Market Simulation Models for Strategic Forecasting
AQS is a specialty consulting firm focusing on forecasting, valuation and other quantitative methods to facilitate strategic planning, project prioritization, investment decisions and operational efficiencies. Our clients include:

- Johnson & Johnson Global Business Development
- Ethicon Endo-Surgery
- LifeScan
- Ethicon, Inc.
- Ortho-McNiel-Janssen
- Codis
- Codman
- DepuySynthes Spine
- Vistakon
- Becton Dickinson & Company
- Roche
- Easton Associates
- Metaphor, Inc.
- Smith & Nephew
- Chiasma Pharmaceuticals
- Reliant Pharmaceuticals
- Endo Pharmaceuticals
- Eisai Pharmaceuticals
- J&J Pharmaceutical Group Strategic Marketing
- Merial, LTD
- Cryonics Medical
- Anika Therapeutics
- Breathe Technologies
- Deloitte
- Immuno Technologies
- Magellan Health Services
- Proctor & Gamble - MDVIP
- Florida Department of Children & Families
A forecast is a belief about the future in the context of a specific set of assumptions with the purpose of informing planning and/or investment decisions.

- In order for it to be useful it must be truthful
  - Transparent as to methodologies, sources of potential bias or conflicts of interest
  - Reliable representation of the belief regarding how probable the represented outcomes are to occur
  - Representative of important relationships between variables

- Transparent with regard to the assumptions and mathematical treatment of relationships between them

- A forecast MODEL, is a tool to facilitate the understanding of potential futures and the selection of a forecast to forward for decision-making

“How close to the truth to you want to come, sir?”
Scenario Forecast Models

- Inputs are represented as single point estimates
- Outputs represent a single scenario out of a multitude of possible scenarios
- Confidence in the outputs may only be as high as the confidence in the complete accuracy of all inputs
Simulation Forecast Models

• Inputs are represented as probability distributions representing the range of possible values
• Outputs are representative of what is possible, with likelihoods calculated for any value (scenario) within the range of possible outcomes
• Confidence in the outputs is selected and the value calculated at that confidence level
AQS Forecasting Standards

- Relevance
- Flexibility
  Models are comprised of modular components that are interchangeable as data and or market conditions evolve
- Assumptions drive outcomes
- Transparency
  All inputs are maintained separate from mathematics and are fully documented as to source and date
- Quality control

“How close to the truth to you want to come, sir?”
A systematic process increases reliability and credibility of the forecast (though it will likely be iterative)
You may have a plan, but there are often multiple agendas (hidden and otherwise) that will influence the process.

- Scope creep
- Complexity
- Ex post facto impeachability

Following the guidelines in this segment will help you achieve alignment, representativeness and credibility in your forecast.
A strategic revenue model is fundamentally very simple. The dynamics underlying these high level variables are what makes market modeling more challenging (and interesting).
Add uncertainty to the mix, and it becomes even more interesting!

Revenue = Target Pool * Adoption * Market Share * Price

Disruptive Risk
- Instability in population
- Emerging Technologies
- Healthcare Economics
- Study Data

Disruptive Risk
- Time of entry
- Relative advantage
- Contracting
- Supply chain
- Sales force
- Study data

Disruptive Risk
- COGS
- Competition

Uncertainty
And if you add uncertainty to your model with any realism, you will likely have to codify the relationships between various inputs to ensure plausible outcomes. This often means correlations.
Segmentation decisions should be driven by the need to establish identifiable sub-populations with unique adoption characteristics.
Segmentation and target pools in the context of the strategic forecast model

Revenue = Target Pool * Technology Adoption * Market Share * Price

Target Pool = Segment * (1-Exclusions)

Prevalence-based
Segment = Population * Prevalence

Incidence-based
Segment = Population * Incidence
Incidence and prevalence based conventions

• Incidence-based conventions
  – Only newly established cases within the modeled interval of time are considered as potential targets for adoption

• Prevalence-based conventions
  – Number of individuals with an existing attribute or condition at any given time
  – Prevalence pool replenishment / decrement rates
    • Replenishment via incidence (including relapse)
    • Decrements due to mortality, cure, etc.
  – Decrementing prevalence pool by adoption ratios
  – Once an individual has adopted, they are removed from the pool of potential adopters
Launch timing is relevant to the addressable population.

- Target pool size is often a function of time
- Applying standard adoption mathematics to the portion of a target pool whose availability to adopt has expired can dramatically overstate initial year adoption
  - This overstates early forecast unit sales, which overstates early forecast revenue, which overstates early forecast NPV, ...
- We address this issue through prorating the target pool:

Prorated Target Pool = Target Pool * Percent of Year Technology is Commercially Available
Launch strategy can also impact modeling of the addressable population.

- Simple case: conventional launch strategy
- Staged Launch
  - Technology is made available to fractions of the target pool incrementally through time
  - If continuous growth, transition function
  - If incremental circumscribed groups, model as unique target pools with dependent launch timing
How we define adoption is key to how we understand the market being modeled and how the rest of the forecast is structured. What is adoption?

- The proportion of the relevant population, or target pool, that will use a technology at any given point in time
  - Sets the boundary of the population within which brands will compete for market share
Characteristics of adoption

- **Systematic**
  - Non-random
  - Predictable pattern
  - However, can take a variety of shapes depending on influencing factors

- **Monotonic**
  - Organically, an increasing function relative to zero
These characteristics make it possible to establish functional models of adoption.

- Provides the ability to make a few estimates that drive many periods of an adoption forecast
- This, in turn, eliminates a significant source of estimation error (from period-to-period estimation)
- There are a number of functional variants
  - Bass
  - Logistic
  - Gompertz
  - etc.
- We have found the Bass model to be the most flexible in the majority of our work
There are multiple determinants of the speed and shape of the adoption process.

• The innovation (novel technology)
  – Advantage relative to existing alternatives
  – Compatibility
  – Complexity
  – Trialability
  – Observability
• Communication channels
• Time
• A social system
These determinants map relatively well to input parameters for the adoption equation.

- **Standard Bass equation inputs:**
  - Maximum organic adoption \( (m) \)
  - Coefficient of innovation \( (p) \)
  - Coefficient of social contagion \( (q) \)

- **AQS has reparameterized the original Bass equation to establish more discussable inputs:**
  - Maximum organic adoption
  - Percent of maximum adoption achieved in the first 12-months after launch
  - Years to achieve 90% of maximum adoption

**Continuous Bass Model**

\[
\text{adoption}_t = m \left( \frac{(p + q)^2}{p} \cdot \frac{e^{-(p+q)t}}{1 + \frac{q}{p} e^{-(p+q)t}} \right)^2
\]

**Discrete Bass Model**

\[
\text{adoption}_t = n(t) = \left[ p + \frac{q}{N} N(t-1) \right] [\tilde{N} - N(t-1)]
\]
Different methods are employed to forecast adoption for pre- versus post-launch scenarios

**Pre-launch**
- There is no history
- Parameters m, p and q can be assumed to be independent
- Model parameters must be estimated
  - Market research
  - Expert judgment
  - Analogues

**Post-launch**
- There IS history
- Model parameters MUST be consistent with history
- Parameters m, p, and q can be assumed independent for non-probabilistic forecasts
Depending on the scope of available assumptions, we typically recommend two variants of strategic market share models:

- Simple linear model
- Competitive interactive share force model
Simple linear share models are an excellent choice when competitive data are limited or when modeling underlying market dynamics are unimportant

• Benefits
  – Simple inputs
  – Easy to explain
  – Easy to maintain

• Limitations
  – Does not reflect market dynamics underlying share
A competitive interactive share force model takes into account factors of “push” and “pull” associated with product share. It is very useful when competitive data are available or and modeling underlying market dynamics are relevant to decision making.

• Benefits
  – Incorporates underlying market dynamics
    • Relative product preference
    • Sales and marketing force
    • Competitive inertia
  – Facilitates “what-if” scenarios for decisions like
    • Increasing or decreasing sales/marketing spend
    • How much to spend on product improvements/innovations
    • How much a competitive innovation may impact your share

• Limitations
  – Requires more information than the simpler model
  – Not as easy to explain
  – Higher maintenance cost
Pricing schema take many shapes and forms. We have found that most features of pricing dynamics can be modeled with variants of three different structures.

- Fixed price
- Base price with fixed compound annual growth rate (CAGR)
- Base price with dynamic CAGR
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