1. Illustrate the different findings in the literature concerning the relationship between GDP and Life Satisfaction and how to reconcile the differences

Sketch of answer:

Describe what are the different findings in literature concerning GDP and Life satisfaction.

- Time series data (country – happiness data)
    - Easterlin Paradox: Income remains relatively flat for rises in income, however this seems to be more relevant for developed countries (UK, France, Japan, Netherlands..)
    - In developing countries however, there seems to be a slightly greater role for income in determining happiness (e.g. East Germany). However, not much time series data.
- Cross sectional analysis for a single time period
    - Cross country analysis illustrates positive relationship of GDP and life satisfaction.

If we just consider a utility function with diminishing returns, this would explain the differences because our observed samples are different. Literature has suggested that once basic needs are satisfied, income does not play a large role. (Figure in notes is a good reference)

The cross section analysis thus captures a long term view of the effects of GDP: i.e. that higher aggregate income in the country is related to higher aggregate happiness. Meanwhile, our time series data which mainly is on developed countries captures shifts in GDP on the tail end of the utility curve. Developed countries thus have a flatter GDP-happiness relationship because they are on the flat portion (with high diminishing returns) while developing countries are on the steeper portion.

However, the above explanation alone is not complete if we consider additional empirical observations:

- For all countries, within country analysis shows an effect of <u>personal income</u> on happiness; this is steeper in developing countries but also present in developed ones.
- Co-movement of SWB with macroeconomics aggregates like growth.

<u>Talk about briefly (the stuff below is relatively detailed)</u>: How do we explain these differences between cross sectional /within country? Read Clark et. Al.

- Relative income matters: $U_{ijt} = \beta_1 \ln(y_{ijt}) + \beta_2 \ln\left(\frac{y_{ijt}}{y_{jt}^*}\right) + \beta_3 \ln(\frac{y_{jt}^*}{y_t^*}) + controls$ or

  $U_i = \beta_1 \frac{y_i}{y_i+A} + \beta_2 \ln(\frac{y_i}{ybar})$. 3rd term (optional) accounts for cross country comparisons.
- 2nd formulation does not take into account that GDP growth and happiness strongly correlated since effects of GDP growth tend to 0: $\lim \frac{y_i}{y_i+A} = 0$.
- Individuals make some comparison to some reference group (possible measurement issues): if internally set: aspirations, externally set: social comparison[1].
- Social comparison (like keeping up with the Joneses)
    - Lowenstein uses the average income within the country at a point in time.
    - This means that while it may be flat in developed countries, it can still be steep within the country due to effects from comparing with others (status). It is flatter in developed countries possibly because of cross country comparisons?
    - In cross-section reference point is fixed. In time series, with growth in everyone's income, no observed effects from the relative income utility term; i.e. the "long run" curve for individuals in the country is gentler than the short term scenario (consider a change in y_{ijt}^* only versus a change in both it and y_{jt}^*
- Adaptation/aspirations? Habit formation?
    - Aspirations could adapt to increases in current income
    - E.g: past 3 years of income as reference point: need continually rising income over time for happiness to keep rising. Thus flatter long term relations of income to happiness?
- Eugenio: aspirations can result in a bliss point because higher GDP both results in a higher aspiration/ income target which has a negative effect (because harder to fulfil) as well as a higher absolute income which has a positive (diminishing effect). Perhaps the former is much more important in developed countries: status and showing off? Hence the differences in GDP-happiness relations for developed and developing countries.

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[1] Note that there may be some interaction between the two factors as well.

2. Explain the Hyperbolic model of time discounting using the theory that in the brain two different systems interact.

Sketch of answer:
Question is related to Neuroeconomics: see textbook 9.3.6. Lowenstein paper 5.1.

2 systems in the brain, automatic/affect vs control/cognition
- Affective/automatic/impulsive system: not conscious thinking, goes on in parallel, may involve visceral influences, seeking (immediate) pleasure and enjoyment?
- Cognitive/control/reflective system: more rational, consciously thinking through to make a decision about some problem. Ability to take long term consequences into account. Executive control system cut in to interfere with automatic processes and allow for control by consciousness and vice-versa.

Idea of being of two minds is related to present bias and time inconsistency. Decided by which system "wins". Remember for quasi-hyperbolic discounting, we have utility today being $u(c_0) + \beta \sum_{t=1}^{T} \delta^t u(c_t)$. ** specify!** If $\beta = 1$, there is no present bias and time inconsistency: "today" is not treated differently from "future" (besides the normal discounting). δ captures the usual exponential discounting.

We have that the rational portion of brain is associated with the standard exponential discounting portion (time consistent) while the affective and automatic portion is associated with the present bias portion. In particular, it is suggested that the prefrontal cortex creates a "deliberative affect" via directed imagery and thought so as to counter affective forces and thus stimulate the control system.

Mention some evidence for this (from textbook chapter, paper has other examples):
- NAcc (nucleus accumbens): activates with expected rewards (experiencing them): β
- DLFPC (Dorsolateral prefrontal cortex): activated when simulating behavioural consequences: switching to more conscious thought process: δ
- When choosing immediate reward, NAcc activates more than DLFPC while the converse occurs when participant chooses the later reward.
- Damage to prefrontal cortex (Phineas Gage, Damasio): behaved myopically.

Thus intertemporal choice seems to be related to the tension between two different systems: one which values present rewards and the other which is more calculating and thinks in terms of standard exponential discounting (the latter being likely to be more salient for comparison of rewards in the future).

Briefly talk about possible usefulness:
- Hyperbolic discounting predicts that people will always make short sighted decisions when facing incentives which demand so ($\beta < 1$ and fixed), but neuroeconomics suggests that these can be moderated by factors which strengthen or weaken each of the 2 components.
- Example:
  - Sometimes, under load, the executive control system can fail to supress signals from the automatic system resulting in different decisions. For example, stress from work can inhibit one's ability to properly manage one's eating habits.
  - Drugs accentuate activation of affective states and thus increase myopic behaviour.
- May have some interaction? While prefrontal cortex activation is needed to deliberate about the future in decisions to delay gratification, emotions also play a role in how one feels about such decisions: e.g. anxiety experienced if I were to delay preparing for an exam may encourage more future focused thinking (sometimes too much?) Disgust from a previous experience? See the 4 quadrant thing (cognitive/ affective X automatic/control).
- Can be used to explain via the uniquely human propensity to experience fear/ anxiety when thinking about the future: Impulsivity vs workaholics