**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?

Time taken to service a car is 50 minutes.

P (X > 50) = 1 - P (X ≤ 50).

Z = (X - 45)/8.0

Thus, the question can be answered by using the normal table to find

P (X ≤ 50) = P (Z ≤ (50 - 45)/8.0) = P (Z ≤ 0.625) =73.4%

Probability that the service manager will not meet his demand will be = 100-73.4 = 26.6% or 0.2676

1. 0.3875
2. **0.2676**
3. 0.5
4. 0.6987
5. 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.
6. More employees at the processing center are older than 44 than between 38 and 44.

**False**

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

**True**

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,σ12+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

qnorm(0.995,100,20)

[1] **151.5166**

qnorm(0.005,100,20)

[2] **48.48341**

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.
3. Specify the 5th percentile of profit (in Rupees) for the company
4. Which of the two divisions has a larger probability of making a loss in a given year?

**Ans:**

1. We need to convert first into rupees by multiplying by 45Rs.

(5+7) 45 = 540

(5) 45 = 225

Z (95%) = 1.96

Confidence Interval = 540 ± 225 (1.96) = **(99, 981)**

1. 90% confidence interval

C.I = 540 ± 225(1.645) = **(169.875, 910.125)**

**3. (**0-5)/3, (0-7)/4

-1.66 , **-1.75**

**The 2nd distribution has more probability of making a loss**