

What is Your Safe Withdrawal Rate?

Alice laughed. "There's no use trying," she said " One *can't* believe impossible things."

"I daresay you haven't had much practice," said the Queen. "When I was your age, I always did it for half-an-hour a day. Why, sometimes I've believed as many as six impossible things before breakfast."

- From Through the Looking Glass by Lewis Carroll

Your Beliefs Drive Your Actions

- ② Successful investing requires you to act on your true beliefs about future
- ② Account balances depend only on return rates and inflation rates, irrespective of what causes them
- ② Whether you choose historically based assumptions or use your own, or take advice from another, your actions depend on what you believe



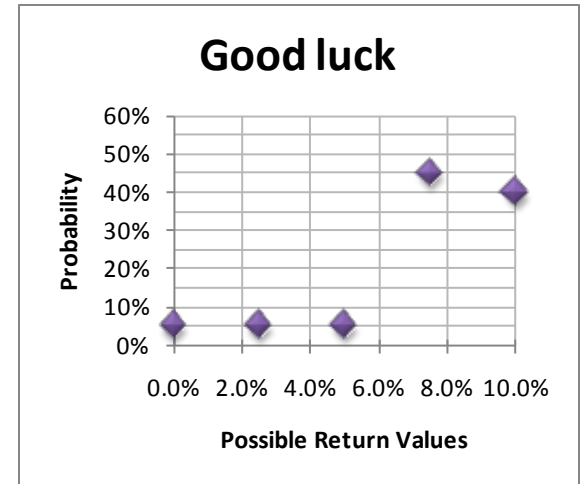
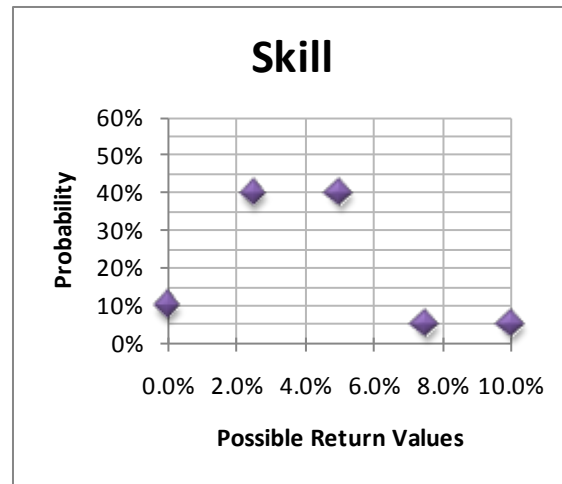
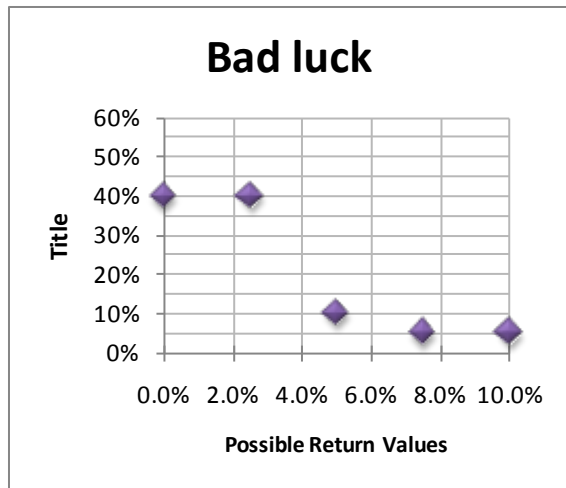
How to Capture Your Beliefs

- ② Create Scenarios for future investing environment
- ② Possible values of inflation
 - Subjective probability those values occur
- ② Possible values of returns
 - Subjective probability those values occur
- ② Your investment path for that Scenario
 - Your probability distribution of future returns
 - Your probability distribution of future inflation
- ② Your belief the Path itself occurs



Return Scenarios

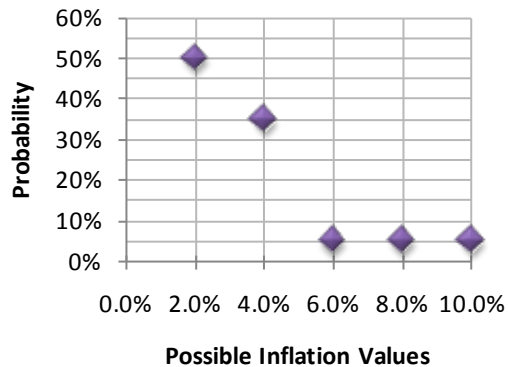
- ② Each investing future has different odds for getting specific returns
- ② Each scenario S_r implies a distribution of return rates over the whole horizon



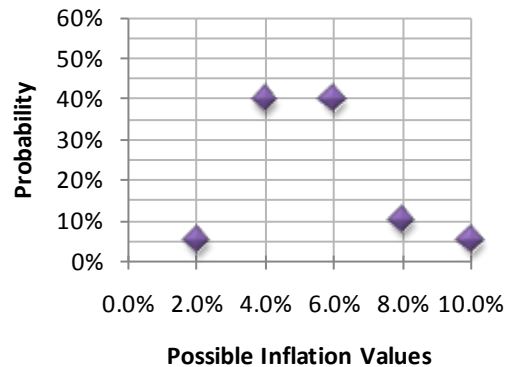
Inflation Scenarios

- Ⓢ Each investing future has different odds for getting specific inflation rates
- Ⓢ Each scenario S_i implies a distribution of inflation rates over the whole horizon

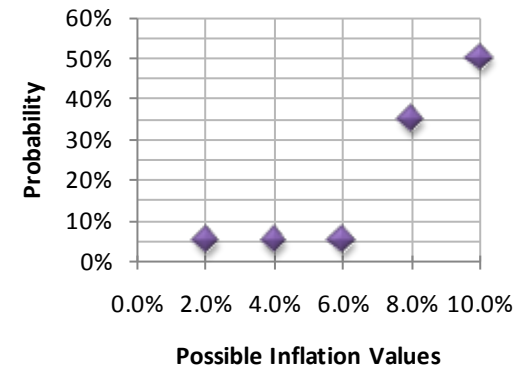
Minimal



Observable



Runaway



The Investing Path

④ The future path of an investment account is driven by the pair of realized Return and Inflation rates

④ One Investing Path \mathbb{P}

■ \mathbb{P} = One Return Scenario S_r and One Inflation Scenario S_i

■ $\mathbb{P} = (S_r, S_i)$

How Likely is an Investing Path?

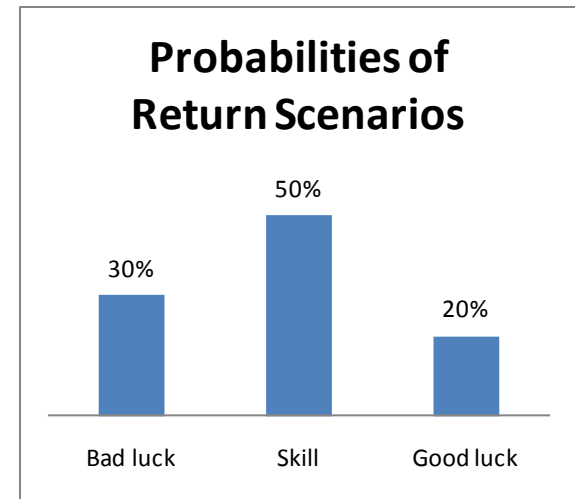
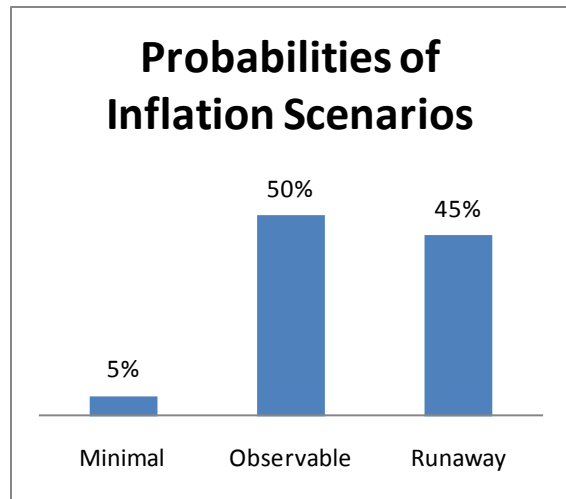
- ⓐ The scenarios S_r for return rate and S_i for inflation rate have a joint probability $\Pi\{r, i\}$ of values of (r, i) occurring
- ⓐ Each path \mathbb{P} has a probability of occurrence $\Pi\{\mathbb{P}\} = \Pi\{r, i\}$
- ⓐ Example, assuming independence:
 - 3xReturn rate Scenarios S_r ,
 - 3xInflation rate Scenarios S_i
 - 9 paths

Joint Probabilities of paths (independent scenarios)

		Inflation			
		Minimal	Observable	Runaway	
			5%	50%	45%
Return	Bad luck	30%	1.500%	15.000%	13.500%
	Skill	50%	2.500%	25.000%	22.500%
	Good luck	20%	1.000%	10.000%	9.000%

Path Beliefs

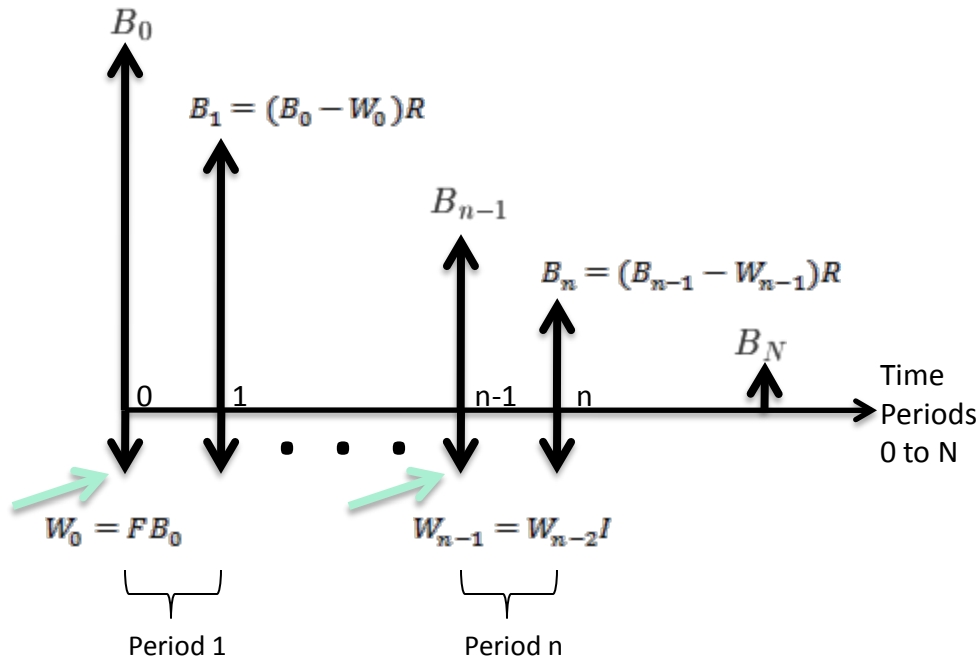
- Defining the Scenarios (return rate and inflation rate distributions) creates a path, with its own joint probability distribution of the possible values



Joint Probabilities of paths (independent scenarios)

		Inflation			
		Minimal	Observable	Runaway	
Return	Bad luck	30%	1.500%	15.000%	13.500%
	Skill	50%	2.500%	25.000%	22.500%
	Good luck	20%	1.000%	10.000%	9.000%

Account Balance Evolution



@ Initial account balance at start of period 1 is B_0

Computing Withdrawal Fractions

④ Point Withdrawal Fraction = $F(r, i | N, \mathbb{P})$

- Prob distribution determined by path \mathbb{P}

- $F(r, i | N, \mathbb{P}) = \mathcal{I}\mathcal{F}\{r=i, 1/N, (1-q)/(1-q^N)\}; q=(1+i)/(1+r)$

④ Path Withdrawal Fraction = $f(\mathbb{P} | N)$

- $f(\mathbb{P} | N) = \mathbf{E}\{F(r, i | N, \mathbb{P})\}$

- $= \sum_r \sum_i \Pi\{r, i\} F(r, i | N, \mathbb{P})$

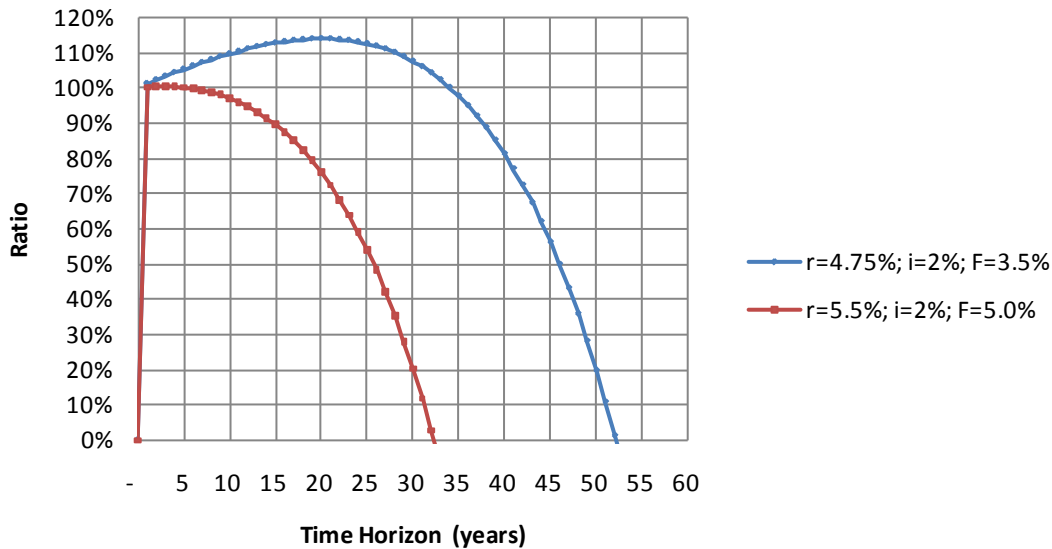
- f depends explicitly on \mathbb{P} for any horizon N

④ $\mathbf{F}(N) = \mathbf{E}\{f(\mathbb{P} | N)\} = \sum_{\mathbb{P}} \Pi\{\mathbb{P}\} f(\mathbb{P} | N)$



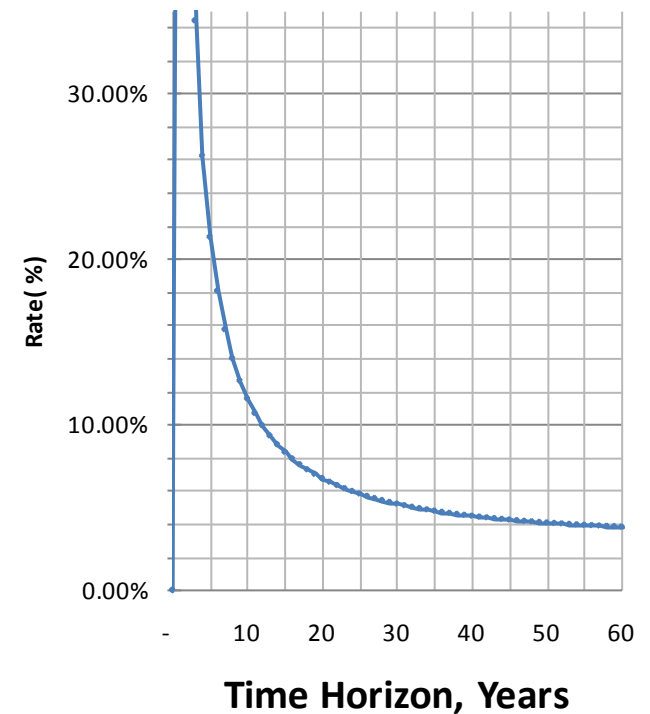
Balances and $F(r,i | N, \Phi)$ vs N ; Point Withdrawal Rate

Evolution of Account Balance, Relative to Initial Balance

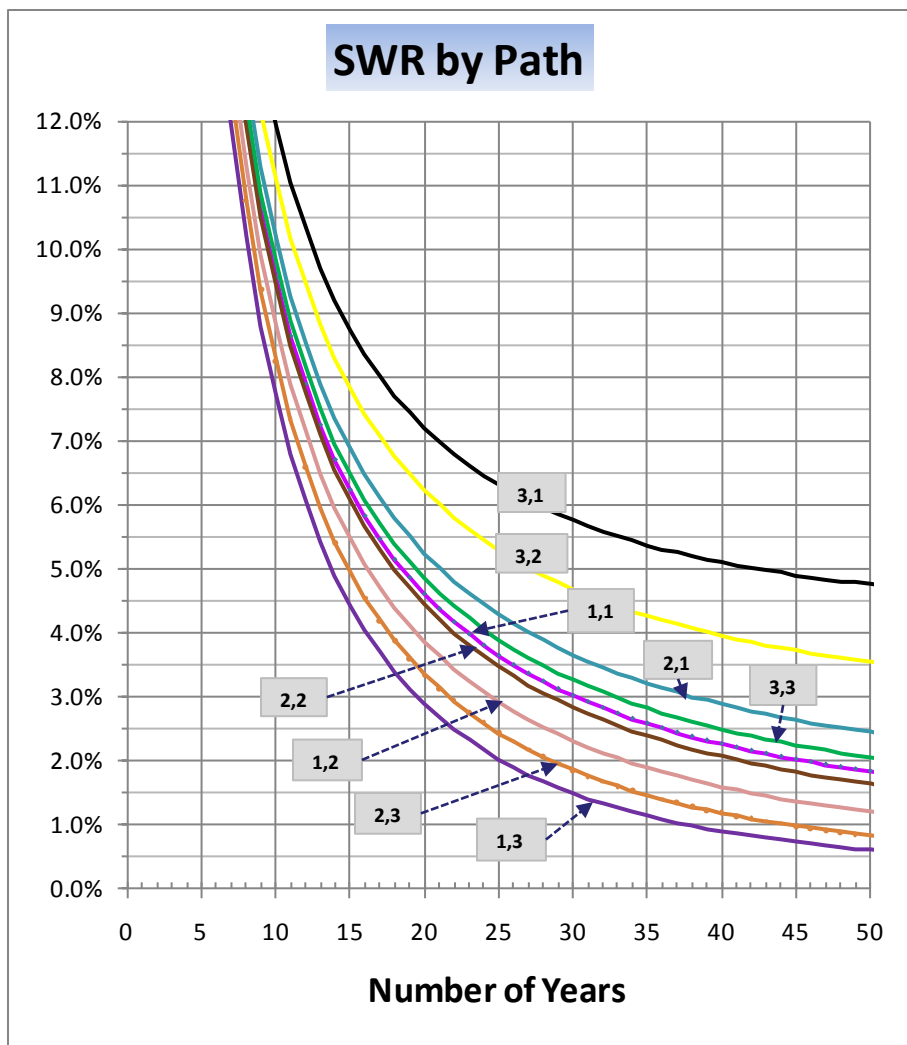


Point Withdrawal Rate:

Return = 5.5%/YR; Inflation = 2%/YR



Path Withdrawal Fraction= $f(F | N)$ for 9 Paths



- ⓐ Each curve is the SWR for a specific path in the 3x3 matrix
- ⓐ For a constant F, notice the large number of years in the range from Path (1,3) to (3,1).
 - For F=4%, the range of years N for all scenarios is >34
- ⓐ This means the path outcomes matter very much.

Ranking of Path Results

		Inflation			
		Minimal	Observable	Runaway	
Return	Bad luck	30%	5%	7%	9%
	Skill	50%	3%	6%	8%
	Good luck	20%	1%	2%	4%



SWR = F(N) = E{f(⌘ | N)}: Average Over all Paths

