**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

from scipy import stats

np.round((1 - stats.norm.cdf(60,loc=55,scale=8)),5)

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.

Z\_score\_44 = np.round((stats.norm.cdf(44,loc=38,scale=6)),5)

Z\_score\_38 = np.round((stats.norm.cdf(38,loc=38,scale=6)),5)

Z\_score\_44 - Z\_score\_38

People between 38 & 44 age = 0.34134 = 34.13% = approx. 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.

Z\_score\_30 = np.round((stats.norm.cdf(30,loc=38,scale=6)),5)

0.09125 = 9.15% = approx. 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.

2 *X1* ~ *N*(2μ*X1* , 22\* σ*X1*2)

*X*1 + *X*2 ~ *N*(μ*X1* + μ*X2* , σ*X1*2 + σ*X2*2)

(2 *X1) – (X*1 + *X*2*)* ~ *N*(μ*X1 +* μ*X2* , 22\*σ*X1*2 + σ*X1*2 + σ*X2*2)

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

stats.norm.ppf(0.005)

stats.norm.ppf(0.995)

Z = (x - 100)/20 => x = 20z+100

a = (20\* -2.576) + 100= 48.5

b = (20\*2.576)+100= 151.5

Two values symmetric about mean for the given standard normal distribution is [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.

import numpy as np

from scipy import stats

from scipy.stats import norm

Mean = 5+7

print('Mean Profit is Rs', Mean\*45,'Million')

SD = np.sqrt((9)+(16))

print('Standard Deviation is Rs', SD\*45, 'Million')

print('Range is Rs',np.round((stats.norm.interval(0.95,540,225)),4),'in Millions')





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

X= 540+(-1.645)\*(225)

print('5th percentile of profit (in Million Rupees) is',np.round(X))



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

np.round((stats.norm.cdf(0,5,3)),4)

np.round((stats.norm.cdf(0,7,4)),4)

0.0478 > 0.0401