STEVENS INSTITUTE OF TECHNOLOGY

SYS-601 Homework #7

Due Apr. 2 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).

7.1 Revisiting Super Bowl Coin Flips [10 points]

Recall the Super Bowl coin flip problem. Assume the random variable X is defined as:

$$X = \begin{cases} 0 & \text{NFC wins coin flip} \\ 1 & \text{AFC wins coin flip} \end{cases}$$

(a) 3 PTS If the coin were fair (50/50 chance of winning a flip), what is the theoretical:

   (i) Probability mass function $p(x)$ (Hint: don't over-think this)

   (ii) Population mean $\mu_0 = \sum_{i=0}^{1} p(i) \cdot i$

   (iii) Population standard deviation σ_0 or variance $\sigma_0^2 = \sum_{i=0}^{1} p(i) \cdot (i - \mu_0)^2$

(b) 2 PTS Compute the following for $N = 52$ observed values of X in `superbowl.csv`:

   (i) Sample mean $\bar{x}$

   (ii) Sample standard deviation s_x or variance s_x^2

(c) 2 PTS Create a plot of the PDF $f(\bar{x})$ for values $0 \le \bar{x} \le 1$ using the Central Limit Theorem to model the distribution of sample means for $N = 52$ trials.

(d) 2 PTS Perform a hypothesis test for the following:

$$H_0 : \mu_x = \mu_0$$
$$H_a : \mu_x \ne \mu_0$$

Report the p-value and determine whether H_0 can be rejected at $\alpha = 0.05$.

(e) 1 PT What can you conclude about the validity of the Superbowl coin flip?

7.2 GRE Tutoring Service [10 points]

A \$1799 tutoring service advertises a significant increase in verbal reasoning GRE score. The attached file **gre.csv** contains a set of $N = 100$ samples of pre- and post-test scores for participating students.

(a) 3 PTS Assuming the pre- and post-test data are *not* related (i.e. randomly ordered), perform a hypothesis test for the following:

$$H_0 : \mu_{\text{pre}} = \mu_{\text{post}}$$
$$H_a : \mu_{\text{pre}} < \mu_{\text{post}}$$

Report the p-value and determine whether H_0 can be rejected at $\alpha = 0.05$.

(b) 1 PT Do the results in (a) support the tutoring service's advertising claim?

(c) 3 PTS Assuming the pre- and post-test data *are* related (i.e. paired from the same student), perform a hypothesis test for the following:

$$H_0 : \mu_{\text{pre}} = \mu_{\text{post}}$$
$$H_a : \mu_{\text{pre}} < \mu_{\text{post}}$$

Report the p-value and determine whether H_0 can be rejected at $\alpha = 0.05$.

(d) 1 PT Do the results in (c) support the tutoring service's advertising claim?

(e) 2 PTS Are the results in (c) *practically* significant? Would you buy the service? Why?