Random Processes (Contd..)

Okay so um if you recollects we have looked at the definition of random processes these are the two ways of looking at random process one is as a collection of waveforms which we are randomly available right any particular waveform is certain probability depending on the probability distribution of the underlying probability space right they will have to inform only for to the set of functions which are functions of time how ways to think of it have a sequence in this sequence of we are there is some kind of index which gives out the functional dependency eventually it could be a functional dependency on t index could be t the index could be some special variable or any other kind of variable right so you have sequence one after another or random variables occurring distributions in that constitute of random process the later approach is convenient from the point of view of characterization of the random process in terms of probability distribution functions only thing is the complete characterization is a very elaborate affair and we discuss that it is very very difficult for a complete characterization of an object random process because you when need to characterize the process at every time instant individually at every pair of time instant jointly and so on so forth for every the points every quadrate the points that you and therefore one and infinitive number of going to distribution functions distribution function as well as joined distribution function of various orders you completely correct raise the process the simplify the process to simplify the tapes of you made some assumptions above the process we can make some assumptions of course they must be valid if you are going to use this typically many of this functions are valid why assumption that we made is the stationarity assumption the with processes as one whose turbidity distribution functions or who characterization who statistical characterization is independent of timology right time shift so these are the things are we cover last time we also looked at the definition of certain limits of a elements process mainly the new value function and the auto correlation function so we will start from the auto correlation function is second order characterization why we various size of characterization because um required the joint density function of the two in the X(t) way and X(t) so next call it Rx t one t two um in this square so take the random will be values random process values are time t one that will be denoted by the value x one of course
this could occur anywhere from this value could be anywhere lying between the value of this minus infinitive plus infinitive x one into x two multiply these two multiply to the join density function of these two random variables so this is one notation by which we can the note the join density function random variables t one by samply the random process x t at the time instance t one and t two right so this is the notation this t one and t two this ((…)) in general there will be a time dependency yes there will be a time dependency of the processes not stationary if the processes stationary the time dependency only being in terms of P one minus two this ((…)) t one and t two separately right but yes in general this is [noise] evaluate as this joint density function depends on this dimensions t one and t two therefore the auto correlation function that dependent the various of symptoms of random process right so this is the general definition for strictly stationary processors for [noise] stationary processors this will be a function only or you could say this you could right as Rx t two minus t one if the be if you are Rx star the star is defined to the variable t two minus t this is I thing we are we stop last so now let’s look at a few things let’s look at the value of Rx top ((…)) equal to zero that is it mean that we are looking at what is this equal to you can think of this portion in terms of expectation of portion are equal to expected value of x t one into x t two right this ((…)) is nothing for the expected value or average value of the ((…)) of the p random variables ((…)) sampling the process of time instance t one and t two right so where is Rx ((…)) if you choose t one equal to t two that will be that will be give you tau equal to zero right so it could say this is equal to expected value of x square t any arbitrary time instance t okay so this um the value of the auto correlative constant for a stationary process at all could zero it going to be equal to the mew square value of the process um it’s a constant suppose the process was not stationary then with this be a constant no um in fact we will not ride Rx ca in that case we will write Rx t t or t one t one right ((…)) dependent the value of t so this equivalently for a non stationary process the corresponding relation could be Rx t t it represent t one equal to t two equal to t and this will be equal to expected value of x square t that is correct but this is going to be a function of time it’s are to be constant in this case it is not going to be a function of time it’s going to be constant right is it clear so for a time um for a non stationary process this is the relation for stationary process ((…)) it’s clear from the definition of the auto correlation function at least for here value processors that if I interchange t one and t two if I interchange um write x t two first x t one later it would make any difference we just multiplying the same two numbers right the average value will be the same right what did it mean the Rx um Rx tau will be equal to Rx minus tau right so this is a important property of the auto correlation function for real value processors right
(Student: Question)
they are same for stationary processors
this will become this for stationary process for stationary process this will be equal to t
minus [noise] ((…)) t minus t
but in general it is not a stationary process this we have ((…)) have to work with

if it is a stationary process work with this place
(Student: Question)
with next right because the value of this auto correlative function has been discussed we
depend only on the ((…)) of the t time instance have a [noise] on ((…)) value in the time
instance
because if it is a ((…)) the basic function ((…))

(Student: Question)
no no no please understand if it is what is the um what is the Rx t one and t two t two
value x t one and x t two
so ordinary ((…)) choosing t one and t two will be the same time instance okay
the tau zero um any kind of term look nearly these value that is R zero
Rx stop is a functional stop then tau equal to zero if it is it becomes it could be a least
four validity function that is the point that you are trying [noise] make sure

look at the basic definition can place of the ((…)) okay
so this is true for real value processors so sometimes I simply use a word process when I
want to say random process okay
in general you could also ((…)) field that the ((…)) Rx stop of course we can prove it
more formally like it is with that yourself the magnificent of RX stop cannot be more
than the value of tau equal to zero is in it
again for the same reason we can expect next line correlation to occur when the p random
variable of the same right
the way you example of a different time extend the additional random variables it can
have correlation right
but obviously that will be less than the correlation that you will have of random variable
with itself that will be perfectly ((…)) right
so of course one can ((…)) with mathematically which are likely to be yourself it’s very
easy to do easy to check that the ((…)) correlation function for a laptop the variable size
as sometimes sometimes called the long variable
because long between two time instance t one and t two are the time difference t one and t
two
it’s always less than or equal to the value of the auto correlation function the tau equal to
zero
please understand that Rx tau is not a random quantity in case this there is any kind of
confusion in your mind
(Refer Slide Time 12:34 min)
((…)) is the highly deterministic function right it’s a deterministic function because a basically look here this interview right it’s a function of um i like x t which is a random process Rx tau Rx t t or Rx t one t two they are deterministic functions which are properties which are um which describe the second order of the um random process x t right it tells you the behavior of the random variables with respect to each other on an average by look here the average value of the product by sampling a random process the different kinds of things the multiplying this random variables and looking at the average value of this product its some kind of a characterization of the process some kind of a characterization of the process it’s a vale it’s a fixed value for again process even though the random process x t um random in nature it’s the value that you will see random in nature just nothing random in a Rx t one t two or Rx t t or Rx zero or Rx stop right lot of correlation function is a deterministic function so these are some of the properties of a stationary process you say it is just I will mention um possibly here and we leave it if ((…)) if the process x is a complex value process for example if you are working with in a narbom process narbom process when we looking are its complex envelop then it will be a complex value process right in that case the definition are slightly modify that correlation function is defined as x t one into x t two right we do a ((…)) correlation that you will use that one in the ((…)) okay [noise] suppose in a same instinct sensation process could briefly simplify our characterization of the process right we discussed earlier in many many cases your real life when you are working with random signals or random processors we don’t really need to worry about distribution beyond second order right typically we are interested in collectors in the process in terms of individual value that you might see are various time instance or in terms of join behavior of a sphere of values right typically very early need to um work work a situation very need to look at more than two values at a time right which essentially means that we don’t need to worry about characterization beyond certain order of ((…)) in many many application in practice right
so if that with the case wherever the process executes stationality in the stripes or not is another key all of them really then want us that the process be second order stationary right
the second order stationary means that the first order density function E x t one x should be independent of t and second order joint density function E x t one and x t two should be independent of should over dependent on t one minus t two right
[noise] so if the process set as files this time origin you various only the respective these two distribution function we say the process is second order stationary rather sensationally right
In reality you don’t to worry about second order sationarity as engineers
It is sufficient for us if the first two elements of the process execute these properties right so if that happens we are working with that process which is set to be stationary in the widest sense or wide sense
so we define a nation of wide sense stationarity which is a special case of stripes rather stripes sentationalility imply of course this
so wide sense stationarity is defined as follows [noise]
if the mean value function the various function which of course is redundant because if the auto correlation and the third thing auto correlation if the auto correlation is a lead to various as a special case or if these two are independent of time
and if the automobiles function is a function only of t two minus t one um t two minus t one um is a function only of the difference variable tau
then the process x t is set to be void sensation this your usual notation WSS okay
so what I am saying we not asking even in the density functions to be invariants even the first and second order density function you only say that the new value function you know what is new value function
(Refer Slide Time 18:43 min)

how will you new value function define mew x t will be simply equal to expected value of x t
now it’s a um that’s the definition of mew looking at the random variable of time t look in survey value what is this going to be equal to x E x x it will also dependent t in general
so if it is a first our stationary process \( P_x t \) could not dependent \( t \) right [noise] therefore it is obvious that mew \( x \) with constant right
but other definition of wide sense stationary process does not even require this to be independent of \( t \) all as various if this is independent \( t \) that for enough for us right
we look all the other first of the movement associate with this \( x t \) function \(((\ldots))\) right that is one
what is this various various is sigma \( x \) square \( t \) it will be expected value of \( x t \) minus \( x \) bar \( t \) whole square right
again this will depend only on the density function \( p x t \) right
so this will be equal to \( x \) minus \( x \) bar that the definition of various is in it that expected value of \( x \) minus \( x \) bar whole square that is integral of \( x \) minus \( x \) bar and the density function associated with \( x \) right
again this is um this is independent of \( t \) therefore this should be in dependent of \( t \) but again in WSS whereas in the this should be independent of \( t \) are you say yes this should be independent of \( t \) right
the second order movement also independent of \( t \)
and finally what we are saying is \(((\ldots))\) auto correlation function \( R_x t \) one \( t \) two as defined earlier should be a function only is tau right [noise]
of course the various function is related to this function this will display this property actually this will be automatically implied this is something that we can check right
so if these three conditions satisfy actually two conditions then we the mew value function is independent of time and the auto correlation function is dependent only of on the time difference between the two dimensions \( t \) one and \( t \) two these are the processors stationary wide sense stationary
and many times we are quite happy the processors wide sense stationary be many times you don’t you are need to worry about the distribution functions right don’t need to worry about the first and second order movement functions then we the mean value function and the auto correlation function
the mean value function is a first order \(((\ldots))\) function because the race power race power of \( x \) that we racing two is one right when we taking the movement is a first order movement the auto correlation function the various function in a second order function second order movement function
and many time it is sufficient to work with the first movements right they contain most to the physical information’s um we are generally interested in in looking other processes right
so therefore introduce the concept of strict sense stationary process a process which is stationary up to second order or third order could be a special case of there but wide sensational process is something which is all together much more tolerate of [noise] non stationary this process maybe non stationary \(((\ldots))\) stationary in the wide sense right
so what your \(((\ldots))\) is that if a process is strict sense stationary this stands for strict sense stationary it could obviously implied that it is wide sense stationary is in it that obvious should be obvious I think this could imply WSS property the \(((\ldots))\) will happen only very very special cases
WSS could not in general imply strict sense stationary right [noise] because this is independence only in terms of movements there also if the first thing first two orders right and therefore we cannot say that all density functions or the complete statistical characterization could be independent of time right but in very very special cases this could imply this for example for a class of association which we call casion processors right that’s very very special to clear example of a process which could be which is not strict sensationary and get it is wide sense stationary right I will just give you one simple of example I leave a (…)) file to work out yourself (…) we can do that quickly where itself suppose I generate a Raymond process in a following bit the many reasons of ((…)) n m process right that we define a random process which essentially we can random by virtual of its dependents on it’s a finite function of time right it’s a finite sense function of time but A that three parameters in the cosine functions the ((…)) is if you ((…)) and phase theta right let me look to one of them that it the phase random way that’s say the value of theta is something that of course randomly from one function to another function if you look upon this as an example of functions right all every function in this collection should be cosine function but with different phase and the value of phase is govern by some distribution right (Refer Slide Time 25:30 min)

so as much as you have a collection of function it’s a random process is it clear and that um every function occurs with a certain probability right so becomes random if any one move of its parameters random variable so for this becomes random because we assuming the theta is random variable let’s say with uniform distribution that’s why if I say its uniformly distributed between zero and two pie there could be the um density function of theta with B equal to one by two pie O zero and two pie and zero elsewhere okay
this will imply this is the density function of the random variable theta we have could be okay
next look at the mean value of this next we look at the mean value function we want to see whether this function is a function of time or not right
mind you we are not looking at density function of x t here right now but sometimes we can work around that even the doubt completely the base density function of x t you can compute so this is the important point we can compute this quantity even without move density function of x of t right because we know how to compute the expected value of or function of a random variable
so you can think of you can think of this constant as a function of random variable theta and complete this every value on that process so will be at the it will be A cosine omega a t plus theta you multiply with the density function of theta right think of this as a function of theta is entire thing at any given time right multiplied to the density function of theta which is one by two pie or zero to two pie d theta is there okay your function of theta multiplying the density function of theta integrating over the range of theta or the d one of theta right that’s um that’s one way of computing the expecting this ((…)) and using the ((…)) lets me recollect file the disused expected value of any function of x requires simply do this a portion is in it I am using this solution here [noise] x here is our theta variable theta f of x is this function right we are multiplying the density function of x or density function of theta the integration of theta now look upon um what will be the value of this integral zero right so it is independent of ((…)) right so value of this is equal to zero just look at the auto correlation function um just look at x t one into x t two or lets say more conveniently just write this as x t into x t plus tau right um p one to be some arbitrary time is complete and t two um t plus tau for the difference between ls equal to tau right so this will be equal to zero to two pie again now the function is different that’s how the function is now this kind of function everything else with the same so become A square cosine omega t plus theta into cosine omega zero t plus tau plus theta multiply this with the joint um if the basic function of theta right integrate theta right and a simple evolution of this interview we will show you that this is equal to a square by two into cosine omega zero tau (Student:Question) no no no no ((…) joint density function I am just looking at this product as a function of theta I am again using the same definition here (Refer Slide Time 30:21 min)
because I am not going through the path of first joint density function of x t one and x t two that could be one way
that's very complicated in this phase it's not necessary
in this case much easier to look upon this simply as a function of random variable theta
this product function right multiply the basic function of theta and into our theta okay
so you can see that after this intervention it is not going to depend on t its depends only a tau
(Student:Question)
please repeat your question
no no it has do dependent time theta is a parameter of this function function right
depending on the value of theta you have a different time function [noise] this different
time function are all cosine a same frequency in same ((…)) but ((…)) different phase
right
so therefore basically this collection if you are looking at is a collection like this um and
so on and so forth
it's a infinite collection you can define a fairly different value of theta right so ((…)) this
shape of article this shape of article this shape of right
the way document the new value function yeah say okay if I pick up some times is
empty what is the average value that I am likely to see here across the example it also is
zero
if I pick up two time instance t one and t two which are separated by time instance um
separate by some interval at all
what is the average cos ((…))
it is these two random variables ((…)) top it doesn’t depend on the class of t one and t
two this is what you have demonstrate right is it clear
(Refer Slide Time 32:36 min)
so here is an example of a process which is obviously not strict sense stationary it obvious its not strict sense stationary okay it is not obvious um I am assuming that it obvious you think about it it is not obvious but it is possible to argue very easily okay to see that lets looks at [noise] lets say one time is tend like this um I think it look at um little bit of thinking I think um like linear of the timing because we are going to dige a square a bit Its possible to argue um the density function is not constant with I right you will a first add density function is not constant this specific time actually it is one of the problems in the book please look at the problem with very carefully and you will arrive this argument but even though the density function itself is a function of time the first elements then will the mean value function expected value of x of t and the auto correlation function set if pie the required properties of a wide sense stationary process there is not a strict stationary process and we are taken a wide sense stationary process um its okay so only only you need to wide pie rates not a strict sense stationary process so please do the as an exercise okay now what are lets take talk about what we are discussed so for we say that if we are working with random form random process we can characterize it for all ((…)) as ((…)) engineers most of the time it is sufficient for is to characterize it with two kinds of functions the mean value function that gives us an idea of what is the average behavior of the time functions what is the average behavior the various time functions which constitute the process right that’s um that’s one property the second is the auto correlation function which tells us if I look at two random variables which are ((…)) which other bian interface tau seconds what will be the obvious value of the cross correlation of the two random variables right so rather than trying to specify the density function and the joint density function which has much more information many times as engineers we are sufficient you are sufficiently happy with these two information’s namely the mean value function property and the auto correlation function property right
in some cases we need to going to more detail but many times this is good enough 
so all purposes the function may mew x t which is going to be a constant function for a 
wide sensation process 
and the function R x t one t two which is going to be the function only of tau for wide 
sensation processors is good enough us 
you don’t going to worry about the density functions in many many cases right 

now as electrical engineers we are use to describing things in the time ((…)) as well as in 
the ((…)) right 
when we talked about the time ((…)) function immediately ask ourselves okay what its 
specters domain description 
what is it spectro live is in it 
I um you have worked out the elaborate theory for bring that in the [noise] ((…)) 
transcription 
you could have similar interest here you have occur whether the signal is deterministic 
signal however is a random signal 
you can ask some properties post in the time domain as well as in the frequency domain 
right 
so we like to also see whether it’s possible to characterize a random process in a 
frequency domain 
now lets see look me just discuss a few basic concepts or conceptual difficulties 
associated with this and then just give you the important results in this connection 
lets look at the difficulty just say you are defining a random process as a collection of um 
waveforms right that’s from you are looking ((…)) 
now when we take a ((…)) as form 
what is the ((…)) 
((…)) is lets say you have function x of t and you multiplied e to power minus j two pie ft 
and take the intervals from minus infinitive to infinitive that this is the ((…)) that’s the 
initial one thing that you work with 
What are the assumptions in this the ((…)) x of t is a energy signal right it is a um its 
absolutely interviewable right 
remember the base shape condition specify with the definition of a whether um the 
system ((…)) transform associated with a system approach transform 
so what are the requirements are that x t should be absolutely integrable that way we 
should be a ((…)) power signal 
when you are working a random processors we don’t know where we are be working a 
energy signal of process that is one issue one difficulty with need to work with right 
a functions maybe power signals your function maybe energy signals 
but that’s the problem that we are also direct with the in the context of deterministic 
signals and we typically better around that by introducing in ((…)) function in the 
frequency domain right if you recollect that’s one problem 

the second problem is more difficult more conceptually more difficult um except you 
have a very well defined waveform very well defined mathematical function of time right 
its very transform you are taking for example e to the power minus alpha t or cosine 
omega zero t right
but the collection um when we talk about x of t be a random process you need not know what waveform you are working with actually its one of infinite number waveforms an every one of them ((…)) transform what we exist for that waveform you have a different transform and therefore you could have a different kind of spectrum so what’s we talk about does it make sense to talk about ((…)) transform or the spectramine in the normal sense are you ((…)) no it doesn’t make sense right however what that make senses on an average where is a energy distribution as a function of frequency what is the power distribution as a function of frequency depending on whether we are working a energy signals of approximate right so important frequency domain concept for random processors is not the usual spectral which is just the um which is just a ((…)) transform of a function but a average kind of function which is known that the layer of power spectral density function first just define this process density function conceptually right okay let’s say we have random process x of t okay so what we will do is to convert this into an energy ((…)) alpha can takes this process so lets rasam random waveform just look at this waveform between that’s a minus one to plus t right this ((…)) waveform ((…)) one same sample function in the process ((…)) with here one sample function the process as you know random process is a infinite collection of such sample functions right its some arbitrary selected sample function from that collection okay so you pick up one and truncated between minus t to plus t you note the result in process x sub T t so x sub T t has been generated from x t by looking at its interval between [noise] minus t to plus t making it zero outside this interval this this artificial construction ensures that high converted even a power signal into an energy signal right is it clear because now clarifying that energy and for the peri transformer this could be define again sense again this is your random quantity I don’t want to take the full transform of this right where I am tested in what is first of all I scored this function because of I don’t interested in the power energy I am not interested in the individual functions values by themselves right (Refer Slide Time 41:53 min)
squaring is measure of the energy at various time instance right is um of course not literally but some approximations
((…)) is [noise] no that thing in beginning long ((…))
so one let me define a free transform of X T all here using the capital letter please remember I have pick a one sample function right
I pick a one sample function and that sample function is low energy signal I am taking pay transfer right
this pay transfer what exist now whatever the function maybe whichever ((…)) it doesn’t matter
because I have converted this into energy signal the pay transform will exist all right so I take the pay transfer
this will now become a function of frequency right take the magnesium square of that right
now this will be the magnesium square or the um energy as a function of frequency of one sample function ((…))
if I want to look at the average value average properties what shall I do here is the average value of this right
and if I want to convert this energy function this a energy function is in it into a part function what shall I do
do varied the two T because of my function duration is two T and if I want look at the original function take the limit us theta um theta as infinitive
so this motivates my definition of the parse with density function of a random process S x f
I denote it by S sub x f as limit as T tends to infinitive of one by two t expected value of magnitudes square of the free transform of X T t
look at this carefully I have gone through the argument reading to this [noise] that if you have a doubt please ask your questions
that’s a formal definition of the ((…)) density function
it is a measure of the average distribution power for given random process X t in the figures ((…)) right
how is the power distributed among difference frequency components in the frequency in the net
are you agree you have any questions
so that’s you can take that as a definition
now without going through the details of a result I just like to give a result which is
should no off which is a very important result in the characterization of NM processors
it relates the density function the ((…)) density function when we talk about density
function as a process you must ask the where you talking primitive density function we
are talking about ((…)) density function
((…)) density function is um is a um its what so say it’s a psychological um declarization
once again
do you agree with that because you are taking a random process in this I just not enough
scoring in that in the time domain ((…)) in the ((…)) limit
now we are any way squaring it up right and you taking the away value of the x squared
in a function of frequency right
so it’s a second order movement just like the auto correlation function was the second
order movement [noise] right
so if you look at this way it must be natural to expect the least two second order
movements must be some more related is in it
we are saying in the auto correlation function is a second order movement description of
the random process x t
and now we are say similarly that the less function at the just define the ((…)) function is
also a second order movement characterization in some cases
only thing this is the frequency ((…)) characterization that was a ((…)) characterization
therefore it sounds logic error the these two second order movement description should
be related to each other right
and that is the important result that I am talking about there is a very simple way to not
exactly very simple but it possible to show that these two things the second order element
description in time delay which is auto correlation function and the second order
movement remaining in the frequency domain which is the ((…)) density function or
essentially free transform phase right
so which your result to very similar to what you are used to doing for deterministic
signals
what you thing is where reject the free transform of the signal directly where we taking
the free transform of the auto correlation function right
(Refer Slide Time 47:45 min)
this result is note the name wires khinchin theorem which essentially states that the \((\ldots)\)
density function of a process \(x_t\) and the auto correlation function of a process \(x_t\) or the
auto correlation function of a process \(x_t\) or previous \((\ldots)\)
one determines the other
so \(p_{s \tau}\) we put here like that in auto correlation function of free transfers okay
and therefore in as much as the mean value function and the auto correlation function are
complete second order characterization of a random process
similarly the mean value function that the \((\ldots)\) density function of complete second
order characterization of the \([\text{noise}]\) random process okay
let me now finally define one more concept and then next time we will now will
essentially concentrate on concept that we are specifically go to need in our treatment of
the communication systems
the final concept is the concept of ergodicity
I will just mention it here will have to \((\ldots)\) discussion of this concept but we need to
know it right a twice
the concept is as follows we say that the process that I need a random process is \((\ldots)\) if
its statistical average is or equal to or can be replaced with \([\text{noise}]\) its time averages
that is statistical averaging of any \((\ldots)\) is equal to the corresponding time average of a
given any any sample function
now this is the very peculiar concept that the very useful concept because without this
concept you know really we particulate we have to work with random process
particularly when comes to measurement of what properties of random process just look
at the very quickly a modification for this property before talk about the property itself
motivation is as follows I was said our concept of random process is limit of how you
recovery basically it’s a collection of infinite number of waveforms
and you not know which waveform we are going to see suppose \((\ldots)\) perform the
experiment are you look at the random processes as it um as it occurs and display
waveform that you see \((\ldots)\) some arbitrary waveform which we cannot predict right
now anytime in typical situations I will see just one such waveform from this infinite
collection
so for what \((\ldots)\) measures properties average properties lets us say if you want to
measure the mean value
so \((\ldots)\) measure the auto correlation function right suppose I don’t know a \((\ldots)\)
density functions
how will I have find out this qualities right very difficult because I have only one sample
function available in front of t right
I have just one sample function which I have observed I don’t know what are the other
infinite what are the other members of the this infinite family
in the other hand this property if it is valid for a given random process \((\ldots)\) with find
this properties just from a single sample function that we might have observed
so what we saying is even if I don’t know if I even if I \((\ldots)\) average they cross the
whole family because I done have the whole family with we
if I just look at the average across the time of one sample function of the family it’s good
enough I I get the same value right \([\text{noise}]\)
so processes with exhibit such properties are called algolic process
Fortunately for us many physical processes which we work with I got it in nature right and therefore many times we can obtain this the auto correlation function by looking at the time mean auto correlation function of a given sample function or the mean value function by just looking at the mean value of a given time to mean function just like you do for any time (…)) okay so um what is a time mean average are you simply this right take the limit as the T junction infinite that the time mean average this not involved this (…)) involve the density function of x is taking a sample function right and integrating minus T to T that’s the sum of all the values that you see between minus infinitive the vary for the time interval that’s the time mean average what is the correspondent statistical average it will be x Px t x dx that’s the correspondent statistical average [noise] (Refer Slide Time 53:02 min)

so what you are saying is this is equal to this similarly for the auto correlation function for any other kind of average if this kind of relation hold for all time averages corresponding statistical averages the process is continue step by step um I (…)) final statement in this connection I know time this one final statement because overall this continuous if I denote by this space as a clause of all stationary um clause of all random processes right clause of white sensationary processes so this is ALL processes clause of white sensationary process is a sub clause its satisfy those two conditions which I mentioned linearly function is independent of time auto correlation function is dependent only on time difference (Refer Slide Time 54:21 min)
strict sense stationary is a further sub set of that right and ((…)) it’s a smallest sub set okay that just I want to it make and complete this discussion okay so if a process I go to it will also be strict sentationary it will also be wide sentationary etcetera
thank you