**Comprehensive Analytical Report on District Incident Causes and Financial Impact (1992-2022)**

**Questions**

Construction and maintenance tasks are inherently dangerous, and injuries and financial claims are nearly inescapable. Recognizing this reality, the Kentucky Department of Transportation (KYTC) has actively addressed these concerns by establishing a dedicated safety office in the year 2018 and moving the hierarchy of the office in 2021. The major goal of this safety office is to reduce and avoid injuries linked with construction and maintenance activities, as well as to alleviate financial damages resulting from such accidents. As we look into the substantial injury claim data spanning 30 years throughout the KYTC's 13 districts, our analysis hopes to answer two key issues.

First, we investigate whether the formation of the safety office has had a significant impact on injury prevention and financial loss reduction. Second, we look into whether particular types of injuries are more prevalent in certain districts, allowing us to recommend focused efforts by the safety office to address certain categories of injuries in those regions. By analyzing this data, we hope to provide insights that can be used to improve safety measures and optimize resource allocation for the KYTC Secretary's Office of Safety to provide a safer working environment in for the employees working in construction and maintenance sectors.

**Methodology**

The data required for this analysis was collected from the Kentucky Transportation Cabinet Office itself. The dataset under consideration is a historical record of incident reports and financial claims made and settled by the Kentucky Transportation Cabinet organized by Policy Year, the district where the injury occurred, the category of the Injury and Date of Injury and the amount of money paid by the KYTC in claim of it. The data spans several districts, each contributing to a comprehensive picture of incidence patterns across time. The dataset's scope includes not only the chronological aspect but also a wide range of categories of the injury which could occur in a construction or a maintenance site like “Fall or Slip”, “Struck by an object”, “Strain or Injury By - Holding or Carrying” that reflect a wide range of occurrence kinds.

The analytical process undertaken to extract insights from this dataset involved the following steps:

* **Data Munging:** The initial phase of the research focused on purifying the data, methodically screening through to exclude any records tainted by missing values in critical fields such as ‘Cause Code’ or ‘District’.
* **Temporal Delimitation:** To coincide with the extent of current relevance and data completeness, the inquiry was limited to the years 1992 to 2022.
* **Trend Analysis:** Trend analysis that includes the total number of injuries that occur over a specified period of time “Policy Year” as well as the total amount of money lost as a result of the claims made for those injuries, “Total Incurred” was performed.
* **Chi-Square Association Testing**: By using the Chi-Square Test of Independence on the contingency table, it was possible to quantify the degree to which districts and cause codes were associated.
* **Assessment of Residual Significance:** The standardized residuals' computation provided insight into the strength of the correlation between district-cause code pairings.

**Findings**

**Trend Analysis**

The trend analysis reveals a discernible decline in the incidence rate of occurrences since 1994, with a marginal upswing observed in 2010. In contrast, the trajectory of total losses incurred by the Kentucky Transportation Cabinet (KYTC) exhibits a stochastic pattern devoid of any discernible trend. Consequently, the advent of the Secretary's Office of Safety in 2018 does not appear to have yielded a statistically significant alteration in the incidence rate beyond the pre-existing trend. It is noteworthy, however, that the subsequent year did not witness an escalation in incident numbers.

Moreover, the examination of loss patterns over the three-decade period exposes sporadic spikes in injury-related claims losses sustained by the KYTC. Intriguingly, post the inception of the Office of Safety, the total loss incurred for injury claims has stabilized at approximately $4,500,000, indicative of a sustained equilibrium or, in colloquial terms, a noteworthy gain in the financial context.

A graph with green and blue lines

Description automatically generated

Figure 1 Number of Cases and Total Incurred Per Year

Likewise, a consistent downward trend in the number of incidents is discernible across nearly all districts. Notably, District Six emerges as the top-performing district in recent years, demonstrating an incident rate of approximately five incidents annually. Following closely behind, Districts Five and Seven exhibit commendable performances as well. In contrast, Districts Four and Nine, while not characterized by a prominent downtrend, also do not manifest a notably high incidence rate.

**Chi Square Association Test and Residual Significance:**

A substantial correlation between district and cause code was found by the Chi-Square Test of Independence, which produced a chi-square statistic of 1593.64 with a p-value much lower than the standard alpha threshold of 0.05. Each district's standardized residuals were calculated, and the cause code with the greatest residual was determined to have the strongest link within that district.

Furthermore, the analysis has brought to light distinctive patterns in specific districts, exemplified by 'District 12,' where cause code '56' exhibits a substantial deviation. This implies an overrepresentation of cause code '56' in District 12 compared to other districts, signifying a noteworthy anomaly. Similar patterns have been identified in various districts, each characterized by specific cause codes that stand out due to their elevated standardized residuals. The standardized residual indicates how much the observed frequency (actual occurrences of the cause code in that district) deviates from the expected frequency. A positive residual indicates an overrepresentation, while a negative residual indicates underrepresentation.

The detailed information for the remaining districts is provided in the accompanying table:

|  |  |  |  |
| --- | --- | --- | --- |
| **S.N.** | **District** | **Cause Code** | **Standardized Residual** |
| 1 | District 1 | 85 | 5.682684 |
| 2 | District 2 | 85 | 6.502015 |
| 3 | District 3 | 82 | 2.63596 |
| 4 | District 4 | 31 | 2.586865 |
| 5 | District 5 | 84 | 4.007137 |
| 6 | District 6 | 50 | 2.72286 |
| 7 | District 7 | 90 | 2.847054 |
| 8 | District 8 | 95 | 3.982317 |
| 9 | District 9 | 6 | 5.781174 |
| 10 | District 10 | 98 | 2.970884 |
| 11 | District 11 | 85 | 4.299116 |
| 12 | District 12 | 56 | 7.068335 |
| 13 | CO | 31 | 5.666762 |

*A graph of a graph

Description automatically generated with medium confidenceFigure 2 No. of Cases per year across the Districts*

**Conclusions and Recommendations**

Recommendations include focused interventions in districts with high standardized residuals, giving priority to cause codes to address safety issues. It is recommended to monitor continuously to assess the efficacy of established measures and recognize emerging trends. This strategy approach seeks to optimize resource allocation and create a better working environment for employees while improving safety in the Kentucky Transportation Cabinet's construction and maintenance sectors.