# Weekly Homework 2

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CS 1675: Intro to Machine Learning

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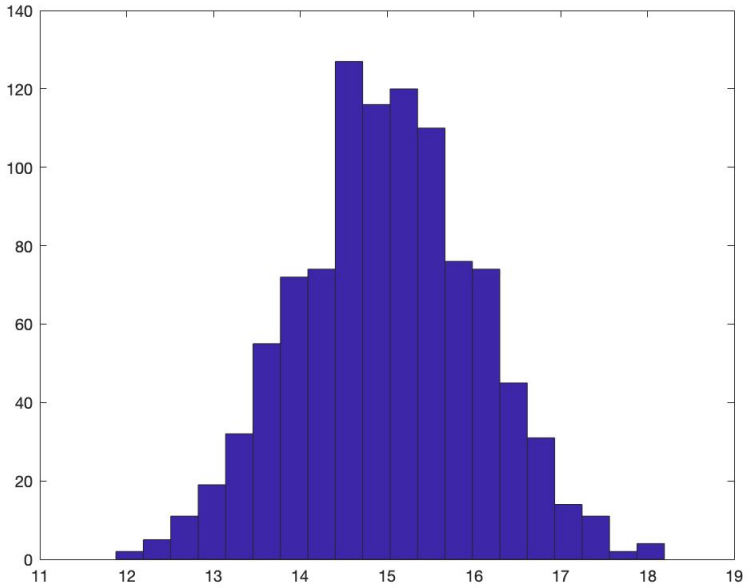
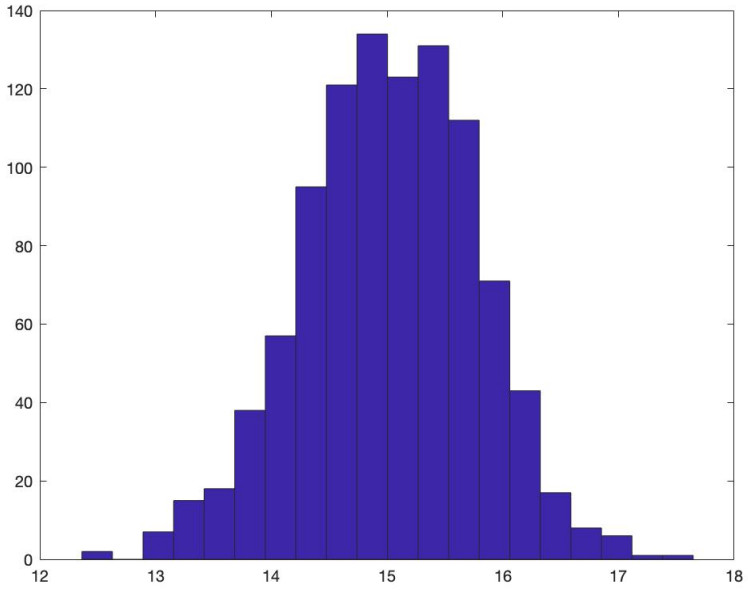
**Problem 1.** Mean estimates and the effect of the sample size

(1) Mean = 15.041, Standard deviation = 5.0279
The calculated mean and standard deviation are approximately the same to the true mean and standard deviation. This means that the subsets of data are approximately equivalent.
(2) See code
(3) Mean = 15.0094




(4) The means are approximately the same. There is about a 0.03 difference between the two means.
(5) Mean = 15.00231
All of the means are approximately the same. There is no more than a .03 difference between any mean.




(6) From the t-test, h returns 0 telling us to not reject the null at a 5% significance level. Yes, the mean = 15 falls within the .95 confidence interval.

**Problem 2.** k-fold cross-validation
(1) See code
(2)

| m | Mean | Std |
|---|---|---|
| 1 | 3.99 | 4.43 |
| 2 | 1.82 | 3.62 |
| 3 | 2.14 | 2.35 |
| 4 | 1.79 | 3.16 |
| 5 | 2.08 | 3.37 |
| 6 | 1.76 | 3.26 |
| 7 | 2.11 | 3.46 |
| 8 | 1.03 | 2.58 |
| 9 | 1.58 | 3.41 |
| 10 | 2.42 | 2.28 |

**Problem 3.** Probabilities
($a$)

| Sum | Probability |
|---|---|
| 2 | 1/36 |
| 3 | 2/36 |
| 4 | 3/36 |
| 5 | 4/36 |
| 6 | 5/36 |
| 7 | 6/36 |
| 8 | 5/36 |
| 9 | 4/36 |
| 10 | 3/36 |
| 11 | 2/36 |
| 12 | 1/36 |

(*b*) 2*(1/36) + 3*(2/36) + ... 12*(1/36) = 7
(*c*) Probability we never see and outcome of the sum of 4 = $(11/12)^5$
Probability we seen and even outcome in all 5 trials = $(18/36)^5$

**Problem 4.**
The probability of observing heads given the data in coin.txt is 65/100.

**Problem 5.** Practicing function derivatives
(*a*) $\frac{d}{dx}(2x) = 2$

(*b*) $\frac{d}{dx}(5x + 2x^4) = 5 + 8x^3$

(*c*) $\frac{d}{dx}(e^{2x^2}) = 4x(e^{2x^2})$

(*d*) $\frac{d}{dx}(sin(x^2)) = 2xcos(x^2)$

(*e*) $\frac{d}{dx}(1/(5x)) = -(1/(5x^2))$

(*f*) $\frac{d}{dx}(1/(2x + x^2)) = -(2(x + 1))/(x^2(x + 2)^2)$

(*g*) $\frac{d}{dx}(ln(x^5)) = 5/x$

(*h*) $\frac{d}{dx}(\ln \prod_{i=1}^{n} x^i = x^{1/2n(n+1)})$