**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

Ans: - μ=45min, =8min

μ=10min after = 45+10=55

Car will be ready in 1hr=60min(x)

Z=x- μ/σ

=60-55/8

=0.625

1=stats.norm.cdf(z)

1=stats.norm.cdf (0.625)

=0.2659

P value for z score is 0.2659 approx. to 0.2676

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.

Ans: - :- is FALSE

µ = 38

*σ*  = 6

Z score = (X- µ)/ *σ*

Z score for 44 = (44 - 38)/6 = 1

In python- stats.norm.cdf (1) => 84.13 %

=> People above 44 age = 100 - 84.13 = 15.87%

Given 400 clerical employees, that is calculating 15.87% of 400=336.52 out of 400

=400 – 336.52

= 63.49≈63 (approx.)

Z score for 38 = (38-38)/6=0

In python- stats.norm.cdf (0) => 50%

Hence People between 38 & 44 age = 84.13 - 50 = 34.13 % ≈ 137 out of 400

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

Ans: - IS TRUE

Z score for 30 = (30 - 38)/6 = -1.33 = 9.15 %   ≈ 36 out of 400

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.

Ans: - As both are independent normal random variables, X1+X2 is normal with *N* (μ1+ μ2, σ21+ σ22). And 2X1 will just scale the normal distribution by 2 times

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

Ans: - p(a<x<b) = 0.99, µ=100, σ = 20

To find: -

Identify symmetric values for the standard normal distribution such that the area enclosed is 0.99

Using Python

stats. norm.interval(0.99, 100, 20)

Two values symmetric about mean for the given standard normal distribution are [48.5,151.5]

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

Ans: - Refer Assignment – 2 python files

Range is Rs (99.00810347848784, 980.9918965215122) in Millions.

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

Ans: - Refer Assignment – 2 python files

5th percentile of profit 202.05 million

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

Ans: - Refer Assignment – 2 python files

Probability of Division 1 making a loss P(X<0)

0.047

Probability of Division 2 making a loss P(X<0)

0.040