

[CLICKING]

PHILIP

GREENSPUN:

All right, folks. I know you're excited to learn about weather data. I've been told you're excited to learn about weather data. I'm going to do the first few slides. Tina's going to take over for the ones that require intelligence. And I'm going to come back at the end. OK. Remember that VFR, ordinarily, is a ceiling of 1,000 feet or more and visibility of three statute miles or more. That's one of the few things in aviation that's reported in statute miles is the visibility.

As Tina mentioned earlier, a ceiling is a broken or overcast layer, or sometimes, if it's really nasty, you'll see a vertical visibility reported. So here are some of the abbreviations that you might see on the right in a

METAR. Remember these weather minimums, so VFR pilots, we're looking at the weather reports to see if we're going to be able to maintain these cloud clearances and, generally, stay out of the clouds. So I wanted to tell you that it's not quite as hard as you might think because computer programs make a lot of what you're going to learn about simpler.

On the other hand, we want to give you the good fundamentals, because what we're going to show you, these are the basis of what these computer programs are presenting to you. They're oftentimes getting the same data and spinning it in some interesting graphical way.

So we're going to show you all the fundamental text weather that people have been relying on since at least the '50s. There are weather graphics you can grab on the web or sometimes in flight. How do you get the weather on the ground and how do you get it in the air?

So most of what you're going to see in the rest of this presentation can actually be summarized by clever programmers. And I think the cleverest programmer of all is this guy David Boozer who taught the class last year. And fortunately, he's taking a jet type-- well, fortunately, for him he's taking a jet type rating course right now. So he couldn't be with us, but here is WeatherSpork. If you want to ever have a good illustration of the value of an MBA and studying marketing, just think about the name for this product of WeatherSpork.

Let's say we want to go from Bedford to the Gaithersburg, Maryland airport. It's going to show us-- this was I think from Sunday evening. It's pretty nasty here at Bedford. I believe that's low IFR, that purple, and then here a marginal VFR, marginal VFR. Actually, sorry, maybe the blue

is a VFR. That's the problem with color codes. Anyway, you get these symbols for VFR, marginal VFR, IFR, and low IFR. But here, here's the altitude. We're going from C level up to 11,000 feet or 12,000 feet at the top.

It shows you inside this blue area where the freezing levels are. It's kind of a weird mixed up situation here with this freezing level here, another freezing level here. There's AIRMETS. It looks pretty scary. Once we get down closer to the DC area, it's not so bad. There's only one AIRMET and it looks like we could be in the clear of the clouds up here. But this is a good way to summarize. It this already shows you that it's probably not going to be wise to go on Sunday at, I guess, this was Sunday at 1:00 PM. OK.

Here, notice on the bottom, the time keeps changing. So we're going from Sunday at 1:00 PM. The middle screen capture is to go Sunday at 10:00 PM. This is at eastern time. And the last one is to go Monday at 8:30. So you can see from this already that you could take off from Hanscom field, rise up to 1,500 feet or so on the right, and just cruise along never even getting inside a cloud until you landed at Gaithersburg. That's kind of a low altitude, so you might end up deciding, well, what I really want to do is find a hole and go up to about 7,000 or 8,000 feet and go on top of it all and come back down, but whatever.

It looks like you could probably remain clear of clouds, make it to your destination. You're not going to pass through a lot of AIRMETS. Over here, let's look at this one in the middle because it's not quite as terrifying. There's a low turbulence low from the surface all the way up to 18,000 feet. If it says a turbulence AIRMET that goes up to 8,000, that's kind of normal. And oftentimes, if you climb to four or five or six, it'll smooth out. But if the turbulence is forecast to go all the way up into the flight levels, you know that's a pretty ugly day.

They're saying there's going to be low level wind shear from zero to 2000 feet. There's going to be IFR conditions. And it's going to be gusting 18 knots, so all of that is pretty bad unless you really have to go. Here look, icing from the freezing level up to flight level 230, just a collection of hazards. But also look at the difference between Sunday and Monday. If you just hang out in the ground and you're patient. You don't need a superior level of skill if you have a superior level of judgment.

Here's some more presentations from WeatherSpork. Again, I kind of love this app. You have all the airports you're going to fly near. So you go from Bedford to Worcester, some places in Connecticut. I think that's Morristown in New Jersey, Pennsylvania, Lancaster, anyway, on the

way to Gaithersburg. And it shows you here's your time of departure. You're going to depart, but hey look, It would just get to be-- I guess that is. That does mean blue must be marginal VFR, and then green it's going to be windy, but it will be nice VFR weather. So if we just wait a little bit, we won't have to fly through any areas that are challenging.

ForeFlight has a mode where you can ask for your weather briefing in a PDF format. And this is the first page of that PDF format. It shows some of the same ideas. There are these graphics, these blue half moons, if you will, for icing. You can see there's a key down here. It says icing severity. So up here, you've got varying degrees of ice. You probably don't want to be up there in an aircraft like the Cirrus. It doesn't have de-icing capability.

So now I think it said all up to Tina to talk about the exciting world of actual weather data.

TINA

All right. So we're going to talk about weather data in the form of reports as well as forecasts.

SRIVASTAVA:

So what is the difference between a report and a forecast? So a report is actually telling you what's actually happening, so it's a current weather condition at a particular location. A forecast is a forecast. It's a guess as to what is going to happen. So it's really important to know the difference between these. We now have Mark Nathanson up in the back who's going to be talking to you at 4:00 about some really cool stuff. And as we talked about, he's an FAA examiner.

Probably doesn't remember this, but he asked me during my oral exam, for a given piece of weather data, is that a report or a forecast? And if it's a forecast, how much should I rely on that or depend on that? And so that's something to really keep in mind the difference between knowing what the actual situation is and what somebody guesses the situation is going to be. And of course, depending how far out that guess is, it may or may not actually turn out to be true.

So a METAR is a report, and so it's timestamped so it will tell you the weather at a particular time and a particular location. And one thing that's important to think about when you think about direction is the way that the wind is reported. So if you hear it, so like if you're listening to the ADDS. We talked about the ADDS quite a bit, so you tune in the ADDS frequency and you listen to it. They're going to be telling you that wind direction in magnetic. If you read it on a printed document, it's pretty much always at true heading. And certainly, on the internet as we'll give you some sources, that's like the same as reading it.

We already covered ceilings. I won't get into that. So let's just talk about the breakdown of a

METAR report. So I discussed that generally, for example, at Bedford. You might hear the METAR updated every hour or so. And we talked about the identifier, that this is information whiskey, maybe an hour later it's the next as they keep going through the alphabet. And one time that you might see it updated more frequently than once every hour or so is if they need to do a special report. And so that's the other type of acronym that you see there S-P-E-C-I, and that's if the weather is changing a lot.

That's usually a bad thing. You don't like weather changing frequently. It's probably not something you want to be flying in, but maybe the conditions are deteriorating, the wind or the conditions or the ceiling has changed significantly, so they'll update that information. So there are a whole bunch of different abbreviations when you read these reports. I highlighted a couple in red.

You could make your way through sort of guessing, OK, thunderstorms is TS. It seems kind of intuitive, but I highlighted some that are really, really kind of get you. So hail is GR and mist is BR, as someone was pointing out on this side. Yeah, so mist, if you just look at it and you try to think, oh, is it broken? No, broken is BKR. So they just try to trick you with that's, so try to keep an eye on those, and it's good to refresh your memory on these.

So this is an example of a METAR report. So it starts off with the location and then the first two numbers, the 16, are telling you that it's a 16th day of the month. And then it's followed by 1653, so that's the time and has a Z for time in Zulu. We already talked about how you subtract hours depending on Eastern standard time versus Daylight Time to get to the current time. And then instead of telling you a heading of the wind, in this case, it has variables. So sometimes, it will say winds variable at about four knots, in this case.

And then the next is the visibility, so 10 SM is standing for 10 statute miles. And then, in this case, the ceiling is overcast, overcast at 6,000. The next two numbers, you see the 14 slash 07? So that's talking about the temperature and the dew point. So who remembers what is dew point? Yes.

AUDIENCE: The temperature where the air reaches saturation for water.

TINA SRIVASTAVA: So we heard the temperature where the air reaches saturation for water. So what happens when the dew point and the temperature are very close to each other? So here, we have seven degrees Celsius for dew point, 14 degrees Celsius for temperature. What if the dew point and the temperature were much closer, only a couple degrees apart? Yes.

AUDIENCE: Clouds would form.

TINA Yeah, it can be very humid. You could be inside of a cloud or heavy fog or precipitation.

SRIVASTAVA: Exactly. So here's a good source of weather information. So you can go to AviationWeather.gov and they have a bunch of menu options up there. So if you click on METAR right here, this METAR button, it will take you to a place where you can request the METAR data. And it asks for an ID, so that's the airport identifier. So in this case, I wrote in KBED which is Bedford airport, Hanscom field that we keep referring to.

And then you can actually tell it to decode the data for you. So as much as you want to memorize all of these different codes and symbols, in general practice, you can hit decode it and it'll tell you that. You can look up at the time, so you can actually ask for weather data in the past. And you could include a TAF. What does TAF mean? Yes.

AUDIENCE: Terminal area forecast.

TINA Terminal area forecast. That's right. So if you do that and you hit Enter, it gives you this data.

SRIVASTAVA: So first thing it does is it tells you the date at which it's producing the data for you. And then the first is the METAR and the second here is the TAF. And so the METAR here is telling you the location, so it starts with KBED. And then here is the information raw, so you see that data right here or you can have it decoded.

So again, the first two numbers 23-- that's the date-- 20 23rd, and then it gives you the time in Zulu. And then they basically go forward with all that information. So it's defined it here because it's decoded, so you see the temperature, dew point. So I actually just updated this this morning so you could see the weather and what it's looking like.

Now I'll go over to the Document Viewer for a moment.

PHILIP Oh, probably don't want the light. Or maybe we probably need this. OK. Qualified personnel
GREENSPUN: are here. I'll entertain you. That first METAR was from PDK. Anybody know where that is? KPDK. Southerners?

AUDIENCE: DeKalb.

PHILIP DeKalb, yes. Peachtree DeKalb in Atlanta. It's the Teterboro or Hanscom Field of Atlanta. I
GREENSPUN: landed there once in a Diamond Star. I had to have the wings taken off in Florida to fix a fuel

gauge. I took off from there and I filed a VFR flight plan, landed in DeKalb, and I forgot to close my VFR flight plan. So the FAA and flight service folks at the time, they start searching for me and calling everybody. And they called the tower at DeKalb and they said, hey, did you see 505 whiskey tango? And they said, no, we hadn't seen an airplane. And I really freaked out.

And I was right there on the ramp. So I kept silencing my phone because I was at a barbecue place with my friend and didn't want to be disturbed. Anyway, so they called the mechanic who took the wings off and they told him like the aircraft was missing. He had some choice words for me. So now, whenever I activate a VFR flight plan usually, if I do a flight plan at all, its IFR. They close that for you automatically. I move my watch from my left wrist to my right as a reminder to close the flight plan. All right, Tina. Take it away.

TINA SRIVASTAVA: So this is the ForeFlight app. I've passed the iPad around a couple times, so I think you guys have gotten to play with it. This is just a setting where the blue dot is showing where we currently are, and I've actually overlaid one of those instrument flight plans on top going here. So this is it an instrumented approach to Bedford. But if I wanted to get this weather data here, I can go to Airports and pull up the airport that I'm looking for. And then click on this Weather and it shows me the METAR. So it has both the raw data there and then it depicts it. And again, blue is showing marginal VFR, and so it explains that.

What's also nice is it tells you the weather at nearby airports, as well. And then you can also go to your TAF, your terminal area forecast, and you can look at how that is changing over time.

PHILIP GREENSPUN: Oh, Tina, you don't mind, click on MOS, also. Yeah, if you're planning travel, MOS is good because it gives you weather a few days in advance so you can decide whether or not it makes sense to depart here on Friday and hope to come back VFR on Sunday.

TINA SRIVASTAVA: MOS is talking about the models, so the weather models and what the outputs are.

PHILIP GREENSPUN: I think it stands for Model Outputs Statistics, not very helpful, but anyway, it's a longer-- ForeFlight and Garmin Pilot and some other sources, like WeatherSpork, will turn that into a sort of a virtual TAF for you that lasts three days instead of just 24 hours. 30 for the big airports.

TINA So another type of weather report is a PIREP or a pilot report. And so this is where a pilot

SRIVASTAVA: could be flying and wants to report the condition, so for example, turbulence or icing. Those are types of things that are frequently reported by pilots. And you can actually report one, as well.

So one time when you're getting your flight instruction, if you do notice a wind shear, turbulence, icing, try to see if you can actually provide your own PIREP. And it'll ask you certain information such as your location, the time, the altitude at which you experienced it, what type of aircraft. I think that's really relevant because, for example, wind shear experienced by a small Cessna is one thing. If a large aircraft, like a big jet, a JetBlue aircraft, is telling you that they have wind shear, I'd really pay attention. If they seem to have trouble with it, that means you're definitely going to have trouble with it.

And then you could also have printed weather forecasts that tell you-- so we just talked about the TAF as an example. And as Philip was just saying, it only goes out 24 hours. So same type of information as a METAR and similar abbreviations. And then we were just talking about that those models, and so you can forecast even farther out if need be.

You can also get a forecast for a general area. So this is what we were discussing earlier when we were talking about radios and you might want to call in and ask for a weather forecast or weather brief for a given flight plan. We talked about how you'd call in, give your tail number, where you were starting, where you were going, about how much time is out you'd be en route or in flight. And then, they might tell you the weather for the general area as well as the local current readings as well as the forecasts.

PHILIP
GREENSPUN: And notice that these area forecasts, if you go to the page on AviationWeather.gov, they're now only available for two or three regions, like the Gulf of Mexico. They used to have them for all over the continental US and they included cloud tops, which was very useful. The forecast top of the cloud because if it was, say, 4,000 feet, you would know that as long as you get on top of those IFR, you're not going to pick up any ice because you'll be above the clouds.

And now you have to try to tease that out of the MOS data sources or use something like WeatherSpork that tries to depict graphically where the clouds are. I think ForeFlight's Profile View will also try to do some of that.

TINA
SRIVASTAVA: You can also get forecasts of winds aloft. We talked about that a couple times. And so this will tell you kind of what the winds are going to be at a particular altitude, for example, at 3,000

feet or 6,000 feet, and so it helps you estimate especially in a cross-country flight or a longer flight how long it might take for you to get there. On apps, such as ForeFlight, if you-- in fact, we'll just do that right now so you can see.

So you can actually enter in a flight plan very quickly, so you can have a starting place. And then-- so where do you guys want to fly to?

AUDIENCE: Boston Logan.

TINA That's a pretty short flight, but sure.

SRIVASTAVA:

PHILIP You guys, if you have the patience to stay with us tomorrow afternoon starting at 3:00, the founder of ForeFlight's going to be here, and I'm sure you'll get a pretty thorough demo. He and a colleague are going to talk for a couple hours about first the app, and also the startup, and then some of the engineering behind it.

TINA So the blue dot is showing where we are here at MIT. But of course, generally, you'd be doing this when you're at Bedford and you're flying to Logan. And then here, it's telling you it wants to know about the aircraft that I'll be flying in order to calculate some of the information. But when you do these types of things with the flight, it can estimate kind of how long you'll be in flight. And you can provide what is the altitude at which you want to fly. And then it will be able to-- so it says coloring based on winds aloft. It looks like it's not detecting that maybe because I haven't given it all of its data right now.

So in terms of what that means is just that the winds aloft are a good way of helping you predict how long it's going to take you to get to certain places. And it'll be part of that cross-country planning that you'll have to do.

PHILIP The winds aloft forecast also shows you the temperature, which is critical because that's going to tell you whether icing is-- icing is not possible if it's above freezing, generally.

TINA There are also a bunch of severe weather reports. Philip has already talked about a number of them, AIRMETs and SIGMETs, as he was talking about. And then they have different abbreviations, even more abbreviations, related to this. So what they mean for icing and turbulence. So here we'll look at some examples of an AIRMET. And in the picture, it shows a broad area where that AIRMET is valid. And so this is talking about icing and freezing level.

So SIGMETs also talk about hazardous weather such as icing, turbulence, volcanic ash, which I don't think you'll encounter very often, but it was an issue in Europe, for example. And then here's a breakdown of decoding a SIGMET, as an example, to show you the type of information, what it stands for, and you can read through these to understand the adverse weather. And certainly, if you're planning your own cross-country flight, I recommend you also use your normal weather data sources, as well. So just turn on the Weather Channel or Weather.com or Accu Weather, whatever you use on a regular basis.

If it's a crummy day, it's probably not a good day to go flying anyway and you may not want to dive so deep into all of these different tools. But if it seems like a nice day, then I would really recommend diving more specifically into understanding if there's a front coming in or other types of issues. And then, convective SIGMETs are really, really concerning. So there are things that are much more severe, so you're talking about thunderstorms, hail, some things you really don't want to be flying during at all.

There's a lot of different ways that the weather is also produced not in a text form but in a graphical format. So this is a relatively complicated weather depiction chart. So we'll break it down in detail. But let me just tell you some of the main things. Do you have the-- oh, I left it over there. Thanks, Phillip. So can anyone guess what all the little circles are? We see some circles that are white and some circles that are black. Does anyone know what those are? Any guesses?

AUDIENCE: Weather stations?

TINA SRIVASTAVA: Weather stations? Good guess. So it's actually trying to tell you what the cloud cover is like. So you can see certain places where the circle is empty. It's a clear day when it's fully filled in, that it's showing the cloud cover. And then you see some that are like little pie chart, so that they're partially filled in. So the purpose of looking at a weather chart like that is just to get the general conditions.

There's a lot of different things. So here, it's more specific so it breaks down that the circles indicate the percent cloud cover. So if it's a quarter filled, it's saying few clouds. If it's 3/4 filled, it's broken. And then it also has shaded areas that depict when you have the IFR conditions. So zooming in, you can just kind of see those circles a little bit bigger, and the charts provide a lot of information, as well. But you can see a little bit more clearly also here some of the circles that are like pie charts that's showing how much they're filled in and what the cloud cover is

looking like.

And again, you can actually get the same type of thing on your ForeFlight. It's basically an option. For every airport that it depicts, it can show this cloud cover, as well. And you can also look at a radar summary chart. There are a bunch of prog charts, so they talk about when you're looking at a front. You guys have seen a lot of these things on the Weather Channel, probably didn't pay attention to them very much, but it's good to understand what the different types of fronts are, what's happening across the country, more than just your particular region.

So if you're planning you know if it's a-- I think today's a Wednesday, so if you're planning on a flight this upcoming weekend and you want to think about what's going to happen, basically, you're trying to see are there some fronts coming in? What's happening? Or is it likely to going to be a clear day? And then, of course, as we've talked about, all of these have good legends just like we talked about the sectional chart quite a bit and the details of the legend. It's always good to take a look at how they have indicated these different lines, where the fronts are.

And you really want to know which ones, again, are reporting the actual conditions versus which is a guesstimate of what's going to happen in six hours, 12 hours from now. Again, if it's a forecast, it could be wrong. And then this is just a little bit more detail of types of things you can see on a chart. I think the most important thing to look at is this weird little R symbol with kind of an arrow at the bottom. It's indicating thunder. So that's a big one to look out for. If you see that, it's probably not something you're interested in flying in. I'm not, for sure.

And then, there are a couple of shards here that are not specifically on the-- usually going to be asked about, but it's good to see. So you might have seen these kind of surface analysis charts. And they talk about high pressure areas and low pressure areas. And so that high and low pressure, what are we talking about? So that's the same thing is that pressure that you're dialing into your altimeter, right? So we talked about 29.92, but there might be a day where it's really dropped very low and it's 28 or something very, very low. That means you're in a low pressure area.

And if it's very high, you're at 30 point something, it's a higher pressure area. And if you see that as you're flying around that pressure setting is getting updated very rapidly and changing rapidly, that usually is related to a change in your overall weather system. So you really want to be aware if that number is changing quite a bit, that's a big problem. You can also take a look at when you get into your airplane and you're first setting that dial when you're sitting on

the ground, see how much it's changing.

You might want to-- in general, when you get into a plane, I like to think about when the plane was last flown. There are parts where you are checking the oil that you can kind of generally feel the engine and see if it's warm or not, if it needs to be primed or not, those types of things. If you see that the plane has just been flown and you're really dramatically having to change that pressure setting, that means the weather has recently changed quite a bit. It makes you want to really make sure that your projections and your knowledge about the weather is still accurate.

PHILIP GREENSPUN: Tina, you want to mention these numbers here are the metric equivalent. So instead of 2 99 and 2, you'll see 1,000 millibars or so.

TINA SRIVASTAVA: So we have a bunch of these. And all of these are also on that first website, the AviationWeather.gov. You can look at actually seeing the clouds from a satellite picture and kind of just seeing what's going on. These are hopefully not the first time you've seen these types of charts before.

And then this is a way that they like to depict the winds aloft. So these little lines, and then depending on how many lines are coming off the side, it indicates how strong that wind is and what the amount is. So you can see here some that have a lot of little dashes coming off of it, whereas some that don't have any. It's a way to very quickly see where the wind is very strong and where it's not.

And this is what I had talked about last time when we're in the radio section, the radio ATC and communications section. But just as a reminder, this is the number that you can call and you can get your full weather briefing done there.

PHILIP GREENSPUN: Tina, do you want me to take over now?

TINA SRIVASTAVA: Sure.

PHILIP GREENSPUN: All right. So thank you. Tina covered the stuff that requires a brain. Now, I'm going to just tell you about how do you get this stuff as a practical matter. You can call this phone number it's very good when you're a novice pilot. Again, think about crew resource management. The weather briefers are another person that you can pull in. They may say VFR flight not

recommended. That's there at the bottom. That's worth paying attention to.

They used to work for the FAA. They were outsourced in 2005, and now they're contractors from a company called Leidos, so you might hear the name Leidos. You can get a full weather briefing over the phone. I actually do this sometimes if I'm in an Uber on my way to the Gaithersburg airport. I'll just call the weather briefer and that makes life very easy. OK.

So AviationWeather.gov, as we mentioned earlier, has all the chart that we saw. The weather briefers themselves run their own website, which is a little bit of a twist on that. I kind of like this site, actually, because you get to set up a home page where you pick your favorite airport. So I picked Bedford, Teterboro which is where you go in the New York Metro area if you enjoy paying \$8 or \$9 a gallon for gasoline. And then Dulles Airport where the two competing FBO's also charge about \$9 a gallon for gasoline.

But anyway, they'll have the METARs for your favorite airports and the TAFs and all this, and you can set up these charts. So basically, as soon as you log in, you get a whole bunch of current weather information. That's kind of a nice feature for this website. And it is free. They will give you, just like AviationWeather.gov, they'll give you the METAR. Here's one for Bedford from the other day. I guess that's from the 21st. Yeah. The wind was 310.

So it was on the 21st at 0256 Zulu, so it was late at night, early in the morning in London. Wind was 310 at 18 knots, gusting 25, 10 miles of visibility, clear. Temperature was minus 11, dew point minus one niner, altimeter two niner, four seven, and there's a remark. The peak wind was 310 at 31 knots and that happened at 0225 Zulu time. OK.

There are private websites. The most popular free one is probably fltplan.com at least among the turbine crowd. They have very accurate models for a lot of jet powered or turboprop aircraft. And they have some example briefings that I think I do want to show you. OK. Again, you'll have access to this. So one nice thing about fltplan.com is they start you off with a nav log. Remember, we talked about that? And in the nav log, they tell you what magnetic course to steer. Oh, sorry. They give you the magnetic course? Sorry, magnetic course is 303. I guess they don't give you the wind correction angle, or maybe the wind's right in our faces. No, it's not.

Maybe this is not such a great site. All right. Well anyway, they tell you roughly how long it's going to take you to get there. And they will calculate your ground speed for you. So I think I

put in the Piper Warrior or something, so this is a pretty low airspeed, 124 knots. And you can see at the different altitudes how much fuel you're going to burn and how long it's going to take you.

So there's really not a lot of difference. You can see here, you could go at 10,000 feet and take 58 minutes. You could go at 4,500 feet and it would take you an hour. So there's not a lot to choose from. Your airspeed goes up a little bit as you climb higher, but the wind is also a little bit stronger.

They're giving you the weather to go from Bedford to Bennington, Vermont. Giving you a little bit of information about the runways. You can look at the approaches there. Departure airport forecast, so look at this. Departure airport NOTAM, so they did a pretty good job here. They pulled out the most important NOTAM. They were doing snow clearing. So at Bedford, they said, look, runway 112 niner is closed except with one hour of prior permission to this phone number. Now how about that?

Look at all those other NOTAMs. You can really get lost because they're telling you about stuff-- taxiway-- Let's go here. Taxiway November edge markings obscured maybe by this snow. I don't know why. Anyway, that's probably not really important. That maybe is taxiway that you're not even going to use. So this is actually a pretty good computer program, I think, because they put that closed runway NOTAM right up at the top where you might actually see it, and they put it in boldface.

Anyway, so that's a fltplan.com weather briefing. Let's see how ForeFlight presents the same information. You saw that before. They also give you this wind temperature and turbulence. Oh, this is to a different spot. This is to Gaithersburg. Significant weather from flight level 250 to 630. Not going to be able to use that in the Cirrus, unfortunately. That's up above 25,000 feet.

We get the METARs. It looks like, sorry, the METARs and TAFs. So we get our METAR for Hanscom and it looks like they put in boldface the relevant portion of the TAF. So they're saying, look, at your flight time, this is the one that's going to apply. It's going to be better than six miles of visibility but overcast at 800, so not a bad IFR situation as long as you can handle any icing.

They've color coded a bunch of stuff. So you can see here at Worcester, they've got-- well, that looks pretty nasty. They're forecasting, for example, wind 030 at 11 knots, only half a mile

of visibility. Tina, help me out. What's minus PL? Freezing fog. I don't know what minus PL is, but it sounds bad. Overcast 500. So they're calling that low IFR. Where are the NOTAMs? Let me see what they did with the NOTAMs. I think it was the same day. Ice pellets. OK. Well, we don't want that.

So this is an interesting thing. ForeFlight kind of missed-- I think it was out there, maybe it's here. OK. So up at the top, it says runway 523 is closed, which normally wouldn't bother me at all because that's the crosswind runway and we don't like to use it unless we have to. Maybe that NOTAM was not out at the time that I got this one. Yeah, there's nothing about that PPR. I guess they hadn't started plowing the snow at that time.

Anyway, so the NOTAMs are important. They can tell you if the airport is having some kind of construction going on. Mobile apps-- ForeFlight is for the iPhone or iPad only. That's a major difference between ForeFlight and Garmin Pilot. NavMonster is a fun, free app. It works at least on iOS, I think on Android, as well. That gives you a lot of good stuff. WeatherSpork is all three platforms. So we're just going to show you ForeFlight in case you're not able to come to the talk tomorrow starting at 3:00. Here's a little flavor of ForeFlight.

Notice that in the airport information page here on the left, they highlight the fact that runway 523 is closed by NOTAM, so they're making an attempt to pull out the most significant runways. But actually, they missed one. Look at this. Runway 112 niner is also closed except for this one hour prior permission. Somehow that exception didn't get the software excited. So if you showed up, actually this is a good example of when you might want to run your minimum fuel burn, maximum endurance airspeed.

So you get to the airport and you didn't check the NOTAMs or maybe it was a newly issued NOTAM. And they tell you the runway's closed and it won't reopen for another half hour. So in that case, you're going to go out and loiter somewhere until the airport reopens unless you want to land somewhere else. OK.

The next page is apparently about NOTAMs. And over on the right, we have the weather which Tina already showed you. And you see the density altitude? Look at that. It's minus 2,500 feet. It's 2,500 feet below sea level at Hanscom Field. ForeFlight can give you the TAF and the MOS, as I said. So this was, I think, on Sunday. And have a look there. We're getting the weather for Wednesday, so we can plan our trip to return-- what's today, Wednesday? And look, the MOS is pretty right. It's nice. It's not too much wind. 190 at 5 knots, overcast below

12,000.

Here's Garmin Pilot. Garmin really believes in the old white on black, like a 1970s monitor. ForeFlight will actually flip into sort of a style like this at nighttime. And this one, it doesn't highlight for you. It's the same time as I was using ForeFlight, and nowhere in here does it highlight that that runway 523 is closed or that two niner is having any kind of issue. I think it was the same time. I could be wrong. Yeah, see? 523 closed. Runway 1129 closed except one hour prior permission.

So you're fat, dumb, and happy looking at this page, getting all ready to go to Hanscom Field, and then if you don't check the NOTAMs, you discover that there's no runway. So another good reason to always have some reserve fuel and not overcommit to your plan. All right.

In-flight weather sources. There's something called TWEB, transcribed weather broadcasts. You might be asked about it on the exam. I doubt it. Anyway, that's my friend Eric, again, with his DC-3. If you were flying a DC-3 in its prime, you might have heard of TWEB. HIWAS is still being broadcast off of certain VORs that are indicated on the chart. So look at this, see that H symbol there in the middle? That H symbol tells you that if you tune in to this VOR and tell your audio panel in the airplane that you want to actually listen to whatever is being modulated, that you'll hear this pre-recorded weather announcement about maybe thunderstorms in a certain area.

You can call Flight Service Enroute. They're very helpful. They'll take a PIREP from you and they'll tell you what is going on. They can call your mom if you're going to be late due to forecast headwinds. I was actually flying through New York on my way to DC, and there were horrible headwinds. I was in a Diamond Star, which was not a very fast airplane, so when you've got a 50 knot headwind, you slow down to a Honda Accord speeds.

So I asked New York for a frequency change to Flight Service and they said, well, why do you need it? And I said, well, I want to have them call my mom and tell her I'm going to be late. And they said, oh, we can do that for you. So in between vectoring the airbus's out to Germany, they were calling my mom. I think each controller in New York has an assistant right next to him or her and that was who actually made the phone call.

TINA
SRIVASTAVA:

Just quick note. The last point there. So Flight Service can accept your PIREP. So when we talked about how you should make a pilot report or a PIREP, you can call them and tell them, hey, I experienced turbulence.

PHILIP I think if it's really ugly, the controllers can also put it in, like if it's icing or--

GREENSPUN:

TINA Wind shear they usually accept cause wind shear is such a bad thing, and you're fighting the
SRIVASTAVA: wind shear and trying to deal with the wind shear, so they'll usually except that PIREP.

PHILIP All right. NEXRAD. So this is an actual photo of our Cirrus screen on our way to Oshkosh. So
GREENSPUN: remember, I showed you that one earlier which with the track from FlightAware. So we had planned to go from Rutland, Vermont, oh, sorry. We had planned, I guess, yeah, we came up with a new plan. We really wanted to go from Bedford over to Syracuse, and I think initially we decided that going to Rutland would keep us away from the rain.

The NEXRAD radar, what they're really seeing is water in the clouds. So they can actually see rain. They can't see a cloud that's just vapor and it's going to produce a rain storm at some point. They're really seeing the big water droplets of rain. Anyway, so we elected to fly over here and refuel at Watertown, New York instead of at Syracuse. Oksana was on that flight. We flew through some of that rain and it actually was pretty smooth. So we probably could have just charged through, but we took a more conservative route. OK.

So NEXRAD data, instead of paying for a receiver in your airplane and then paying a subscription fee, the FAA give you NEXRAD data as well as a bunch of other stuff, like some text weather data. That's another good reason to be able to read METARs because if you're looking at it in the cockpit, it could be on a pretty small display and the raw format is very compact and actually very convenient for in-flight use.

Anyway, here's a little diagram of how it's transmitted. You have to have this-- you have to have-- let's see if we talked about this. Yeah, so you have to have a UAT receiver to get these data. The aircraft position, see the big airliner transmitting on 1090 megahertz extended squitter it's called.

That's fine, but you need to be able to receive on 978 megahertz, which is this alternative frequency that I guess had more bandwidth available. And that's where the FAA can push all these data up to you, like about other traffic, even traffic who doesn't comply with ADS-B. Although by January 1st of next year, almost everybody will have ADS-B out at least.

Anyway, so that the feds are pushing this stuff up to your airplane. I'm going to turn it over to

Tina now to talk about--

TINA
SRIVASTAVA: Yeah, so I just added in this slide. This is the one that we had been talking about. If you're in a plane that does not have the ADS-B receiver but you want to receive that information so that you get real-time weather information or real time traffic information, you can actually make that happen by building it yourself. And I did that. It really doesn't take very long. If you want to seem really cool, you can go and buy just a regular Raspberry Pi and a couple different parts. And also that link will show you how you can just buy a little kit where they've put everything together and you just buy it.

It's very easy to assemble. So it just has a little Raspberry Pi inside. And it has a little cooling fan, and then it has these antennas. The Stratics Software is actually kind of free, open source software, and it's really great. And it syncs up to your other apps. So for example with ForeFlight, it just shows up like a Wi-Fi signal that you connect to. And then while you're in the air, when you don't have access to this data, this will actually update.

So you can see on the right is kind of a zoomed in picture from ForeFlights. So it shows that you can see the weather on the bottom left corner and then you also see these little pictures that show traffic. So yeah, exactly. So on the further bottom right, you can also see-- it just shows you other airplanes, other traffic, and kind of the altitude that they're at. And so it's really useful I think it's kind of nice to have, especially in a little airplane to have that visibility and knowledge that you're not just relying on Flight Service giving or kind of like a area controller giving you traffic advisories, but you can see it in advance.

We're about to dive into human factors, and Philip has talked a lot about using the person sitting next to you whether they are actually a pilot or just a friend. Even just a friend can sit there and hold the iPad and see the little blue traffic. And then when they hear on the radio that's someone saying, hey, it looks like in this situation, no traffic, 3 o'clock, you're trying to look for that plane. Well, they can have a little sense of, OK, yeah, it's near that, and they can help you find the other aircraft. So it's very helpful.

PHILIP How much were the parts for that, Tina?

GREENSPUN:

TINA It's like \$80.

SRIVASTAVA:

PHILIP OK. Yeah. So the ones that you can buy commercially all packaged, like the Stratux-- I think
GREENSPUN: this is a play on Stratus. This is one of the competitors in that market. They're anywhere from \$400 to \$1,000, I think. The commercial ones also have an electronic gyro in there and AHARs, attitude heading reference system. So they can actually give you on your iPad an attitude indicator and some information about your speed and so forth. All right.

So this is a reminder that, again, all those data are intended to help you fly within the VFR weather minimums, which provide a good margin of safety. I put this \$20 magazine up here for you guys because this whole talk has really been about software and different ways of spinning the same data. So this is everything, in case you're not a core six major. This is everything you need to know to become a programmer in one \$20 magazine.

TINA So we're running a little behind. So I'm going to go straight to human factors. While I'm pulling
SRIVASTAVA: it up, let Phillip know if you have any more questions.

PHILIP Yeah, anything going on?

GREENSPUN:

AUDIENCE: How do you know if your weather briefing is adequate with all these sources out there and you're not good. I'm just not really sure.

PHILIP That's a great question. How do you know if your weather briefing is adequate? The
GREENSPUN: professional weather briefers at Leidos, at 1-800-WX-BRIEF, they tend to go a little above and beyond. They'll give you NOTAMs about any VOR that's out of service on your route of flight, even if you're navigating with the GPS. So if you're at all unsure, just do your self-service stuff online, and then just call 1-800-WX-BRIEF and ask for a full briefing. It won't take you more than 10 minutes, and you will definitely be at least-- you'll probably be over briefed, at that point.

They'll tell you about an unlit tower even if you're flying at noon, and there's no possibility of it being dark and the lighting on the tower making a difference.