CASE 7: GOLD CLAIM AT STURGEON LAKE

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OUTLINE

- Problem Statement
- Assumptions
- Model Development
- Base Solution
- Sensitivity Analysis
- Conclusion

PROBLEM STATEMENT

- **Grant Murphy** owned two mining claims to property on Sturgeon Lake near Thunder Bay, Ontario.

- His friend, Andrew McKendry, a freelance geologist was asked for advice on the mining claims in **February 2009**. That is, whether **there was enough gold** in the property to pursue an economically feasible mining opportunity.

- The key problem was to help Grant Murphy make the decision by determining **the value of the gold** and the **cost of developing** the mine.

- There are 3 options: Do nothing, build a temporary road, or build a permanent road.

ASSUMPTIONS

- Grant Murphy's property only included **one mine**.

- The **price of gold** would very likely be unpredictable. In the base solution, the gold price in the next 10 years follows a **triangular distribution with min = average min, mode=average mean, max=average max** from 1980 to 2008.

- The gold elemental density, the width, depth, length and the grade for the mine follow **uniform distributions**.

- The scales (length, width, and depth) of the property are assumed to be the average values of those of nearby similar properties.

ASSUMPTIONS

- The cost estimates illustrated in Exhibit 4 are assumed to be in **triangular distributions** since estimates are given.

- The process of drilling is assumed to **take no time** in the model.

- The temporary road is assumed to take one year to form.

- The cost of drilling and the sales of gold incur after each year's mining.
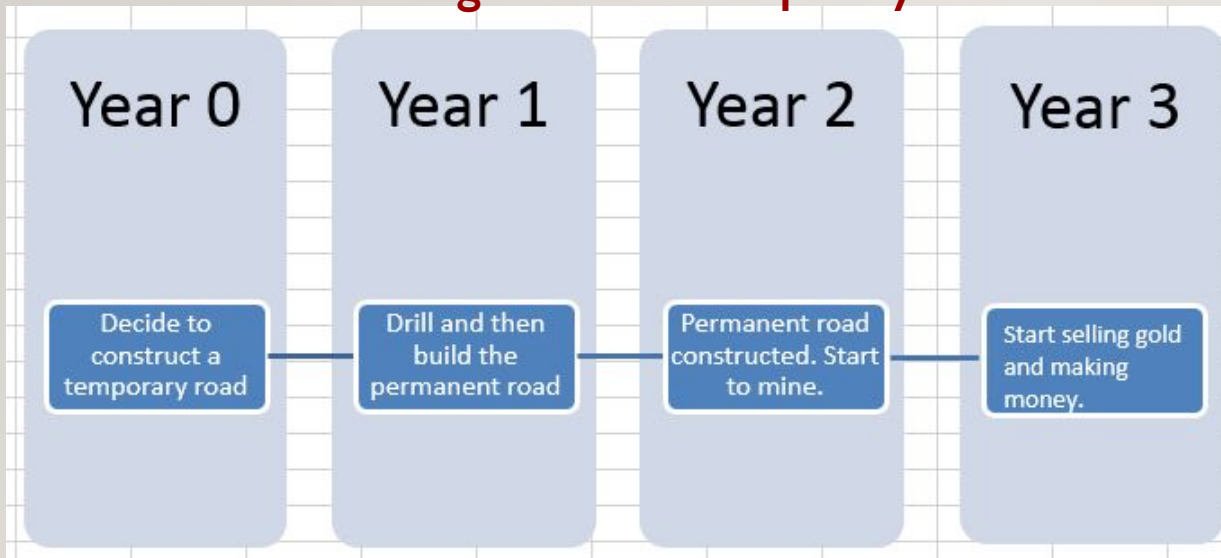
- Discount rate is 20%.

MODEL DEVELOPMENT

- Due to the existence of several decisions and uncertainties, **Excel** and its **@RISK** add-in were used to address this problem.

- Considering the uncertainties, the range and probability of profit in each decision is calculated and we will choose the option that gives the best chance of profit.

- Each of the **@RISK** simulations is ran 10,000 times.
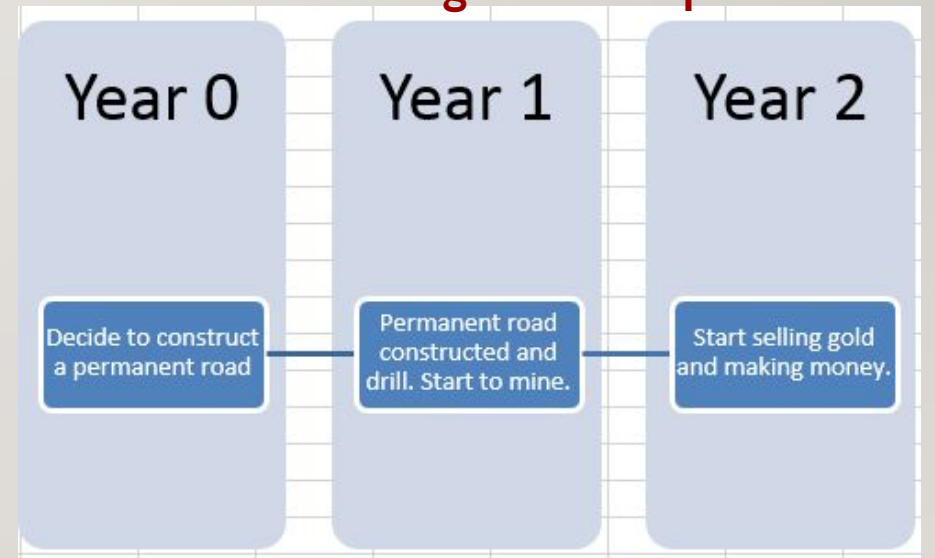
- Profit for each ounce of gold = current gold price – $30

MODEL DEVELOPMENT - Timeline

- This is an illustration of the timelines when assuming all of the procedures are successful.
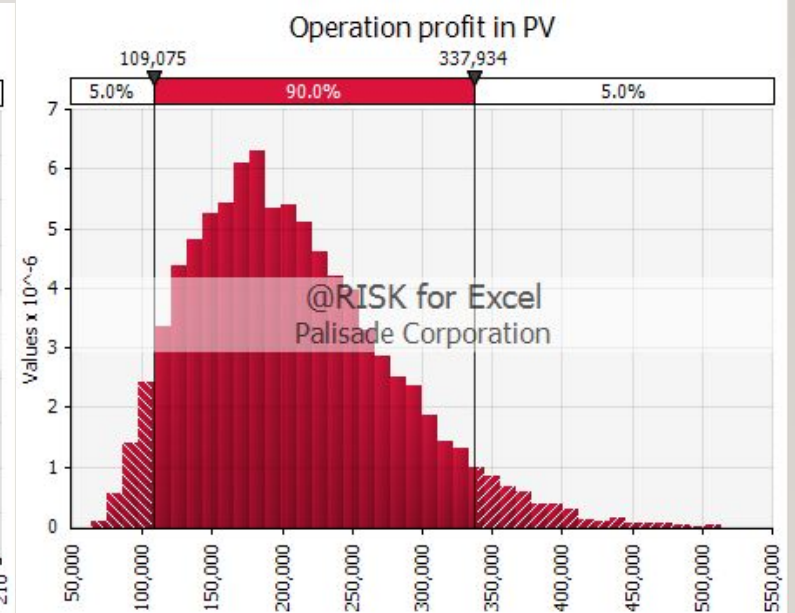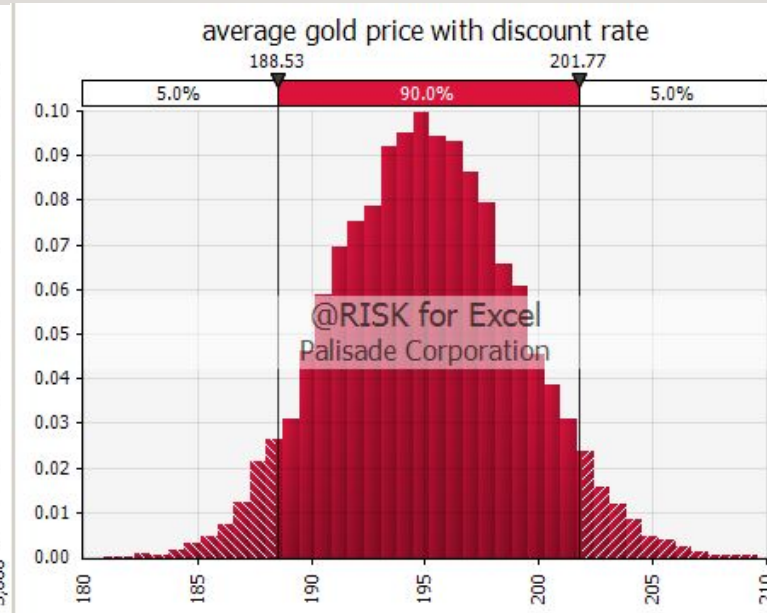
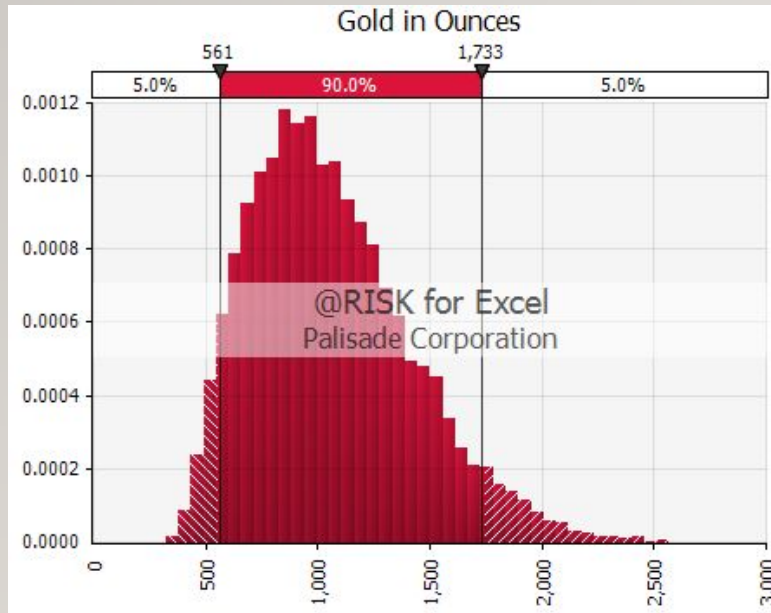**Timeline of choosing to build a temporary road**

Year 0	Year 1	Year 2	Year 3
Decide to construct a temporary road	Drill and then build the permanent road	Permanent road constructed. Start to mine.	Start selling gold and making money.

Timeline of choosing to build a permanent road

Year 0	Year 1	Year 2
Decide to construct a permanent road	Permanent road constructed and drill. Start to mine.	Start selling gold and making money.

# MODEL DEVELOPMENT – Operation income in PV (minus opearation cost, $30 per ounce)

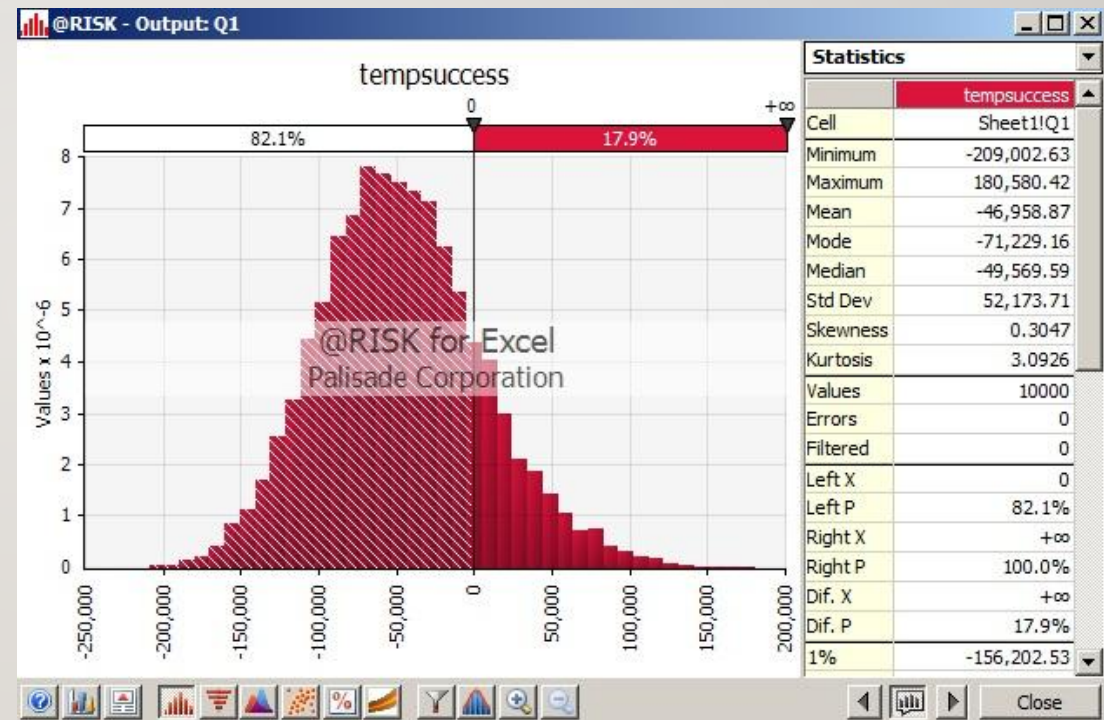# MODEL DEVELOPMENT – Cost of Option Temp. Road
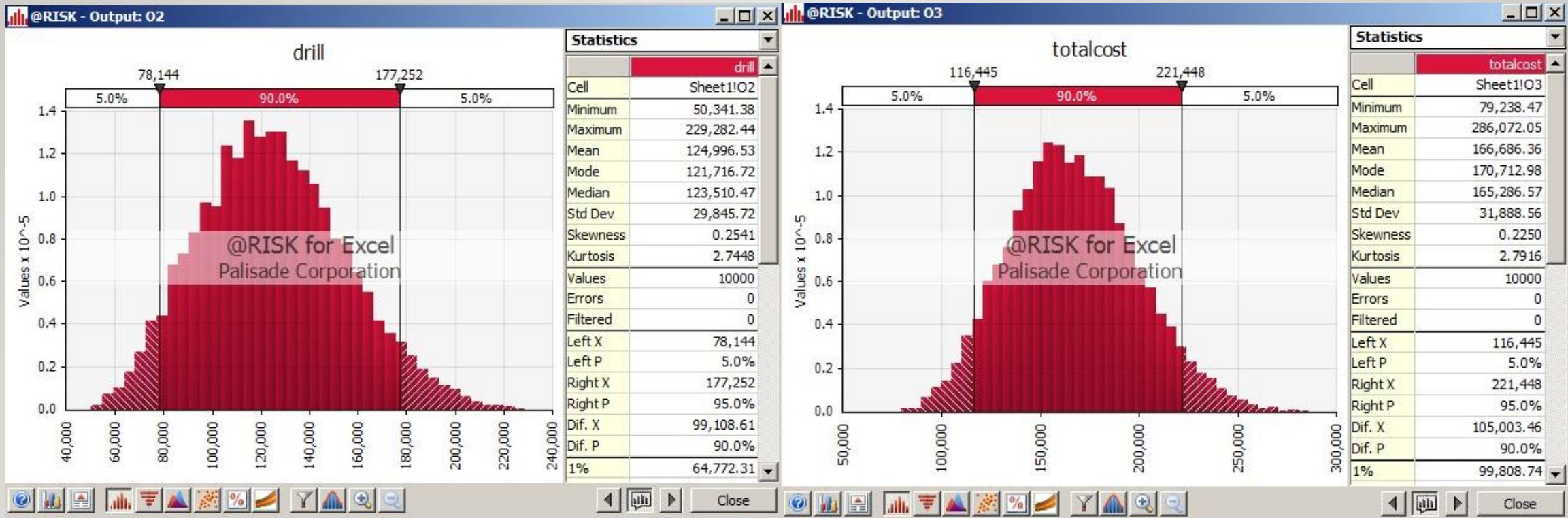
MODEL DEVELOPMENT – Enough Gold to Build Road?

- After a successful drilling, we can determine the amount of the gold in the mine and decide if we should build the road. It turns out that even with the smallest mine size possible (87,500), it would be more profitable to build a road (assuming road is successfully built) and sell the gold than to stop investing.
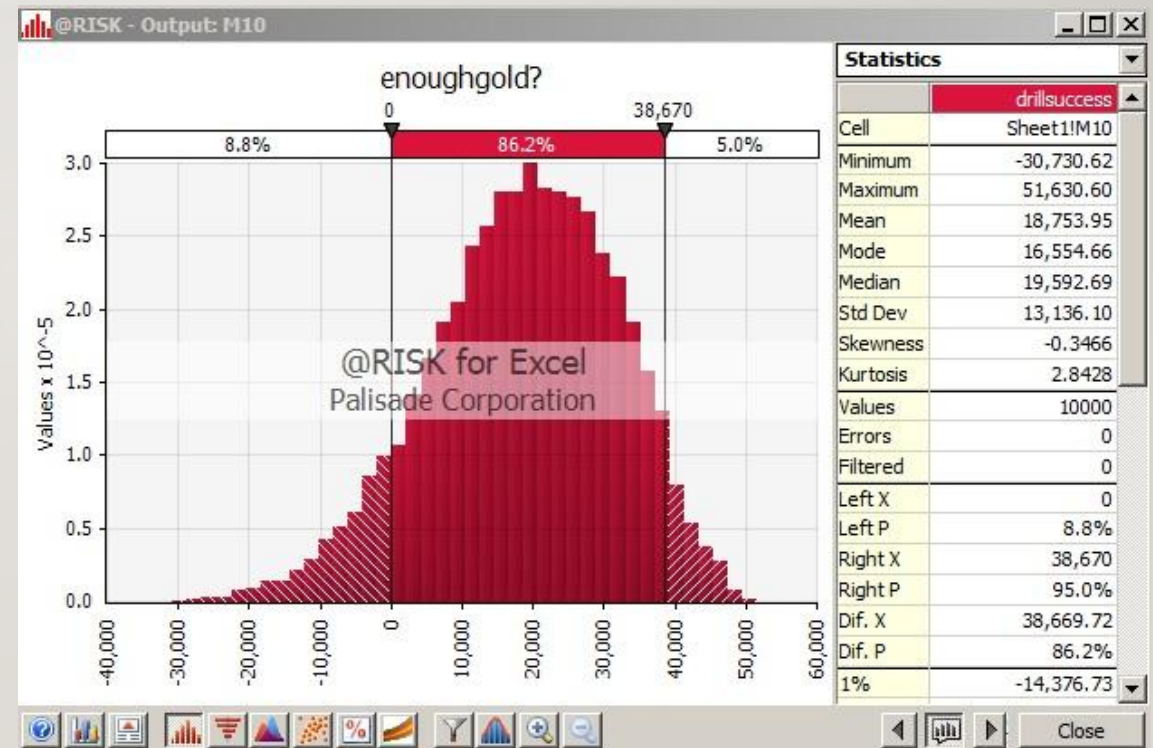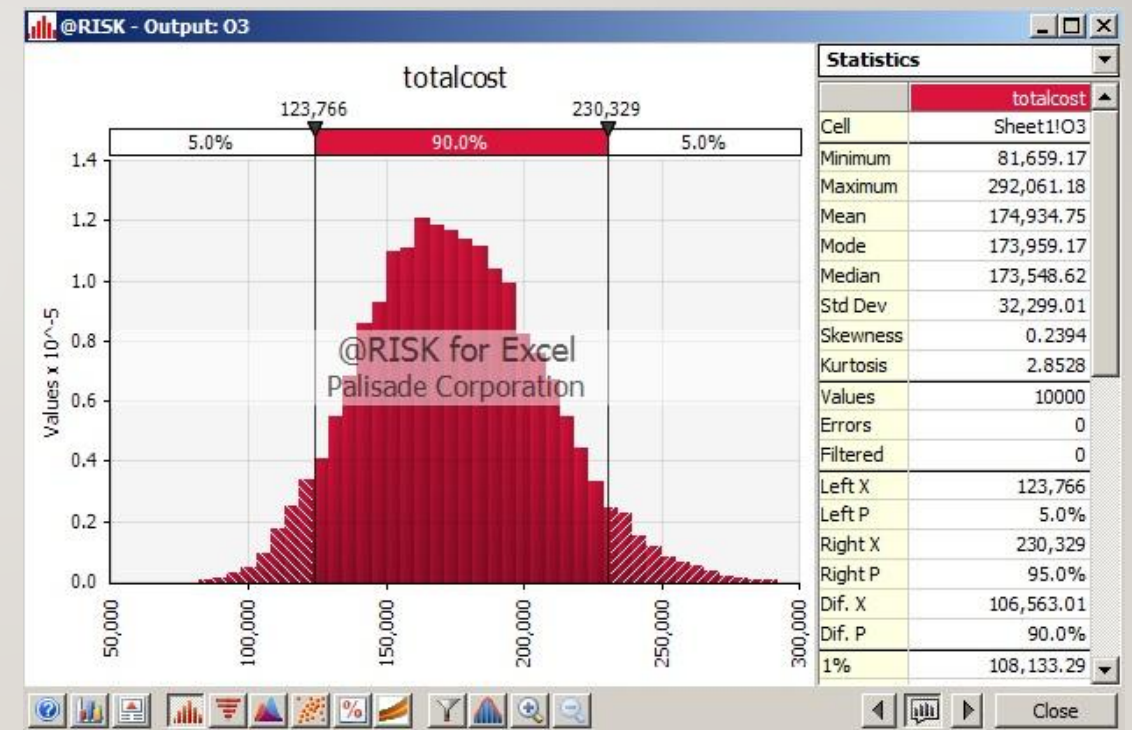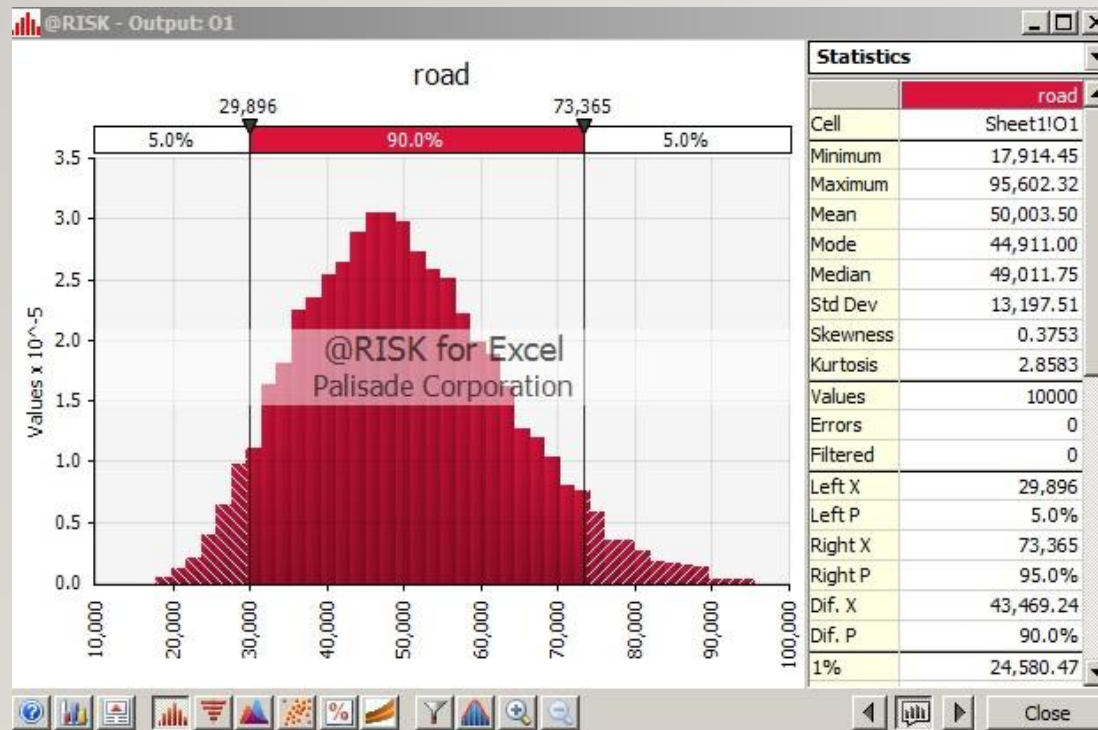
MODEL DEVELOPMENT – Profitability of Option Temp. Road

- 82.1% of chance of making a loss when both drilling and building the permanent road are successful
- Not a profitable option at all, considering the losses incurred when drilling or building the permanent road fail
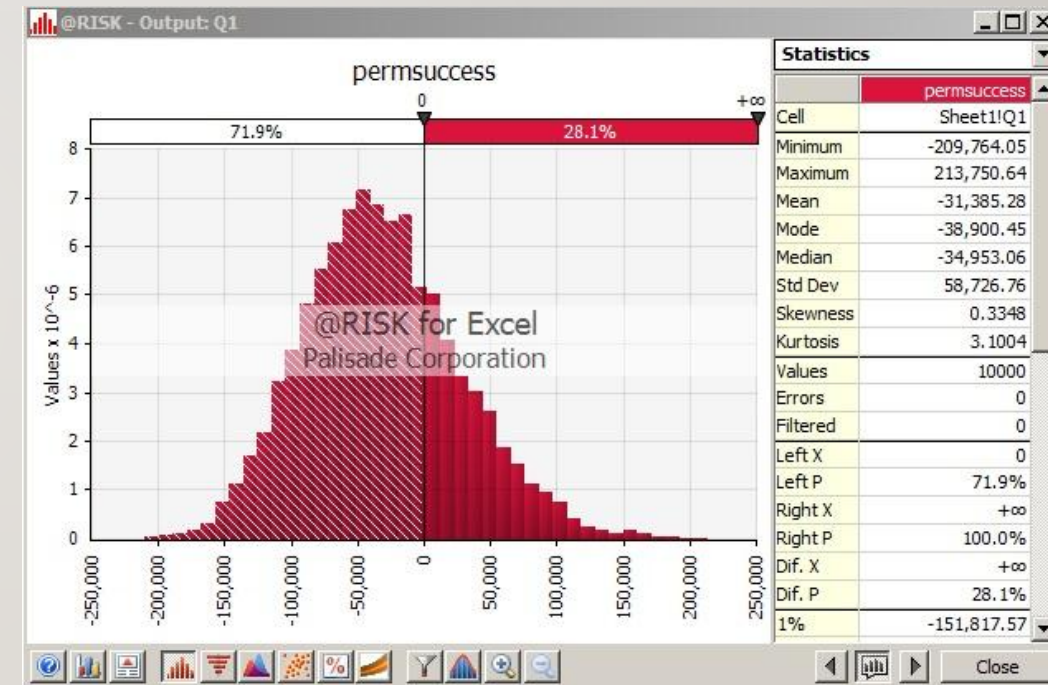
MODEL DEVELOPMENT – Cost of Option Perm. Road

MODEL DEVELOPMENT – Profitability of Option Perm. Road

- 71.9% of chance of making a loss when both drilling and building the permanent road are successful
- Not a profitable option at all, considering the losses incurred when drilling or building the permanent road fail

BASE SOLUTION

- To provide a more precise evaluation, we calculated the 95% confidence intervals of profits in different options/scenarios.

- As we know, the expected value of doing nothing is **$0, which is the best option**. The results of other decisions are shown in the next slides.

BASE SOLUTION – The Expected value of Constructing a Temporary Road at the Start

The Decisions and Outcomes	The Expected Value
The **drilling** process was **not successful** and the project was automatically abandoned.	–$177,252 ~ –$78,144
There was not enough gold and the following processes were abandoned (very unlikely).	–$177,252 ~ –$78,144
The **permanent road was constructed** successfully and the mine was developed.	–$128,244 ~ $44,173 (82.1% of the cases that the value is negative.)
The construction of the **permanent road** was **not successful** and the project was abandoned.	–$221,448 ~ –$116,445

BASE SOLUTION - The Expected value of Constructing a Permanent Road at the Start

The Decisions and Outcomes	The Expected Value
The construction of the **permanent road** was **not successful** and the project was abandoned.	-$73,365 ~ -$29,896
The construction of the **permanent road** was **successful** and the **drilling process** was **successful.** The mining process went on well.	-$120,781 ~ $72,432 (71.9% of the cases that the value is negative.)
The construction of the **permanent road** was **successful** but the **drilling process failed**. The project was abandoned.	-$230,329 ~ -$123,766

BASE SOLUTION - Decision Tree
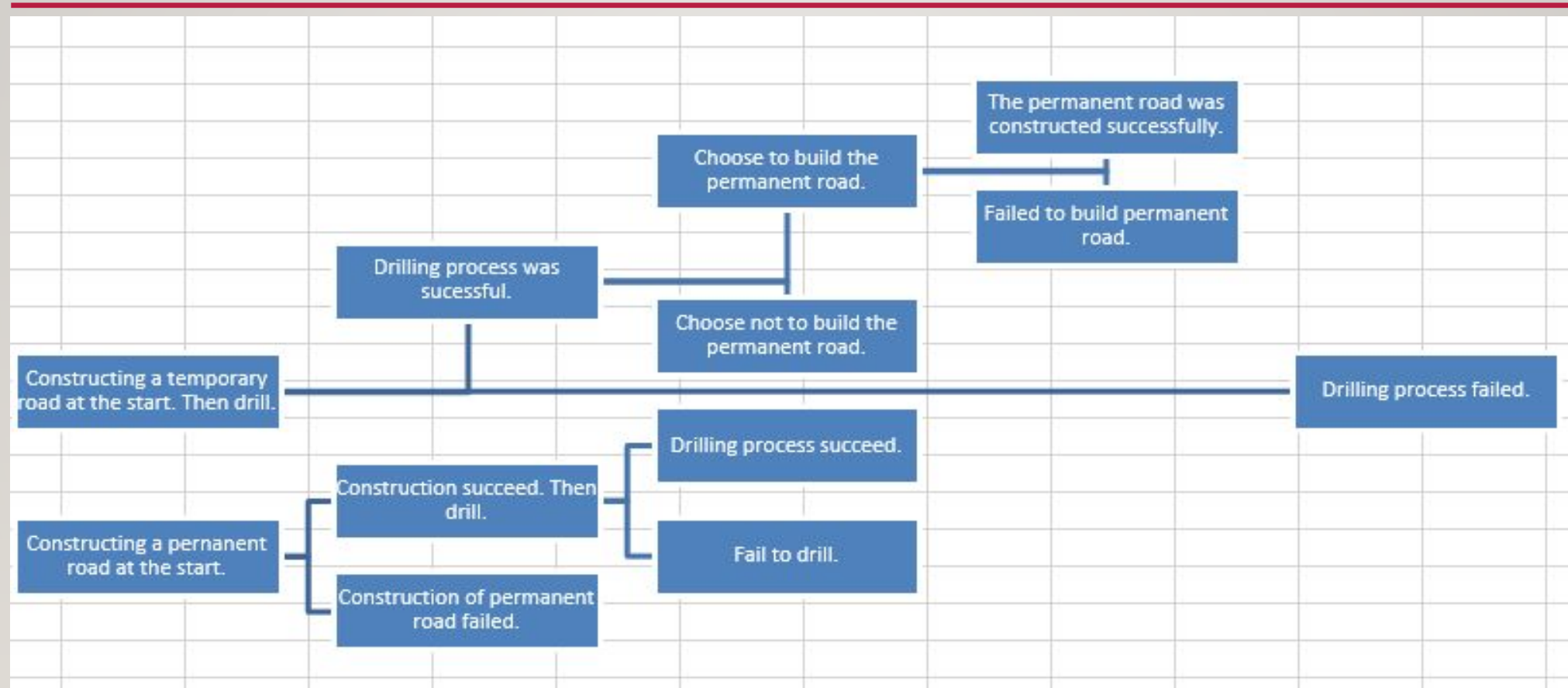
SENSITIVITY ANALYSIS 1- Amount of Gold

- As mentioned in the assumptions, the scales (length, width, and depth) of the property are assumed to be the average values of those of nearby similar properties.
- However, there are values that are distinctively large/small.
- So in this sensitivity analysis, **the largest values** and **the smallest values** of **width & length** would **not be used** in order to get a more accurate value.
- For width, we trimmed the 2 largest and 2 smallest mins and maxs
- For length, we trimmed the 1 largest and 1 smallest min and max

SENSITIVITY ANALYSIS 1- Results

- Turns out it becomes even less profitable for both options.
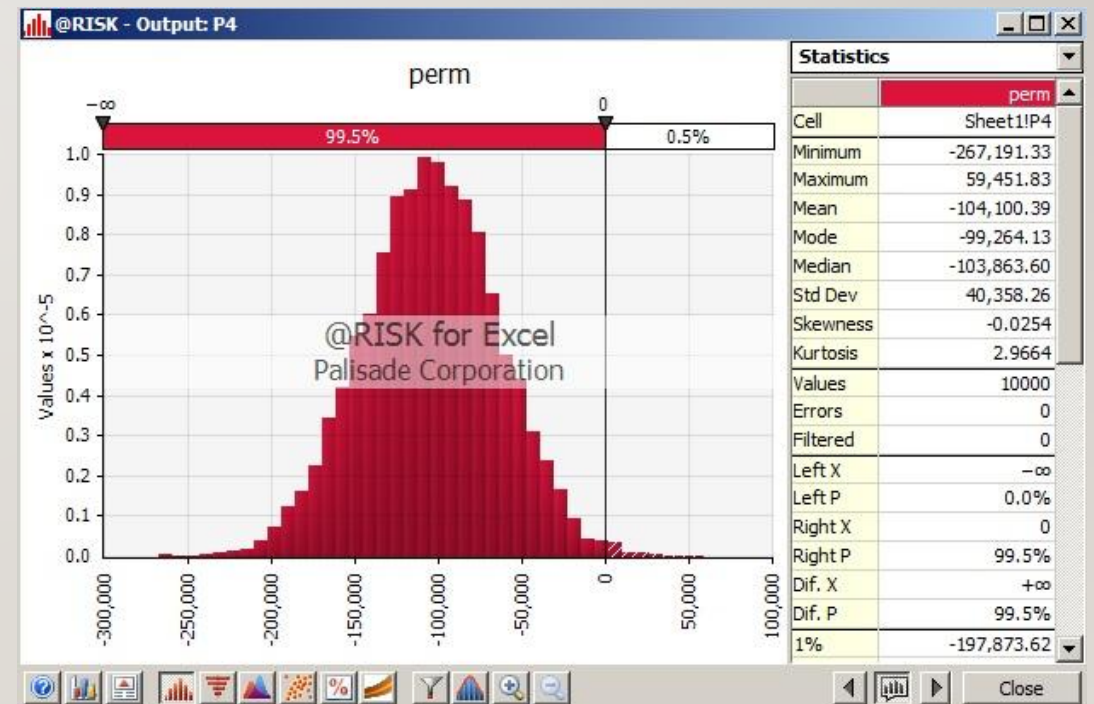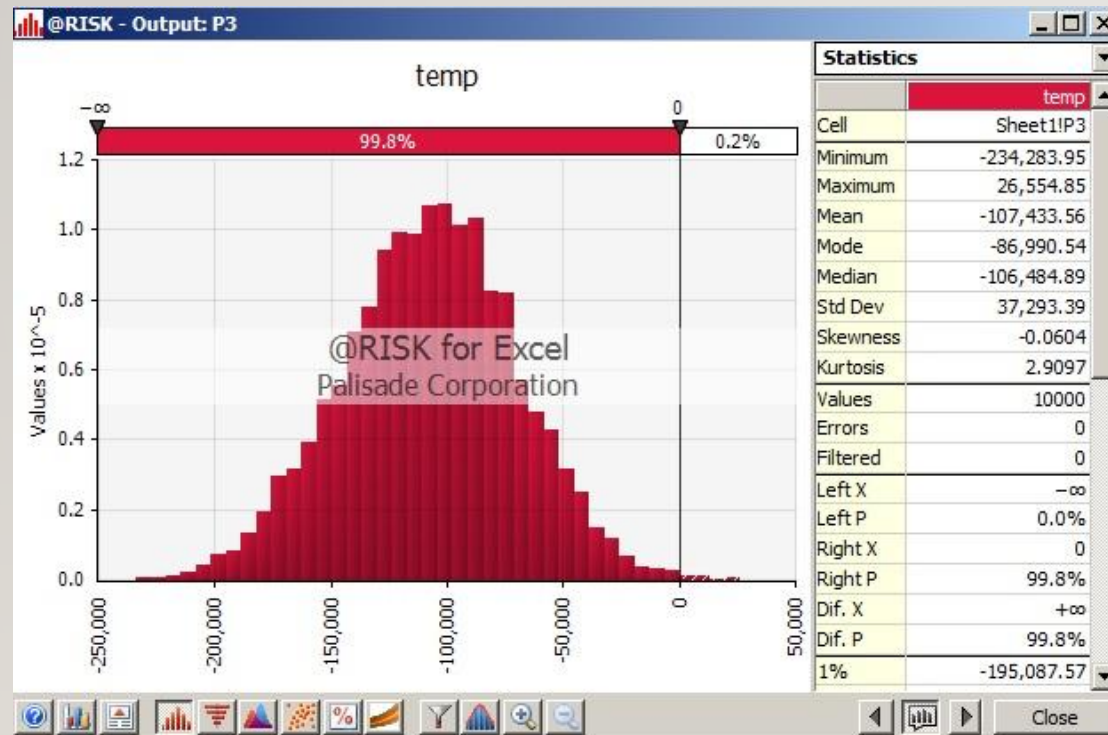
SENSITIVITY ANALYSIS 2- Gold Price

- The gold price in the past 28 years have been extremely unpredictable

- If we can actually predict the gold price in the next 10 years, we would be investing in gold rather than extracting gold mines

- To address the total unpredictability of gold price, we decide to use a **uniform distribution** with the all time **min (253)** and **max(1011)** in the past 28 years.

SENSITIVITY ANALYSIS 2 – Operation Income

- As we can see, the operation income in PV increase dramatically.
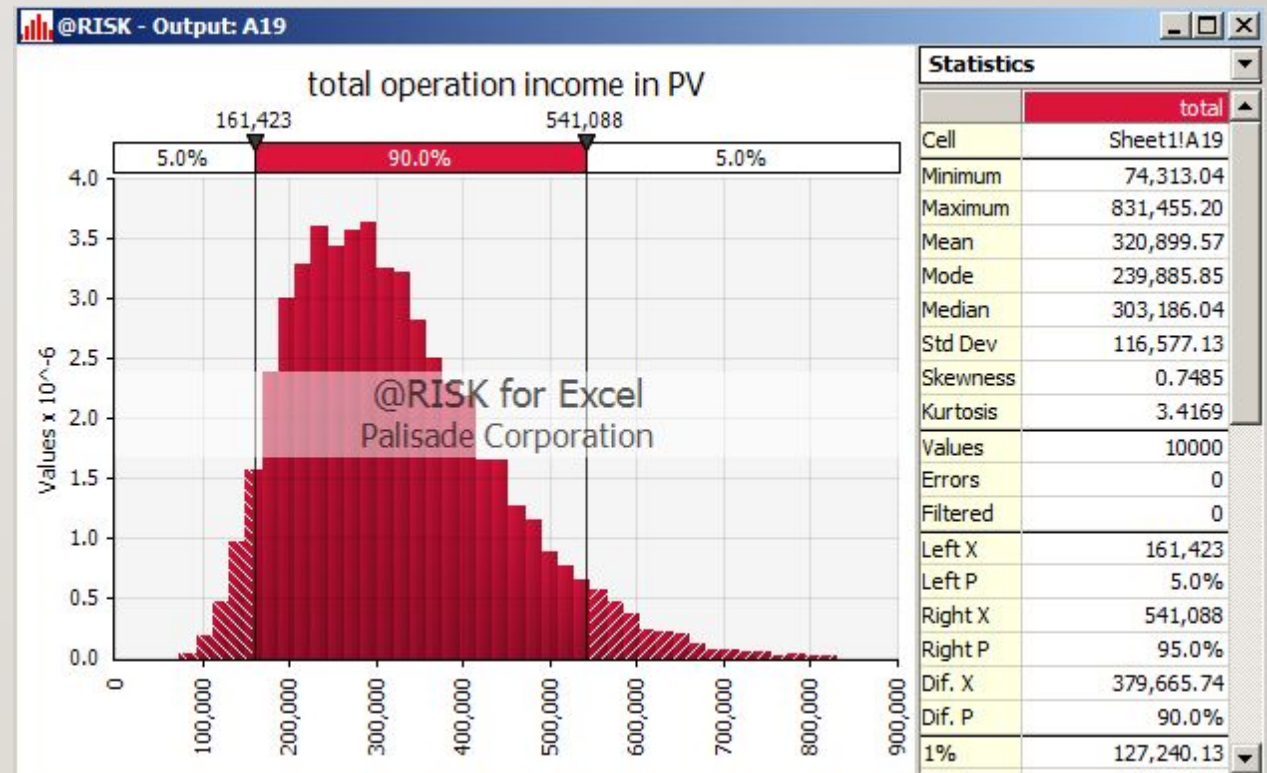
SENSITIVITY ANALYSIS 2 - Probabilities

- Both drilling and road building are successful
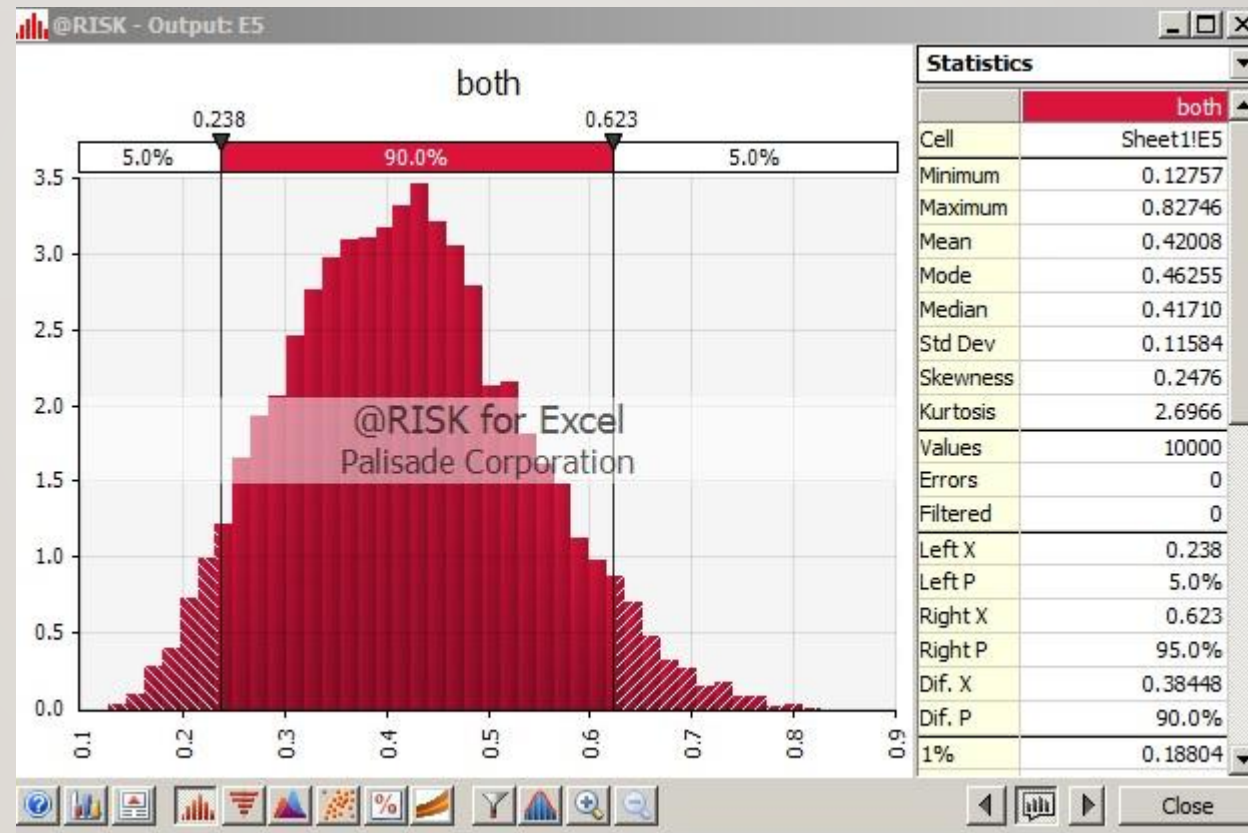
SENSITIVITY ANALYSIS 2 – Probabilities

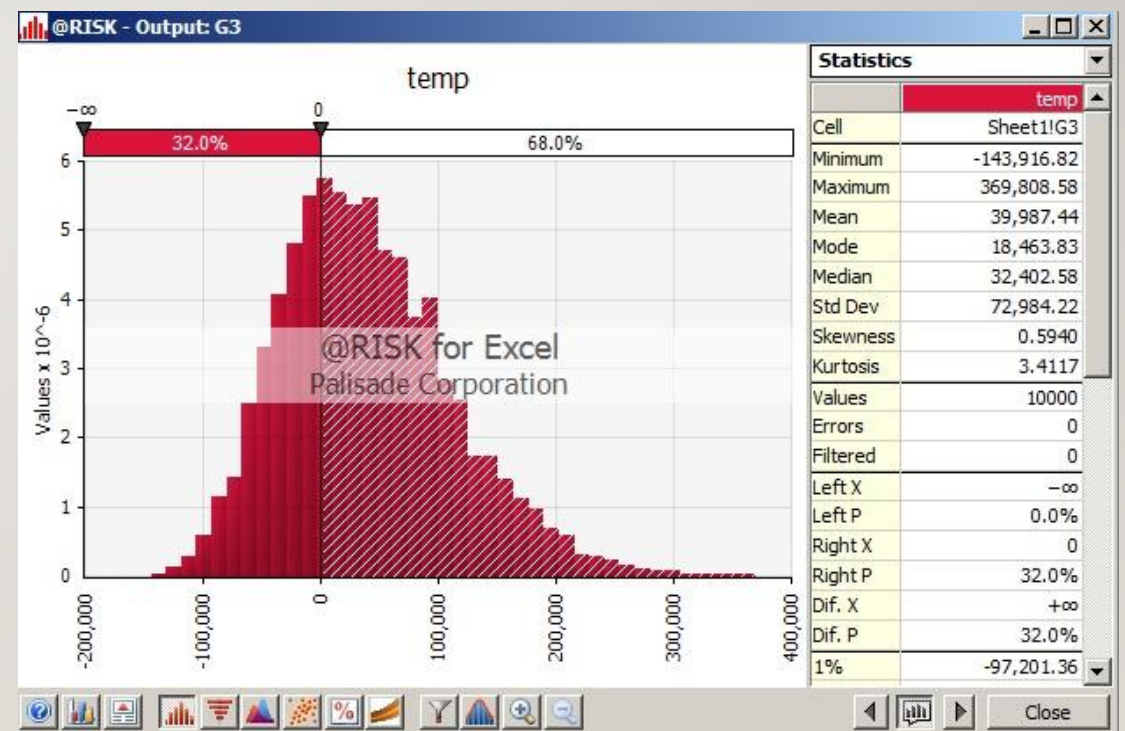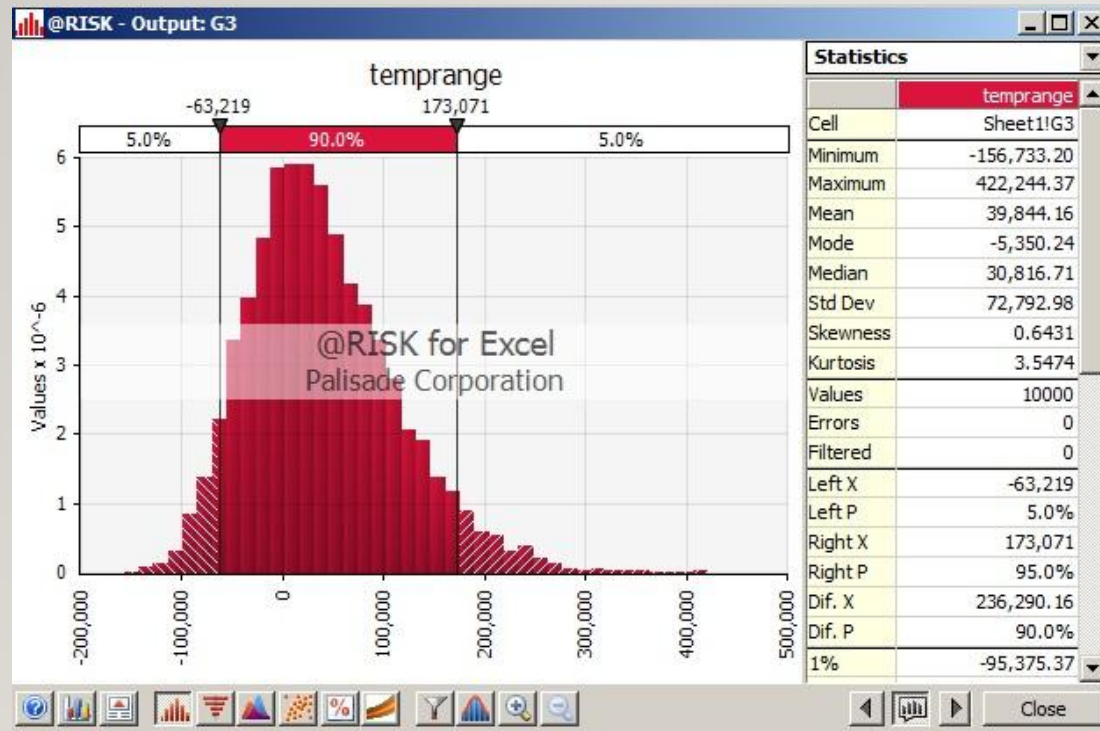- After drilling, we failed to build the road.
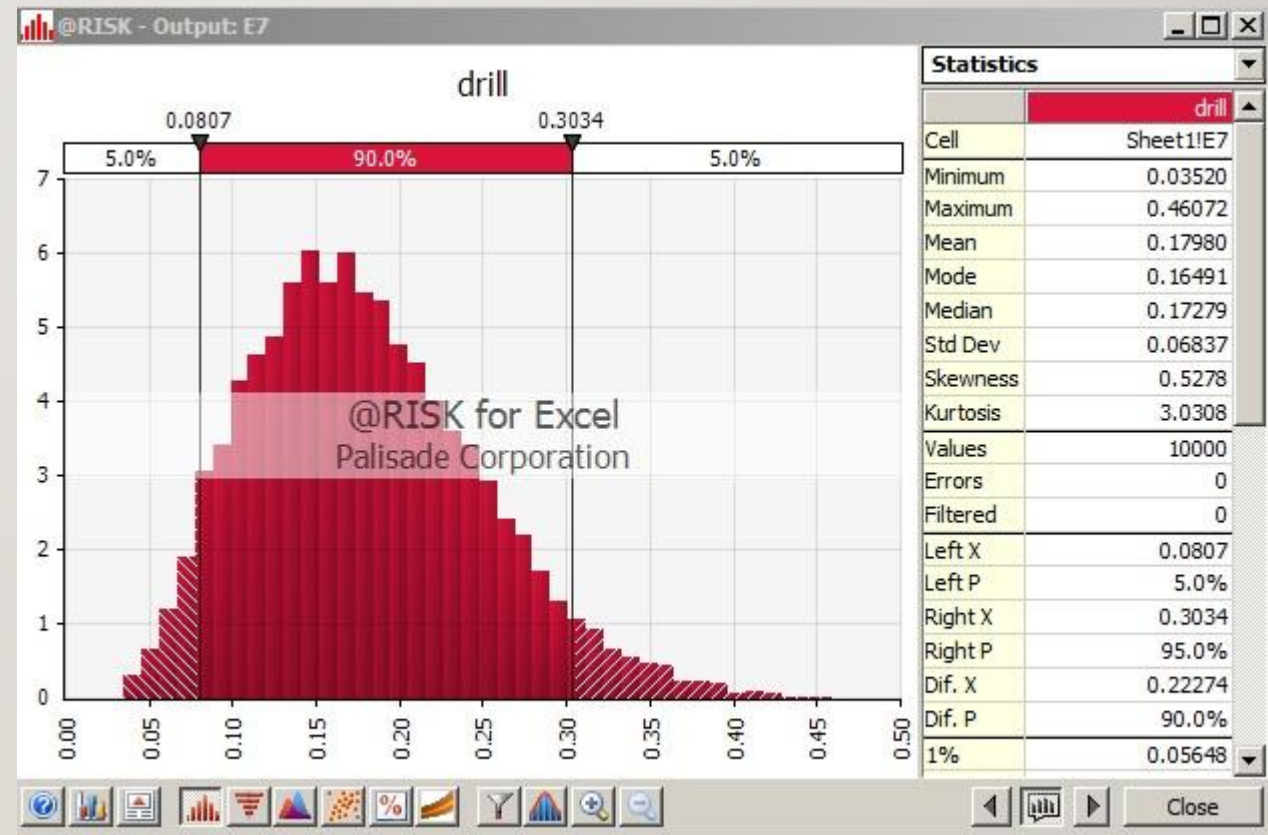
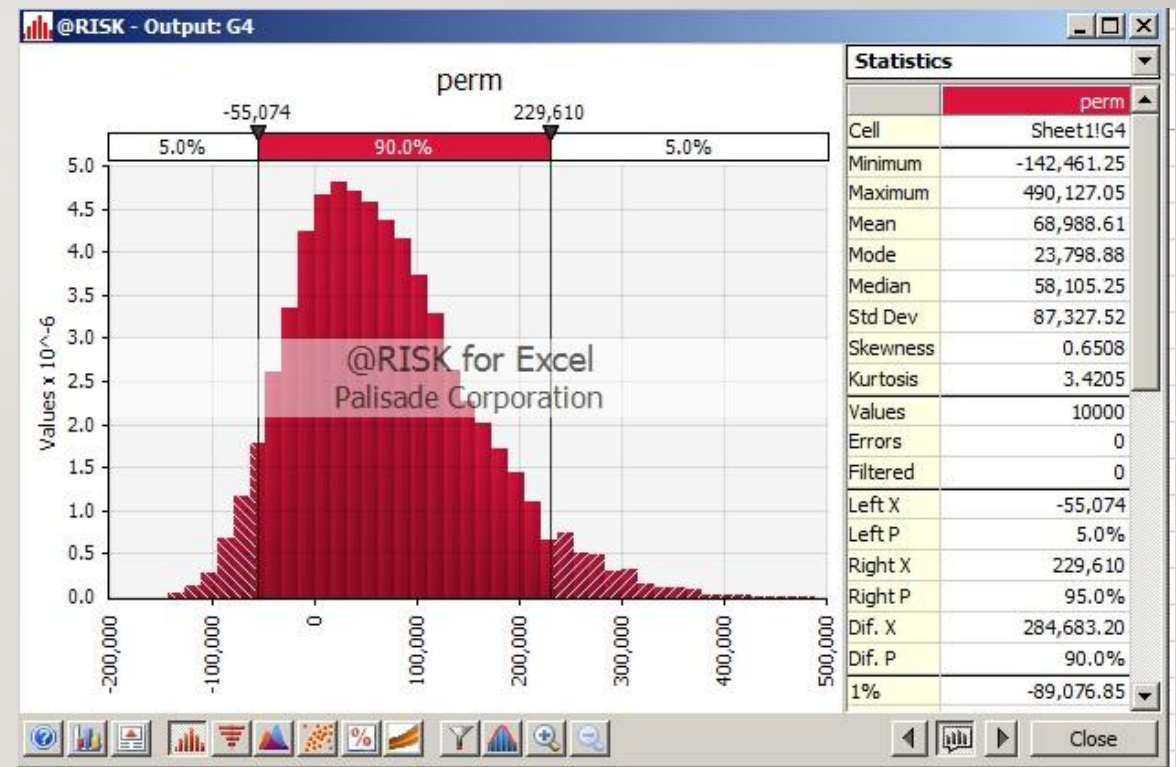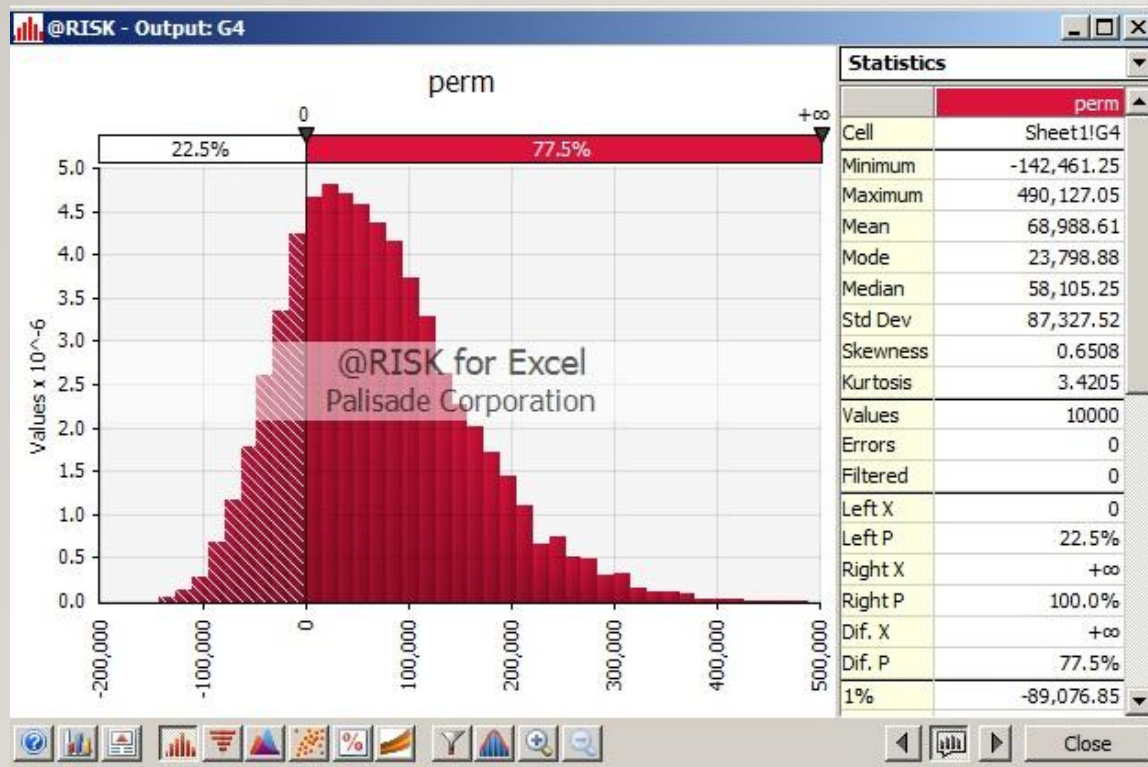# SENSITIVITY ANALYSIS 2 - Probabilities

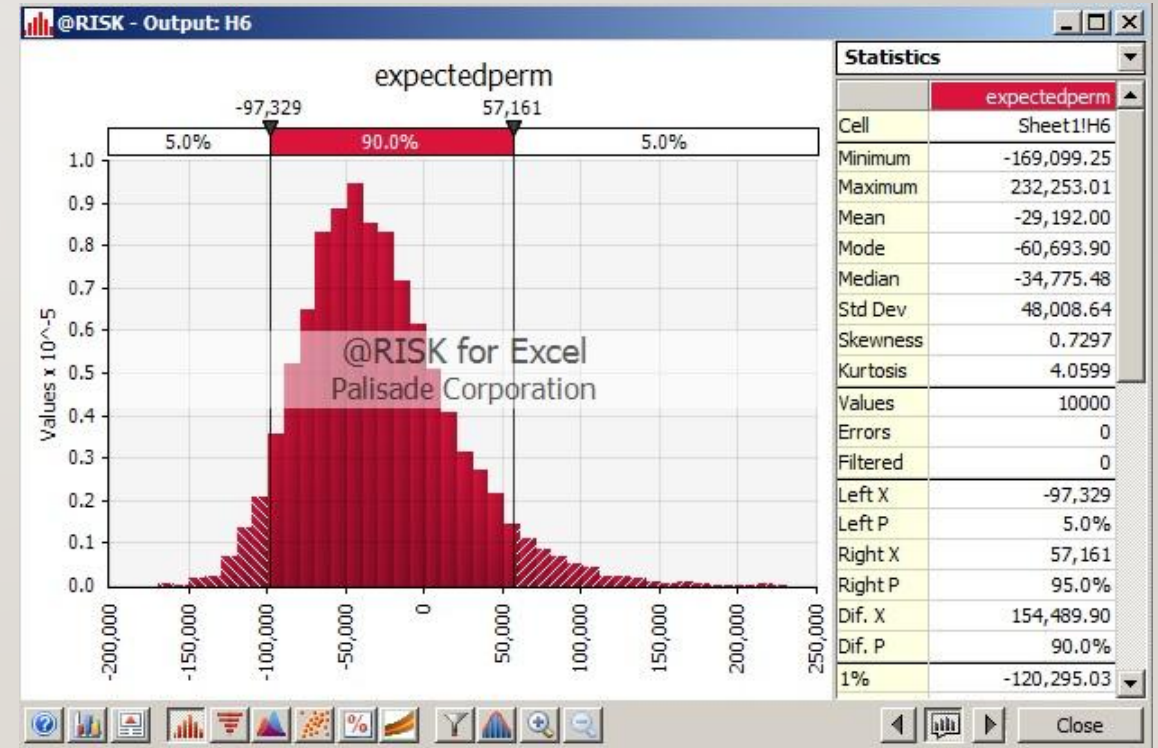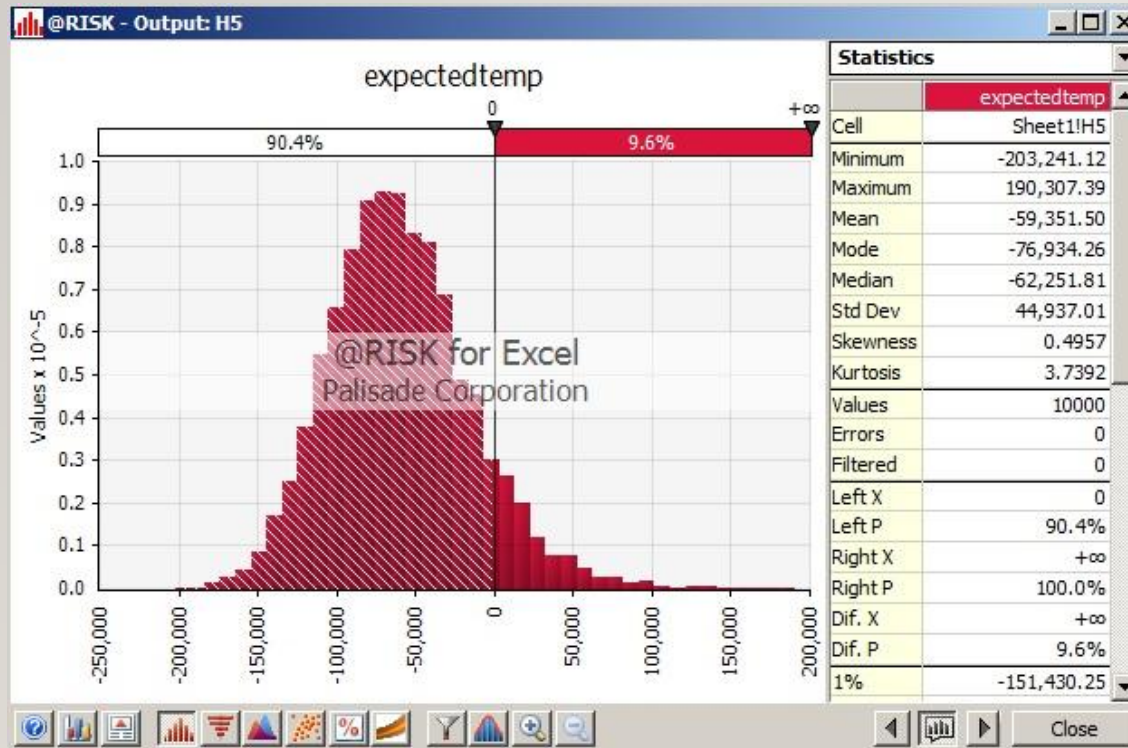- After building the road, we failed to drill.
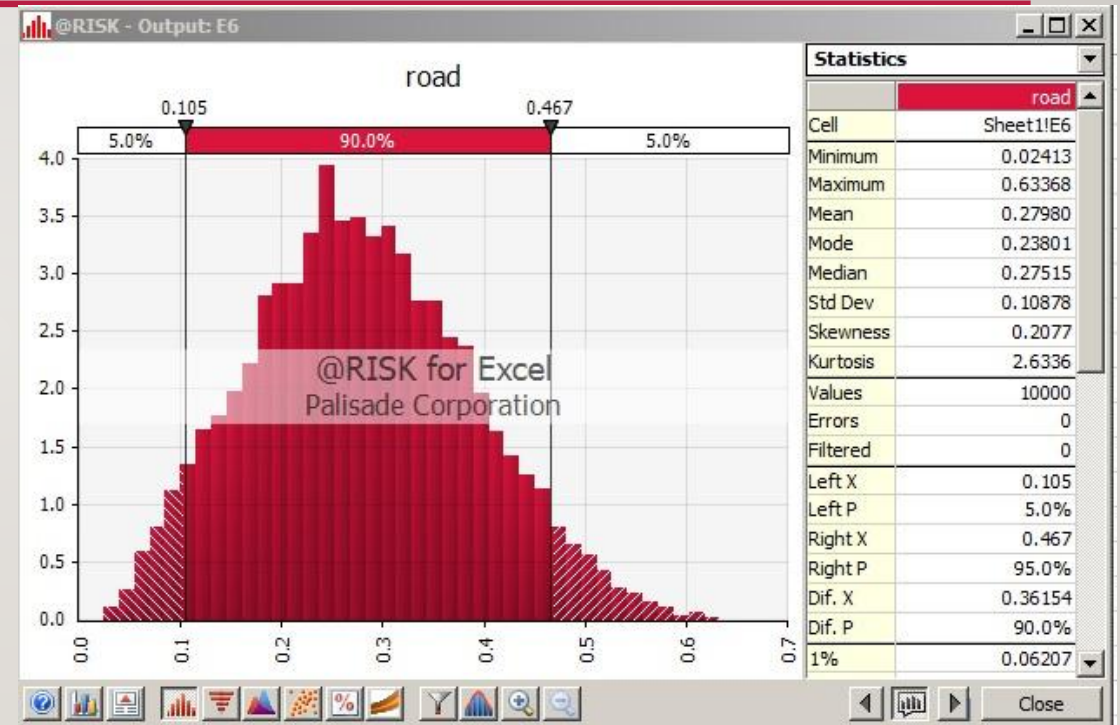
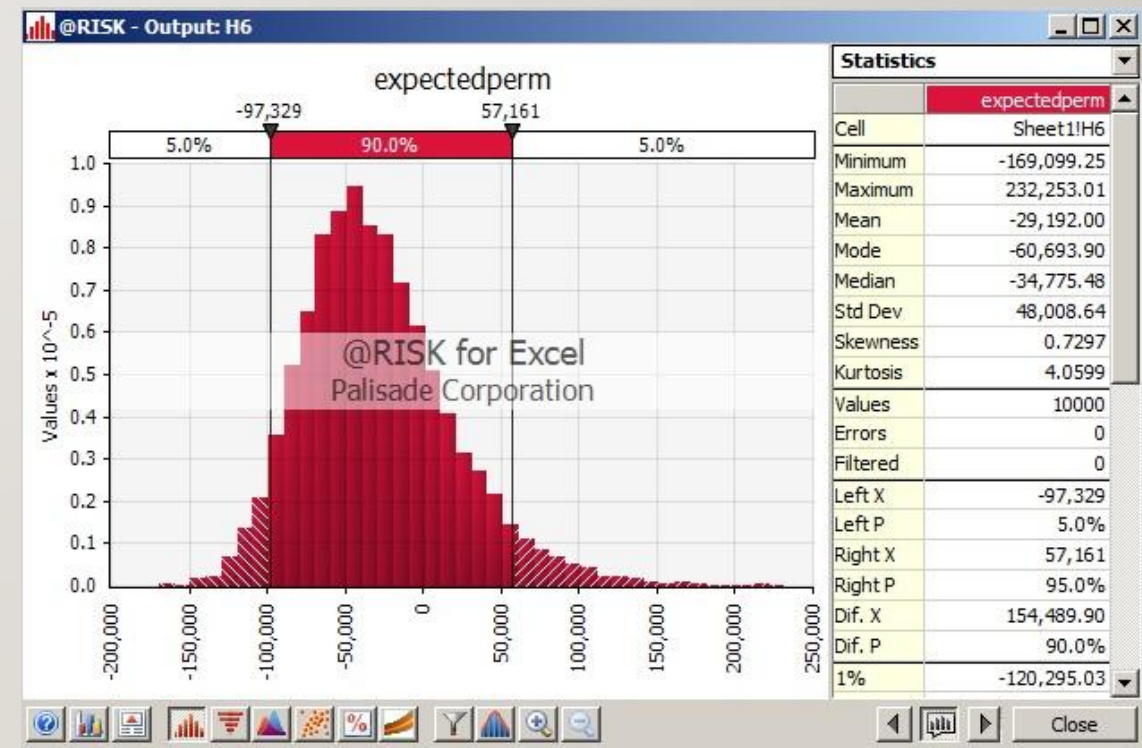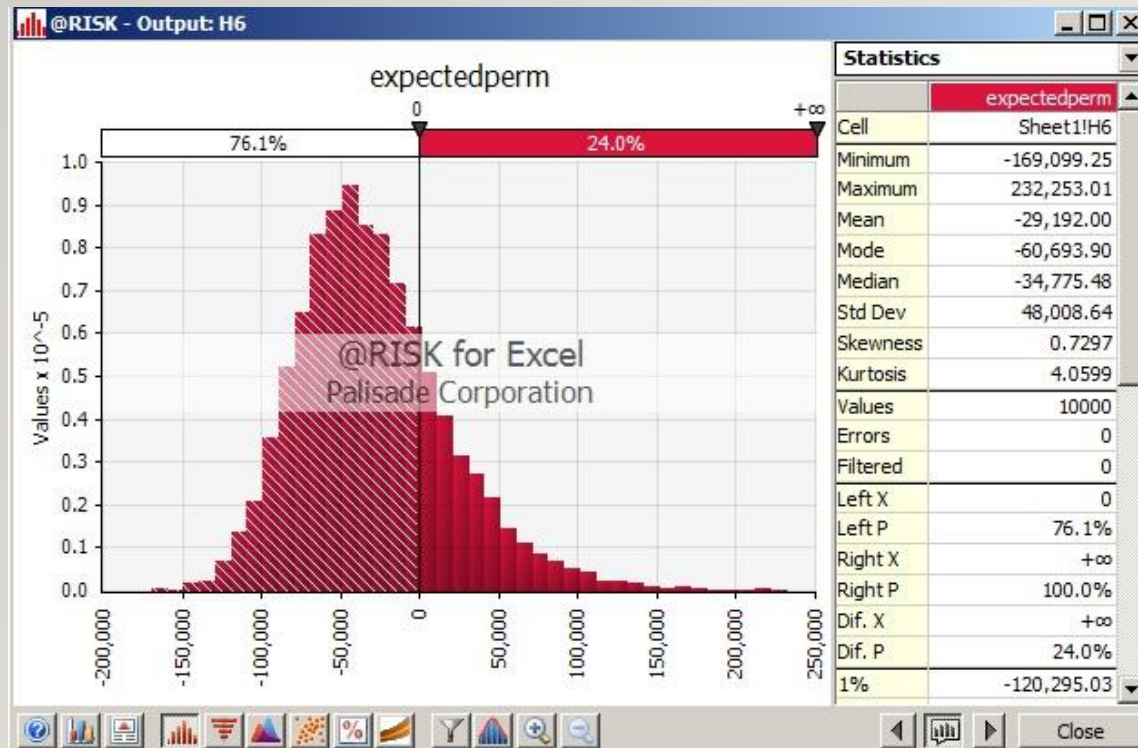# SENSITIVITY ANALYSIS 2 – Potential Profit for Option Temp. Road

SENSITIVITY ANALYSIS 2 – Potential Profit for Option Perm. Road

SENSITIVITY ANALYSIS 2 – Expected Return on Option Temp.Road

SENSITIVITY ANALYSIS 2 - Expected Return on Option Perm.Road

CONCLUSION

- Even under different gold price simulations, all of the decisions have negative expected values and there is a low probability to profit.

- The best choice for Grant is to do nothing.

- Even if we are given the perfect information about the gold mine, due to the uncertainty in gold price we are unable to give another option that is guranteed to be profitable.