

■ "why 'chi squared' is insufficient" "vose"
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The Chi-squared ( $\chi^2$ ) goodness-of-fit test is often considered insufficient for risk analysis (such as that conducted using [Vose ModelRisk](#)) because categorical data, requires large sample sizes, and lacks the sensitivity to distinguish between similar distributions, particularly in the tails of the distribution. [Wikipedia +2](#)

Here is why the Chi-squared test is insufficient, particularly in the modeling:

Key Assumptions Behind the Chi-Square Test

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## 1. Inappropriate for Continuous Risk Data [🔗](#)

Chi-squared tests require data to be grouped into discrete categories (bins). In risk modeling, where you are fitting continuous probability distributions to data (e.g., insurance losses, project durations), breaking continuous data into bins causes a loss of information and accuracy. [Handbook of Biological Statistics +1](#)

- **Result Sensitivity:** The results can vary wildly depending on how the bins are defined.
- **Alternative:** In scenarios with continuous data, superior "distribution-free" tests like **Anderson-Darling** or **Kolmogorov-Smirnov (K-S)** are preferred, as they compare the empirical cumulative distribution directly to the theoretical one, rather than relying on binning. [www.quality-control-plan.com](#)

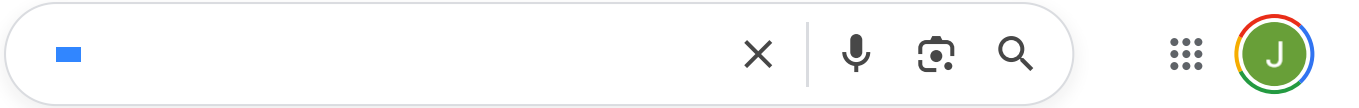
## 2. Failure to Capture Tail Behavior

Risk analysis is usually concerned with low-probability, high-impact events (tail risk). The Chi-squared test does not give special weight to the tails of a distribution, often leading to a good overall fit statistic even if the model fails spectacularly in the tails. [Handbook of Biological Statistics +3](#)

## 3. High Sample Size Requirements

The Chi-squared approximation is only valid when expected frequencies in each bin are sufficiently large—typically at least 5. [Psychology Town +1](#)

- **Small Data Sets:** In many, if not most, risk scenarios, data is scarce.



## 4. Poor Discriminatory Power [↗](#)

Compared to other tests like the Anderson-Darling, the Chi-square meaning it is more likely to accept a poor-fitting distribution (Type I error). [www.quality-control-plan.com](http://www.quality-control-plan.com)

## 5. Invalidation with Parameter Estimation

If you estimate the parameters of the distribution (e.g., calculating standard deviation) from the same data you are testing, the standard test is invalid unless complex corrections are made. [www.quality-control-plan.com](http://www.quality-control-plan.com)

## Summary of Alternatives

For robust modeling (e.g., in ModelRisk), the following tests are generally superior to Chi-squared:

- **Anderson-Darling (A-D) Test:** Highly sensitive to tail differences.
- **Kolmogorov-Smirnov (K-S) Test:** Good for overall shape, better for continuous data than  $\chi^2$ .
- **Likelihood Ratio Test/Akaike Information Criterion (AIC):** Better for comparing which distribution fits best among several options, which is often the actual goal in risk modeling. [Handbook of Biological Statistics +4](#)

### Key Assumptions Behind the Chi-Square Test

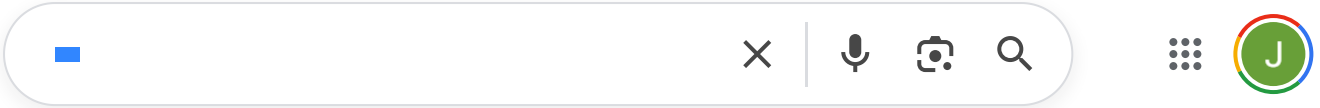
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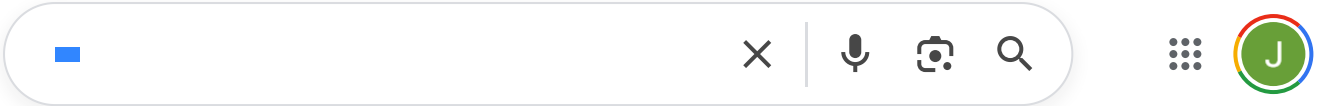
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by HY Kim · 2017 · Cited by 2105 — The **chi-squared** test and Fisher's exact test can assess for independence between two variables when the comparing groups are independent and not...

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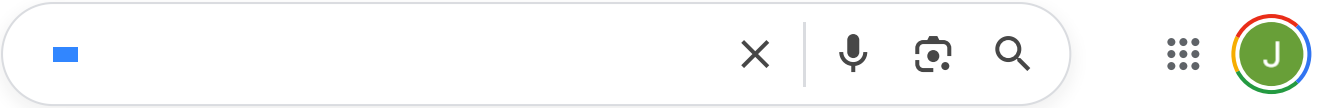
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