**Topics: Normal distribution, Functions of Random Variables**

1. **The time required for servicing transmissions is normally distributed with μ = 45 minutes and σ = 8 minutes. The service manager plans to have work begin on the transmission of a customer’s car 10 minutes after the car is dropped off and the customer is told that the car will be ready within 1 hour from drop-off. What is the probability that the service manager cannot meet his commitment?**
2. **0.3875**
3. **0.2676**
4. **0.5**
5. **0.6987**

**Answer:**

First, we determine Z value because the data is Population Z = (X-***μ***)/***σ***

If the service is completed in an hour, then the value of X will be 50 because we are starting after 10 minutes, which results in Z = (50-45)/8 = 0.625, and the likelihood of finishing the work on time is 0.734.

1-0.734=0.26 is the probability that the manager won't fulfill their commitment.

Please Refer to the python notebook

1. **The current age (in years) of 400 clerical employees at an insurance claims processing center is normally distributed with mean μ = 38 and Standard deviation σ =6. For each statement below, please specify True/False. If false, briefly explain why.**
2. **More employees at the processing center are older than 44 than between 38 and 44.**

**Answer:**Probability that an employee is older than 44 years: 0.1587.  
Probability that an employee is between 38 and 44 years old: 0.3413.

Conclusion: There are more employees older than 44 (0.1587) than between 38 and 44 (0.3413).

1. **A training program for employees under the age of 30 at the center would be expected to attract about 36 employees.**

**Answer:**

Probability that an employee is under 30 years old: 0.0912.

Expected number of employees under 30 in a training program out of 400 employees: 36.48  
  
Please Refer to the python notebook.

1. **If *X1* ~ *N* (μ, σ2) and *X*2 ~ *N* (μ, σ2) are *iid* normal random variables, then what is the difference between 2 *X*1 and *X*1 + *X*2? Discuss both their distributions and parameters.**

**Answer:**

**Distribution:**

2X1 follows a normal distribution with mean 2μ and variance 4σ^2.

X1 + X2 follows a normal distribution with mean μ + μ (2μ) and variance σ^2 + σ^2 (2σ^2).

**Parameters:**

For 2X1: Mean = 2μ, Variance = 4σ^2.

For X1 + X2: Mean = 2μ, Variance = 2σ^2.

In summary, both 2X1 and X1 + X2 have the same mean (2μ), but 2X1 has a larger variance (4σ^2) compared to X1 + X2 (2σ^2). This means that X1 + X2 is generally less spread out than 2X1.

Please Refer to the python notebook.

1. **Let X ~ N (100, 202). Find two values, *a* and *b*, symmetric about the mean, such that the probability of the random variable taking a value between them is 0.99.**
2. **90.5, 105.9**
3. **80.2, 119.8**
4. **22, 78**
5. **48.5, 151.5**
6. **90.1, 109.9**

**Answer:**

stats. norm. Interval (0.99, loc = 100, scale = 20)  
(48.48341392902199, 151.516586070978)  
np. round (stats. norm. interval(0.99, loc = 100, scale = 20),1)

array ([ 48.5, 151.5])

Please Refer to the python notebook.

1. **Consider a company that has two different divisions. The annual profits from the two divisions are independent and have distributions Profit1 ~ N (5, 32) and Profit2 ~ N (7, 42) respectively. Both the profits are in $ Million. Answer the following questions about the total profit of the company in Rupees. Assume that $1 = Rs. 45**

**Answer:**

The Mean Profit of both division: 12 million$

The Mean Profit of both division: 54.0 Crore Rupees

The Standard Deviation of both division: 5.0 million$

The Standard Deviation of both division: 22.5 Crore Rupees

1. **Specify a Rupee range (centered on the mean) such that it contains 95% probability for the annual profit of the company.**

Rupee Ranges from 2.2 to 21.8 million$ in Annual profit of the Company 95% of the time

Rupee Ranges from 9.900000000000002 to 98.1 Crore Rupees in Annual profit of the Company 95% of the time

1. **Specify the 5th percentile of profit (in Rupees) for the company.**

The 5th percentile of Profit for the company is 3.78 million$

The 5th percentile of Profit for the company is 17.0 Crore Rupees

1. **Which of the two divisions has a larger probability of making a loss in a given year?**

The Probability of Division #1 making a loss is 4.78 %

The Probability of Division #2 making a loss is 4.01 %

The Division 1 has a larger Probability of making a loss.

Please Refer to the python notebook.