REPORT ON ADVANCE STATISTICS

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# **CASE 1: FOOTBALL TEAM**

A physiotherapist with a male football team is interested in studying the relationship between foot injuries and the positions at which the players play from the data collected

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Striker | Forward | Attacking Midfielder | Winger | **Total** |
| Players Injured | 45 | 56 | 24 | 20 | **145** |
| Players Not Injured | 32 | 38 | 11 | 9 | **90** |
| **Total** | **77** | **94** | **35** | **29** | **235** |

1.1 What is the probability that a randomly chosen player would suffer an injury?

*The* *probability that a randomly chosen player would suffer an injury = 145/235 = 0.6170*

1.2 What is the probability that a player is a forward or a winger?

*The probability that a player is a forward or a winger = 123/235 =0.523*

1.3 What is the probability that a randomly chosen player plays in a striker position and has a foot injury?

*The probability that a randomly chosen player plays in a striker position and has a foot injury = 45/77 = 0.58*

1.4 What is the probability that a randomly chosen injured player is a striker?

*The probability that a randomly chosen injured player is a striker = 45/145 = 0.3103*

1.5 What is the probability that a randomly chosen injured player is either a forward or an attacking midfielder?

*The probability that a randomly chosen injured player is either a forward or an attacking midfielder = 80/145 = 0.5517*

# **CASE 2: Radiation Leak Problem**

An independent research organization is trying to estimate the probability that an accident at a nuclear power plant will result in radiation leakage. The types of accidents possible at the plant are, fire hazards, mechanical failure, or human error. The research organization also knows that two or more types of accidents cannot occur simultaneously.

According to the studies carried out by the organization, the probability of a radiation leak in case of a fire is 20%, the probability of a radiation leak in case of a mechanical 50%, and the probability of a radiation leak in case of a human error is 10%. The studies also showed the following:

* The probability of a radiation leak occurring simultaneously with a fire is 0.1%.
* The probability of a radiation leak occurring simultaneously with a mechanical failure is 0.15%.
* The probability of a radiation leak occurring simultaneously with a human error is 0.12%.

On the basis of the information available, answer the questions below:

2.1 What are the probabilities of a fire, a mechanical failure, and a human error respectively?

*Probabilities of a fire = 20/80 = 0.25*

*Probabilities of a mechanical failure = 50/80 = 0.625*

*Probabilities of a human error = 10/80 = 0.125*

2.2 What is the probability of a radiation leak?

*The probability of a radiation leak is 80 %*

2.3 Suppose there has been a radiation leak in the reactor for which the definite cause is not known. What is the probability that it has been caused by:

* A Fire.
* A Mechanical Failure.
* A Human Error.

*The probability that radiation leak it has been caused by Fire = 0.3*

*The probability that radiation leak it has been caused by Mechanical error = 0.55*

*The probability that radiation leak it has been caused by Human error = 0.18*

# **CASE 3: Cement Company Data**

The breaking strength of gunny bags used for packaging cement is normally distributed with a mean of 5 kg per sq. centimeter and a standard deviation of 1.5 kg per sq. centimeter. The quality team of the cement company wants to know the following about the packaging material to better understand wastage or pilferage within the supply chain; Answer the questions below based on the given information; **(Provide an appropriate visual representation of your answers, without which marks will be deducted)**

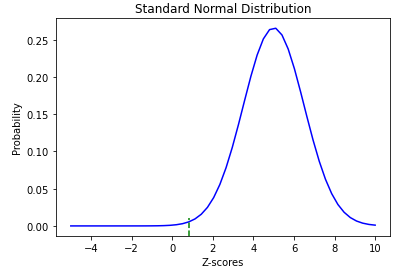
3.1 What proportion of the gunny bags have a breaking strength less than 3.17 kg per sq cm?

Chart

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*From the above Normal distribution, we can see that the Proportion of the gunny bags have a breaking strength less than 3.17 kg per sq cm = 11.11 %*

3.2 What proportion of the gunny bags have a breaking strength at least 3.6 kg per sq cm.?



*From the above Normal distribution, we can see that the proportion of the gunny bags have a breaking strength at least 3.6 kg per sq cm = 82.46 %*

3.3 What proportion of the gunny bags have a breaking strength between 5 and 5.5 kg per sq cm.?

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*From the above Normal distribution, we can see that the proportion of the gunny bags have a breaking strength between 5 and 5.5 kg per sq cm = 13.05 %*

3.4 What proportion of the gunny bags have a breaking strength NOT between 3 and 7.5 kg per sq cm.?

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*From the above Normal distribution, we can see that the Proportion of the gunny bags breaking strength between 3 and 7.5 kg per sq cm = 86.09%*

*So, the remaining proportion of the gunny bags must be breaking strength NOT between 3 and 7.5 kg per sq cm = 13.91 %*

# **CASE 4: Student Data**

Grades of the final examination in a training course are found to be normally distributed, with a mean of 77 and a standard deviation of 8.5. Based on the given information answer the questions below.

4.1 What is the probability that a randomly chosen student gets a grade below 85 on this exam?

*The probability that a randomly chosen student gets a grade below 85 on this exam = 82.63 %*

4.2 What is the probability that a randomly selected student score between 65 and 87?

*The probability that a randomly selected student score between 65 and 87 = 80.12%*

4.3 What should be the passing cut-off so that 75% of the students clear the exam?

*83% should be the passing cut-off so that 75% of the students clear the exam*

# **CASE 5: Zingaro Stone Printing Company Data**

Zingaro stone printing is a company that specializes in printing images or patterns on polished or unpolished stones. However, for the optimum level of printing of the image the stone surface has to have a Brinell's hardness index of at least 150. Recently, Zingaro has received a batch of polished and unpolished stones from its clients. Use the data provided to answer the following (assuming a 5% significance level);

* 1. Earlier experience of Zingaro with this particular client is favorable as the stone surface was found to be of adequate hardness. However, Zingaro has reason to believe now that the unpolished stones may not be suitable for printing. Do you think Zingaro is justified in thinking so?

*Null Hypothesis: H0 (mu= 150) Unpolished Stone Suitable*

*Alternative Hypothesis: H1 (mu not equal 150) Unpolished stone not suitable*

*From the T test We can conclude that the probability value is lesser than the significant value. Hence, with this evidence to reject the null hypothesis.*

*Thus, we can conclude that Zingaro reason to believe that the unpolished stones may not be suitable for printing is correct and justified.*

5.2 Is the mean hardness of the polished and unpolished stones the same?

*The Mean Hardness of the Polished Stone = 147.78*

*The Mean Hardness of the Unpolished Stone = 134.11*

*It does not have the same mean hardness between polished and unpolished stones*

# **CASE 6: Aquarius health club Data**

Aquarius health club, one of the largest and most popular cross-fit gyms in the country has been advertising a rigorous program for body conditioning. The program is considered successful if the candidate is able to do more than 5 push-ups, as compared to when he/she enrolled in the program. Using the sample data provided can you conclude whether the program is successful? (Consider the level of Significance as 5%)

*Note that this is a problem of the paired-t-test. Since the claim is that the training will make a difference of more than 5, the null and alternative hypotheses must be formed accordingly.*

*Null Hypothesis: H0 (mu<= 5) Pushups after program*

*Alternative Hypothesis: H1 (mu > 5) Pushup after program*

*From the T test We have enough evidence to reject the null hypothesis in favor of alternative hypothesis*

*Hence, the program conducted by Aquarius health club is a success.*

# CASE 7: Dental Implant Data

Dental implant data: The hardness of metal implant in dental cavities depends on multiple factors, such as the method of implant, the temperature at which the metal is treated, the alloy used as well as on the dentists who may favour one method above another and may work better in his/her favourite method. The response is the variable of interest.

1. Test whether there is any difference among the dentists on the implant hardness. State the null and alternative hypotheses. Note that both types of alloys cannot be considered together. You must state the null and alternative hypotheses separately for the two types of alloys.?

*Null Hypothesis H0: Dentist are significant cause for better response in the alloy 1 of dental hardness*

*Alternative Hypothesis H1: Dentist are not significant cause for better response in the alloy 1 of dental hardness*

*Null Hypothesis H0: Dentist are significant cause for better response in the alloy 2 of dental hardness*

*Alternative Hypothesis H1: Dentist are not significant cause for better response in the alloy 2 of dental hardness*

1. Before the hypotheses may be tested, state the required assumptions. Are the assumptions fulfilled? Comment separately on both alloy types.?

*There 2 types of alloys used*

*3 types of Methods used*

*5 types of Dentists used*

*3 types of Temperatures used*

1. Irrespective of your conclusion in 2, we will continue with the testing procedure. What do you conclude regarding whether implant hardness depends on dentists? Clearly state your conclusion. If the null hypothesis is rejected, is it possible to identify which pairs of dentists differ?

*Yes, the dentist plays a significant role, and they are the cause for the mean response. They play major role in the interaction effect.*

1. Now test whether there is any difference among the methods on the hardness of dental implant, separately for the two types of alloys. What are your conclusions? If the null hypothesis is rejected, is it possible to identify which pairs of methods differ?

*Yes There are differences in the Methods for different types of alloys and they cause significant effect and cause.*

1. Now test whether there is any difference among the temperature levels on the hardness of dental implant, separately for the two types of alloys. What are your conclusions? If the null hypothesis is rejected, is it possible to identify which levels of temperatures differ?

*Yes, Temperature levels plays a significant role in the mean response of the Dental Hardness. The Temperature for alloy 2 are minimum like 1500 and have a good response.*

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1. Consider the interaction effect of dentist and method and comment on the interaction plot, separately for the two types of alloys?

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*Chart, line chart

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*Both Dentist and Method have Significant cause. They are causes for the interaction*

1. Now consider the effect of both factors, dentist, and method, separately on each alloy. What do you conclude? Is it possible to identify which dentists are different, which methods are different, and which interaction levels are different?

*The Dentist response for the alloy 2 is better compared to the alloy1 as they dip extensive.*

*The Method response for the alloy 2 is also showing difference for the both Methods 1 and 2.*