



# Investment in Real Estate or Stocks

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# Part 01

## Problem Definitions

### Problem

- David has \$1 million for investment over a 10-year period
- He plans to invest his money in real estate or stock

### Objectives

### Alternatives

- Single House/Apartment in LA area
- Vanguard Real Estate ETF (VNQ)
- S&P 500 Index
- Alphabet, Inc. (GOOGL)

- Minimize Risk
- Maximize Return
- Flexibility of Use
- Marketability / Liquidity

# Part 02

## Assumptions

### Annualized Volatility Definition

$$\sigma_{\text{annually}} = \sigma_{\text{monthly}} \sqrt{12}$$

#### Property Investment (Los Angeles, CA)

##### Average time to sell a home in California:

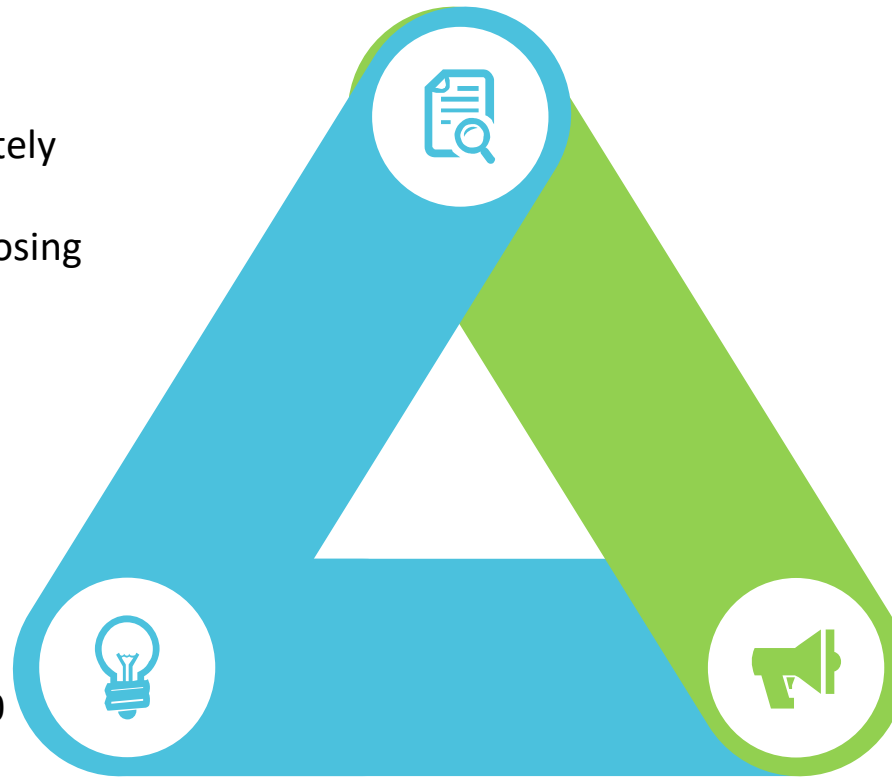
- From listing through closing is approximately 77 days.
- 42 days to get an offer + typical 35-day closing period

##### Rent Income + Property Management :

- Rent Income: \$5,000
- Property Management: 8~12% of Montly Rental Value
- Assume gains = \$4,500

##### Property Tax Calculation:

- The average tax rate is 0.755% in LA
- The annual tax deduction is up to \$10,000



#### Stocks / Stock Indexes

##### Return Rate Calculation Rule:

- Disregarding dividend in calculations

##### Average time to sell stocks:

- 365 days / 252 trading days = 1.45 days

##### Stock Tax Calculation:

- David and his family belong to the category of Married Filing Jointly.
- If stocks are sold at a loss, David can deduct up to \$3,000 per year.
- David's investment in stock belongs to long-term investment and he has to pay for the tax according to the long-term tax bracket (20%)

# Part 03

## Data Collection

### Property Investment

From Zillow Research, collecting data monthly from Sep 01 2004 to Sep 01 2019.

### REITs (VNQ)

From Yahoo Finance, collecting data monthly from Sep 01 2004 to Sep 01 2019.



### Stock Index (S&P 500)

From Yahoo Finance, collecting data monthly from Sep 01 2004 to Sep 01 2019.

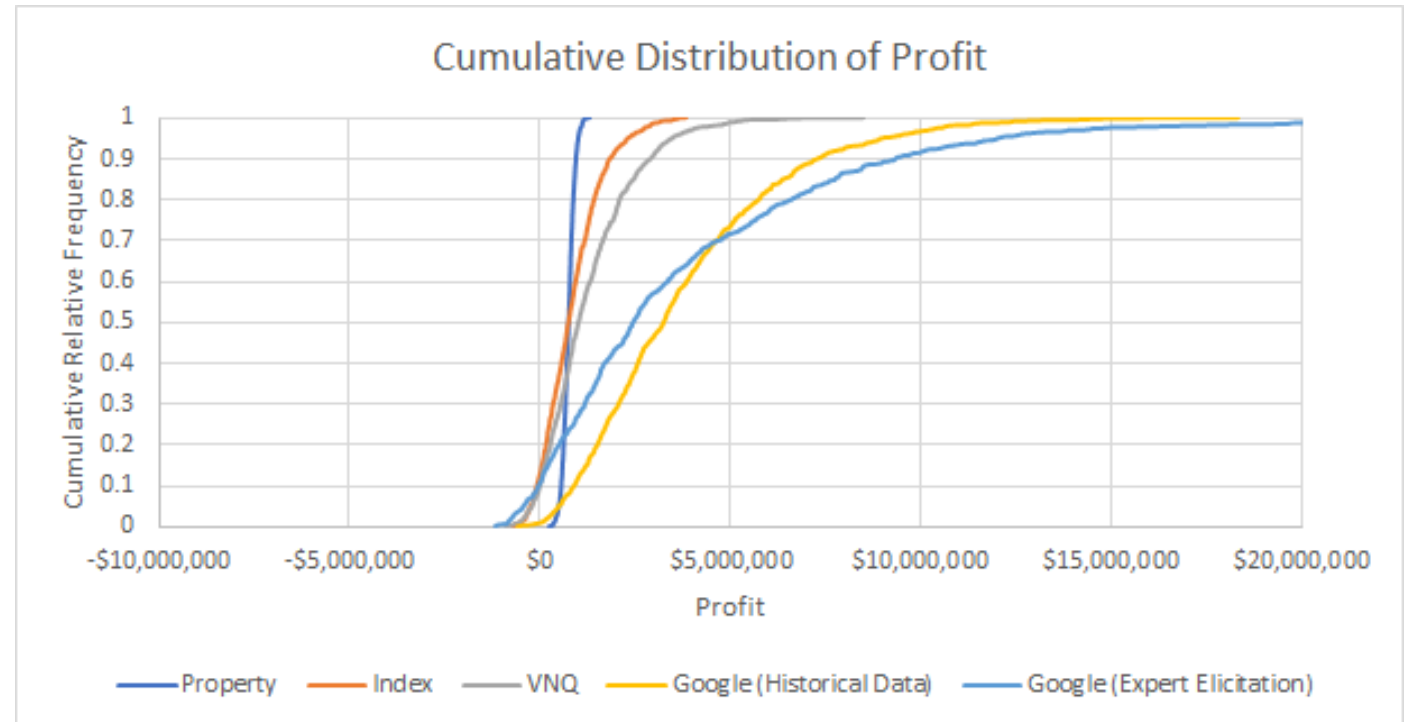
### Stock Shares (GOOGL)

From Yahoo Finance, collecting data monthly from Sep 01 2004 to Sep 01 2019.

# Part 04

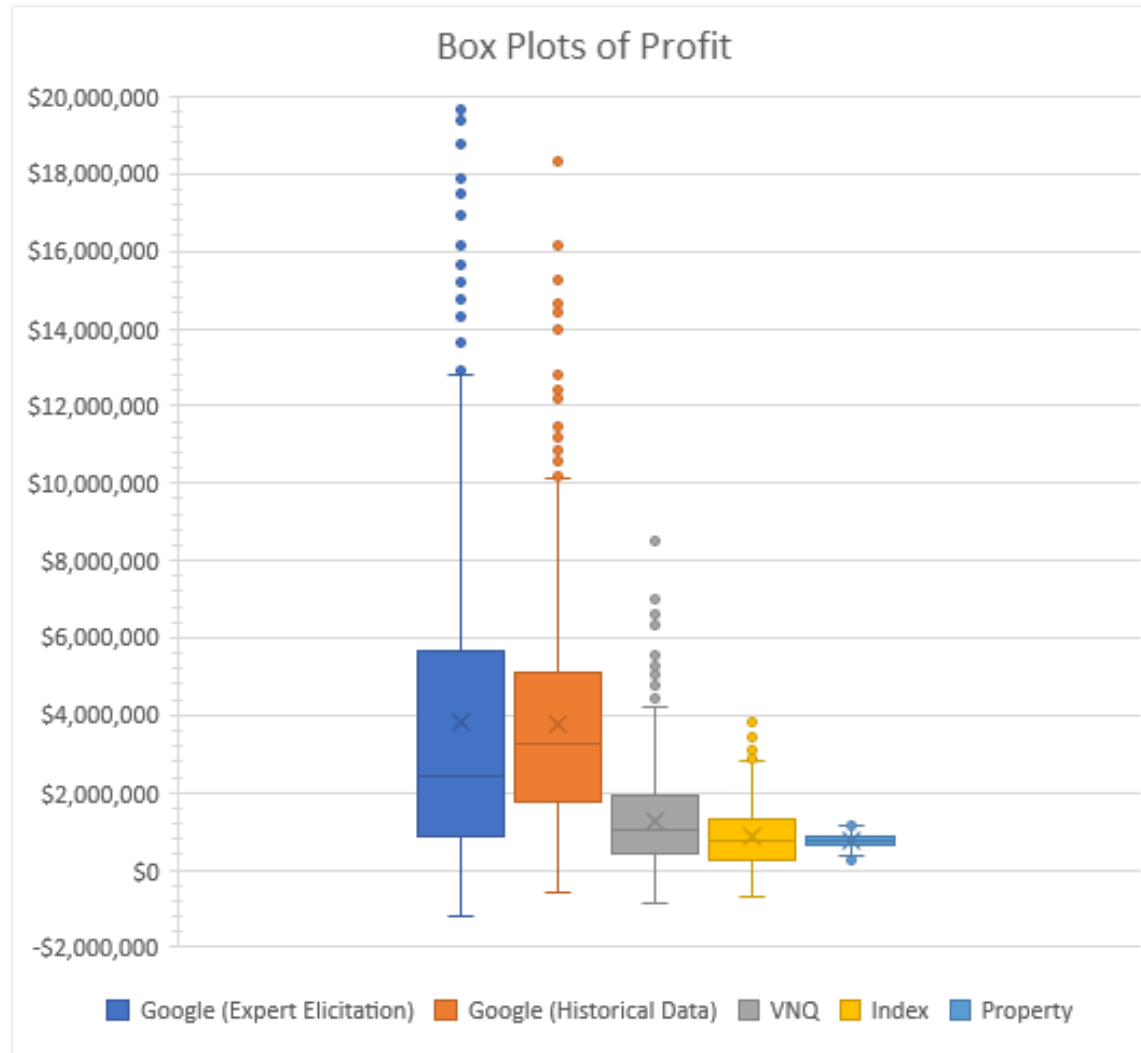
## Analysis Framework (Probabilistic Simulation)

- **Assumption:** Percent Return per year is normally distributed
- Obtain Mean and Standard Deviation of Percent Return per year to generate a normal distribution
- Every year we obtain the Percent Return by sampling from the RandomNormal distribution
- Calculate the total income generated, and subtract it by the income tax to find total profit of this investment over a ten year period
- Run Monte Carlo Simulation (10,000 Trials) of the total profit



# Part 04

## Analysis Framework (Probabilistic Simulation)



### Average expected return of different investments

- Google (Expert Elicitation)
  - \$3,860,540
- Google (Historical Data)
  - \$3,769,984
- Vanguard Real Estate ETF (VNQ)
  - \$1,349,890
- Stock Index (S&P 500)
  - \$849,775
- Property Investment (Los Angeles, CA)
  - \$738,340

# Part 05

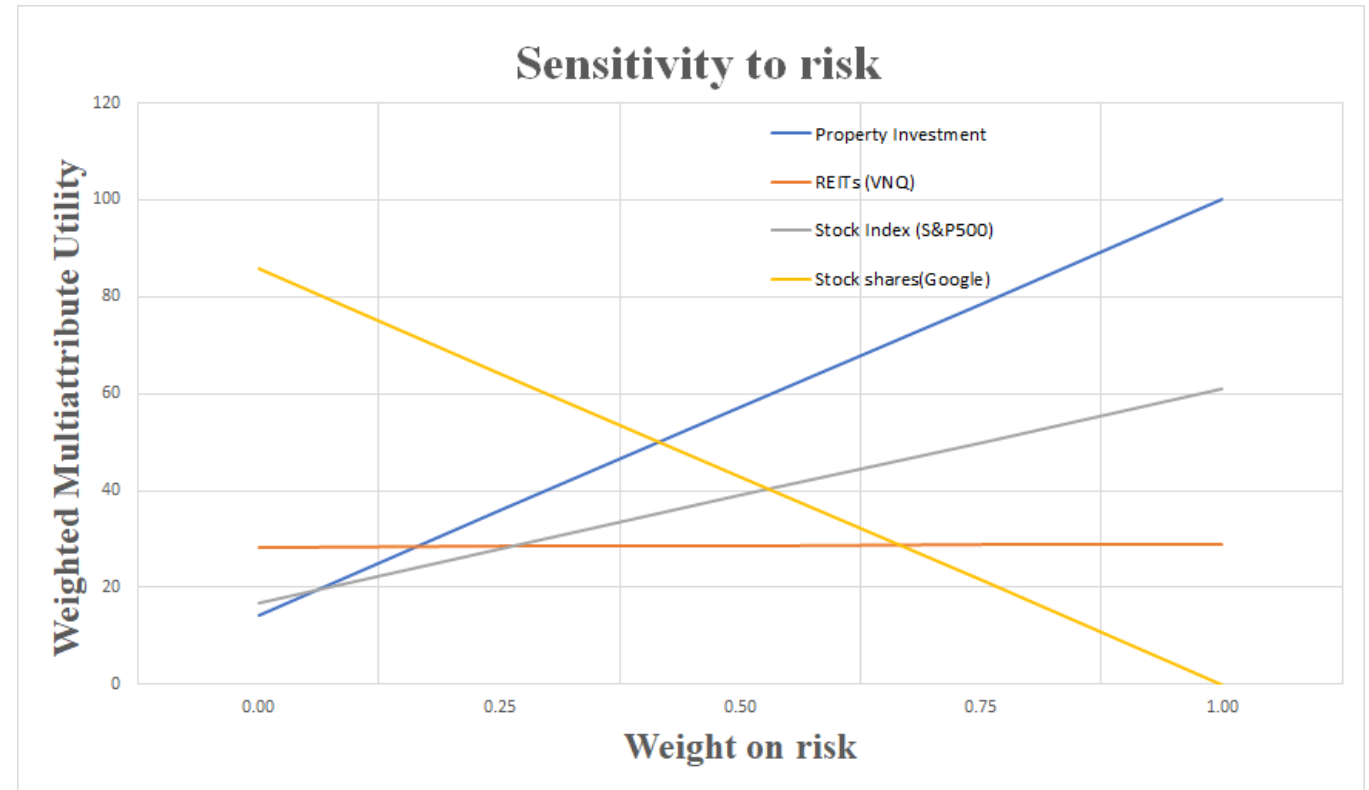
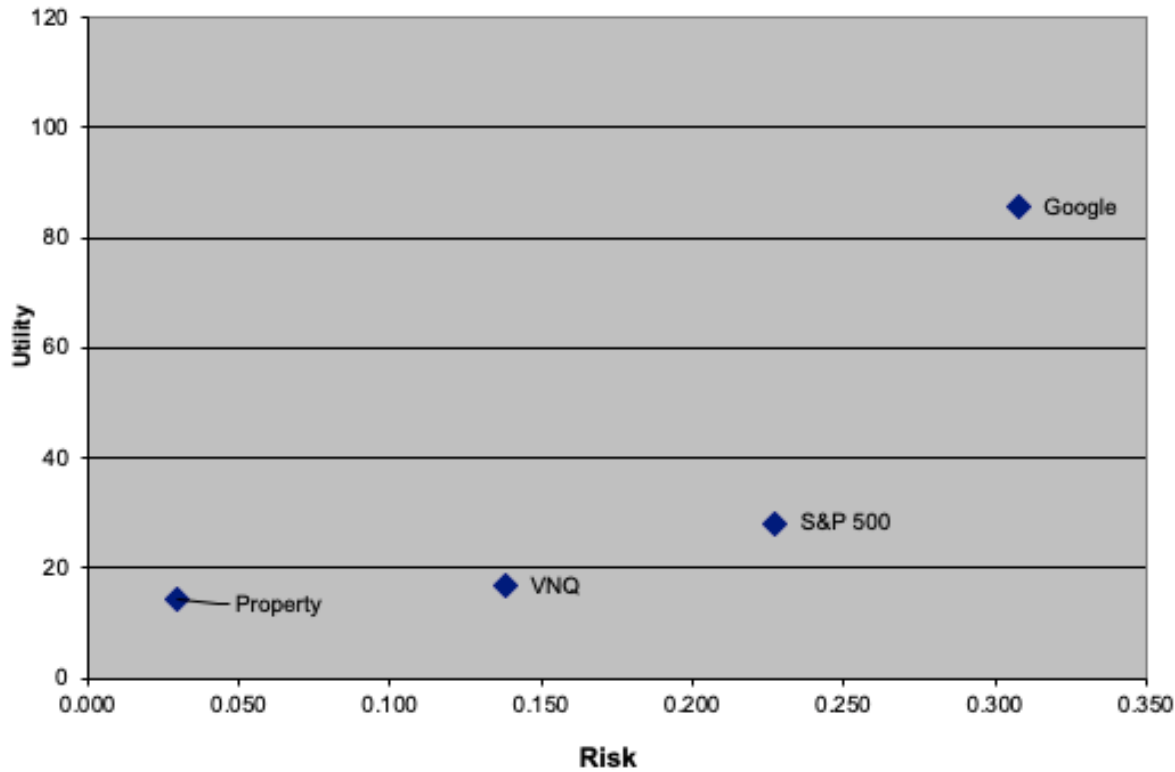
## Consequence Table

	<b>Return (% Return)</b>	<b>Risk (Annual volatility)</b>	<b>Flexibility of Use</b>	<b>Marketability (Day)</b>
<b>Property Investment</b>	<b>60.57%</b>	<b>0.0292</b>	<b>Yes</b>	<b>77</b>
<b>REITs (VNQ)</b>	<b>110.74%</b>	<b>0.2275</b>	<b>No</b>	<b>1.45</b>
<b>Stock Index (S&amp;P 500)</b>	<b>69.68%</b>	<b>0.1382</b>	<b>No</b>	<b>1.45</b>
<b>Stock Shares (GOOGL) (Expert Elicitation)</b>	<b>317%</b>	<b>0.3079</b>	<b>No</b>	<b>1.45</b>



# Part 05

## Sensitivity Analysis



# Part 06

## Evaluation and Recommendation

### Risk seeking

Invest all the money in Stock Shares (GOOGL)

- If the decision maker is able to take short-term risks, we recommend him to invest in Stock Shares (GOOGL)
- Return rate is as many as 5 times higher than the alternative options
- Risk is higher than any other alternatives, but in the long term, it will definitely make profit

### Risk neural (42%)

Invest part of money in property and the rest in Stock Shares (GOOGL)

- If the decision maker plans to achieve a balance between risk and the profit, we recommend him to first Invest in property and then invest the rest in Stock Shares (GOOGL).
- The price of the property is around \$500,000, which is the average price for houses with 3 bedrooms in LA.

### Risk averse

Invest all the money in Property

- If the decision maker doesn't want to take too much risk, we recommend him to invest in Invest in Property
- Risk is as many as one-tenth of the alternative options
- Return rate is the lowest
- The decision maker could feel free to either rent the house or live in the house with his family