Stevens Institute of Technology

SYS-601 Homework #6

Due Mar. 26 2018

Submit the following using the online submission system: 1) Completed assignment cover sheet, 2) Written responses in PDF format, 3) All saved models (e.g. .xlsx or .py files).

6.1 Donut Inference I [6 points]

Castle Point Bakery (CPB) makes delicious donuts. The high-tech production line is set up to make donuts with mean mass $\mu = 100$ grams and standard deviation $\sigma = 4$ grams. Assume this information is accurate and donut mass follows a normal distribution. Compute the following for a single ($N = 1$) donut:

(a) 2 pts A PDF plot for X, the mass of a CPB donut.

(b) 1 pt The 5th percentile CPB donut mass.

(c) 1 pt The 95th percentile CPB donut mass.

(d) 1 pt The probability a CPB donut mass is ≤ 90 grams.

(e) 1 pt The probability a CPB donut mass is > 110 grams.

6.2 Donut Inference II [7 points]

Hoboken-Os (H-Os) also produces delicious donuts. After $N = 100$ visits you have collected sample data showing the average donut mass to be $\bar{y} = 99.1$ grams. Assume H-Os has the same standard deviation as CPB ($\sigma = 4$ grams). Based on this data, compute the following:

(a) 2 pts A PDF plot for $\bar{Y}$, the mean mass for $N = 100$ H-Os donut samples.

(b) 1 pt The 5th percentile mean mass for $N = 100$ H-Os donut samples.

(c) 1 pt The 95th percentile mean mass for $N = 100$ H-Os donut samples.

(d) 1 pt The probability the mean mass for $N = 100$ H-Os donut samples is ≤ 100 grams.

(e) 2 pts A 95% confidence interval for the mean mass of H-Os donuts.

6.3 Spring Break Recovery [7 points]

Assume you have completely forgotten how to calculate joint probabilities over spring break. The binary random variable X measures the event of rolling a sum of 7 or 11 from a pair of dice (1 for rolling 7 or 11; 0 for anything else).

Using a random dice generator[1], collect at least $N = 30$ samples for X.

(a) 1 PT Compute the sample mean $\bar{x}$.

(b) 1 PT Compute the sample standard deviation s_x and use it as an estimate of σ.

(c) 2 PTS Compute the 95% confidence interval for the population mean, i.e. the true probability of rolling a 7 or 11.

(d) 2 PTS Estimate how many samples would be required to reduce the 95% confidence interval to a maximum error $|\bar{x} - \mu| = 0.01$.

(e) 1 PT Was the true probability of rolling a 7 or 11 within your 95% confidence interval? How often do "mistakes" happen?

[1] See `https://www.random.org/dice`, or create your own using a function like `RANDBETWEEN` in Excel.