

**American University**  
**The Department of Computer Science**  
**Spring 2021**

**Introduction to Simulation and Modeling, CSC 432/632**

**Exam 2**  
(Total of 20 points)

**Instructions:** Copy and paste the following page to the top of a word file and after that use as many pages as required to write your answers. Save the file as “lastname\_Exam 2” and Use WORD or PDF documents to submit your answers in the Blackboard. There is no minimum and maximum number of words for each question, but your answers need to be comprehensive and address the question. Please submit additional .py file and provide adequate comments within the code you write.

*“Pledge: I understand that this exam is an individual task and I have done it by myself and have not received any extra help including coding, writing the answers, or any other general advises. I have also not used the Internet resources, and a in rare situation, if I needed to do so, I have provided the Internet resources at the end of the question. I understand that this exam is closed-book and closed-note and I have not used these resources in any format.  
Signature: (Write your complete name as your signature) \_\_\_\_\_” (lack of pledge signature results in a 0.5 grade deduction and a follow up email to confirm that the pledge is valid).*

**Question 1 (3 points)**

**RUBRIC:** (-Write down all steps of the answer. Write down your final answers and explain as needed. Lack of each item results in 0.5-to-1-point deduction)

Delta Airlines quotes a flight time of 2 hours, 5 minutes for its flights from Cincinnati to Tampa. Suppose we believe that actual flight times are uniformly distributed between 2 hours and 2 hours, 20 minutes.

- a) Show the graph of the probability density function for flight time.
- b) What is the probability that the flight will be no more than 5 minutes late?
- c) What is the probability that the flight will be more than 10 minutes late?
- d) What is the expected flight time?

## **Question 2 (4 points)**

RUBRIC: (-Write down all steps and formular. -Write down (or copy) the normal distribution formula in Excel or Python. Write down your final answers. For each item Sketch or draw the normal distribution and highlight the desired area. Lack of providing the graph for each question results in 0.5-1-points grade deduction).

Automobile repair costs continue to rise with an average 2015 cost of \$367 per repair (U.S. News & World Report website). Assume that the cost for an automobile repair is normally distributed with a standard deviation of \$88. Answer the following questions about the cost of automobile repairs.

- a) What is the probability that the cost will be more than \$450?
- b) What is the probability that the cost will be less than \$250?
- c) What is the probability that the cost will be between \$250 and \$450?
- d) If the cost for your car repair is in the lower 5% of automobile repair charges, what is your cost?
- e) If the cost for your car repair is in the upper 3% of automobile repair charges, what is your cost?

### **Question 3 (3 points)**

RUBRIC: (-Write down all steps and formular. -Write down (or copy) the normal distribution formula in Excel or Python. -Write down your final answers. -For each item Sketch or draw the normal distribution and highlight the desired area. Lack of providing the graph for each question results in 0.5-1-points grade deduction).

Sales personnel for Skillings Distributors submit weekly reports listing the customer contacts made during the week. A sample of 65 weekly reports showed a sample mean of 19.5 customer contacts per week. The standard deviation was 5.2.

- a) Provide 90% and 95% confidence intervals for the population mean number of weekly customer contacts for the sales personnel.
- b) Provide the conclusion that you can make based on this interval estimation.
- c) Repeat Part a) using a Python code. Provide the code file in a .py file and provide comments within the code. For this problem in python use a t-test (as described in the class).

#### **Question 4 (4 points)**

RUBRIC: (-Write down all steps and formular. -Write down (or copy) the normal distribution formula in Excel or Python. -Write down your final answers).

Many medical professionals believe that eating too much red meat increases the risk of heart disease and cancer. Suppose you would like to conduct a survey to determine the yearly consumption of beef by a typical American and want to use 3 pounds as the desired margin of error for a confidence interval estimate of the population mean amount of beef consumed annually. Use 25 pounds as a planning value for the population standard deviation and recommend a sample size for each of the following situations.

- a) A 90% confidence interval is desired for the mean amount of beef consumed.
- b) A 95% confidence interval is desired for the mean amount of beef consumed.
- c) A 99% confidence interval is desired for the mean amount of beef consumed.
- d) For the above three parts Part a-c, write a Python code to calculate the sample size.
- e) When the desired margin of error is set, what happens to the sample size as the confidence level is increased? Would you recommend using a 99% confidence interval in this case? Discuss.

### **Question 5 (3 points)**

RUBRIC: (-Write down all steps and formular. -Write down (or copy) the normal distribution formula in Excel or Python. -Write down your final answers. -For the hypothesis test provide a graph of critical values. Lack of providing the graph for each question results in 0.5-1-points grade deduction).

A shareholders' group, in lodging a protest, claimed that the mean tenure for a chief executive office (CEO) was at least nine years. A survey of companies reported in The Wall Street Journal found a sample mean tenure of  $\bar{x} = 7.27$  years for CEOs with a standard deviation of  $s = 6.38$  years.

- Formulate hypotheses that can be used to challenge the validity of the claim made by the shareholders' group.
- Assume 85 companies were included in the sample. What is the p-value for your hypothesis test?
- At  $\alpha = .01$ , what is your conclusion? Draw the graph and show critical values.

### **Question 6 (3 points)**

RUBRIC: (-Write down all steps and formular. -Write down (or copy) the normal distribution formula in Excel or Python. -Write down your final answers. -For the hypothesis test provide a graph of critical values. Lack of providing the graph for each question results in 0.5-1-points grade deduction).

The U.S. Bureau of Labor Statistics reports that 11.3% of U.S. workers belonged to unions in 2013. Suppose a sample of 400 U.S. workers is collected in 2018 to determine whether union efforts to organize have increased union membership.

- Formulate the hypotheses that can be used to determine whether union membership increased in 2018. Clearly write down the Hypothesis test including  $H_0$  and  $H_a$ .
- If the sample results show that 52 of the workers belonged to unions, what is the p-value for your hypothesis test?
- At  $\alpha = .05$ , what is your conclusion?
- Write a Python code to determine and address the hypothesis tests that you developed in Part a) and manually answered in Part b).