

# Project Risk & Simulation

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# Outline

- What is Risk anyway?
- Risk Attitudes
- Uncertainty
- Simple ROM estimate
- Scenarios vs. Simulations
- Addressing uncertainty through simulation
- How to define risks in an era of simulation

# What is Risk anyway?

- The *probability* of an event with negative consequences
- The *likelihood* of an *uncertain* amount of loss
- Exposure to a chance event with a negative outcome
- The *potential* for realization of unwanted, adverse consequences
- The *possibility* that something unpleasant will happen
- The quantitative measurement of an outcome which can be *predicted*

The terms uncertainty and risk are often used interchangeably, but they shouldn't be: *Uncertainty is objective*, Risk is subjective

# Risk is in the Eye of the Beholder

- Everyone has a tolerance to uncertainty and a unique ***Risk Attitude***
- Fundamentally a question of whether an event has a material impact
  - Can only be established if asked with respect to what, or with respect to whom
- Different answers depending on the question
  - What is the risk to the project?
  - What is the risk to the department?
  - What is the risk to Canada?

# Three Categories of Uncertainty

## 1. Reducible (epistemic) uncertainty

- Refers to limited knowledge we may have about an artefact
- Can usually 'buy' or obtain more knowledge / data

## 2. Irreducible (aleatory) uncertainty

- Refers to the inherent variability in a system and cannot be reduced with increased knowledge/information
- E.g. a car's engine RPM varies as you drive down the street
- Not a lack of information – it is a naturally occurring process. Therefore we need to provide margin for events materializing from aleatory type uncertainties

## 3. Error

- E.g.  $2+2=5$

# Simple ROM Estimate (CY\$2000)

Institution	Carleton	University of Toronto	Harvard	Oxford
	CAD	CAD	USD	GBP
Tuition	\$4,000	\$5,000	\$23,000	£16,000
Room & Board	\$7,000	\$9,000	\$11,000	£12,000
Books	\$1,000	\$1,000	\$1,000	£1,000
Car	\$0	\$2,000	\$2,000	£0
Travel (5 trips home)	\$0	\$3,000	\$3,000	£4,500
<b>1-year TOTAL</b>	<b>\$12,000</b>	<b>\$20,000</b>	<b>\$40,000</b>	<b>£33,500</b>
<b>4-year TOTAL</b>	<b>\$36,000</b>	<b>\$80,000</b>	<b>\$160,000</b>	<b>£134,000</b>

# Simple ROM Estimate (CY\$2018)

Institution	Carleton	University of Toronto	Harvard	Oxford
	CAD	CAD	USD:CAD = 1.28	GBP:CAD = 1.77
Tuition	\$17,139	\$18,567	\$42,048	\$40,448
Room & Board	\$9,998	\$12,854	\$20,110	\$30,336
Books	\$1,428	\$1,428	\$1,828	\$2,528
Car	\$0	\$2,856	\$3,656	\$0
Travel (5 trips home)	\$0	\$4,285	\$5,484	\$11,376
<b>1-year TOTAL</b>	<b>\$28,565</b>	<b>\$39,991</b>	<b>\$73,126</b>	<b>\$84,688</b>
<b>4-year TOTAL</b>	<b>\$114,260</b>	<b>\$159,964</b>	<b>\$292,505</b>	<b>\$338,751</b>

# Scenarios

- A unique set of inputs which represent a possible future
- Typically only considered in small batches (~5-10)
- Often incorporate best/worst bounding cases



# FOREX - Scenarios



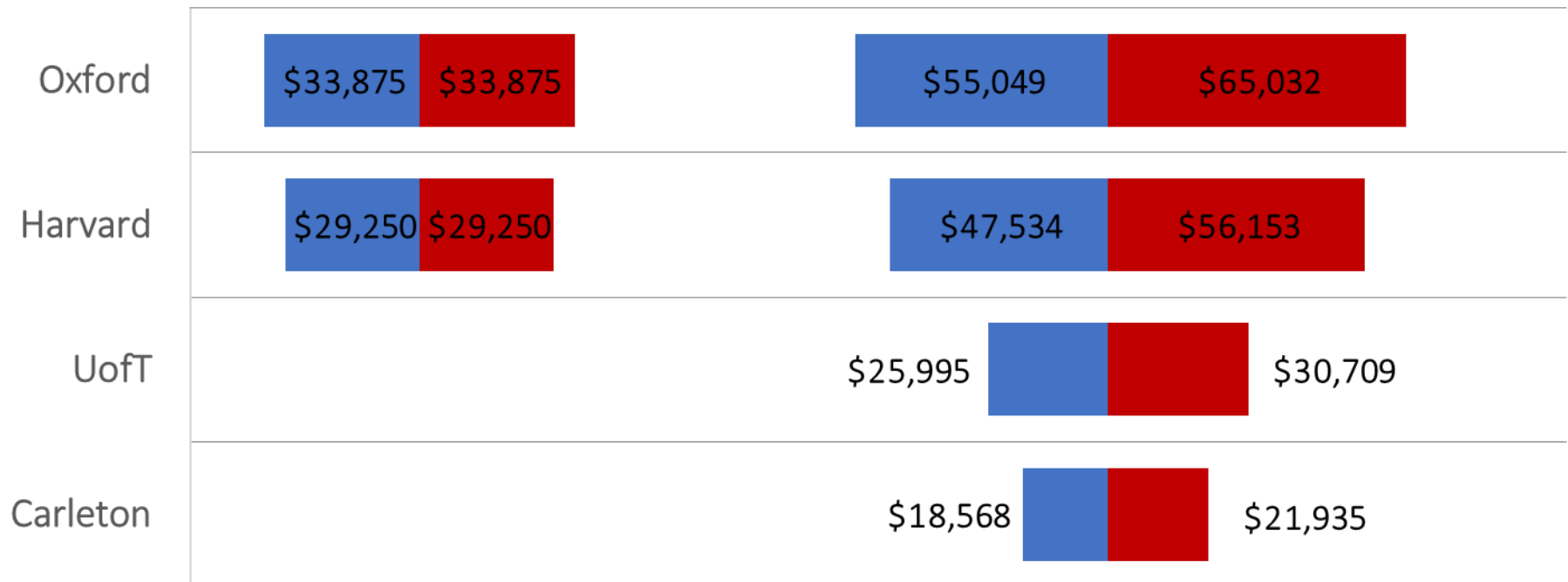
# Simple 'Sensitivity'

## FOREX

Assume  $\pm 10\%$

## INFLATION

Assume  $\pm 1\%$



# Scenarios & Simulations

- A unique set of inputs which represent a possible future
  - Typically only considered in small batches (~5-10)
  - Often incorporate best/worst bounding cases
- An ensemble of scenarios representing possible futures
  - Requires thousands (>50,000) of scenarios to be considered
  - Scenarios range from minor to extreme deviations

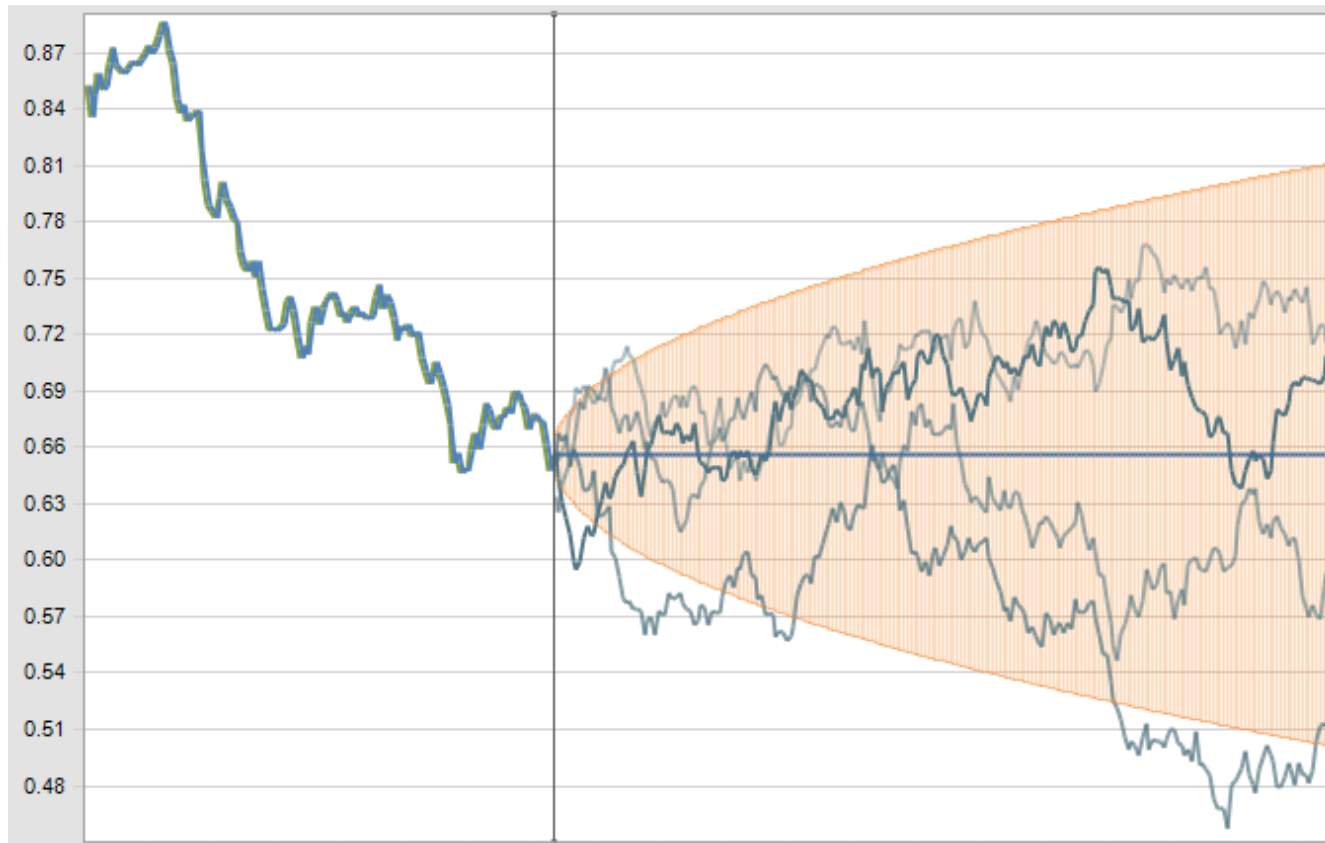
# FOREX - Simulation

- How to forecast into the future?



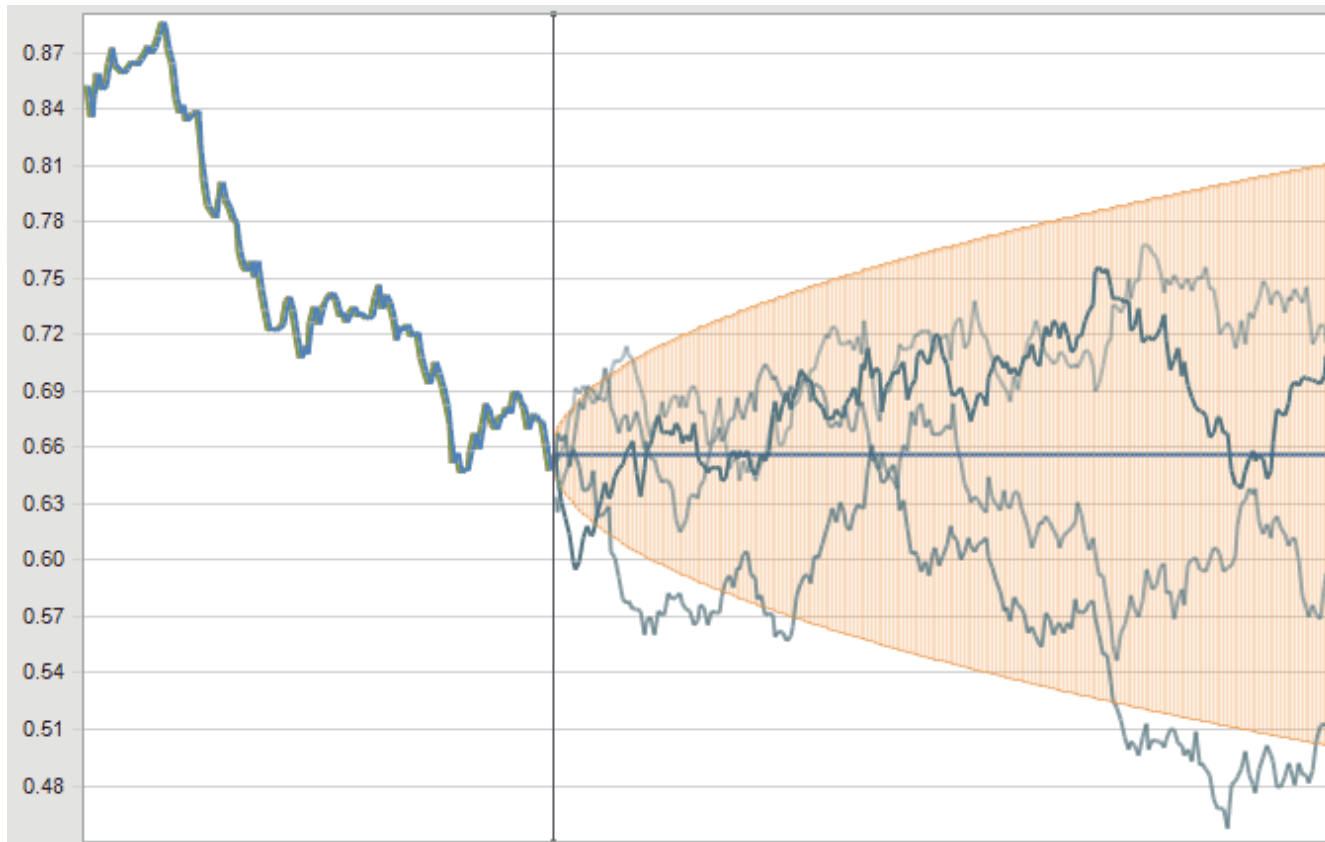
# FOREX - Simulation

- Possible to model using Random Walk

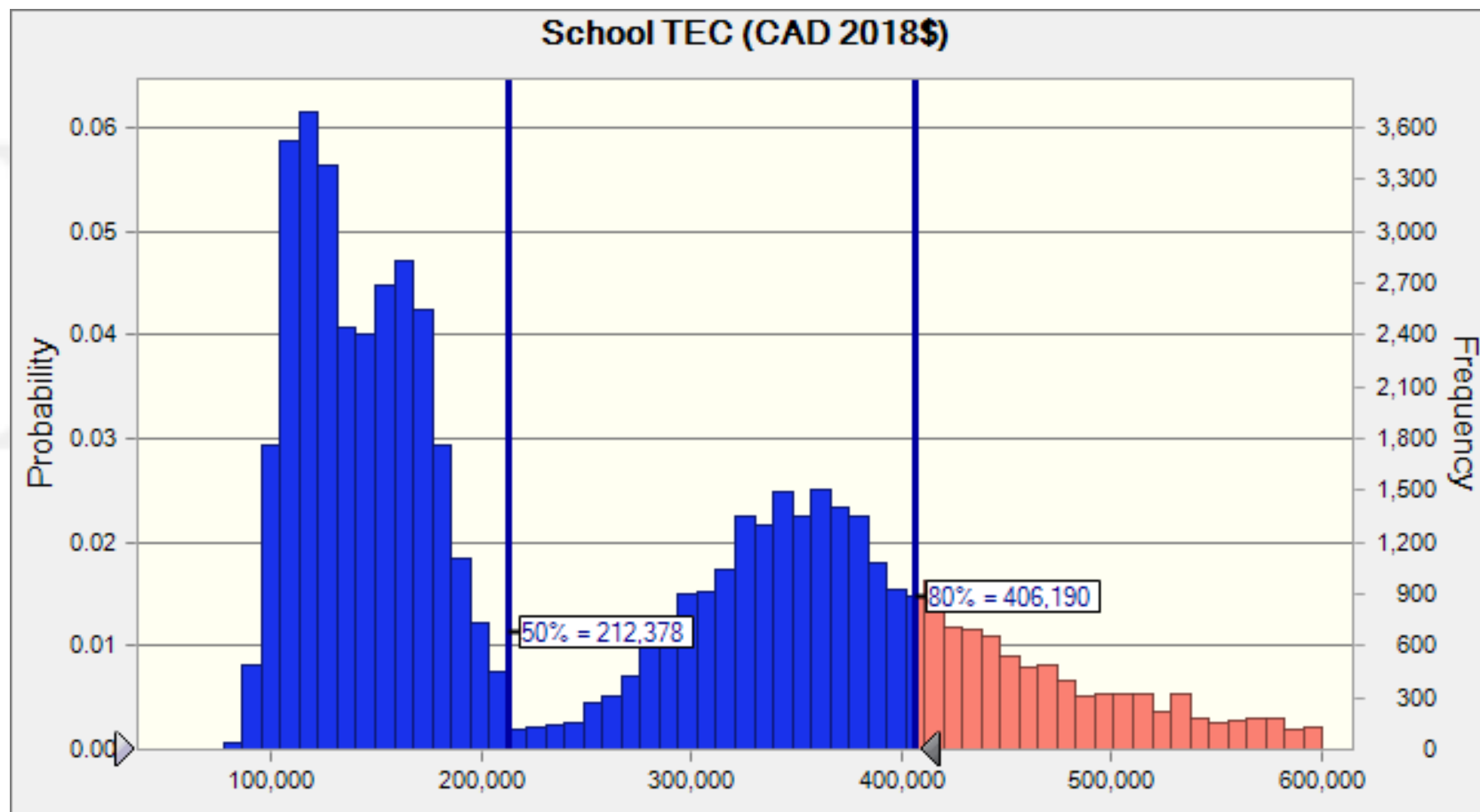


# FOREX - Simulation

- Possible to model using Random Walk



# Simple Example (simulation)



# Risks and Simulations

- Traditional 'risks' are more appropriately dealt with via uncertainty analysis, e.g.
  - FOREX *risk* is a misnomer
  - more accurate to speak of FOREX *exposure*
- Events that are 100% likely to materialize, aren't risks
- Risk registers still have a place in cost estimation



# Questions

