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

* **The time required for servicing transmissions is normally distributed with = 45 minutes and = 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?**
* **0.3875**
* **0.2676**
* **0.5**
* **0.6987**

**sol=>B**

let time taken for service transmission= T

T is normally distributed with = 45 minutes and standard deviation = 8 minutes.

Time delay= 10 minutes

Time available to finish the work= 60-10=50 minutes.

Therefore from the equation Z=(T-µ)/

P(T≤50)=p(Z≤(50-45)/8)=p(Z≤0.625)= 0.7324(using z table)

Therefore p(T>50)=1-p(≤50)= 1-0.7324= 0.2676

(Or)

Using R-function : [1-pnorm(50,45,8)]=

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|  |
| --- |
| > 1-pnorm(50,45,8)  [1] 0.2659855 |
|  |
| |  | | --- | |  | |

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

**sol=>False.**

• 68% of the data falls within one standard deviation of the mean (µ+*)*.

Here µ=38, =6

Then, µ+*= 38+*6=44

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

**sol=>True**

Z=(X-µ)/

P(X≤30)=p(Z≤(30-38)/6)=p(Z≤-1.33)= 0.0918(using z table)

Expected count=0.0918\*400= 36.72

* **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.**

**sol=> 2** is simply a larger scale version of the random variable *X1.* If is normally distributed then 2X1 is also normally distributed.

*X*1 and *X*2 are normal distributed, the associated sums and random samples are exactly (and not just approximately) normal, with the appropriate parameters.

* **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.**
* **90.5, 105.9**
* **80.2, 119.8**
* **22, 78**
* **48.5, 151.5**
* **90.1, 109.9**

**sol=> D**

Here we need range of 99% data which lies between 3rd standard deviation of the mean.

Here µ=100, =20

From empirical rule, µ±3*= 100±3\*20=>(100-60, 100+60)=>(40,160).*

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

**sol=>**let, X is the sum of two random variables having normal distribution.

E[X]= E[45\*(profit 1+profit 2)]= 45\*(5+7)=540 million rupees

SD[X]= SD[profit 1 +profit 2]=> 45\*()

= 45\*= 225 million rupees.

**Therefore, X~ N(540,)**

* From the empirical rule, Approximately 95% of the data falls within two standard deviation of the mean.

μ ± 2σ = 540±2\*225=> (540-450, 540+450)=> **(90,990)**



From the above normal distribution we can say that to find 5th percentile from the left side we can use the formula,

μ - 1.5σ => 540-(1.5\*225) =>202.5 million rupees.

c) this question concerns the original profit distributions.

For division1= Z score for a profit of zero: Z=(X-µ)/ *=>*  (0-5)/3 => -1.66=0.0485

(or)

> pnorm(0,5,3)

[1] 0.04779035

For division2= Z score for a profit of zero: Z=(X-µ)/ =(0-7)/4 => -1.75= .0401

> pnorm(0,7,4)

[1] 0.04005916

Division2 has a higher probability of making a loss.