

Introduction: Current Interpretation (Rules 1+2)

Nature of Probability Difficulties - The Paradoxes
Objective + Subjective

The relationships of \mathcal{V} to reality (models)

The aims of a Physical theory - homomorphism - interpretation

The role of Correlations in wave mechanics - Consequences of 3-N dimensional wave equation - Correlations as a consistency preserving mechanism — conservation laws as correlation laws

Mathematical Information Theory + Correlation - Algebra of correlations

1. Information or Probability distribution - Plausibility arguments
2. Joint distributions, dependence + independence - marginals, etc
3. Introduction of binary Correlation as expected info. gain
4. General Algebra of Correlation
5. Relationships of Info to entropy

Consequences of Classical Liouville theorem

In terms of the theory, all branches are regarded as equally "real" since the fundamental entity is \mathcal{V} itself. In interpreting the theory we should not think of one outcome being selected out of the many possibilities, but of all outcomes existing simultaneously, each with a corresponding observer who perceives that outcome. Interpreting further, one sees that as to each of these observers it appears that a random selection was made. This is a result of the subjective interpretation of the theory which results when one introduces entities (natural beings, servomechanisms, etc.) called observers into the formal theory itself, and inquires as to the behaviour of these observers.

Thus all of the usual probabilistic aspects of QM. arise from the theory on the subjective level while the theory remains objectively deterministic.

Section D

§1 Probability distributions (joint)

P_{XY} notation, connection to marginals
independence and dependence
Conditional probability.

§2) Information

Definition, Heuristics, (Paradoxical Example)
general usefulness

Difference of discrete vs continuous

Reference to underlying measure

examples for discrete + Continuous

Transformation properties for Continuous etc.

§3) Correlation

Intuitive considerations - measure of strength def
 $\rho_{xy} = \frac{Cov(x,y)}{\sqrt{Var(x)Var(y)}}$ hence symmetric
property \Rightarrow dimensionless index

General Correlation algebra

Transformation properties

Invariance of Correlation of events. - Fundamental
nature

Comparison with usual measures. Stress that it is
a measure of strength only, not nature since
distributions assumed known in advance.

relegate Von Neumann Meets to II

(maybe put II first)

Copenhagen View : No statements meaningful except those which include a description of classically functioning apparatus, -- "reality" taken to be classical phenomena only.

Question of objective description ie
to be able to give description (assign state) to systems independently of any observation acts.

Complementarity contained in general form in present scheme.

Physical theory : a mathematical model some elements of which

Look closer at Margenau, who, although all wet on his Quantum Interpretation, since excluded by double observer paradox, among others, nevertheless has good ideas about the nature of Physical theory.

Relativity Principle: In any composite system there is, in general, no state for a subsystem, but only a relative state, relative to some (arbitrary) specification of the state of the remainder.

sort of a parallel to usual Relativity principle
since denies absolute significance to subsystem state,

$$\psi_s = \psi(s_1, s_2)$$

s refers to collection of all coords of s_1 etc

given $\psi_{s_2}^i = \cancel{\psi}(s_2) \psi^i(s_2)$

$\Rightarrow \cancel{\psi} =$ expand in terms of P_{ψ^i} and P_{\perp}

↑
whole remaining space

arbitrary basis ϕ_i for s_1 u_j for s_2

where

$$u_j \text{ particular} = \psi^j$$

Then $\psi(s_1, s_2) = \sum a_{ij} \phi_i u_j$

where $\cancel{(\phi_i u_j, \sum_{u,v} a_{uv} \phi_u u_v)} = a_{ij}$

Then $\cancel{\psi_{s_2}^i} = \sum_i a_{ij} \phi_i = \sum_i (\phi_i u_j) \psi_s \phi_i$
(unnorm)

$$= \sum_i (\phi_{(s_1)}^* u_j^*(s_2) \psi(s_1, s_2) ds_1 ds_2) \phi_i$$

where the a_i , b_j 's and c_k 's are arbitrary positive numbers representing the base measures on the sets $\{x_i\}$, $\{y_j\}$, ..., $\{z_k\}$ respectively, relative to which our information is defined in (9.2), which represents the expected log of the probability density relative to the product measure of the a_i , b_j and c_k 's. Our previous definition thus results from the choice of $a_i = b_j = \dots = c_k = 1$, i.e. by considering all values of the random variables on equal footing.

We note, however, that the correlations, ~~are~~ defined as in (3.4) do not depend upon the ~~base~~ ^{information measure} measure (a_i 's, b_j 's, c_k 's), since, computation of the correlation $\{X, Y, \dots, Z\}$ through ^{3,4} using information relative to the above base measure:

$$\begin{aligned}
 (5.3) \quad \{X, Y, \dots, Z\}' &= \exp \left[\ln \frac{P_{ij\dots k}}{a_i b_j \dots c_k} \right] = I'_{XY\dots Z} - I'_X - I'_Y \dots - I'_Z \\
 &= \exp \left[\ln \frac{P_{ij\dots k}}{a_i b_j \dots c_k} \right] - \exp \left[\ln \frac{P_i}{a_i} \right] - \exp \left[\ln \frac{P_j}{b_j} \right] - \dots - \exp \left[\ln \frac{P_k}{c_k} \right] \\
 &= \exp \left[\ln \frac{P_{ij\dots k}}{P_i P_j \dots P_k} \right] = \{X, Y, \dots, Z\}
 \end{aligned}$$

so that the correlation for discrete distributions, as defined by (3.4) is independent of the choice of base measure.

Moreover, for a set of arbitrary random variables X, Y, \dots, Z , with information measures u_X, u_Y, \dots, u_Z , and ~~a~~ probability measure M_p on the direct product $X \times Y \times \dots \times Z$, if we consider, as before, partitions of Ω into $\{X_i\}, \{Y_j\}, \dots, \{Z_k\}$

Liber Dado de base etc.

Knowability of Ψ -function - irreversibility of splitting.
Ability of date of diff observers (spacelike)

Practical uses - New insight, grow. field

Case of H atom Formation - true that radiatio, uncertainty increases - Analogue of Liouville theorem - ~~which~~ should show that total info in 2-particle system is constant. Since formation of H atom definitely increases info about the two particles (by amount = to the comilation) could then imply info about E.M field decreased correspondingly.
(Now have photons of unknown whereabouts.)

Give Image of how Correlation takes place
(thru example - $\langle \bar{r}_1 \cdot \bar{r}_2 \rangle$)

Moving of smear out - low natural max - amplification

effect of Radiation - (introduce any lack of Correlation?)
↓ necessary to form strong correlations.

Show that at classical levels
correlations are almost instantaneous

Show that holds for any servo (configuration)
which may be interpreted as consciousness
ie abstract to different configurations of machine
(including memory) as representing different perceptions.

Problem of Stat. interp. - χ^2 density meaning
(as a limit perhaps? ie may be that selection
of future tracks insensitive to distribution of selection-
had always to χ^2 locally, - Alternatively,
self consistency argument - only one
applicable at all levels.

Knowability of Ψ -function - irreversibility of splitting.
Pooling of data of diff observers (topeles)

Practical uses - New insight, grow. field

Case of H atom formation - true that radiator uncertainty increases - Analogue of Liouville theorem - ~~which~~ should show that total info in total system is constant. Since formation of H atom definitely increases info about the two particles (by amount = to the correlation) could then imply info about E M field decreased correspondingly.
(Now have photons of unknown whereabouts.)