SatComm: Satellite Data to derive indicators for Commodity Price

- Using satellite data to predict commodity prices
- Focusing on crops (academic literature focuses on wheat, corn, and soybeans)
- The idea is to track crop health using maths, coding, and remote sensing data to spot trends that can influence market prices
- Will use free satellite data (e.g., Sentinel-2 and Landsat) to keep it simple
    - Its not optimal, as the revisit frequency is 1x per 10 days for pre-2017, but I will also check if the university has access premium data sources like Airbus (revisit rate of 2x per day), that hedge funds likely use
    - Academic papers use Sentinel-2 and Landsat data and have been able to generate alpha, so still okay

BTS Quant Team 3 Members:

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- Miles Weedon (MW)
- Kade Stroude (KS)

Workflow Summary:

1. Decide on a commodity and specific crop to focus on (everyone)
2. Identify a geographic area of interest (well discussed in literature is US, Ukraine and a few other regions, so doesn't necessarily have to be novel) (everyone)
3. Use satellite images to monitor crop health (everyone)
4. Calculate vegetation indices like NDVI to track yield potential (KS)
5. Build a trading strategy that links these insights to commodity prices (everyone)
6. Execute trades through Interactive Brokers (IKBR) (TBD)

Data Sources

- **Sentinel-2**:
    - **Resolution**: 10 x 10m (for visible / NIR wavelengths – these are the ones relevant for us)
    - **Revisit Freq.**: 5 days (post-2017), 10 days (pre-2017)
- **Landsat 8/9**:

- **Resolution**: 30 x 30m (across all wavelengths)
- **Revisit Freq.**: 16 days
- This satellite constellation (not 8/9 but earlier fleets) has a lot more historical data, so is key for training / backtesting

Workstream Detail:

1. Commodity and AOI Selection (everyone can be involved)

A lot of this can be based on academic literature for simplicity as some topics are already discussed, however if we are focused on returns we might want to be innovative here as anything discussed will like also be somewhat saturated from HF strategies

- **To do list:**
  - Agree on a specific commodity (e.g., wheat, corn, soybeans)
  - Agree on a geographic area of interest (e.g., Midwest USA, Ukraine)
- **Deliverable**: A clear focus on one crop and one AOI

2. Data Acquisition

- **To do list:**
  - Set up accounts on Copernicus Hub and USGS Earth Explorer (KS has done already)
  - Download Sentinel-2 and Landsat imagery for the chosen AOI (KS to do, but has experience with this)
  - Preprocess images (crop regions, apply corrections) (KS to do, but has experience with this)
- **Deliverable**: Dataset for AOI

3. Vegetation Index Calculation

- **To do list**:
  - Use Python/QGIS to calculate NDVI from satellite images (KS to do, but has experience with this)
  - Analyse NDVI trends over time to track crop growth patterns (KS to do, but has experience with this)
  - Visualise changes in NDVI with simple plots (KS to do, but has experience with this)

- **Deliverable**: Time-series NDVI analysis for the AOI

4. Historical Data Collection (TBD)

- **To do list**:
    - Gather historical commodity prices (e.g., Yahoo Finance, Quandl) (split between everyone)
    - Collect relevant weather data for the AOI (TBD, probably a one man job)
    - Align these datasets with NDVI time series (TBD, probably a one man job)
- **Deliverable**: A consolidated dataset combining satellite and market data

5. Model Building and Trading Strategy (TBD, probably something we should look at together as quite key)

- **To do list**:
    - Train simple regression models to predict price changes using NDVI (TBD, KS happy to do)
    - Experiment with additional features (e.g., weather data, seasonal effects) (TBD)
    - Validate the model on historical data to assess accuracy (TBD)
    - Define signals based on NDVI trends. E.g. if NDVI indicates poor crop health, this signals reduced supply and therefore price increases
    - Set entry and exit trading criteria (everyone)
        - Entry: e.g. we buy commodity futures if NDVI signals are below a certain threshold and sell when NDVI trends stabilise / recover
        - This would be Python-based via QuantConnect
    - Backtest the strategy (TBD)
        - Use QuantConnect to simulate how the strategy would perform over past [X] years (TBD dependent on dataset for AOI)
    - Optimise parameters to improve strategy performance
    - Set up IKBR accounts (Everyone should have done this)
    - Integrate into IKBR e.g. API configuration etc. (TBD)
    - Deliverable: A backtested trading strategy with performance results