Dr. Todd Brun, Institute for Advanced Study (TP 10-17-01) Consistent Quantum State Assignments

Consistent Quantum State Assignments

Missed information.

Von Neumann entropy

Thermodynamically, this idea is illustrated by the

von Neumann entropy

non-normalized density operator, etc.

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We require that any state possessing maximal info about a system must

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Talk Wed 17 Oct 2001, TP 1102

Compatible Quantum State Assignments

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so it satisfies $P_2$.

However, $0 \neq \langle \phi | P_1 | \phi \rangle$.

This all seems compatible. But.

Now, more, enough to eliminate $1'$. Bob's state is either $1'P_1$ or $1'Q_1$. Bob's state is either $1'P_1$ or $1'Q_1$. He's thinking of $P_1$.

When $\langle \phi | P_1 | \phi \rangle \neq 0$, I urge think of $P_1$.

$P_A = | \phi \rangle \langle \phi | + (d-1)| \psi \rangle \langle \psi |$

The description is having state.

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Maximal Alice, however, has less info.

Suppose that Bob describes the state $\rho$.

Unfortunately, it is wrong.

The state $\rho$ has less info.

I.e., noncontradictory.

The 2 matrices must be nonorthogonal.

The 2nd criterion is intuitively obvious:

$P_1 : \rho_{AB} \neq 0$

$P_1 : \rho_{AB} = 0$

compatible in our sense:

The Peres axioms.

by Peres. Peres suggested two simple
criteria for density matrices to be

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For some $i,j$,
\[ |i\rangle = 1/\sqrt{2} (|a\rangle + |b\rangle), \]
\[ |j\rangle = 1/\sqrt{2} (|c\rangle - |d\rangle). \]

There are at least one state in common, such that the two decompositions have decompositions into pure states. If $|a\rangle$ and $|c\rangle$ are compatible if the

nontrivial intersections support $|a\rangle$ and $|c\rangle$. If $|a\rangle$ and $|c\rangle$ are compatible if their

The criterion is simple:

First, and if $|a\rangle$ is not compatible with $|b\rangle$, then $|a\rangle$ and $|b\rangle$ are compatible if their

Mermin posed this question in a recent

consistent by showing that if they could be brought

This is the basis we should take for our

If Alice learns of Bob's result, she

then obtain the state $|b\rangle$, and getting result 0. He

into by measuring $\mathcal{A}$ in the $\{0,1\}$ basis

For $|s\rangle$, Bob, however, acquires more

This leads to a state assignment

\[ |\psi\rangle = \sqrt{p}|0\rangle + \sqrt{q}|1\rangle + \sqrt{r}|2\rangle + \sqrt{s}|3\rangle. \]

entangled with an ancilla $\mathcal{A}$. Suppose $s$ is

We can see how this can arise
The converse is obvious.

\[ P(A) \neq P(B) \]

\[ \left\langle \phi \mid \left\langle \psi \right| \right\rangle \]

We can do such construction for both.

\[ P(A) = \frac{1}{2} |\langle \psi \mid \phi \rangle|^2 \]

\[ P(B) = \frac{1}{2} |\langle \phi \mid \psi \rangle|^2 \]

where \( |\langle \psi \mid \phi \rangle| \) and \( |\langle \phi \mid \psi \rangle| \) are the same. Then the state is

\[ \{ \psi \} \]

where \( \langle \phi | \{ \psi \} \rangle = \{ \phi \} \]. We can

\[ P \rightarrow \{ \phi \} \]

Then we assume the ordering \( P(\{ \phi \}) \) for all \( P \).

\[ P = P \times P \]

any such \( P \). Define

\[ \{ \phi \} \]

we can find a decomposition of \( \{ \phi \} \) including

\[ |\langle \psi \mid \phi \rangle| \]

\[ |\langle \phi \mid \psi \rangle| \]

can be written in \( \{ \phi \} \). Then the orthogonal decomposition of \( |\langle \psi \mid \phi \rangle| \) is the orthogonal decomposition of \( |\langle \phi \mid \psi \rangle| \).

\[ P = P \times P \]

Suppose \( P \).

What does this mean? Let...
A note about the same system:

They could represent different states if they could satisfy different states of satisfaction if they satisfy the criterion, then will attribute states, and as such they Fourier transforms values of $\phi$, $\psi$, and $\chi$.

Bob measures $B$ and gets a 1 result.

Alice measures $A$ and gets result 0.

$$a' + a''$$

The Fourier transform of the entangled state

Image now a bipartite system

$$p_B = \langle 0| \rho_X | 1 \rangle$$

They have decompositions

Suppose $p_A$ and $p_B$ satisfy the criterion.

Sufficiency

Is this criterion necessary and sufficient for compatibility (in the sense we have discussed)?

This criterion is stronger than $P_I$. This criterion is stronger than $P_II$. $P_I$ and $P_II$ are disjoint. However, if $p_B = 0$ then the supports $p_A$ and $p_B$ are disjoint.

Note that this criterion also implies...
The support is the set of all points one phase-space point in common. The expectation of any observable is the integral of the observable over the state. Suppose we are interested in the observable $\hat{X}$, which has a probability density function $p_X(x)$. Then the expectation value is given by:

$$\langle X \rangle = \int x p_X(x) dx$$

These are characteristic functions.

Classical Analogy

In classical mechanics, the phase space is a manifold $\mathbb{R}^2$. The observables are functions on this space, and the expectation values are given by:

$$\langle X \rangle = \int x f(x) dx$$

Suppose we have a quantum state $\rho$ and a measurement $\hat{A}$. If such a measurement gives result $1/\alpha$, we say that the system is found in state $\alpha^\dagger |\alpha\rangle$. This is a good deal more subtle. Imagination and precession take both.

Classical Quantum State Assignments

Note that in the continuous case, sums become integrals and $\int x^2 dx = \langle X^2 \rangle$. The classical equivalent of a pure state is the classical analog.
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Gained maximum entropy single PTX.
they have the same support, then a prime-
Authors cannot be made to agree. It
vice-versa. This will still be true, and the
so if some xER has Pr=0 and qR=0 for

\[ p_B \rightarrow p_B = \frac{\chi}{n} \]

\[ p_B \rightarrow p_A = \frac{\chi}{n} \]

\[ p_C \rightarrow p_C = \frac{\chi}{n} \]

\[ p_A \rightarrow p_B = \frac{\chi}{n} \]

\[ p_A \rightarrow p_A = \frac{\chi}{n} \]

\[ p_B \rightarrow p_A = \frac{\chi}{n} \]

Then outcome A occurs with probability

\[ Q_B = \frac{\chi}{n} \]

\[ Q_C = \frac{\chi}{n} \]

\[ Q_A = \frac{\chi}{n} \]

\[ Q_B = \frac{\chi}{n} \]

\[ Q_C = \frac{\chi}{n} \]

\[ Q_A = \frac{\chi}{n} \]

Consider 2 distributions and consider 2 distributions

and consider 2 distributions of phase space into regions Rx.

The classical example:

How does this thing come in CMT support?

It is possible if they have identical
outcomes they will agree. This is only
distributions PA, PB, PC, etc. After any
measurement which can bring the 2
regions. We require that there exist
partition of the phase space into disjoint
however, let a measurement be a

we can frame a stronger criterion,

the criterion is equivalent to PII.

distributions are disjoint. So classically
hold only if the supports of the two

we can see that classically this fails to
Not compatible, let’s put Alice thinks it’s in state $|\psi\rangle$ and gets result $0$. He thinks it’s $\psi$ in the state $|\psi\rangle$, but if he measures in the $|\psi\rangle$ basis and gets result $1$, he knows $\psi$ in the $|\psi\rangle$ basis and gets result $1$. Without Bob’s knowledge, Alice measures $\frac{1}{\sqrt{2}}(|0\rangle + |1\rangle)$. 

A joint state $\frac{1}{\sqrt{2}}(|0\rangle + |1\rangle) = 1$.

Suppose initially that $S$ and $A$ are in business in QTM. However, this can be as subtle system itself or other systems correlated. Measurements are done. Either in the direct or indirectly from experience.

Correct, I meant that it should directly not implied information. When implied that $A$ is in the state $|0\rangle$.

Acquiring information and the disturbing effect.

Greater variety of measurements in our nothing at all! This reflects the fact that $\psi$ as well as classically, it implies obviously stronger than our attention in the same support (which is far from implying that $A$ and $B$ must will agree before they contradict).

After the measurement Alice and Bob  

$$|\psi\rangle = \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle)$$

Measure  

$S = |1\rangle$  

$B = |1\rangle$  

$A = |0\rangle$  

Nothing about the states! E.g., two descriptions with agreement implies measurement can with certainty bring...
subtle business in QM.

6. Acquiring information is a more
sensible intuition Feibelman.

5. Classical information is not
sufficiently

4. The criterion of overlapping supports

3. The Bell's criterion are too strong.

2. ...but not different pure states.

1. It is possible for 2 (or more) observers

Summary