500 | 0 | 300 | 3.50 |
| 23 | 18 | 1 | 1 | 0 | 0.333 | 0 | 300 | 2.90 |
| 24 | 18 | 1 | 1 | 0 | 0.133 | 0 | 0 | 3.70 |
| 25 | 20 | 1 | 1 | 0 | 0.333 | 0 | 100 | 3.90 |
| 26 | 21 | 1 | 0 | 0 | 0.333 | 1 | 0 | 3.00 |
| 27 | 19 | 1 | 1 | 0 | 0.208 | 0 | 0 | 3.50 |
| 28 | 18 | 0 | 1 | 0 | 0.300 | 0 | 240 | 3.30 |
| 29 | 18 | 1 | 0 | 0 | 0.533 | 0 | 300 | 3.50 |
| 30 | 18 | 0 | 1 | 0 | 0.833 | 0 | 0 | 3.80 |
| 31 | 19 | 1 | 1 | 0 | 0.333 | 1 | 0 | 3.50 |
| 32 | 26 | 0 | 0 | 0 | 2.667 | 1 | 0 | 3.50 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 33 | 19 | 0 | 0 | 1 | 0.125 | 0 | 0 | 3.70 |
| 34 | 18 | 1 | 0 | 1 | 0.200 | 0 | 0 | 3.70 |
| 35 | 19 | 0 | 0 | 1 | 0.167 | 1 | 0 | 3.50 |
| 36 | 19 | 0 | 1 | 0 | 0.133 | 1 | 0 | 3.50 |
| 37 | 20 | 0 | 1 | 0 | 0.938 | 1 | 0 | 3.70 |
| 38 | 23 | 0 | 1 | 0 | 0.533 | 1 | 0 | 3.80 |
| 39 | 21 | 1 | 1 | 0 | 0.400 | 0 | 0 | 3.90 |
| 40 | 20 | 1 | 1 | 0 | 0.467 | 0 | 150 | 2.50 |
| 41 | 23 | 1 | 0 | 1 | 0.667 | 1 | 250 | 3.77 |
| 42 | 17 | 0 | 1 | 0 | 0.833 | 0 | 50 | 3.00 |
| 43 | 20 | 0 | 1 | 0 | 0.367 | 1 | 125 | 3.10 |
| 44 | 22 | 0 | 1 | 0 | 0.667 | 0 | 250 | 3.60 |
| 45 | 16 | 1 | 0 | 0 | 0.125 | 0 | 0 | 3.20 |
| 46 | 26 | 1 | 0 | 1 | 0.125 | 0 | 100 | 3.96 |
| 47 | 21 | 1 | 0 | 1 | 0.125 | 0 | 100 | 3.70 |
| 48 | 21 | 1 | 0 | 1 | 0.156 | 0 | 100 | 3.94 |
| 49 | 19 | 0 | 0 | 1 | 0.667 | 1 | 190 | 3.68 |
| 50 | 19 | 1 | 0 | 0 | 0.200 | 1 | 0 | 2.00 |
| 51 | 20 | 0 | 0 | 0 | 1.700 | 0 | 300 | 3.00 |
| 52 | 18 | 1 | 0 | 1 | 0.118 | 0 | 0 | 3.30 |
| 53 | 21 | 1 | 0 | 1 | 0.588 | 0 | 0 | 3.30 |
| 54 | 18 | 0 | 0 | 1 | 0.200 | 0 | 0 | 3.40 |
| 55 | 19 | 0 | 1 | 0 | 0.294 | 1 | 180 | 2.90 |
| 56 | 20 | 1 | 0 | 1 | 0.071 | 1 | 200 | 3.30 |
| 57 | 25 | 0 | 0 | 0 | 2.000 | 0 | 0 | 2.50 |
| 58 | 21 | 1 | 0 | 0 | 4.000 | 0 | 100 | 3.80 |
| 59 | 23 | 1 | 0 | 1 | 1.400 | 0 | 100 | 2.20 |
| 60 | 60 | 0 | 0 | 0 | 2.083 | 0 | 200 | 3.80 |
| 61 | 21 | 1 | 1 | 0 | 0.500 | 0 | 300 | 3.00 |
| 62 | 20 | 0 | 0 | 0 | 0.882 | 0 | 0 | 3.40 |
| 63 | 20 | 0 | 0 | 1 | 1.176 | 0 | 0 | 3.60 |
| 64 | 23 | 1 | 0 | 1 | 0.200 | 1 | 0 | 4.00 |
| 65 | 25 | 1 | 0 | 0 | 0.400 | 0 | 20 | 3.20 |
| 66 | 23 | 0 | 0 | 1 | 1.412 | 0 | 0 | 3.60 |
| 67 | 21 | 1 | 0 | 1 | 1.400 | 0 | 0 | 4.00 |
| 68 | 19 | 1 | 0 | 0 | 0.800 | 1 | 0 | 3.00 |
| 69 | 19 | 1 | 0 | 1 | 0.267 | 0 | 200 | 3.00 |
| 70 | 21 | 0 | 0 | 0 | 0.357 | 0 | 160 | 3.20 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 71 | 19 | 0 | 1 | 0 | 0.133 | 1 | 120 | 3.20 |
| 72 | 19 | 1 | 0 | 0 | 2.133 | 0 | 120 | 3.03 |
| 73 | 19 | 0 | 0 | 0 | 0.667 | 1 | 85 | 3.50 |
| 74 | 19 | 0 | 0 | 1 | 1.000 | 0 | 138 | 3.90 |
| 75 | 28 | 1 | 0 | 1 | 0.583 | 0 | 0 | 3.90 |
| 76 | 25 | 0 | 0 | 1 | 1.176 | 1 | 0 | 3.90 |
| 77 | 19 | 0 | 0 | 1 | 0.333 | 0 | 100 | 3.50 |
| 78 | 35 | 1 | 0 | 0 | 1.333 | 0 | 0 | 3.30 |
| 79 | 18 | 1 | 1 | 0 | 0.125 | 1 | 345 | 3.50 |
| 80 | 20 | 1 | 0 | 1 | 1.000 | 1 | 0 | 3.99 |
| 81 | 24 | 1 | 0 | 1 | 0.333 | 1 | 50 | 3.90 |
| 82 | 22 | 1 | 0 | 1 | 0.133 | 1 | 0 | 3.80 |
| 83 | 19 | 0 | 1 | 0 | 0.533 | 0 | 140 | 3.40 |
| 84 | 30 | 0 | 1 | 0 | 0.750 | 1 | 300 | 3.80 |
| 85 | 21 | 1 | 0 | 1 | 0.233 | 1 | 0 | 3.50 |
| 86 | 19 | 0 | 1 | 0 | 0.800 | 0 | 150 | 3.00 |
| 87 | 21 | 1 | 1 | 0 | 0.500 | 0 | 125 | 3.15 |
| 88 | 19 | 1 | 1 | 0 | 0.100 | 0 | 0 | 3.00 |
| 89 | 18 | 0 | 1 | 0 | 0.533 | 1 | 0 | 3.45 |
| 90 | 18 | 0 | 1 | 0 | 0.563 | 1 | 0 | 3.50 |
| 91 | 18 | 0 | 0 | 1 | 0.389 | 1 | 0 | 3.90 |
| 92 | 25 | 1 | 1 | 0 | 0.250 | 1 | 0 | 3.50 |
| 93 | 25 | 0 | 0 | 0 | 3.000 | 0 | 500 | 3.00 |
| 94 | 17 | 1 | 0 | 0 | 0.667 | 0 | 200 | 3.00 |
| 95 | 16 | 0 | 1 | 0 | 0.667 | 1 | 0 | 3.70 |
| 96 | 19 | 0 | 0 | 1 | 0.294 | 1 | 50 | 3.90 |

# *First Model Residuals*

RESIDUAL OUTPUT

| *Observation* | *Predicted Overall GPA* | *Residuals* | *Standard Residuals* |
|---|---|---|---|
| 1 | 3.657078 | 0.042922 | 0.122134 |
| 2 | 3.438208 | 0.061792 | 0.175828 |
| 3 | 3.477668 | 0.022332 | 0.063546 |
| 4 | 3.072247 | 0.427753 | 1.217158 |
| 5 | 3.447029 | 0.052971 | 0.150727 |
| 6 | 3.196975 | 0.503025 | 1.431342 |
| 7 | 3.510087 | 0.339913 | 0.96721 |
| 8 | 3.342576 | -0.84258 | -2.39752 |
| 9 | 3.183476 | -0.18348 | -0.52208 |
| 10 | 3.625656 | -0.12566 | -0.35755 |
| 11 | 3.115513 | 0.364487 | 1.037136 |
| 12 | 3.358691 | 0.341309 | 0.971185 |
| 13 | 3.269086 | -0.26909 | -0.76568 |
| 14 | 3.86482 | -0.06482 | -0.18444 |
| 15 | 3.380307 | 0.019693 | 0.056036 |
| 16 | 3.282102 | 0.567898 | 1.615936 |
| 17 | 3.481348 | -0.30135 | -0.85748 |
| 18 | 3.160715 | -0.06071 | -0.17276 |
| 19 | 3.420634 | -0.22063 | -0.62781 |
| 20 | 3.293222 | 0.206778 | 0.588381 |
| 21 | 3.274131 | 0.025869 | 0.073611 |
| 22 | 3.320002 | 0.179998 | 0.512177 |
| 23 | 3.213788 | -0.31379 | -0.89287 |
| 24 | 3.288608 | 0.411392 | 1.170604 |
| 25 | 3.303978 | 0.596022 | 1.69596 |
| 26 | 3.235991 | -0.23599 | -0.6715 |
| 27 | 3.309408 | 0.190592 | 0.542324 |
| 28 | 3.262599 | 0.037401 | 0.106422 |
| 29 | 2.989315 | 0.510685 | 1.453137 |
| 30 | 3.37611 | 0.42389 | 1.206166 |
| 31 | 3.445948 | 0.054052 | 0.153802 |
| 32 | 3.524872 | -0.02487 | -0.07077 |
| 33 | 3.546286 | 0.153714 | 0.437389 |
| 34 | 3.503762 | 0.196238 | 0.558389 |
| 35 | 3.676377 | -0.17638 | -0.50188 |
| 36 | 3.463803 | 0.036197 | 0.102998 |
| 37 | 3.54103 | 0.15897 | 0.452343 |

| | | | |
|---|---|---|---|
| 38 | 3.554742 | 0.245258 | 0.697873 |
| 39 | 3.354233 | 0.545767 | 1.552963 |
| 40 | 3.299247 | -0.79925 | -2.27423 |
| 41 | 3.666477 | 0.103523 | 0.294572 |
| 42 | 3.346064 | -0.34606 | -0.98471 |
| 43 | 3.459232 | -0.35923 | -1.02218 |
| 44 | 3.34795 | 0.25205 | 0.717201 |
| 45 | 3.01802 | 0.18198 | 0.517818 |
| 46 | 3.587829 | 0.372171 | 1.059 |
| 47 | 3.512848 | 0.187152 | 0.532536 |
| 48 | 3.515266 | 0.424734 | 1.208567 |
| 49 | 3.657882 | 0.022118 | 0.062935 |
| 50 | 3.19568 | -1.19568 | -3.40227 |
| 51 | 3.142923 | -0.14292 | -0.40668 |
| 52 | 3.497389 | -0.19739 | -0.56166 |
| 53 | 3.578795 | -0.27879 | -0.7933 |
| 54 | 3.537093 | -0.13709 | -0.39009 |
| 55 | 3.422067 | -0.52207 | -1.48552 |
| 56 | 3.590474 | -0.29047 | -0.82653 |
| 57 | 3.331418 | -0.83142 | -2.36577 |
| 58 | 3.362775 | 0.437225 | 1.24411 |
| 59 | 3.641508 | -0.80151 | -2.10176 |
| 60 | 3.802538 | -0.00254 | -0.00722 |
| 61 | 3.271675 | -0.27167 | -0.77304 |
| 62 | 3.169946 | 0.230054 | 0.654612 |
| 63 | 3.642652 | -0.04265 | -0.12136 |
| 64 | 3.70561 | 0.29439 | 0.837676 |
| 65 | 3.168248 | 0.031752 | 0.090349 |
| 66 | 3.705849 | -0.10585 | -0.30119 |
| 67 | 3.641614 | 0.358386 | 1.019775 |
| 68 | 3.242112 | -0.24211 | -0.68892 |
| 69 | 3.463719 | -0.46372 | -1.3195 |
| 70 | 3.096139 | 0.103861 | 0.295532 |
| 71 | 3.427684 | -0.22768 | -0.64787 |
| 72 | 3.182308 | -0.15231 | -0.43339 |
| 73 | 3.239541 | 0.260459 | 0.741127 |
| 74 | 3.572462 | 0.327538 | 0.931998 |
| 75 | 3.683389 | 0.216611 | 0.616358 |
| 76 | 3.8445 | 0.0555 | 0.157923 |
| 77 | 3.532309 | -0.03231 | -0.09193 |
| 78 | 3.396458 | -0.09646 | -0.27447 |
| 79 | 3.310988 | 0.189012 | 0.537826 |
| 80 | 3.722531 | 0.267469 | 0.761075 |

| | | | |
|---|---|---|---|
| 81 | 3.715875 | 0.184125 | 0.523921 |
| 82 | 3.685455 | 0.114545 | 0.325934 |
| 83 | 3.325751 | 0.074249 | 0.211272 |
| 84 | 3.586186 | 0.213814 | 0.6084 |
| 85 | 3.678197 | -0.1782 | -0.50705 |
| 86 | 3.343378 | -0.34338 | -0.97707 |
| 87 | 3.324348 | -0.17435 | -0.4961 |
| 88 | 3.301024 | -0.30102 | -0.85655 |
| 89 | 3.479761 | -0.02976 | -0.08468 |
| 90 | 3.482018 | 0.017982 | 0.051167 |
| 91 | 3.678578 | 0.221422 | 0.630049 |
| 92 | 3.529477 | -0.02948 | -0.08388 |
| 93 | 3.258309 | -0.25831 | -0.73501 |
| 94 | 3.014736 | -0.01474 | -0.04193 |
| 95 | 3.460087 | 0.239913 | 0.682666 |
| 96 | 3.671191 | 0.228809 | 0.651069 |

## *Final Model Residuals*

RESIDUAL OUTPUT

| *Observation* | *Predicted Overall GPA* | *Residuals* | *Standard Residuals* |
|---|---|---|---|
| 1 | 3.572053 | 0.127947 | 0.353339 |
| 2 | 3.430691 | 0.069309 | 0.191404 |
| 3 | 3.36313 | 0.13687 | 0.377981 |
| 4 | 3.160429 | 0.339571 | 0.937761 |
| 5 | 3.36313 | 0.13687 | 0.377981 |
| 6 | 3.160429 | 0.539571 | 1.490082 |
| 7 | 3.464472 | 0.385528 | 1.064677 |
| 8 | 3.34624 | -0.84624 | -2.33698 |
| 9 | 3.413801 | -0.4138 | -1.14276 |
| 10 | 3.639615 | -0.13961 | -0.38556 |
| 11 | 3.2111 | 0.2689 | 0.742596 |
| 12 | 3.413801 | 0.286199 | 0.790369 |
| 13 | 3.38002 | -0.38002 | -1.04947 |
| 14 | 3.819169 | -0.01917 | -0.05294 |
| 15 | 3.38002 | 0.01998 | 0.055176 |
| 16 | 3.36313 | 0.48687 | 1.344544 |
| 17 | 3.588944 | -0.40894 | -1.12934 |
| 18 | 3.19421 | -0.09421 | -0.26017 |
| 19 | 3.34624 | -0.14624 | -0.40386 |

PROBABILITY OUTPUT

| *Percentile* | *Overall GPA* |
|---|---|
| 0.520833 | 2 |
| 1.5625 | 2.2 |
| 2.604167 | 2.5 |
| 3.645833 | 2.5 |
| 4.6875 | 2.5 |
| 5.729167 | 2.9 |
| 6.770833 | 2.9 |
| 7.8125 | 3 |
| 8.854167 | 3 |
| 9.895833 | 3 |
| 10.9375 | 3 |
| 11.97917 | 3 |
| 13.02083 | 3 |
| 14.0625 | 3 |
| 15.10417 | 3 |
| 16.14583 | 3 |
| 17.1875 | 3 |
| 18.22917 | 3 |
| 19.27083 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| 20 | 3.177319 | 0.322681 | 0.891117 | 20.3125 | 3.03 |
| 21 | 3.36313 | -0.06313 | -0.17434 | 21.35417 | 3.1 |
| 22 | 3.413801 | 0.086199 | 0.238048 | 22.39583 | 3.1 |
| 23 | 3.34624 | -0.44624 | -1.23234 | 23.4375 | 3.15 |
| 24 | 3.34624 | 0.35376 | 0.976947 | 24.47917 | 3.18 |
| 25 | 3.38002 | 0.51998 | 1.435979 | 25.52083 | 3.2 |
| 26 | 3.19421 | -0.19421 | -0.53633 | 26.5625 | 3.2 |
| 27 | 3.36313 | 0.13687 | 0.377981 | 27.60417 | 3.2 |
| 28 | 3.34624 | -0.04624 | -0.1277 | 28.64583 | 3.2 |
| 29 | 3.143539 | 0.356461 | 0.984405 | 29.6875 | 3.2 |
| 30 | 3.34624 | 0.45376 | 1.253108 | 30.72917 | 3.3 |
| 31 | 3.36313 | 0.13687 | 0.377981 | 31.77083 | 3.3 |
| 32 | 3.278661 | 0.221339 | 0.61125 | 32.8125 | 3.3 |
| 33 | 3.588944 | 0.111056 | 0.306694 | 33.85417 | 3.3 |
| 34 | 3.572053 | 0.127947 | 0.353339 | 34.89583 | 3.3 |
| 35 | 3.588944 | -0.08894 | -0.24563 | 35.9375 | 3.3 |
| 36 | 3.36313 | 0.13687 | 0.377981 | 36.97917 | 3.4 |
| 37 | 3.38002 | 0.31998 | 0.883658 | 38.02083 | 3.4 |
| 38 | 3.430691 | 0.369309 | 1.019886 | 39.0625 | 3.4 |
| 39 | 3.396911 | 0.503089 | 1.389335 | 40.10417 | 3.4 |
| 40 | 3.38002 | -0.88002 | -2.43027 | 41.14583 | 3.45 |
| 41 | 3.656505 | 0.113495 | 0.313429 | 42.1875 | 3.48 |
| 42 | 3.329349 | -0.32935 | -0.90953 | 43.22917 | 3.5 |
| 43 | 3.38002 | -0.28002 | -0.77331 | 44.27083 | 3.5 |
| 44 | 3.413801 | 0.186199 | 0.514209 | 45.3125 | 3.5 |
| 45 | 3.109758 | 0.090242 | 0.249212 | 46.35417 | 3.5 |
| 46 | 3.707176 | 0.252824 | 0.698201 | 47.39583 | 3.5 |
| 47 | 3.622724 | 0.077276 | 0.213405 | 48.4375 | 3.5 |
| 48 | 3.622724 | 0.317276 | 0.876191 | 49.47917 | 3.5 |
| 49 | 3.588944 | 0.091056 | 0.251462 | 50.52083 | 3.5 |
| 50 | 3.160429 | -1.16043 | -3.20465 | 51.5625 | 3.5 |
| 51 | 3.177319 | -0.17732 | -0.48969 | 52.60417 | 3.5 |
| 52 | 3.572053 | -0.27205 | -0.7513 | 53.64583 | 3.5 |
| 53 | 3.622724 | -0.32272 | -0.89124 | 54.6875 | 3.5 |
| 54 | 3.572053 | -0.17205 | -0.47514 | 55.72917 | 3.5 |
| 55 | 3.36313 | -0.46313 | -1.27898 | 56.77083 | 3.5 |
| 56 | 3.605834 | -0.30583 | -0.84459 | 57.8125 | 3.5 |
| 57 | 3.261771 | -0.76177 | -2.10371 | 58.85417 | 3.5 |
| 58 | 3.19421 | 0.60579 | 1.672954 | 59.89583 | 3.5 |
| 59 | 3.656505 | -0.7265 | -2.02229 | 60.9375 | 3.5 |
| 60 | 3.852932 | -0.05293 | -0.14618 | 61.97917 | 3.5 |
| 61 | 3.396911 | -0.39691 | -1.09611 | 63.02083 | 3.6 |
| 62 | 3.177319 | 0.222681 | 0.614956 | 64.0625 | 3.6 |

| | | | | | |
|---|---|---|---|---|---|
| 63 | 3.605834 | -0.00583 | -0.01611 | 65.10417 | 3.6 |
| 64 | 3.656505 | 0.343495 | 0.948598 | 66.14583 | 3.68 |
| 65 | 3.261771 | -0.06177 | -0.17059 | 67.1875 | 3.7 |
| 66 | 3.656505 | -0.0565 | -0.15604 | 68.22917 | 3.7 |
| 67 | 3.622724 | 0.377276 | 1.041887 | 69.27083 | 3.7 |
| 68 | 3.160429 | -0.16043 | -0.44304 | 70.3125 | 3.7 |
| 69 | 3.588944 | -0.58894 | -1.62643 | 71.35417 | 3.7 |
| 70 | 3.19421 | 0.00579 | 0.01599 | 72.39583 | 3.7 |
| 71 | 3.36313 | -0.16313 | -0.4505 | 73.4375 | 3.7 |
| 72 | 3.160429 | -0.13043 | -0.36019 | 74.47917 | 3.7 |
| 73 | 3.160429 | 0.339571 | 0.937761 | 75.52083 | 3.7 |
| 74 | 3.588944 | 0.311056 | 0.859015 | 76.5625 | 3.77 |
| 75 | 3.740957 | 0.159043 | 0.439216 | 77.60417 | 3.8 |
| 76 | 3.690286 | 0.209714 | 0.579149 | 78.64583 | 3.8 |
| 77 | 3.588944 | -0.08894 | -0.24563 | 79.6875 | 3.8 |
| 78 | 3.430674 | -0.13067 | -0.36087 | 80.72917 | 3.8 |
| 79 | 3.34624 | 0.15376 | 0.424626 | 81.77083 | 3.8 |
| 80 | 3.605834 | 0.384166 | 1.060916 | 82.8125 | 3.8 |
| 81 | 3.673395 | 0.226605 | 0.625793 | 83.85417 | 3.8 |
| 82 | 3.639615 | 0.160385 | 0.442921 | 84.89583 | 3.85 |
| 83 | 3.36313 | 0.03687 | 0.101821 | 85.9375 | 3.85 |
| 84 | 3.548924 | 0.251076 | 0.693374 | 86.97917 | 3.9 |
| 85 | 3.622724 | -0.12272 | -0.33892 | 88.02083 | 3.9 |
| 86 | 3.36313 | -0.36313 | -1.00282 | 89.0625 | 3.9 |
| 87 | 3.396911 | -0.24691 | -0.68187 | 90.10417 | 3.9 |
| 88 | 3.36313 | -0.36313 | -1.00282 | 91.14583 | 3.9 |
| 89 | 3.34624 | 0.10376 | 0.286545 | 92.1875 | 3.9 |
| 90 | 3.34624 | 0.15376 | 0.424626 | 93.22917 | 3.9 |
| 91 | 3.572053 | 0.327947 | 0.90566 | 94.27083 | 3.9 |
| 92 | 3.464472 | 0.035528 | 0.098115 | 95.3125 | 3.94 |
| 93 | 3.261771 | -0.26177 | -0.72291 | 96.35417 | 3.96 |
| 94 | 3.126649 | -0.12665 | -0.34975 | 97.39583 | 3.99 |
| 95 | 3.312459 | 0.387541 | 1.070236 | 98.4375 | 4 |
| 96 | 3.588944 | 0.311056 | 0.859015 | 99.47917 | 4 |