# Loss Cost Modeling
# vs.
# Frequency and Severity Modeling

- From the correlation perspective

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## Poll Questions

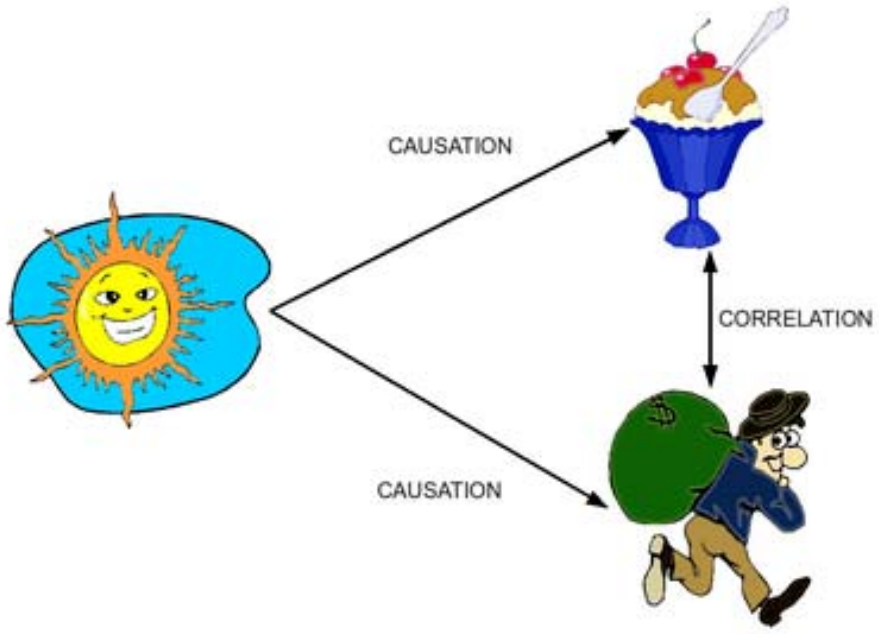
Q1: Which GLM approach do you prefer

- ❑ Loss Cost Modeling
- ❑ Frequency and Severity Modeling
- ❑ Other

Q2: Have you ever considered correlation between Frequency and Severity while selecting Loss Cost vs. Frequency and Severity GLM modeling approaches?

- ❑ Yes
- ❑ No

# Causation vs. Correlation Concept




- **Correlation does NOT mean causation!**
- **It is hard to differentiate causation and correlation in modelling process.**

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## Poll Questions

Q3: For frequency and severity approach, how would you prefer to select explanatory variables for each model?

- ❑ Select more same variables if possible
- ❑ Select less same variables if possible
- ❑ Select by common sense/intuition

It is a hard question, we should chose the explanatory variables which cause the dependent variable instead just correlated to dependent variable. However, it is hard to differentiate between causation and correlation.

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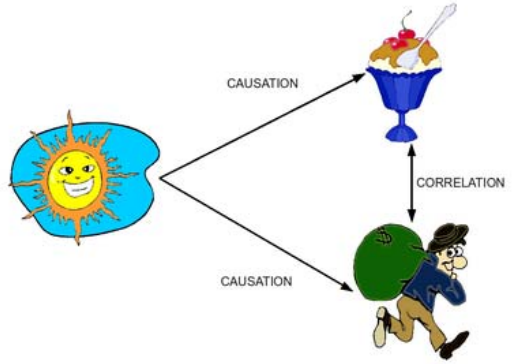
# Causation vs. Correlation Concept: An extreme example (1):

| Exposure Distribution | Rural | Urban |
|---|---|---|
| Married | 1000 | 10 |
| Single | 10 | 1000 |




**Causation**

| Frequency | |
|---|---|
| Married | 0.5 |
| Single | 1.0 |

| Severity | |
|---|---|
| Rural | 1.0 |
| Urban | 0.5 |

- **Correlation:**
  - ✓ almost all rural are married and urban are single
- **Causation:**
  - ✓ Married drivers will have less frequency
  - ✓ Urban drivers will have lower severity
  - ✓ However, modelers does not know the real causation

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# Causation vs. Correlation Concept: An extreme example (2):

## Causation

| Frequency | |
|---|---|
| Married | 0.5 |
| Single | 1.0 |

| Severity | |
|---|---|
| Rural | 1.0 |
| Urban | 0.5 |

Modeler chose rural/urban for both frequency and severity model.

While combining the F-S model, some predictive power lost.

## Modelling

| Frequency | |
|---|---|
| Rural | 0.55 |
| Urban | 1.0 |

| Severity | |
|---|---|
| Rural | 1.0 |
| Urban | 0.5 |

## Rating Plan from causation*

| Exposure Distribution | Rural F*S | Urban F*S |
|---|---|---|
| Married | 0.5 = 0.5*1.0 | 0.25 = 0.5*0.5 |
| Single | 1.0 = 1.0*1.0 | 0.5 = 1.0*0.5 |

## Rating Plan from F-S Models

| Exposure Distribution | Rural F*S | Urban F*S |
|---|---|---|
| Married | 0.55 = 0.55* 1.0 | 0.5 = 1.0*0.5 |
| Single | 0.55 = 0.55* 1.0 | 0.5= 1.0*0.5 |

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*Assume total independent between frequency and severity here.

# Causation vs. Correlation Concept: An extreme example (3)

For the F-S approach

- ❑ Frequency model fits well
- ❑ Severity model fits well
- ❑ However, when combine the two models to creat the rating algorithm, the results does not fit well

Of course, in real multi-variable world. The model will self-correct to a certain level.

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# A real world example – Ontario PPA


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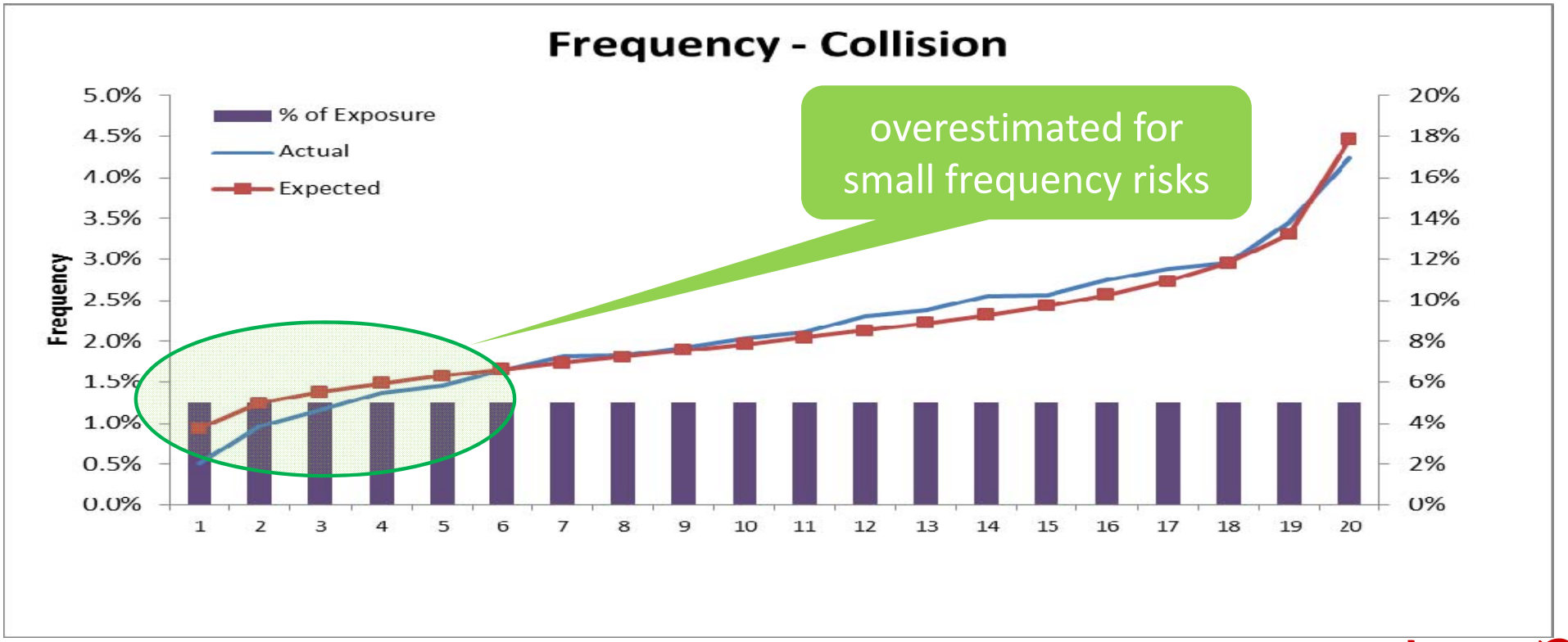
# Example 1 (Frequency-Severity): Ontario PPA – Collision (1)

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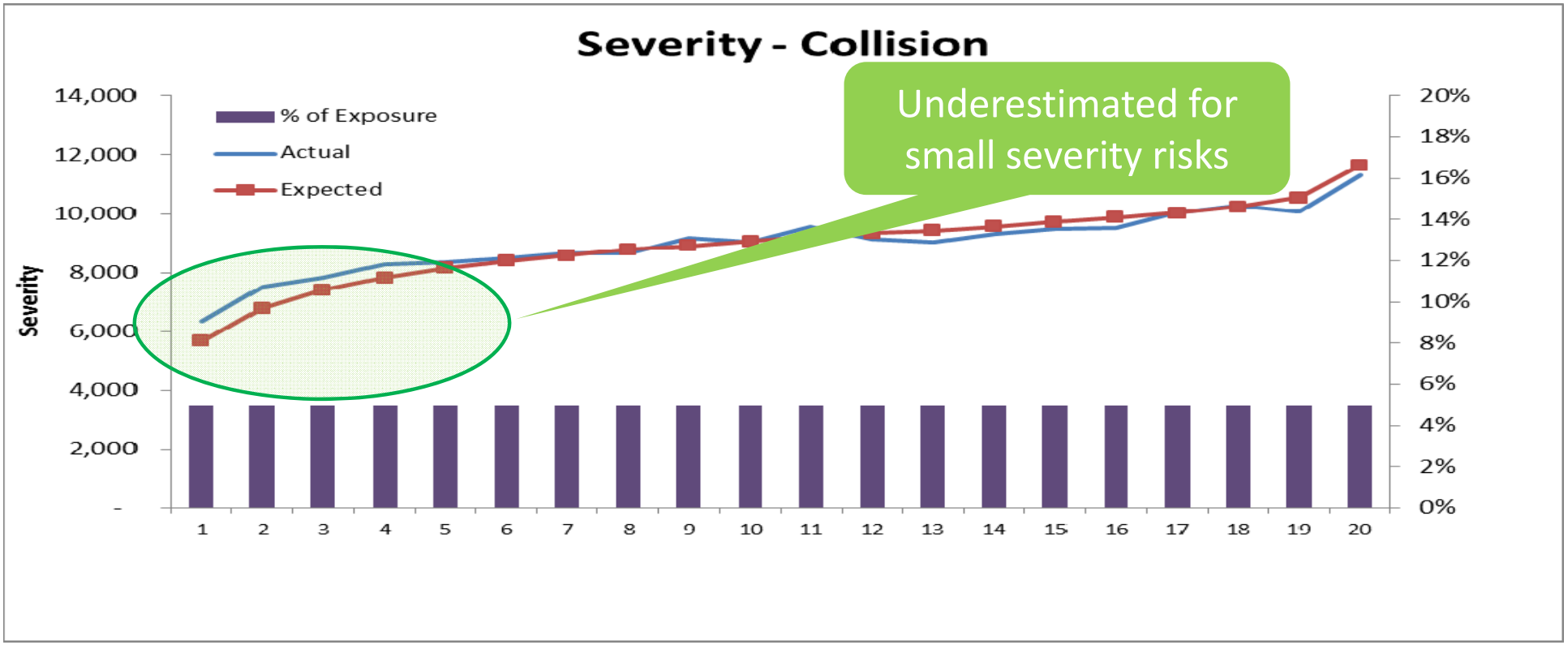
# Example 1 (Frequency-Severity): Ontario PPA – Collision (2)

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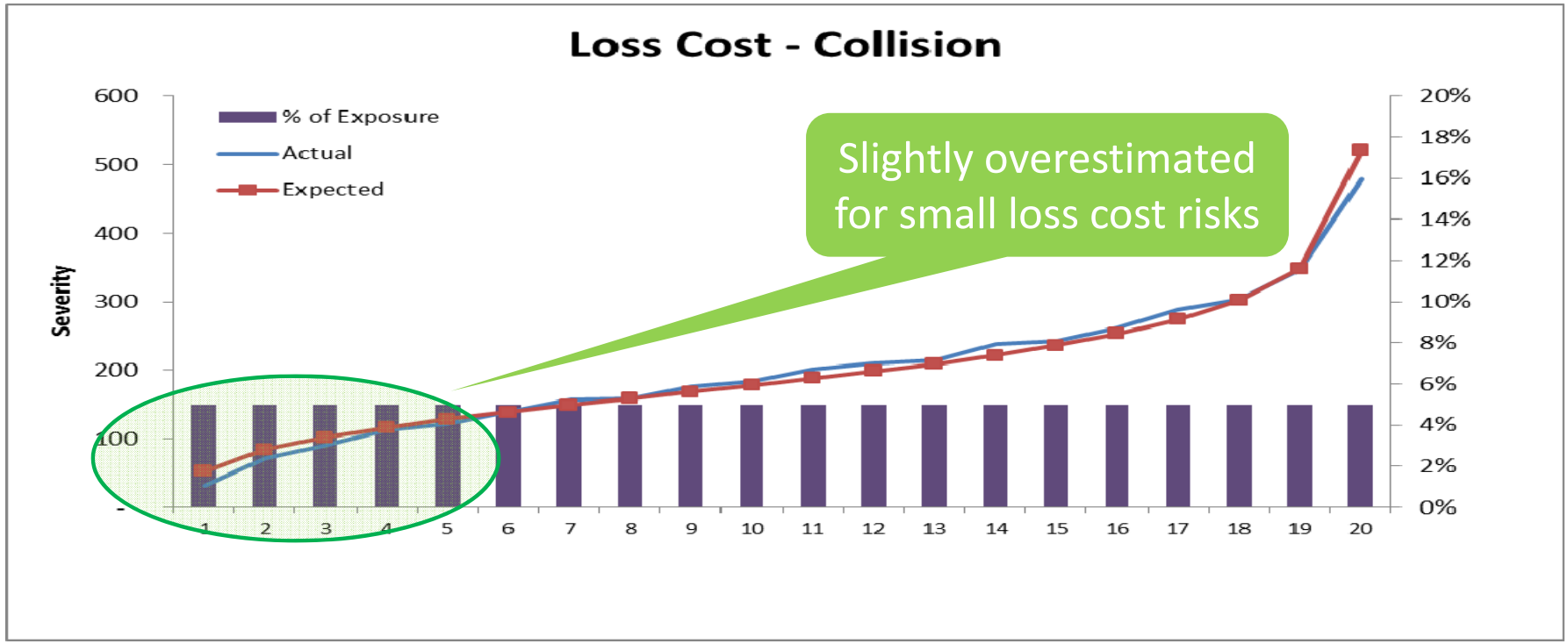
# Example 1 (Frequency-Severity): Ontario PPA – Collision (3)

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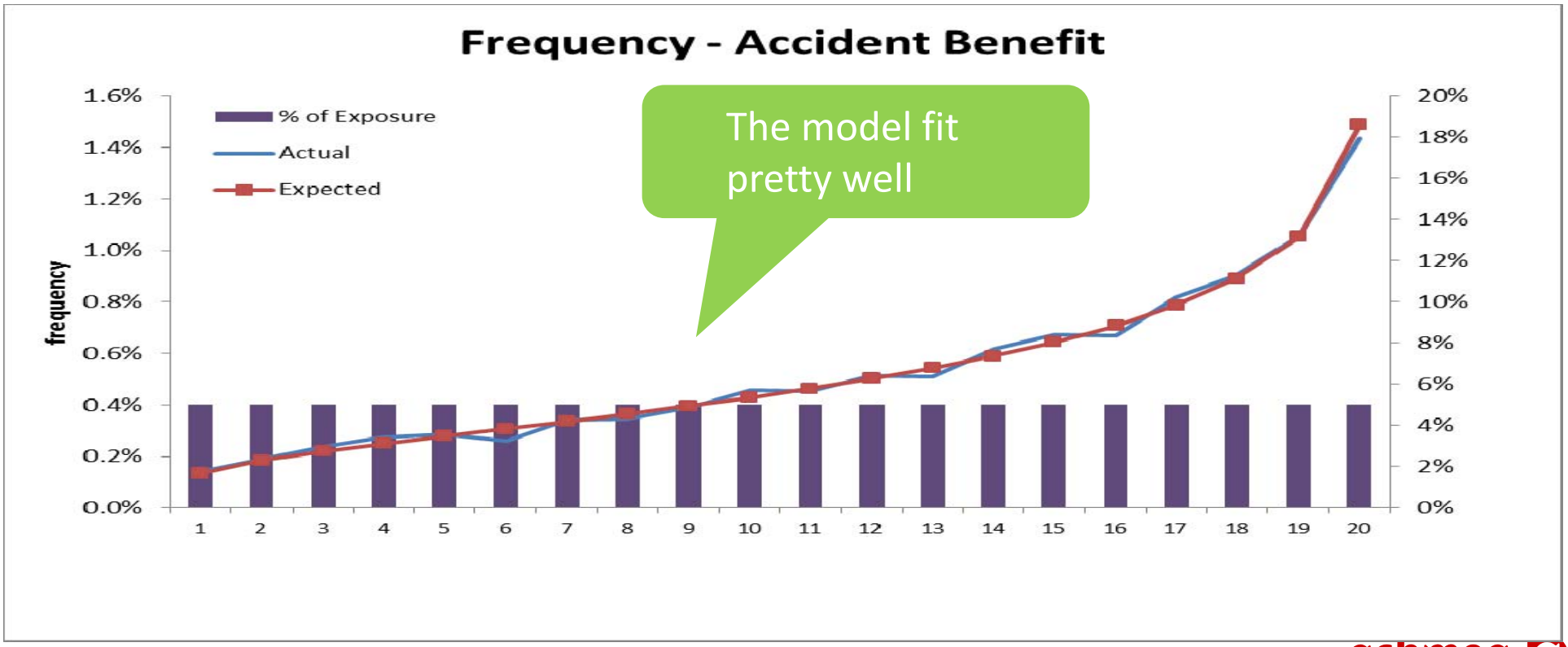
# Example 1 (Frequency-Severity): Ontario PPA – Collision (4)

The Frequency-Severity approach could provide good understanding of the way in which

- ❑ Factors affect the frequency
- ❑ Factors affect the severity
- ❑ The loss cost also has very good fit

# Example 2 (Frequency-Severity): Ontario PPA – Accident Benefit (1)

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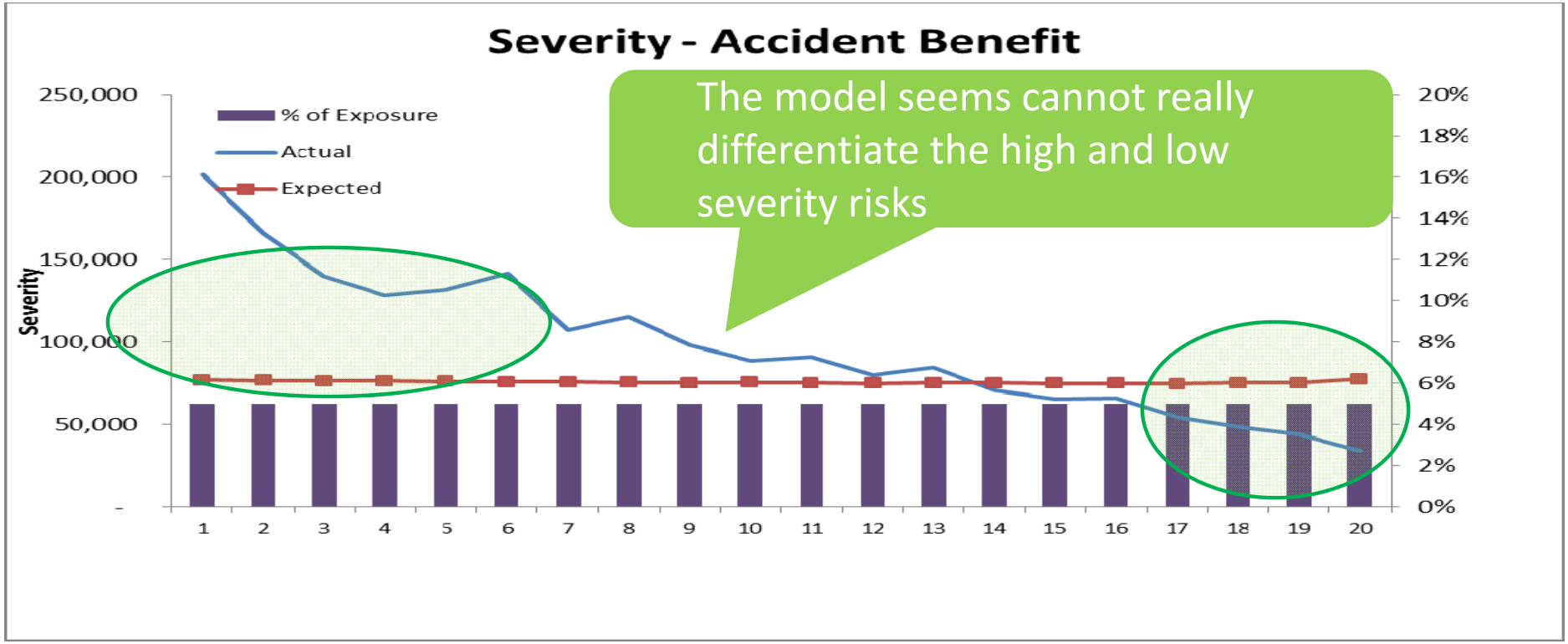
# Example 2 (Frequency-Severity): Ontario PPA – Accident Benefit (2)

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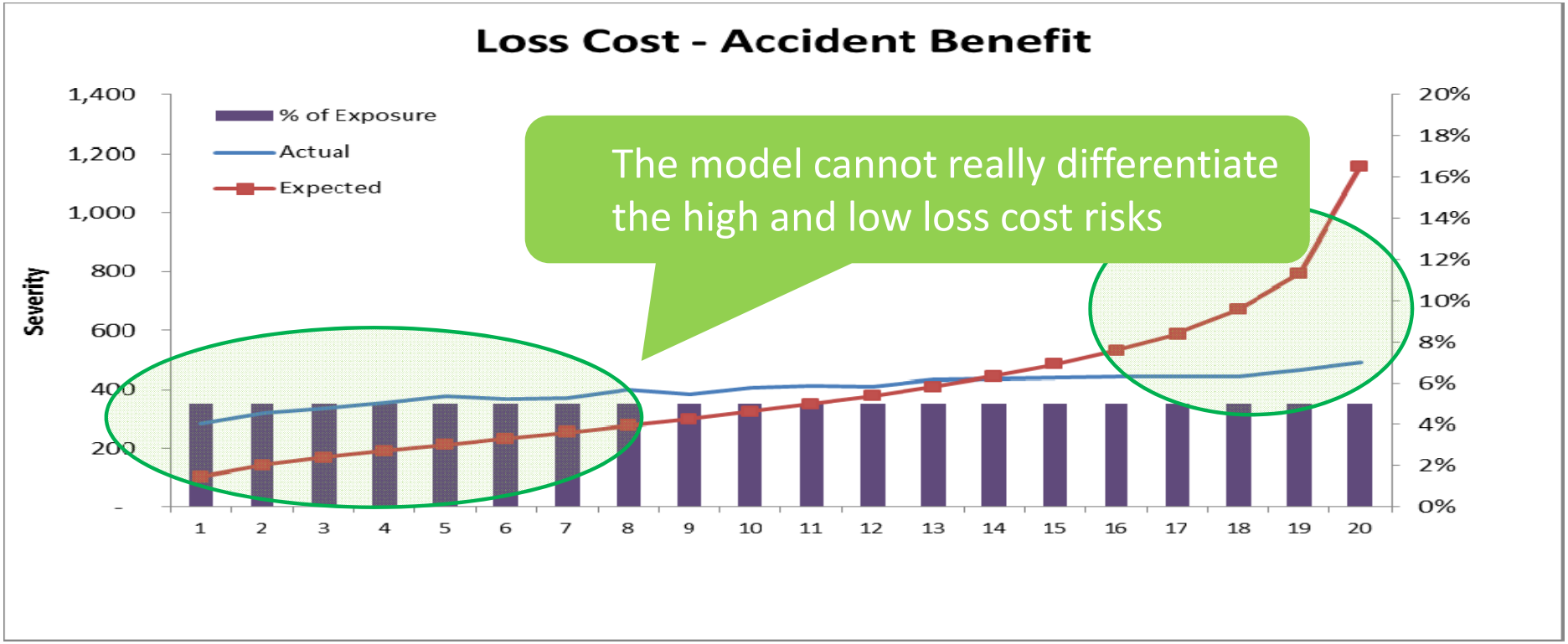
# Example 2 (Frequency-Severity): Ontario PPA – Accident Benefit (3)

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# Example 2 (Frequency-Severity): Ontario PPA – Accident Benefit (4)

The Frequency-Severity approach could provide good understanding of the way in which

- ❑ factors affect the frequency
- ❑ But not for severity
- ❑ The final cost also does NOT has very good fit
- ❑ Further adjustment is needed

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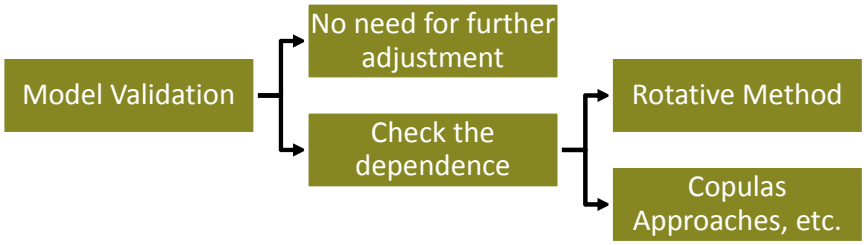
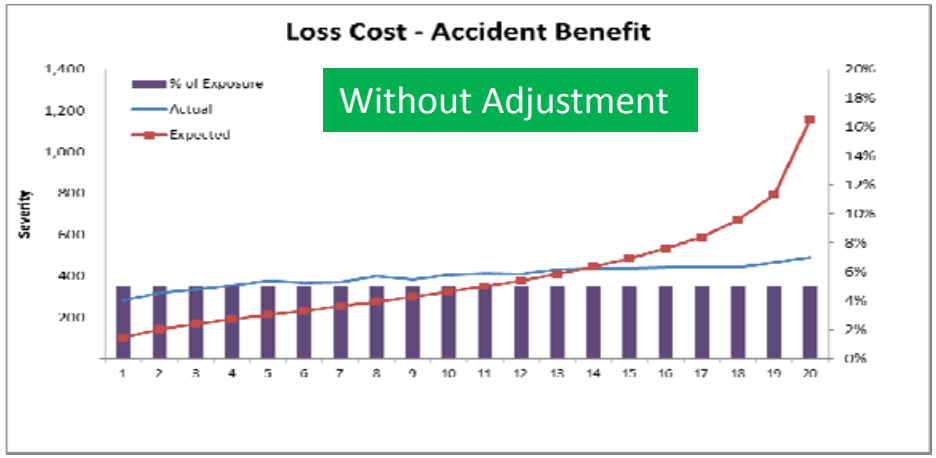
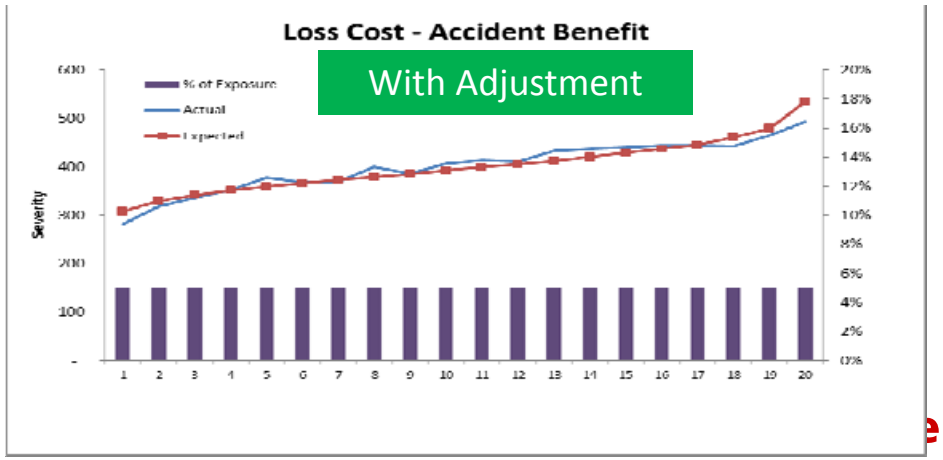
# Example 2 (Frequency-Severity): Ontario PPA – Accident Benefit(5)

Adjustment for Dependence

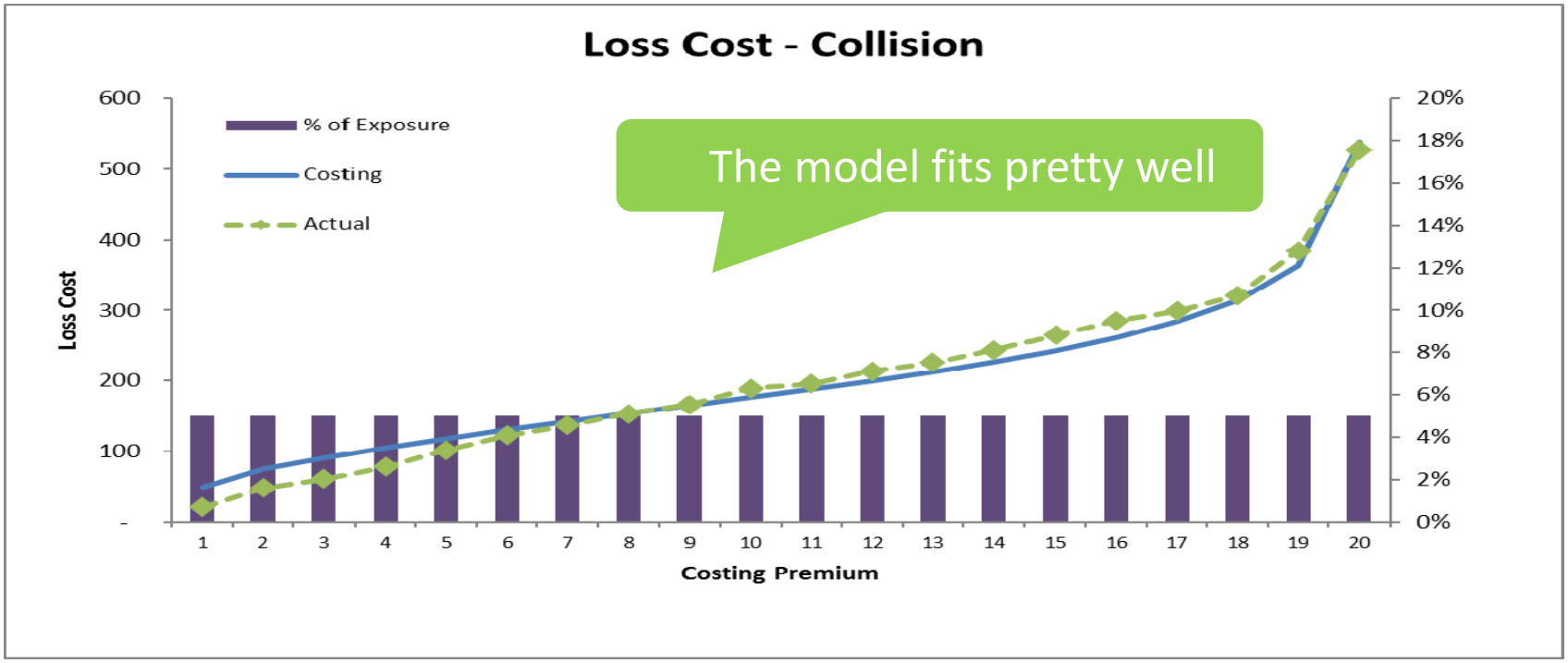



Some intensive iterative process can be done to adjust the correlation between frequency and severity to improve the Accident Benefit Model.

# Example 3 (Loss Cost): Ontario PPA – Collision (1)

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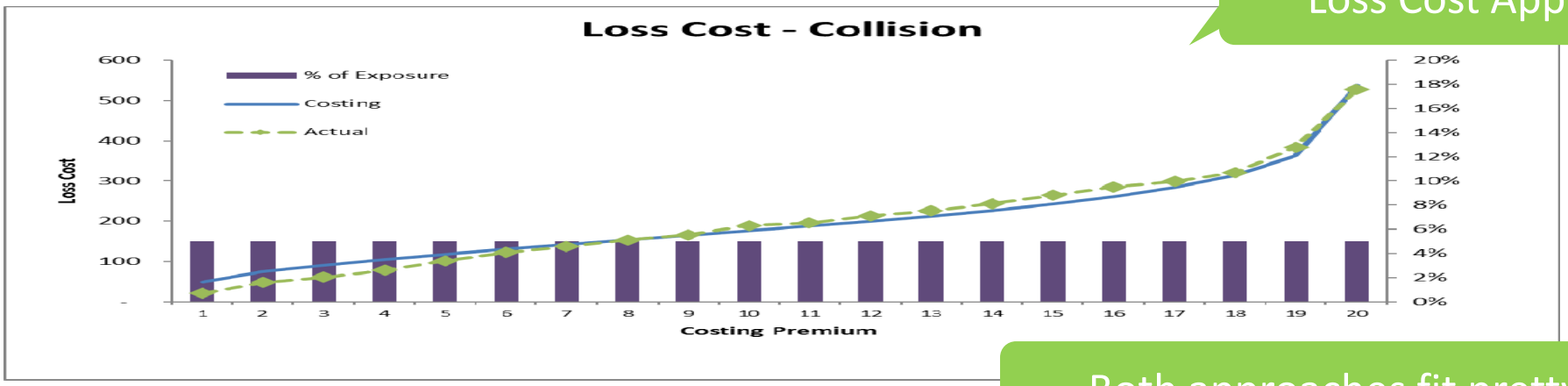
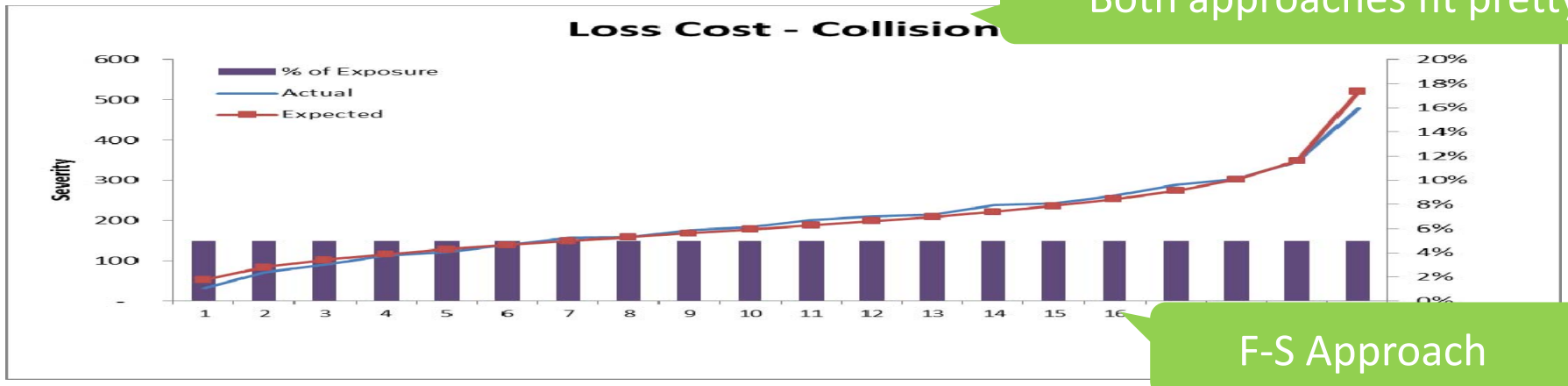
# Example 3 (Loss Cost): Ontario PPA – Collision (2)



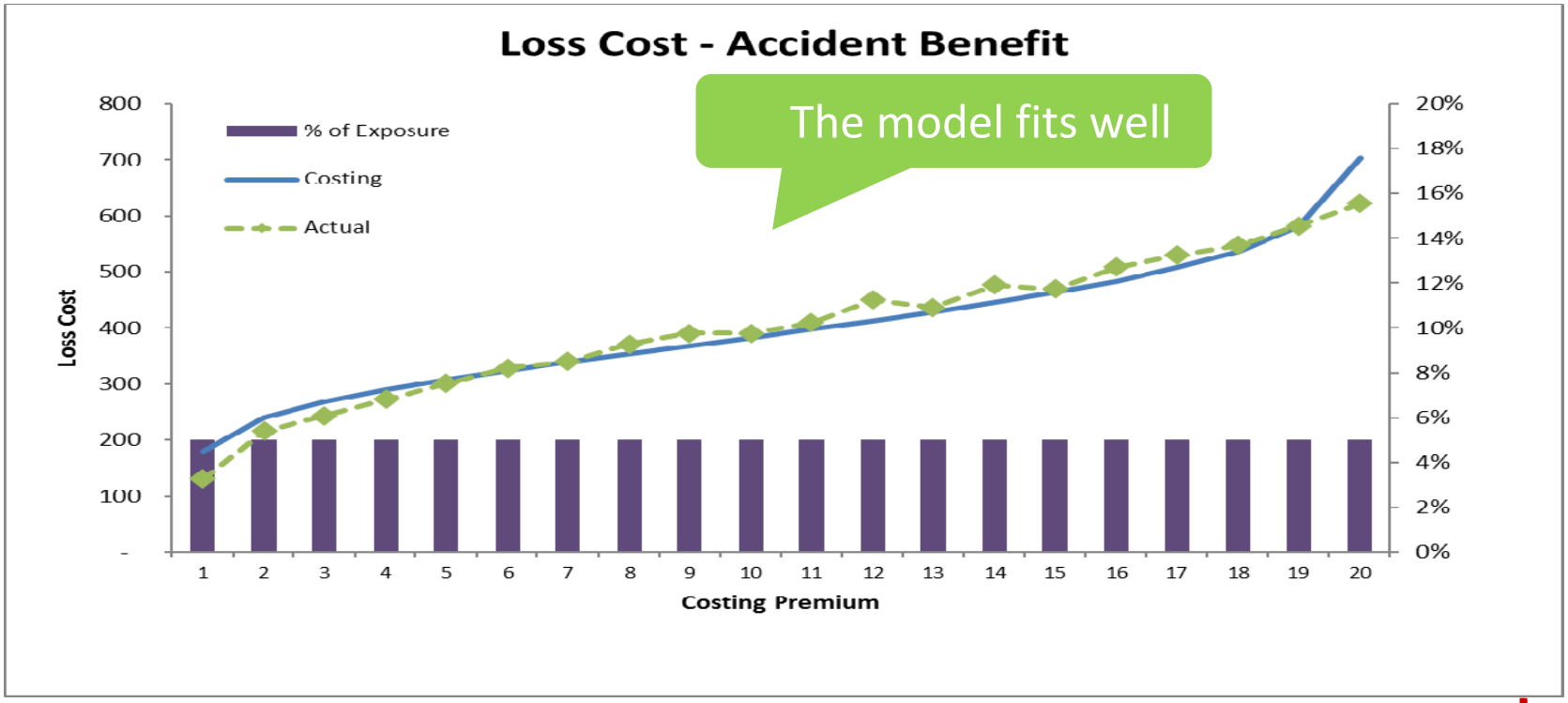

Loss Cost Approach

Both approaches fit pretty well.




F-S Approach

# Example 4 (Loss Cost): Ontario PPA – Accident Benefit (1)

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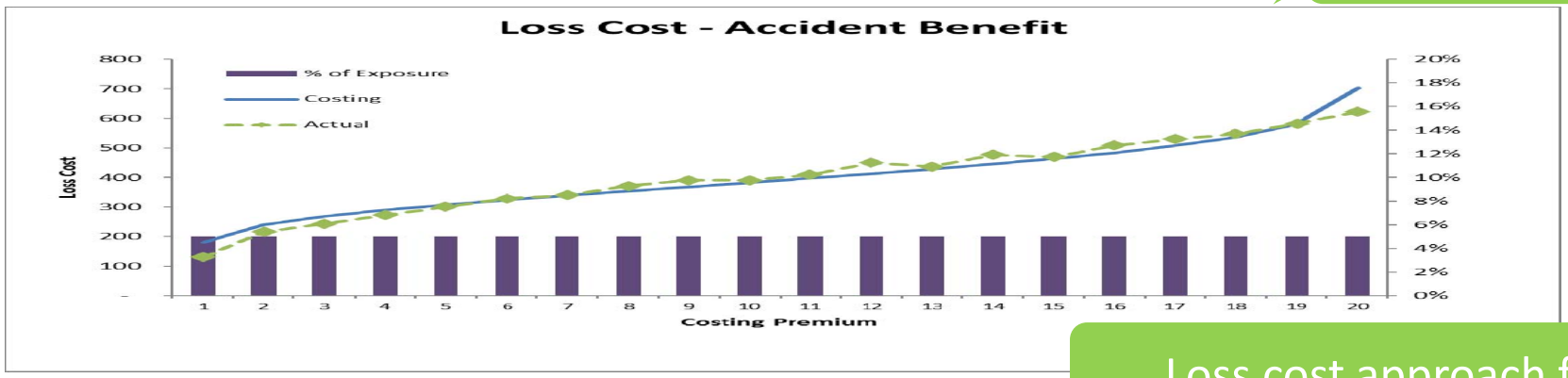
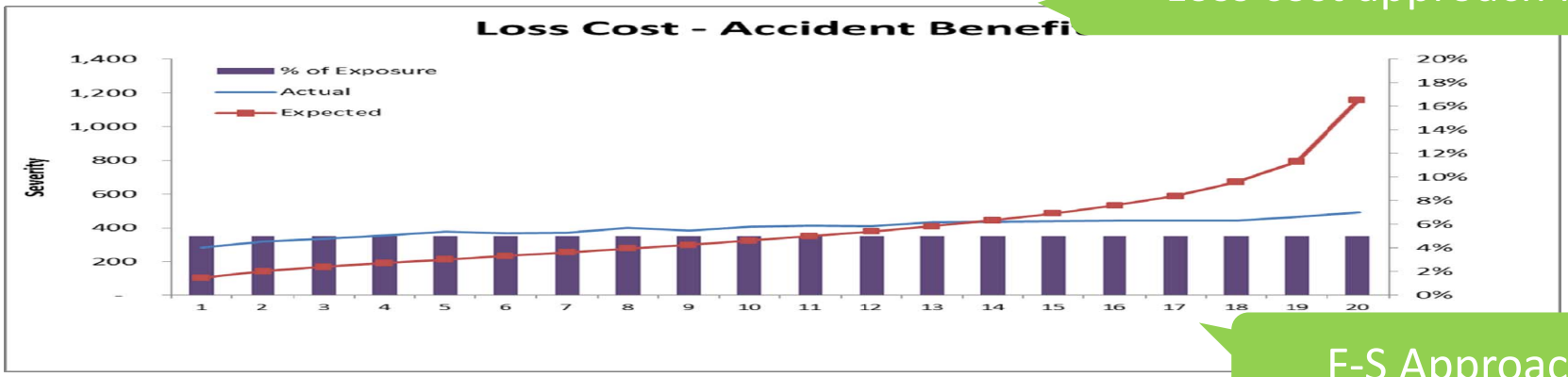
# Example 4 (Loss Cost): Ontario PPA – Accident Benefit (2)

Loss Cost Approach




Loss cost approach fits better




F-S Approach

# Ontario PPA – Collision & Accident Benefit Summary

The Loss Cost approach

- ❑ Could provide as good results as frequency severity approach for collision
- ❑ Could provide much better results than frequency severity for Accident Benefit
- ❑ No need for iteration to include correlations to adjust frequency severity model for accident benefit

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## Quick overview of Pros and Cons for the two GLM modelling approaches

- Frequency & Severity Approach:
  - ✓ Provide a better understanding of which factors affect the cost of claims
  - ✓ Can more easily allow the identification and removal of certain factors from frequency or severity model
  - ✓ May need to adjust to correlation
- Loss Cost Approach:
  - ✓ Reduce the amount of modeling work
  - ✓ Correlation between frequency and severity has been implicitly included
  - ✓ Might loss some of the useful insights

**Conclusions:**

- Both Loss Cost Modeling vs. Frequency and Severity Modeling has pros and cons
- When there are strong correlation between frequency and severity or correlation between explanatory variables
  - ✓ Frequency model can be used to adjust severity model to have a much more accurate loss cost model than simply multiple frequency and severity model results together
  - ✓ Loss cost modeling approach can be simpler and more robust

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# Q&A: