Q1.The time required for servicing transmissions is normally distributed with mean = 45 minutes and std deviation = 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?

In [1]:

```
# Import Necessary Libraries

from scipy import stats
from scipy.stats import norm
```

In [2]:

```
# Find Z-Scores at X=50; Z = (X - μ) / σ
Z=(50-45)/8
Z
```

Out[2]:

```
0.625
```

In [8]:

```
# Find probability P(X>50) = 1-stats.norm.cdf(abs(z_score))
prob = 1-stats.norm.cdf(abs(0.625)).round(4)
print("The probability that the service manager cannot meet his commitment is ",prob)
```

```
The probability that the service manager cannot meet his commitment is  0.26
6
```

Q2. The current age (in years) of 400 clerical employees at an insurance claims processing center is normally distributed with mean = 38 and Standard deviation = 6. For each statement below, please specify True/False. If false, briefly explain why.

- A. More employees at the processing center are older than 44 than between 38 and 44.
- B. A training program for employees under the age of 30 at the center would be expected to attract about 36 employees.

A. More employees at the processing center are older than 44 than between 38 and 44.

In [32]:

```
# p(X>44); Employees older than 44 yrs of age
prob_44 = (1-stats.norm.cdf(44,loc=38,scale=6)).round(4)
print("Probability that Employees at the processing center are older than 44 is ",prob_44)
per_44 = int(400*prob_44)
print("Employee older than 44 are ",per_44, "out of 400")
```

```
Probability that Employees at the processing center are older than 44 is  0.
1587
Employee older than 44 are  63 out of 400
```

In [31]:

```
# p(38<X<44); Employees between 38 to 44 yrs of age
prob = (stats.norm.cdf(44,38,6)-stats.norm.cdf(38,38,6)).round(4)
print("Probability that Employees at the processing center are between 38 to 44 yrs of age
per = int(400*prob)
print("Employee between 38 to 44 yrs of age are ",per ,"out of 400")
```

```
Probability that Employees at the processing center are between 38 to 44 yrs
of age is  0.3413
Employee between 38 to 44 yrs of age are  136 out of 400
```

Hence More employees at the processing center are older than 44 than between 38 and 44. is FALSE

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

In [36]:

```
# P(X<30); Employees under 30 yrs of age
prob_30 = stats.norm.cdf(30,38,6).round(4)
print("Probability that Employees at the processing center are under the age of 30 is ",pro
per_30 = int(400*prob_30)
print("Employee under the age of 30 are ",per_30, "out of 400")
```

```
Probability that Employees at the processing center are under the age of 30
is  0.0912
Employee under the age of 30 are  36 out of 400
```

Hence A training program for employees under the age of 30 at the center would be expected to attract about 36 employees - TRUE

Q4.

In [37]:

```
stats.norm.ppf(0.005)
```

Out[37]:

```
-2.575829303548901
```

In [38]:

```
stats.norm.ppf(0.995)
```

Out[38]:

```
2.5758293035489004
```

Q5. 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 dollar Million. Answer the following questions about the total profit of the company in Rupees. Assume that 1 dollar = Rs. 45

- A. Specify a Rupee range (centered on the mean) such that it contains 95% probability for the annual profit of the company.
- B. Specify the 5th percentile of profit (in Rupees) for the company
- C. Which of the two divisions has a larger probability of making a loss in a given year?

In [39]:

```
import numpy as np
from scipy import stats
from scipy.stats import norm
```

In [40]:

```
# Mean profits from two different divisions of a company = Mean1 + Mean2
Mean = 5+7
print('Mean Profit is Rs', Mean*45,'Million')
```

```
Mean Profit is Rs 540 Million
```

In [41]:

```
# Variance of profits from two different divisions of a company = SD^2 = SD1^2 + SD2^2
SD = np.sqrt((9)+(16))
print('Standard Deviation is Rs', SD*45, 'Million')
```

```
Standard Deviation is Rs 225.0 Million
```

In [46]:

```
# A. Specify a Rupee range (centered on the mean) such that it contains 95% probability for
print('Range is Rs',(stats.norm.interval(0.95,540,225)),'in Millions')
```

```
Range is Rs (99.00810347848784, 980.9918965215122) in Millions
```

In [47]:

```
# B. Specify the 5th percentile of profit (in Rupees) for the company
# To compute 5th Percentile, we use the formula X=μ + Zσ; wherein from z table, 5 percentil
X= 540+(-1.645)*(225)
print('5th percentile of profit (in Million Rupees) is',np.round(X,))
```

```
5th percentile of profit (in Million Rupees) is 170.0
```

In [48]:

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

In [49]:

```
# Probability of Division 1 making a loss P(X<0)
stats.norm.cdf(0,5,3)
```

Out[49]:

```
0.0477903522728147
```

In [50]:

```
# Probability of Division 2 making a loss P(X<0)
stats.norm.cdf(0,7,4)
```

Out[50]:

```
0.040059156863817086
```

Hence Division 2 has a larger probability of making a loss in a given year.