A Return Formula That Doesn't Always Work

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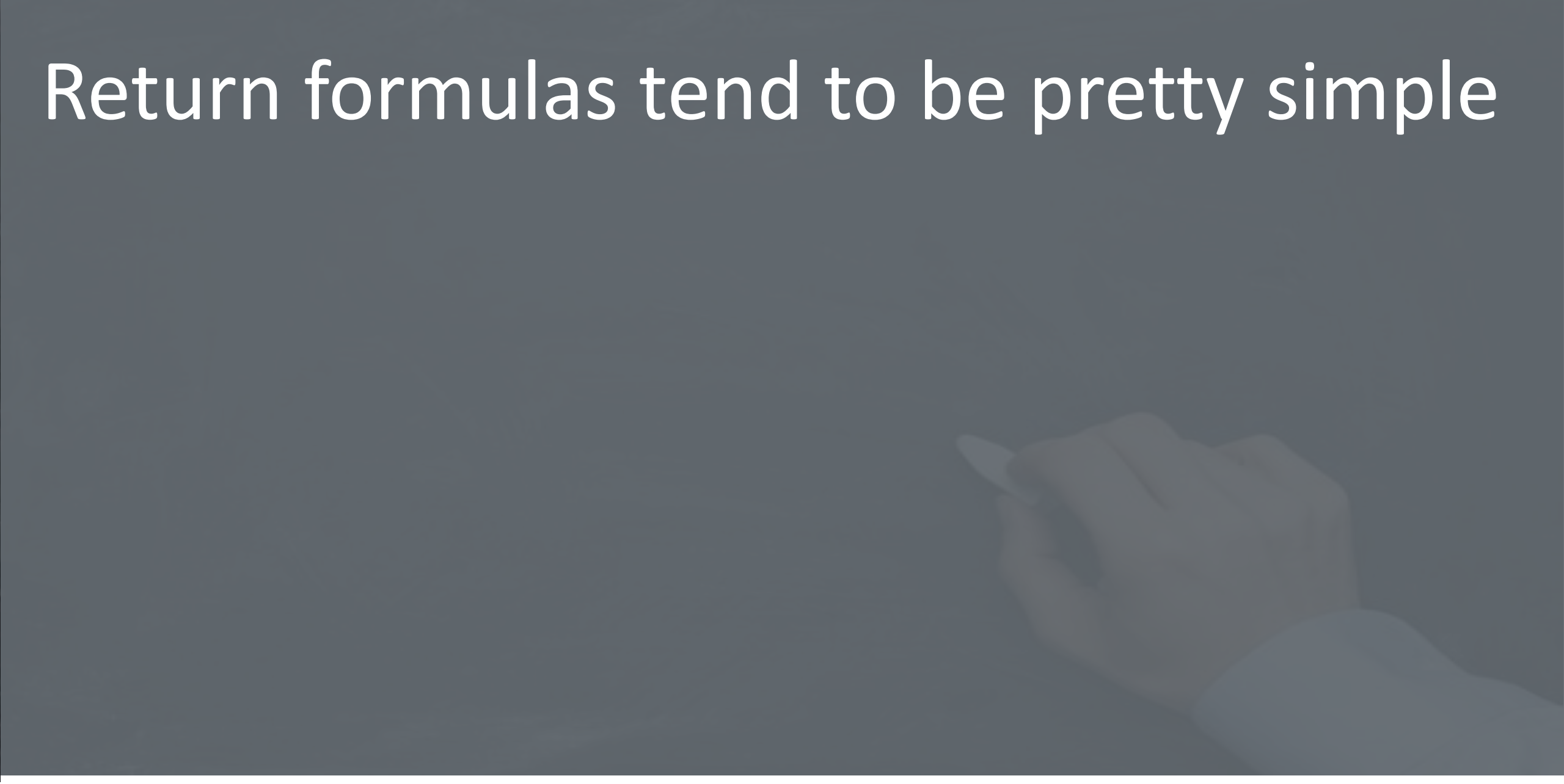
Return formulas tend to be pretty simple



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You're no doubt familiar with:

$$R^{ModifiedDietz} = \frac{V_E - V_0 - \sum C_i}{V_0 + \sum W_i \times C_i}$$

$$R^{Exact} = \frac{V_E}{V_0} - 1$$

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You've probably seen this one, too

$$R = \frac{\sum_{i=1}^{n} V_{0,i} \times r_i}{V_0}$$

Sum product of the sub-portfolio returns

Divided by the portfolio's starting value

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Jose Menchero has often used this form

E.g., from Menchero, Jose G. 2000/2001. "A Fully Geometric Approach to Performance Attribution." *The Journal of Performance Measurement*. Winter.

"The portfolio return R_t for a single period t can be written as the weighted average return of N sectors

$$R_t = \sum_{i=1}^{N} w_{it} r_{it}$$

"where w_{it} and r_{it} are the portfolio weights and returns for sector i."

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Problem w/this formula: it doesn't account for cash flows. So, we expand it a bit:

$$R = \frac{\sum_{i=1}^{n}\left(v_{0,i} + \sum_{j=0}^{m} w_{i,j} \times c_{i,j}\right) \times r_i}{\sum_{i=1}^{n}\left(v_{0,i} + \sum_{j=0}^{m} w_{i,j} \times c_{i,j}\right)}$$

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If used daily, it *should* yield an exact return
BUT, it won't in some cases

Thus, this talk

I'll discuss three scenarios where it fails

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#1: Mixed Weighted Model Problem

- Some use start-of-day (SOD) for all flows
- Some use end-of-day (EOD) for all flows
- But an increasing number use:
  - SOD for inflows
  - EOD for outflows
- Thus, the “mixed weighting method”

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Non-Mixed; using EOD for all flows

Case #1: A case where both inflows and outflows use the same cash flow weighting method (EOD)							
Security	**V_0**	**V_e**	**C**	**W (for flow)**	**Wtd Flow**	**Weight**	**R**
A	100,000.00	130,000.00	25,000.00	0.00	0.00	0.20	5.0000%
B	400,000.00	377,000.00	(25,000.00)	0.00	0.00	0.80	0.5000%
Portfolio (asset-wt)	**500,000.00**	**507,000.00**	**0.00**	**n/a**			**1.4000%**
Portfolio (exact)	**500,000.00**	**507,000.00**	**0.00**	**n/a**			**1.4000%**

$$r_i = \frac{v_{E,i} + v_{0,i} + c_i}{v_{0,i}}$$

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Using Mixed-Weighting

Case #2: A case where inflows are treated as SOD and outflows as EOD							
Security	**V_0**	**V_e**	**C**	**W (for flow)**	**Wtd Flow**	**Weight**	**R**
A	100,000.00	130,000.00	25,000.00	1.0000	25,000.00	0.24	4.0000%
B	400,000.00	377,000.00	(25,000.00)	0.00	0.00	0.76	0.5000%
Portfolio (asset-wt)	**500,000.00**	**507,000.00**	**0.00**	**n/a**	**25,000.00**	**1.00**	**1.3333%**
Portfolio (exact)	**500,000.00**	**507,000.00**	**0.00**	**n/a**			**1.4000%**

$$r_i^{EOD} = \frac{V_{E,i} + V_{0,i} + C_i}{V_{0,i}}$$

$$r_i^{SOD} = \frac{V_{E,i} + V_{0,i} + C_i}{V_{0,i} + C_i}$$

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#2: Not everything is included

- What if our portfolio includes securities that are not at the discretion of the manager: perhaps their legacy holdings that the client wants included in the portfolio. If these securities are excluded from the portfolio's return, we might have a different sort of problem.

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Legacy asset included

Case # 3: A legacy security included; same cash flow method (EOD)							
Security	**V_0**	**V_e**	**C**	**W (for flow)**	**Wtd Flow**	**Weight**	**R**
A	100,000.00	100,100.00	0.00	0.00	0.00	0.18	0.1000%
B	400,000.00	400,100.00	0.00	0.00	0.00	0.73	0.0250%
Legacy security	50,000.00	50,100.00	(1,000.00)	0.00	0.00	0.09	2.2000%
Cash	0.00	1,000.00	1,000.00	0.00	0.00	0.00	0.0000%
Portfolio (asset-wt)	**550,000.00**	**551,300.00**	**0.00**	**n/a**			**0.2364%**
Portfolio (exact)	**550,000.00**	**551,300.00**	**0.00**	**n/a**			**0.2364%**

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Legacy asset excluded

Case # 4: A legacy security excluded; same cash flow method (EOD)							
Security	**V_0**	**V_e**	**C**	**W (for flow)**	**Wtd Flow**	**Weight**	**R**
A	100,000.00	100,100.00	0.00	0.00	0.00	0.20	0.1000%
B	400,000.00	400,100.00	0.00	0.00	0.00	0.80	0.0250%
Cash	0.00	1,000.00	1,000.00	0.00	0.00	0.00	0.0000%
Portfolio (asset-wt)	**500,000.00**	**501,200.00**	**0.00**	**n/a**			**0.0400%**
Portfolio (exact)	**500,000.00**	**501,200.00**	**0.00**	**n/a**			**0.2400%**

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#3: Sub-portfolio transactions don’t pair-off

- If the firm isn’t diligent about ensuring *both sides* of a trade are done on the same day.
- E.g., the buy of a security and the sale of cash (perhaps from a money market)
  - With daily, transactions are missing
  - With monthly, the cash flow weighing formulas are different
- In both cases, we get errors

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This formula

$$R = \frac{\sum_{i=1}^{n}\left(v_{0,i} + \sum_{j=0}^{m} w_{i,j} \times c_{i,j}\right) \times r_i}{\sum_{i=1}^{n}\left(v_{0,i} + \sum_{j=0}^{m} w_{i,j} \times c_{i,j}\right)}$$

- Expects sub-portfolio transactions to pair-off
- If they don’t the returns will be inaccurate.

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Monthly: likely more challenging than daily

- In the above examples, returns were calculated on a single day, thus the asset-weighted approach was compared with an exact time-weighted return.
- If we use it to derive returns on a monthly basis, thus as an approximation method, the situation gets even worse, as the likelihood of internal cash flows occurring increases.

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My experience

- First, I always question the use of the method to derive the overall portfolio return from the sumproduct of the portfolio's sub-portfolio transactions
- It is unnecessary, and often results in errors

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Have I found problems? Yes!

- First time, a UK client, who wanted me to verify their portfolio returns for a year.
- No external flows; so, should have been easy; but:
  - The sub-portfolio transactions didn't pair-off properly
  - And the results were skewed positively
- Second (recent), a long-standing GIPS® verification client, who switched to a system that uses this approach.
  - The client is unable to pair-off the transactions
  - It's been months, and they're still not verified

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Summary

Nothing to be gained from this approach, so why use it? You'll run the risk of errors.

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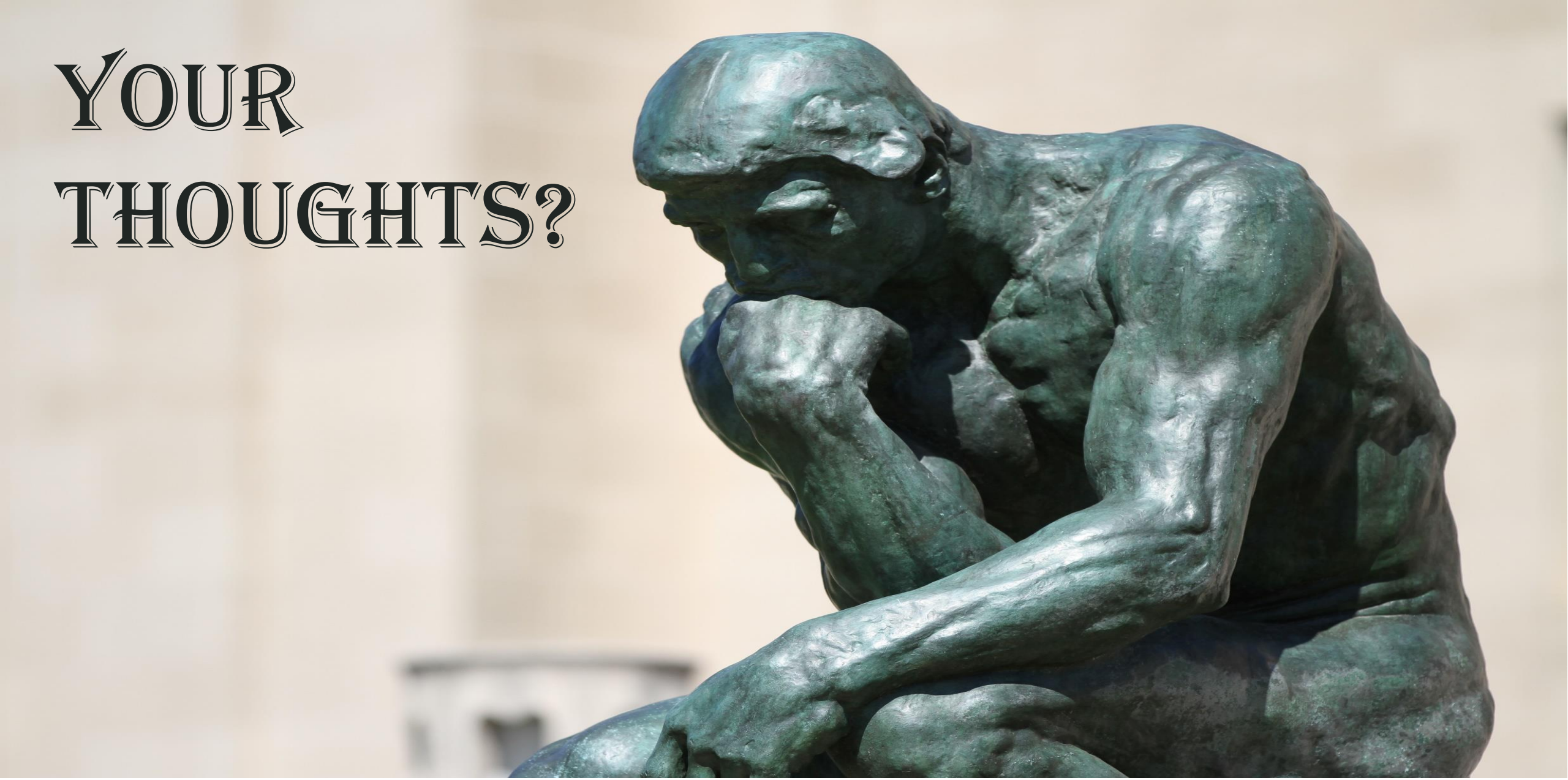
Your thoughts?



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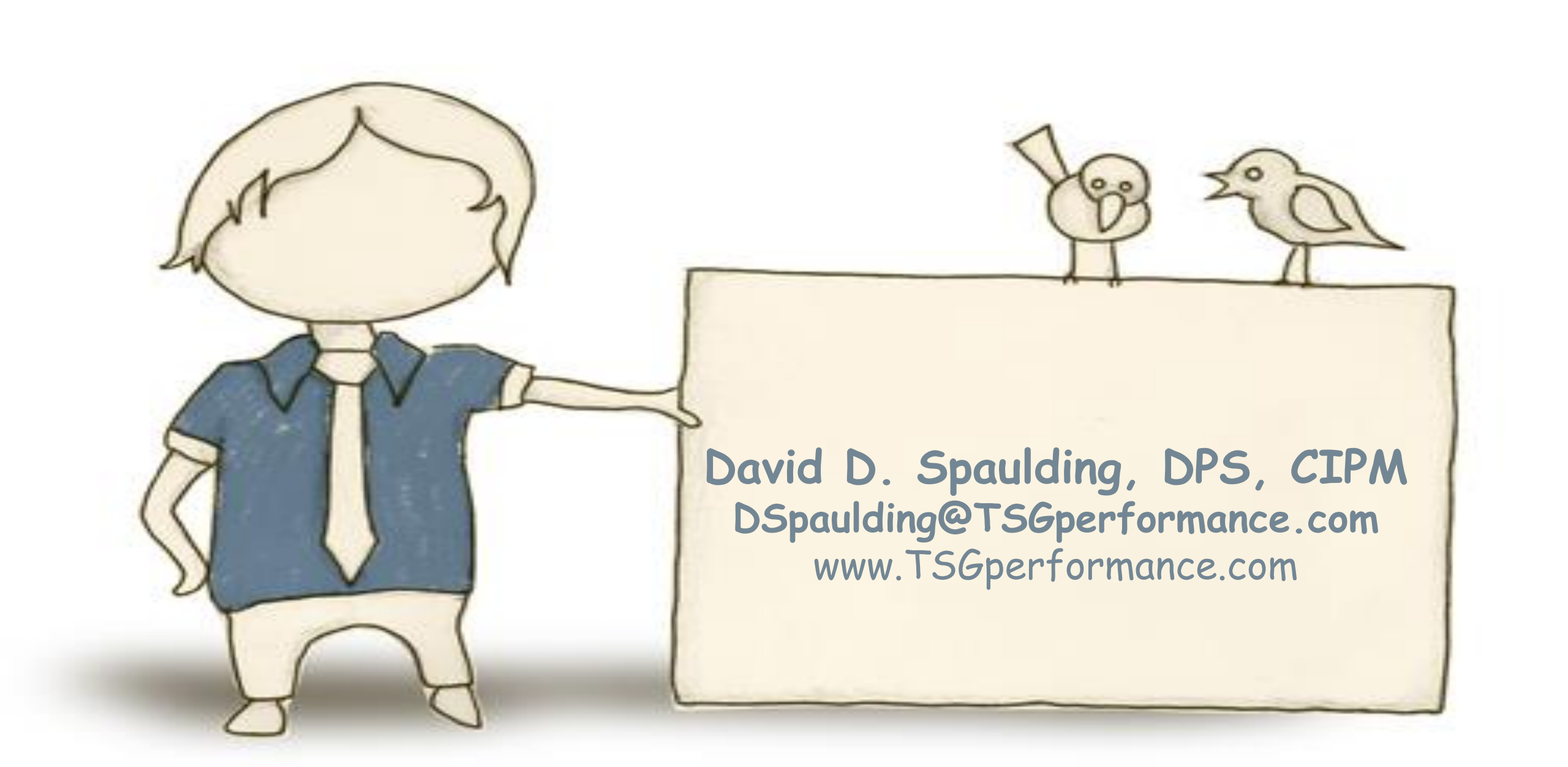

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