Computational Physics HW7

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1 Introduction

Bootstrapping is a powerful technique providing us with a way to get an understanding of the underlying distribution in a sample of data.

2 Results

2.1 Question 1

See below the distribution of `drand48` and `gausrand`. These methods produce a reasonably good approximate distributions. There is high agreement between the PDF and the Histogram.

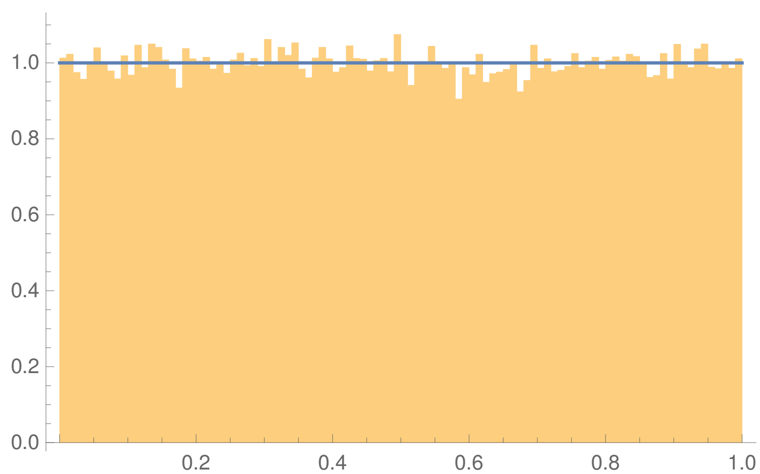

Figure 1: The PDF for a random number between 0 and 1 being chosen VS the Distribution of numbers generated by `drand48`

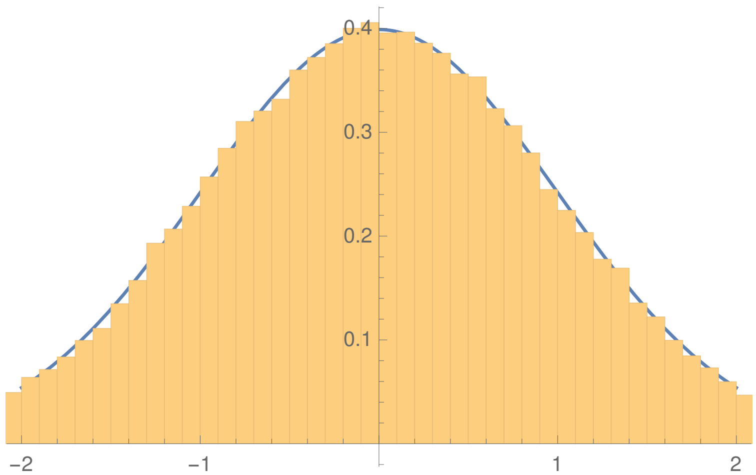

Figure 2: The PDF for a random number between 0 and 1 being chosen VS the Distribution of numbers generated by `gausrand`

2.2 Question 2

When using the `gausrand` to generate 100,000 products of $x \times y$ with $\overline{x} = 1, \sigma_x = 2$ and $\overline{y} = 4, \sigma_y = 1$ we get the Histogram seen below. When compared to the PDF we see that the peak is higher than the naive approach.

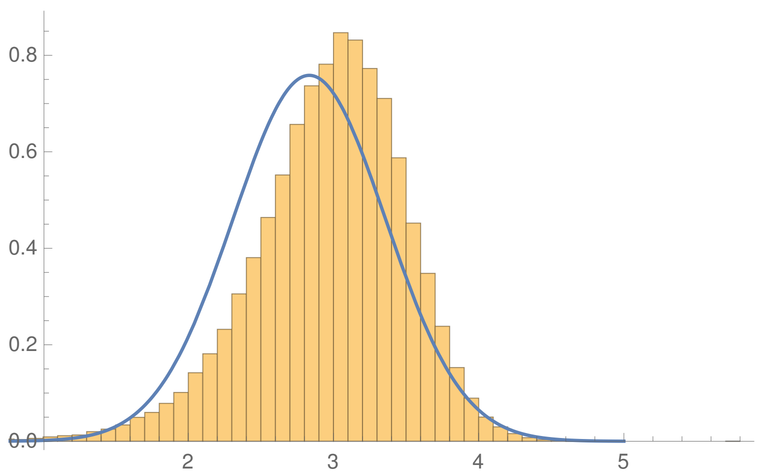

Figure 3: The histogram of the result of $x \times y$ with $\overline{x} = 1, \sigma_x = 2$ and $\overline{y} = 4, \sigma_y = 1$ vs PDF

2.3 Question 3

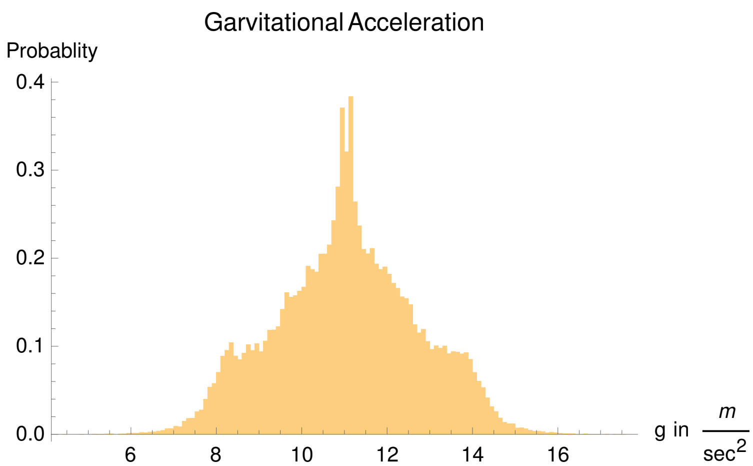

Figure 4: Results of 100000 bootstraps of cannonball.dat

When using `gausrand` to generate 100000 values of g we find $g = 11 \pm 1.66\frac{m}{s^2}$ to 1 standard deviation which to the accuracy of this dataset is a correct value of g when compared to the canonical value of $g = 9.8\frac{m}{s^2}$

2.4 Question 4

This question is confusingly worded and requests actions which cannot be performed in Mathematica. I petition it should be turned into a bonus question.

2.4.1 Task 1

t	y_t	σ_y
0.0	16381.3	101.903
0.5	16380.9	101.563
1.0	16377.6	102.517
1.5	16371.3	101.983
2.0	16364.3	101.296
2.5	16352.6	103.330
3.0	16340.3	102.216
3.5	16324.6	102.911
4.0	16306.0	101.821
4.5	16286.1	102.012
5.0	16263.0	101.756
5.5	16237.9	101.967
6.0	16210.1	102.882

I did the first part, however `ErrorListPlot` does not exist as a function in Mathematica.

2.4.2 Task 2

Not sure what this section was asking for. So I made a histogram of what the distribution would look like if you generated Gaussian random values of y_i and put it into a χ^2 fitter 100000 times.

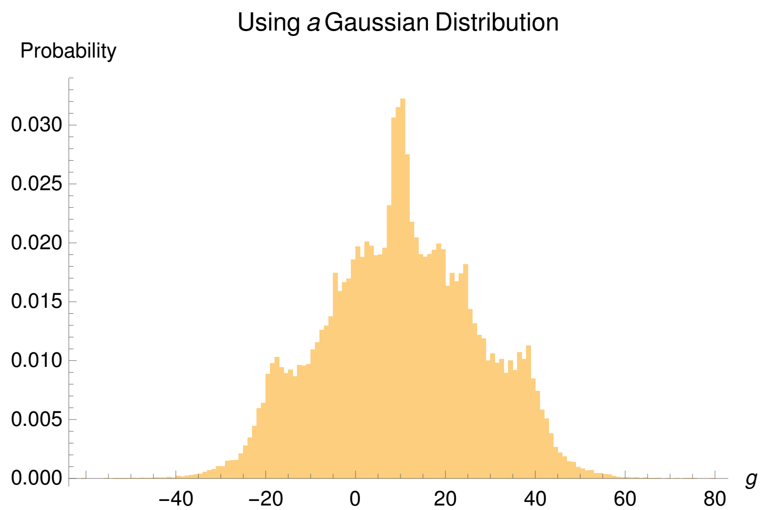

Figure 5: Results of 100000 gausrand of cannonball.dat

We get a mean value of $g = 9.83\frac{m}{s^2}$ with a $\sigma_g = 17.6\frac{m}{s^2}$

2.4.3 Task 3

I am not sure how this is different from Task 2, So instead I am just going to print the bootstrapped output of the χ^2 fitters output for g.

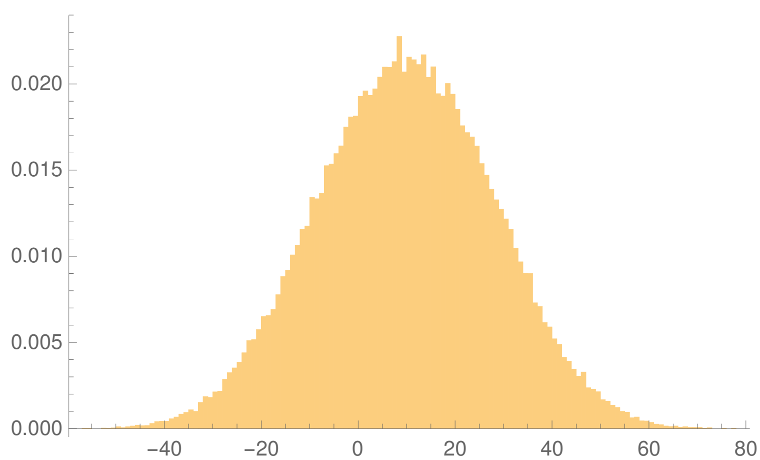

Figure 6: Results of 100000 bootstraps of bootstrap.dat

Here we get $g = 9.7\frac{m}{s^2}$ with a $\sigma_g = 18.1\frac{m}{s^2}$

The values of g are consistent with each other, but you van see from the histogram bootstrapping provides a more consistent normal distribution.

3 Conclusion

The homework was very confusing especially the difference between the tasks. . . I essentially just started guessing what was being asked of me. I would hope for some clarification to be added for future classes.