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**Slot:**L23+L24
**Course Code:**PMDS503P
**Course Title:**Statistical Inference Lab
**DA4**

**Q1:** Printed circuit cards are placed in a functional test after being populated with semiconductor chips. A lot contains 140 cards, and 20 are selected without replacement for functional testing.
(a) If 20 cards are defective, what is the probability that at least 1 defective card is in the sample?

```
#Given
total_cards<-140
samplesize<-20
defective<-20
# Probability of no defective card
p_no_defective <- dhyper(0,defective,total_cards-defective,samplesize)
# probability of atleast 1 defective card
p_atleast_1_defective <- 1 - p_no_defective
cat("Probability of at least 1 defective card:", p_atleast_1_defective)

## Probability of at least 1 defective card: 0.9643816
```

(b) If 5 cards are defective, what is the probability that at least 1 defective card appears in the sample?

```
defective<- 5
p_no_defective <- dhyper(0,defective,total_cards-defective,samplesize)
p_atleast_1_defective <- 1 - p_no_defective
cat("Probability of at least 1 defective card:", p_atleast_1_defective)

## Probability of at least 1 defective card: 0.5429406
```

**Q2:** The number of failures of a testing instrument from contamination particles on the product is a Poisson random variable with a mean of 0.02 failure per hour.
(a) What is the probability that the instrument does not fail in an 8-hour shift?

```
lambda<- 0.02
prob_no_fail_8<-dpois(0,lambda*8)
cat("Probability of no failure in 8 hours:",prob_no_fail_8)

## Probability of no failure in 8 hours: 0.8521438
```

(b) What is the probability of at least one failure in a 24-hour day?

```
prob_atleast_1_24<-1-dpois(0,lambda*24)
cat("Probability of at least 1 failure in 24 hours:",prob_atleast_1_24)

## Probability of at least 1 failure in 24 hours: 0.3812166
```

**Q3:** The thickness of a laminated covering for a wood surface is normally distributed with a mean of 5 millimeters and a standard deviation of 0.2 millimeter.
(a) What is the probability that a covering thickness is greater than 5.5 millimeters?

```
mean_thickness<-5
std_dev<-0.2
prob_greaterthan_5_5<-1-pnorm(5.5,mean_thickness,std_dev)
cat("Probability that thickness>5.5mm:",prob_greaterthan_5_5)

## Probability that thickness>5.5mm: 0.006209665
```

(b) If the specifications require the thickness to be between 4.5 and 5.5 millimeters, what proportion of coverings do not meet specifications?

```
p_within_range <- pnorm(5.5,mean_thickness,std_dev) - pnorm(4.5,mean_thickness,std_dev)
p_outside_range<- 1- p_within_range
cat("Proportion of covering that do not meet specifications:",p_outside_range)

## Proportion of covering that do not meet specifications: 0.01241933
```

(c) The covering thickness of 95

```
thickness_95<-qnorm(0.95,mean_thickness,std_dev)
cat("Thickness below which 95% of samples fall:",thickness_95)

## Thickness below which 95% of samples fall: 5.328971
```

**Q4:** The time between calls is exponentially distributed with a mean time between calls of 10 minutes.
(a) What is the probability that the time until the first call is less than 5 minutes?

```
mean_time<- 10
p_less_5<- pexp(5,rate = 1/mean_time)
cat("Probability that time untill the first call is < 5 minutes:", p_less_5)

## Probability that time untill the first call is < 5 minutes: 0.3934693
```

(b) What is the probability that the time until the first call is between 5 and 15 minutes?

```
p_between_5_15 <- pexp(15, rate = 1/mean_time) - pexp(5,rate = 1/mean_time)
cat("Probability that time until first call is between 5 and 15 minutes:",p_between_5_15)

## Probability that time until first call is between 5 and 15 minutes: 0.3834005
```

(c) Determine the length of an interval of time such that the probability of at least one call in the interval is 0.90.

```
interval_length <- qexp(0.90, rate = 1/mean_time)
cat("Length of interval where probability of at least 1 call is 0.90:", interval_length)

## Length of interval where probability of at least 1 call is 0.90: 23.02585
```