Advanced Statistics

PROJECT REPORT (GUIDED)

DSBA

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Problem 1:

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 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:

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

1.2 What is the probability of a radiation leak?

1.3 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) a fire?

b) a mechanical failure?

c) a human error?

Ans:-

F=fire
M=mechanical error
H=human error
R=radiation leak
N=no accident

Given data:
P(R/F)=0.2
P(R/M)=0.5
P(R/H)=0.1
P(R n F)=0.001
P(RnM)=0.0015
P(RnH)=0.0012

2.1) probability of fire
P(F)=P(P(RnF)/P(R/F))=0.001/0.2=0.005

Probability of mechanical fire =
P(M)=P(P(RnM)/P(R/M))=0.0015/0.5=0.003

Probability of human error=
P(H)=P(P(RnH)/P(R/H))=0.0012/0.1=0.012

2.2)
Probability of radiation leaks
P(N)=1-(0.005+0.003+0.012)=0.98
P(R/N)=0
P(RnN)=P(R/N)P(N)=0
By theorm
P(R)=P(RnF)+P(RnM)+P(RnH)+P(RnN)
=0.001+0.0015+0.0012+0
P(R)=0.0037

2.3) If there has been a radiation leak in the reactor for which the definite cause is not known. The probability that it has been caused by-
The probability of a fire radiation is
P(F/R)= P(P(R n F)/P(R)=0.001/0.0037=0.270
The probability of the mechanical failure radiation leak
P(M/R)= P(P(R n M)/ P(R)= 0.0015/0.0037=0.405
The probability of the Human Error Radiation is
P(H/R)= P(P(R n H)/ P(R)= 0.0012/0.0037=0.324

Problem 2:

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.

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

2.2 What is the probability that a randomly selected student scores between 65 and 87?

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

Ans:-

2.1) z5=(85-77)/8.5

Z5=0.9411

1-stats.norm.cdf(z5)

0.17330721625152523

2.2) z6 = (65-77)/8.5

z6= -1.411764705882353

z7 = (87-77)/8.5

z7= 1.1764705882352942

stats.norm.cdf(z7)-stats.norm.cdf(z6)= 0.8012

80% chance

2.3) stats.norm.ppf(0.25,loc=77,scale=8.5)

=71.2668371233333

Problem 3:
Business Context

The advent of e-news, or electronic news, portals has offered us a great opportunity to quickly get updates on the day-to-day events occurring globally. The information on these portals is retrieved electronically from online databases, processed using a variety of software, and then transmitted to the users. There are multiple advantages of transmitting news electronically, like faster access to the content and the ability to utilize different technologies such as audio, graphics, video, and other interactive elements that are either not being used or aren't common yet in traditional newspapers.

E-news Express, an online news portal, aims to expand its business by acquiring new subscribers. With every visitor to the website taking certain actions based on their interest, the company plans to analyze these actions to understand user interests and determine how to drive better engagement. The executives at E-news Express are of the opinion that there has been a decline in new monthly subscribers compared to the past year because the current web page is not designed well enough in terms of the outline & recommended content to keep customers engaged long enough to make a decision to subscribe.

[Companies often analyze user responses to two variants of a product to decide which of the two variants is more effective. This experimental technique, known as A/B testing, is used to determine whether a new feature attracts users based on a chosen metric.]

Objective

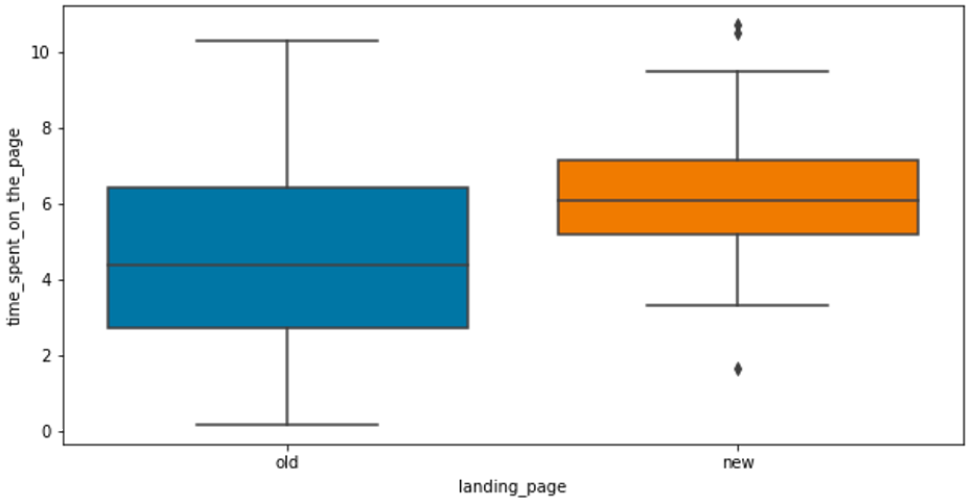
The design team of the company has researched and created a new landing page that has a new outline & more relevant content shown compared to the old page. In order to test the effectiveness of the new landing page in gathering new subscribers, the Data Science team conducted an experiment by randomly selecting 100 users and dividing them equally into two groups. The existing landing page was served to the first group (control group) and the new landing page to the second group (treatment group). Data regarding the interaction of users in both groups with the two versions of the landing page was collected. Being a data scientist in E-news Express, you have been asked to explore the data and perform a statistical analysis (at a significance level of 5%) to determine the effectiveness of the new landing page in gathering new subscribers for the news portal by answering the following questions:

1. Do the users spend more time on the new landing page than on the existing landing page?
2. Does the converted status depend on the preferred language?
3. Is the mean time spent on the new page the same for the different language users?

Ans:-

Key Findings

Time spent on New page vs Old Page



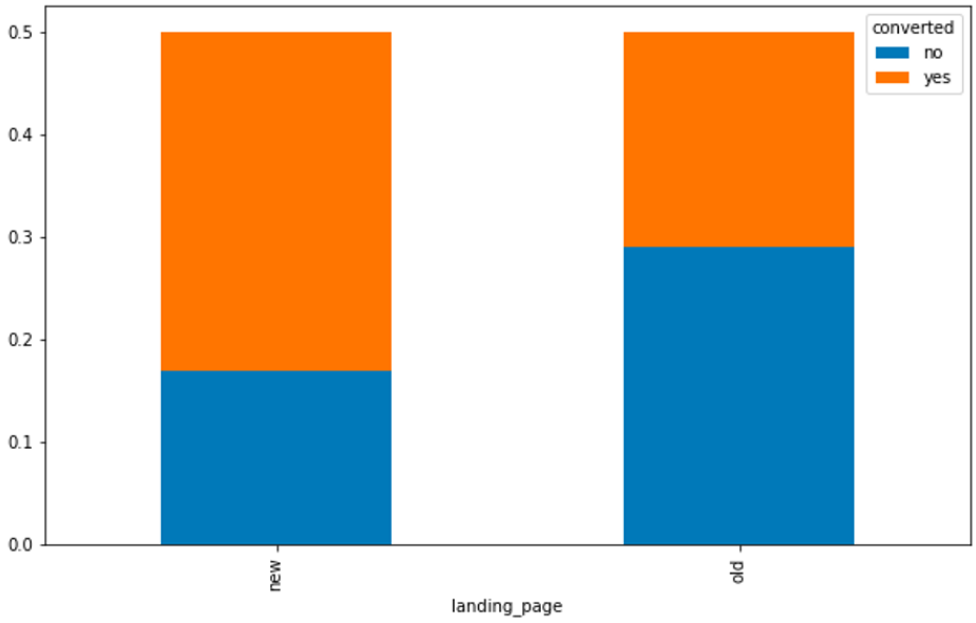
It appears that users spend greater time on the NEW page vs OLD page

We performed a one tailed t-test at the 5% significance level.

P-value came out to be 0.0001 lower than 0.05.

Hence there is enough statistical evidence to say time spent by users on new landing page is greater than time spent by users on the old landing page

Subscriber conversion rate for New Page vs old page



Proportions of users becoming subscribers is greater for users viewing the new landing page compared to the old landing page. Thus, conversion rate for the new landing page seems to be better than the conversion rate for the old landing page¶

We performed a one tailed Z-test of proportions at 5% significance level

P-value came out to be 0.008 lower than 0.05.

Hence, there was enough statistical evidence to say that the conversion rate for users seeing the new landing page is greater than the conversion rate for users seeing the old landing page

Conclusions and Business Recommendations

- There is plenty of evidence that users spend more time on the ne w landing page than on the old page
- The new landing page has a user conversion rate of 66% compar ed to the old old page. The change is 42%. Evidence also support s that users viewing the new landing page convert at a higher rate than users viewing the old page
- We recommend that the Electronic News Express service adopt a new landing page as its de facto landing page, as it can help incre ase user numbers. engagement (users stay on the landing page lo nger), which ultimately leads to more advertising and more revenu e, rather than advertising new records, and therefore more revenu e for e-news services)
- New landing pages will help future marketing campaigns It can be used to attract the attention of more users to use electronic media
- There is not enough evidence in the existing literature to support t he conversion of consumers based on the user's preferred langua ge. Future studies will need larger samples to show whether this r elationship exists.
- There is also insufficient evidence to support the average time spe nt on a new landing page by users who prefer a different language

Additional Comments and Insights

- Enews Express can directly control users without their intervention and ask them what they like about the new landing page and wha t kind of content they want to see. This can help you create new la nding pages that increase user engagement and conversion rates.
- Users who prefer English tend to convert into customers at a slight ly higher rate than French/Spanish. While the impact of language preferences on conversion is unclear, studies can help determine

how Spanish/French content is viewed and improve conversion rat es for people. Spanish/French is preferred.

- ENews may also analyze other metrics regarding time spent on th e landing page. Other metrics collected to improve user engagem ent and conversion (number of site visits per day, time users spen d on site, etc.).