

Ec70 2022 Final Solution

2022 Fall

1 Rolling Over a Traditional IRA to a Roth IRA

1.1 a

The IRA account has \$50,000 to begin with, and it earns a 6% annual return. After 15 years it will have:

$$\$50,000 \cdot (1 + 0.06)^{15} = \$119,823$$

If your tax rate at retirement will be 25% then you will consume

$$\$119,827.9 \cdot 0.75 = \$89,871$$

1.2 b

If you convert your account from a traditional to a Roth IRA you will have to pay your current tax rate of 15% on the \$50,000. You will then earn the 6% on the remainder.

$$(\$50,000) \cdot 0.85 = \$42,500$$

Which means you could invest \$42,500 this year, and would have to pay a tax of \$7,500.

1.3 c

After converting to a Roth IRA we invest the \$42,500 for 15 years, yielding

$$\$42,500 \cdot (1 + 0.06)^{15} = \$101,854$$

available for consumption.

1.4 d

In the calculation in part (C) we found that after switching to a Roth IRA we can consume \$101,854 in retirement, much more than the \$89,871 in the traditional IRA (part a). The main driver of this difference

is that the tax rate is much higher in the future, almost double! Since we are saving for a relatively long time and with a high interest rate, the tax differences translate to big differences in the funds available at retirement.

1.5 e

Yes - anything that would cause the tax rates to be higher in the future. One possibility is the high federal deficit which might necessitate higher tax rates. Another reason might be our expectations over which political party will be in control. On the other hand, if we think the economy will grow more in the future and there will be greater prosperity, perhaps tax rates will be lower. Another alternative is that perhaps you expect overall taxes to be higher than they are today - but for your income group you think they will be lower.

2 Choosing Too Low an Insurance Deductible

2.1 a

For individuals choosing the \$500 deductible, the most they will pay when making a claim is \$500. But this is only *the most* they will pay. If they make a claim lower than \$1,000 their lower deductible will save less than \$500. Consider a claim for \$900. You will pay \$500, and the insurance will cover \$400. If you had the \$1,000 deductible you'd pay the whole \$900 yourself. Hence, the \$500 deductible saved you \$400, less than \$500.

2.2 b

If the average person has a 0.043 probability of making a claim, and the average savings per-claim is \$469.86, then the expected benefit is:

$$\text{benefit} = 0.043 \cdot 469.86 + 0.957 \cdot 0 = \$20.2$$

(When you don't make a claim a lower deductible doesn't give you anything.)

But the average cost is \$99.86, so that on average individuals lose

$$20.2 - 99.86 = -\$70.2 \tag{1}$$

So on average those that choose the \$500 deductible lose \$70.2.

2.3 c

The calculation we carried out would suggest that the company has a high margin from selling this insurance. However, we don't know what the lower deductible does to the probability of filing a claim, even though it most likely increases it. Therefore, a lower deductible probably implies that processing costs also go up for the company. Note that 70\$ is likely between an hour and two hours of labor costs. And so it safe to say that if the company is making higher profits, it is not as much our calculation above would suggest. Actual profits would depend on the increased likelihood of a claim and the costs of processing the claims. Conversely, in the hypothetical situation that all claims would have been filed regardless of the deductible, then yes, the insurance company would make high profits, since it would have had to pay the processing costs regardless.

2.4 d

Let's call the break-even probability of filing a claim as P . The average claim still yields \$469.86 in savings, and the cost is still \$99.86. The break-even probability implies that on average the buyers' benefits equals the cost.

$$P \cdot 469.86 + 0.957 \cdot 0 = 99.86 \rightarrow P = 99.86/469.86 = 0.2125$$

21.25%. You'd need to have a really high chance of filing the claim - over one in five!

2.5 e

As less risky drivers stop buying this insurance, the market will increasingly consist of only high risk drivers. At some point insurance companies will face a torrent of claims, which are both expensive and expensive to process. This will lead to the insurance company increasing it's price. With the new prices, the now sophisticated drivers reevaluate the lower deductible, and the safer ones no longer think it's a good deal. Again, they leave, and again the insurance company will increase it's price.

2.6 f

The mechanism driving the effect is called 'adverse selection', and the situation is called a 'death spiral' or 'market unravelling'.

2.7 g

Individuals may deliberately choose the low deductible as a commitment device and a lack of emergency funds. If an individual knows they will not be able to save an extra \$400, they might choose to pay almost

\$100 now to avoid having to pay \$500 in the future. This is very expensive insurance, and the individual might rather save \$500 in an interest bearing account rather than paying \$100 for sure, but may not be able to in some cases (for example, due to present bias.)

3 Investing in Real Estate

3.1 a

We are told the fund's pre-fee return was like the overall index - 12.9%, yet the brochure claims a return of 10.9%. This would imply fees of 2%.

3.2 b

The fund may be marketing it's most successful fund seeking to attract investors. This is similar to lucky funds drawing a lot of new customers - the fund enjoyed random success in one particular case, and is now hoping people extrapolate. While it's true that Phoenix could *theoretically* have a higher return for good reasons (growing region) the first thing we should suspect is luck, followed by clever marketing.

3.3 c

Real estate markets, like all assets, have good and bad years. Looking only at short horizons means that our analysis is sensitive to such good or bad luck streaks. By looking at a longer period good and bad years are more likely to cancel out, and we'll have a better estimate of the true average return of the asset.

3.4 d

One reason to use a national average is that the returns in Phoenix might have been for a one-off reason, or even just random luck. We can draw on the mutual funds parallel again - it is a bad idea to chase exceptionally performing mutual funds, since they are likely due to luck. Another reason might be that given how successful Phoenix real estate has been lately, many other have already entered, pushing future returns now. This is the real estate version of the efficient markets hypothesis.

3.5 e

We want to use a ten year average, and it is more prudent to use the national housing market return - since Phoenix's success of late might be well marketed luck. That would mean an average return of 5.3% before fees, and 3.3% after fees. The components are: (1) ten year horizon, (2) national average, (3) fee. However, other answers that reasonably incorporate these components are also acceptable.

3.6 f

The Sharpe ratio is the excess return over the safe asset, divided by risk:

$$\frac{R_{\text{asset}} - R_{\text{safe}}}{\sigma_{\text{asset}}} = \frac{3.3 - 1.5}{6.8} = 0.26$$

3.7 g

My uncle could be wrong for a few reasons. First, an individual home is riskier than the market as a whole. It must be, since the market is an average of many houses. For example, a house may need a roof replacement, or a particular neighborhood may lose an important employer. As an owners of a house you must also pay real estate taxes, something that is likely paid through the funds fees. Additionally, your uncle is forgetting the costs of buying a home - the broker and mortgage fees, the sum of which can rise to 5-7% of the price.

3.8 h

My aunt is correct - leverage is an important caveat. By taking out a mortgage we have leverage, meaning that we can expect a much greater return (and higher risk). If we had a mortgage with a 20% downpayment we could increase our exposure, and hence our return, by a factor of 5. It is nearly impossible as an individual to get significant leverage in the stock market, and mortgages come with the option value of defaulting in a worst case scenario.

3.9 i

Your cousin is wrong. Phoenix real estate is imperfectly correlated with other assets, such as stocks and bonds. In general, diversifying across assets can deliver higher risk-adjusted returns - it allows the same average return with a lower risk. By adding another class of risky assets, that is not perfectly correlated with others, we are expanding the 'efficient frontier' of our portfolio. This could allow us to achieve the same return with a lower risk (or higher return with the same risk.) Whether we want to do this in practice will depend on how low the correlation is, and how different are the Sharpe ratios.

Another acceptable answer is that the Sharpe ratio of the S&P might be higher than the fund, but mostly because the its risk might be lower. In this scenario, the S&P might have a lower return (not adjusted for risk) than the fund. With no leverage, an investor might rationally choose the fund with the higher return, even if the *risk-adjusted* return is lower. For the exam, we accepted this answer as well, assuming it was clearly explained. The reader should note this is **not** the case in practice, as the S&P has a historic excess return of about 5% - higher than any reasonable number for the fund's return.

4 Short Explanations

4.1 a

A payday loan has a fee that does not depend on the length of the loan. Therefore, if we are taking the loan a short time before the pay date (a short term) we are paying a lot for a short loan, implying a high interest rate. If there is a long time before the pay date then the implicit interest is relatively lower, because the same fee finances a longer term loan.

In general if n is the number of weeks for which the payday loan is made, then the APR is

$$APR = (1 + R_n)^{52/n} - 1$$

(There are 52 weeks in a year). Holding R_n (the fee relative to the loan) constant, this clearly increases with n .

A numerical example. Suppose the loan is for \$300, and the fee is \$20. This would mean $R_n = 0.071$. If the loan is for two weeks, then $n = 2$ and

$$APR(\text{week}) = (1.071)^{52/2} - 1 = (1.071)^{26} - 1 = 5.01$$

which is 501%. But if the loan is for one week then $n = 1$ and

$$APR(\text{week}) = (1.071)^{52/1} - 1 = (1.071)^{52} - 1 = 35.4$$

A much higher 3,540%.

4.2 b

Crypto exchanges allow their customers to keep their digital wallets through these institutions. The Crypto exchange, in many cases, use consumer funds for various purposes, such as making out illiquid loans and promising interest yields in return. In this case they are not similar to stock exchanges, but rather to brokerage firms or even banks. As such, if every customer came to demand their money back at the same time the exchange would face a liquidity shortage. This leads to the same scenario as a bank run. What makes the situation worse is that recently many of the loans made out by exchanges posted collateral that was crypto currency itself, and hence its value was very volatile and correlated with when customers would like to withdraw funds.

4.3 c

Structured products with a money-back guarantee exploit investors aversion of nominal losses, and a tendency to overlook alternative costs. An investor can always invest in a safe asset with a low, but positive,

return. Structured products are often designed to deliver good returns in relatively rare cases (when the market does very well), and otherwise zero or low returns - lower than the alternative safe asset. The safe asset will often deliver a better Sharpe ratio.

4.4 d

Target date funds allocate a large share of assets to equities when investors are young adults for two reasons. (1) Time diversification allows investors to reduce risk by making the same (or a similar) risky bet multiple times, rather than making one large bet once. Therefore we'd like to have our equity investment in the stock market for as long as possible. (2) When investors are young, they have their working life ahead of them. Labor is a relatively safe asset, and so young adults should seek to increase their exposure to other risky assets to get a total asset allocation that is not so heavily tilted towards safe assets. As they age, the remaining labor income shrinks. This means liquid securities become a larger share of total assets, and to not have too high a share of risky assets, some of the risky assets are converted to safer assets such as bonds.

4.5 e

Mortgage closing costs are usually between 2% and 5%. Real Estate broker costs, which are not part of the mortgage costs, can add another 2%-5%. Some of the components of mortgage closing costs include an appraisal, attorney fees, application fees, origination fees, and title search and insurance fees. With an LTV of over 80% there is also mortgage insurance, and a mortgage broker will add additional costs.